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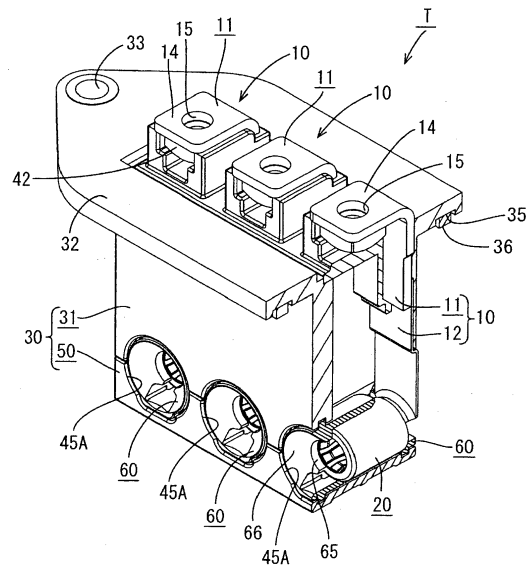
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**(54) Terminal block and method of producing it**

(57) It is aimed to provide a terminal block capable of realizing space saving and improving operability in connecting conductive members and terminals.

A terminal block T for connecting a plurality of inner conductive members and a plurality of outer conductive members arranged inside and outside a device includes a housing 30 which is provided to penetrate through a case 2 of the device in an in-out direction, terminals 10 each of which is mounted in the housing and includes a connecting portion 14 to be connected to the outer conductive member and provided on an outer end part and a tubular socket terminal 20 to be fitted and connected to a pin terminal p provided on the inner conductive member and provided on an inner end part, and sub-housings in which the socket terminals 20 are accommodated and on which terminal insertion openings, into which the pin terminals p are insertable, are open. The sub-housings 60 are mounted in the housing 30 loosely movably in a direction intersecting with an axis.

**FIG. 4**



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## Description

**[0001]** The present invention relates to a terminal block and to a method of producing it.

**[0002]** Conventionally, a terminal block for electrically connecting conductive members provided in electric devices such as a motor, an inverter and the like is known from Japanese Unexamined Patent Publication No. 2010-211933. This includes a housing made of synthetic resin and to be mounted through a case of a specified device in an in-out direction and a plurality of terminals each configured such that a connecting portion with a nut is provided on each of opposite ends of an L-shaped busbar. The terminals are so structured that the connecting portions on one end side and those on the other end side are mounted side by side to be respectively located on an outer end part of the housing and in an inner end part of the housing.

**[0003]** Outer conductive members formed of busbars extending from the electric device such as an inverter are bolted and connected to the outer connecting portions of the terminals mounted in the terminal block, and inner conductive members formed of busbars extending from the electric device such as a motor are likewise bolted and connected to the inner connecting portions of the terminals, whereby the corresponding inner and outer conductive members are electrically connected.

**[0004]** In the above conventional terminal block, an operation space allowing the insertion of a bolting tool into the device is necessary particularly in bolting and connecting the inner conductive members to the corresponding inner connecting portions of the terminals. Thus, the device tends to be enlarged. Further, due to a bolting operation in the device, there has been a problem of being difficult to operate and its improvement has been desired.

**[0005]** The present invention was completed based on the above situation and aims to allow for a terminal block capable of realizing space saving and improving operability in connecting conductive members and terminals.

**[0006]** This object is solved according to the invention by the features of the independent claims. Particular embodiments of the invention are subject of the dependent claims.

**[0007]** According to one aspect of the invention, there is provided a terminal block for connecting at least one inner conductive member and at least one outer conductive member arranged inside and outside a device, comprising: a housing which is provided to penetrate through a case of the device in an in-out direction; at least one terminal mountable in the housing and including a connecting portion to be connected to the outer conductive member and provided on an outer end part and a socket terminal to be fitted and connected to a pin terminal provided on the inner conductive member and provided on an inner end part; and at least one sub-housing in which the socket terminal is to be at least partly accommodated and on which at least one terminal insertion opening, into

which the pin terminal is insertable, is open; wherein the sub-housing is to be mounted in the housing loosely movably in a direction intersecting with an axis of the socket terminal.

**[0008]** According to a particular embodiment, the terminal block is provided for connecting a plurality of inner conductive members and a plurality of outer conductive member arranged inside and outside a device, comprising plural terminals each of which is mountable in the housing.

**[0009]** According to another particular embodiment, there is provided a terminal block for connecting a plurality of inner conductive members and a plurality of outer conductive members arranged inside and outside a device, including a housing which is provided to penetrate through a case of the device in an in-out direction; terminals each of which is mounted in the housing and includes a connecting portion to be connected to the outer conductive member and provided on an outer end part and a tubular socket terminal to be fitted and connected to a pin terminal provided on the inner conductive member and provided on an inner end part; and sub-housings in which the socket terminals are accommodated and on which terminal insertion openings, into which the pin terminals are insertable, are open; wherein the sub-housings are mounted in the housing loosely movably in a direction intersecting with an axis.

**[0010]** In the above configurations, the pin terminal provided on the inner conductive member is fitted into the socket terminal accommodated in the sub-housing through the terminal insertion opening of the sub-housing in connecting the inner conductive member to the inner end part of the terminal. As compared with connection by bolting, it suffices to fit the pin terminal into the socket terminal. Thus, a connecting operation itself is simple, a need for an operation space for bolting can be eliminated and space saving can be realized.

**[0011]** Further, since the (particularly each) sub-housing adopts a so-called floating structure and is mounted in the housing, even if there is, for example, a variation in the arrangement positions of the respective inner conductive members, i.e. the respective pin terminals, the individual pin terminals and socket terminals can be precisely aligned with and fitted to each other while the sub-housings are loosely moved in a direction intersecting with a connection direction of individual pin terminals and socket terminals (or a longitudinal axis of the socket terminal).

**[0012]** Further, the following configurations may be particularly adopted.

**[0013]** Particularly, an easily bendable portion is provided at an intermediate position of the terminal in a length direction. In this configuration, the sub-housing can loosely move while deforming the terminal at the easily bendable portion and more reliably exhibit a floating function.

**[0014]** Further particularly, the terminal includes at least one substantially strip-like portion and the easily

bendable portion is formed or provided at an intermediate position of the strip-like portion in the length direction. In this configuration, the floating function can be more reliably exhibited while a simple structure is ensured for the terminal.

**[0015]** Further particularly, the easily bendable portion in the terminal comprises or particularly is at least one flexible conductor formed preferably by a braided wire. In this configuration, the floating function of the sub-housing can be more reliably exhibited. In addition, if vibration acts on the inner or outer conductive member, this vibration is absorbed by the flexible conductor and the transmission thereof to the opposite conductive member side is suppressed.

**[0016]** Further particularly, the socket terminal is accommodated in an inner end part of the housing; and wherein at least one terminal insertion opening, into which the pin terminal is insertable, is provided on an outer surface of the housing to communicate with the socket terminal.

**[0017]** Further particularly, at least one tapered guiding portion is formed on or near an opening edge part of the terminal insertion opening.

**[0018]** Further particularly, the housing includes a housing main body molded with an opening formed on the side of the socket terminal of the terminal and a cover to be mounted on the opening of the housing main body to at least partly cover the socket terminal

**[0019]** Further particularly, the terminal insertion opening is formed over the housing main body and the cover.

**[0020]** Further particularly, the connecting portion has such a plural- or two-piece structure that a substantially tubular body is fitted on the outer periphery of a louver terminal portion.

**[0021]** Further particularly, the louver terminal portion is shaped such that a plurality of resilient contact pieces, each particularly including a contact portion on or near a tip side and substantially extending forward, at least partly are arranged in a ring shape while being circumferentially spaced apart on the front edge of an annular base portion.

**[0022]** According to a further aspect, there is provided a method of connecting an inner conductive member and an outer conductive member arranged inside and outside a device, particularly using a terminal block according to the above aspect or a particular embodiment thereof, comprising the following steps: providing a housing to penetrate through a case of the device in an in-out direction; mounting at least one terminal in the housing and including a connecting portion to be connected to the outer conductive member and provided on an outer end part and a socket terminal at least partly accommodating the socket terminal at least one sub-housing, on which at least one terminal insertion opening is open, into which a pin terminal provided on the inner conductive member and provided on an inner end part is insertable, wherein the sub-housing is mounted in the housing loosely movably in a direction intersecting with an axis of the socket

terminal; and fitting and connecting the at least one terminal to the pin terminal.

**[0023]** According to a particular embodiment, a plurality of inner conductive members and a plurality of outer conductive member arranged inside and outside a device are connected by means of plural terminals each of which is mountable in the housing.

**[0024]** Particularly, an easily bendable portion is provided at an intermediate position of the terminal in a length direction.

**[0025]** Further particularly, the terminal includes at least one substantially strip-like portion and the easily bendable portion is formed or provided at an intermediate position of the strip-like portion in the length direction and/or wherein the easily bendable portion in the terminal comprises at least one flexible conductor preferably formed by a braided wire.

**[0026]** According to the above, it is possible to realize space saving and precisely and efficiently perform a connecting operation of conductive members and terminals.

**[0027]** These and other objects, features and advantages of the present invention will become more apparent upon reading of the following detailed description of preferred embodiments and accompanying drawings. It should be understood that even though embodiments are separately described, single features thereof may be combined to additional embodiments.

FIG. 1 is a perspective view showing the external appearance of a terminal block according to a first embodiment of the present invention, FIG. 2 is a front view of the terminal block, FIG. 3 is a side view of the terminal block, FIG. 4 is a perspective view partly in section of the terminal block, FIG. 5 is a section along V-V of FIG. 2, FIG. 6 is a vertical section when a housing main body is molded, FIG. 7 is a vertical section of a terminal block according to a second embodiment, and FIG. 8 is a vertical section of a terminal block according to a third embodiment.

<First Embodiment>

**[0028]** A first particular embodiment of the present invention is described with reference to FIGS. 1 to 6.

**[0029]** In this embodiment is illustrated a terminal block T for electrically connecting one or more conductive members, e.g. three conductive members provided in a three-phase alternating current motor mounted in a vehicle such as an electric vehicle or a hybrid vehicle and one or more respective mating conductive members, e.g. three conductive members provided in an inverter. The terminal block T is applied in a case where the motor and the inverter are directly coupled.

**[0030]** More specifically, as shown in FIG. 5, the terminal block T is to be provided on a lateral wall (e.g. an

upper wall) 2 of a transmission case 1 (as a particular electric or electronic device) and an unillustrated motor-side case is adjacently assembled particularly on a front opening side (left side in FIG. 5) of the transmission case 1, whereas an inverter-side case is assembled on the lateral (e.g. upper) surfaces of the integrally joined transmission case and motor-side case. The three conductive members (as a particular inner conductive member) extending from the motor and the conductive members (as a particular outer conductive member) extending from the inverter are to be electrically connected via the terminal block T as described above.

**[0031]** In this specific embodiment, the outer conductive member(s) extending from the inverter are one or more busbars, whereas the inner conductive members extending from the motor are obtained by wires, particularly by solidifying enamel wires in a substantially straight posture using an adhesive or the like, and one or more (particularly substantially round) pin terminals p are to be substantially coaxially connected on the tip(s) of the inner conductive member(s) as shown in FIG. 5.

**[0032]** The structure of the terminal block T is described in detail. As shown in FIG. 1, the terminal block T includes one or more, particularly shown three terminals 10 and a housing 30 which is made e.g. of synthetic resin and in which one or more, particularly these three terminals 10 are to be mounted particularly side by side.

**[0033]** As shown in FIG. 6, the terminal 10 particularly is structured such that a (particularly substantially strip-like) piece 12 made of a conductive member (particularly a metal plate) thinner than a busbar 11 bent particularly substantially into an L shape is connected to a hanging or distal end of the busbar 11. The strip-like piece 12 particularly is bent into a crank shape for reinforcement and the like at an intermediate position in a longitudinal or height direction.

**[0034]** A (particularly substantially horizontal) part of the busbar 11 which is one end side of the terminal 10 serves as an outer connecting portion 14 to be connected to the outer conductive member and particularly is formed with an insertion hole 15 for a bolt. A socket terminal 20 which functions as an inner connecting portion to be connected to the inner conductive member is provided on another end (particularly a distal or lower end) of the (strip-like) piece 12 which is the other end side of the terminal 10.

**[0035]** This socket terminal 20 particularly has such a plural- or two-piece structure that a substantially tubular body 25 is fitted on the outer periphery of a louver terminal portion 21. The louver terminal portion 21 is shaped such that a plurality of resilient contact pieces 23 each including a contact portion 23A on or near a tip side and substantially extending forward at least partly are arranged in a ring shape while being circumferentially spaced apart on the front edge of an annular base portion 22. A rear edge part of the lower surface of the base portion 22 is bent outward to form a projection 22A.

**[0036]** A jaw portion 26 (shown in Fig. 6) substantially

facing inward to protect the tips of the resilient contact pieces 23 of the louver terminal portion 21 is formed on or near the front end of the tubular body 25. The lower surface of the tubular body 25 particularly is cut from the rear edge to form at least one groove 28 into which the above projection 22A at least partly is insertable. The tubular body 25 is to be fitted onto or connected with (particularly the outer periphery of) the louver terminal portion 21 particularly substantially from front, the pushing thereof particularly is stopped when the projection 22A comes into contact with the back edge of the groove 28, and/or the tubular body 25 particularly is retained and mounted by bending or folding back one or more, particularly a pair of joining pieces 27 projecting from the rear edge onto the base portion 22.

**[0037]** The above (particularly substantially strip-like) piece 12 is integrally or unitarily erected from the upper or distal edge of the base portion 22 of the louver terminal portion 21, and an upper or distal end part of this strip-like piece 12 is placed in contact with the hanging or projecting end of the terminal 10 and fixed such as by spot welding, soldering, gluing, bolting or the like. In this way, the terminal 10 is formed, and the socket terminal 20 as the inner connecting portion is provided on a lower or distal end part of the terminal 10 in such a posture as to substantially face in the same direction (leftward direction of FIG. 6) as a bending direction of the outer connecting portion 14 of the terminal 10.

**[0038]** In this specific embodiment, a total of three terminals 10 are provided, and each terminal 10 is so mounted in the housing 30 that the socket terminal 20 is at least partly accommodated in a sub-housing 60 (see FIG. 5). The sub-housing 60 is described later.

**[0039]** The housing 30 particularly is composed of or comprises a housing main body 31 and a cover 50. As shown in FIGS. 1 and 6, the housing main body 31 substantially is formed into a box shape having a lower surface opening long and narrow substantially in a lateral direction, a laterally long flange 32 is formed on the lateral or upper edge thereof, and one or more mounting holes 33, into which one or more collars 34 at least partly are fitted, are provided laterally of the flange 32, particularly on substantially opposite lateral (left and right) ends of this flange 32. A packing mounting groove 35 particularly is circumferentially provided on the lower surface of the flange 32, and an annular surface packing 36 is to be mounted thereinto.

**[0040]** A seat block 40 on which the outer connecting portion(s) 14 of the respective terminal(s) 10 is/are mounted (particularly substantially side by side) is provided in a central or intermediate part of the lateral or upper surface of the housing main body 31. This seat block 40 is formed with one or more (e.g. three) seats 41 on which the outer connecting portions 14 are individually mounted, and the (particularly each) seat 41 is formed with an accommodating chamber 43 for a nut 42 which is recessed from a placing surface and substantially open forward. The nut 42 is to be at least partly accommodated

in each accommodating chamber 43 with the displacement (particularly rotation) thereof prevented.

**[0041]** First, a procedure of producing the housing main body 31 is described with reference to FIG. 6. First, the seat block 40 is formed over the one or more, particularly three terminals 10 arranged at specified (predetermined or predeterminable) intervals (including connected parts to the respective strip-like pieces 12) by primary molding, whereby the one or more, particularly three terminals 10 are held in specified (predetermined or predeterminable) postures on the seat block 40.

**[0042]** Subsequently, secondary molding is performed with this seat block 40 and the one or more, particularly three terminals 10 as a core, thereby forming the housing main body 31. At this time, a first part (particularly lower half) of the (particularly each) socket terminal 20 projects laterally (particularly substantially downward) from the lateral edge (particularly the lower edge) of (particularly a front wall 31A directly behind the front wall 31A of) the housing main body 31. Note that the collars 34 are also mounted.

**[0043]** The cover 50 particularly is formed separately from the housing main body 31 and/or substantially in the form of a rectangular deep dish to at least partly cover the aforementioned lateral or lower surface opening of the housing main body 31. As shown in FIG. 3, one or more resiliently displaceable lock frames 51 are formed to rise on one or more lateral (left and/or right) side surfaces of the cover 50, whereas one or more lock projections 38 are provided on one or more lateral (left and/or right) side surfaces of the housing main body 31. When the cover 50 is properly mounted on the lateral or lower surface opening of the housing main body 31, the lock frame(s) 51 is/are resiliently fitted to the lock projection(s) 38, thereby forming the housing 30 in which the housing main body 31 and the cover 50 are integrally joined.

**[0044]** As described above, the socket terminal 20 as the inner connecting portion of the terminal 10 is to be at least partly accommodated in the sub-housing 60. This sub-housing 60 is made e.g. of synthetic resin and particularly substantially formed into a hollow cylindrical shape which is provided with a front wall 61 and into which the socket terminal 20 is at least partly insertable particularly substantially from behind as shown in FIGS. 4 and 5. The sub-housing 60 particularly has a length equivalent to a dimension of the housing main body 31 in a front-back direction, but a first part (particularly an upper half) is cut off in a length area (particularly having less than half the length) on a rear end side, thereby forming an escaping portion 62. In other words, only a semicylindrical portion 63 on a second part (particularly a lower half) is present on the rear end side of the sub-housing 60.

**[0045]** A terminal insertion opening 65, into which the above (particularly substantially round) pin terminal p at least partly is insertable, is open on the front wall 61 of the sub-housing 60, and a guiding portion 66 widened toward a front side is formed in a front end part of the

terminal insertion opening 65.

**[0046]** A locking lance 67 for locking the projection 22A of the socket terminal 20 is resiliently deflectably provided on (particularly the bottom wall of) the sub-housing 60 particularly while substantially extending backward. The socket terminal 20 is to be at least partly inserted into the sub-housing 60 (particularly substantially from behind) and displaced or pushed while resiliently deflecting the locking lance 67. When the socket terminal 20 is positioned or pushed to such a position as to come into contact with the front wall 61, the projection 22A passes over a locking portion 67A of the locking lance 67 and the locking portion 67A is engaged with the projection 22A while the locking lance 67 at least partly is restored and displaced, whereby the socket terminal 20 is retained and accommodated in the sub-housing 60.

**[0047]** A front rib 68 (particularly substantially having a constant height or projecting distance) is formed (particularly over the substantially entire circumference) on the outer periphery of a front end part of the sub-housing 60, specifically in a central or intermediate part of the front wall 61 in a thickness direction. Further, a rear rib 60 (particularly substantially having the same height as the front rib 68) is formed on the outer periphery of the semicylindrical portion 63 of the sub-housing 60.

**[0048]** On the other hand, as shown in FIGS. 1 and 5, one or more fitting holes 45A into which front end part(s) (front wall(s) 61) of the sub-housing(s) 60 accommodating the above socket terminal(s) 20 is/are to be fitted are formed in positions corresponding to the terminal(s) 10 (socket terminal(s) 20) and/or at the same interval(s) as the terminal(s) 10 (socket terminal(s) 20) on a joint of the lower edge of the housing main body 31 and the upper edge of the cover 50 on the front surface of the housing 30. A fitting groove 46A into which the front rib 68 of the sub-housing 60 at least partly is to be fitted is formed over the entire circumference on the inner surface of each fitting hole 45A.

**[0049]** Note that since the housing main body 31 and the cover 50 are integrally assembled later as described above, a first part (particularly an upper half) of each fitting hole 45A is formed on the (lower) edge of the front wall 31A of the housing main body 31 and a second part (particularly a lower half) thereof is formed on the (upper) edge of a front wall 50A of the cover 50.

**[0050]** Further, one or more (particularly substantially semicircular) fitting holes 45B into which rear end part(s) of the semicylindrical portion(s) 63 of the sub-housing(s) 60 is/are to be fitted are formed on (particularly the upper edge of a rear wall 50B of) the cover 50, and one or more fitting grooves 46B into which the rear rib(s) 69 of the sub-housing(s) 60 at least partly is/are to be fitted are formed on the inner surface(s) (particularly lower semicircumferential surface(s)) of the fitting hole(s) 45B.

**[0051]** An inner diameter of the fitting hole 45A on the front surface side of the housing 30 particularly is set to be larger than an outer diameter of the front end part of the sub-housing 60 by a fixed dimension and/or an inner

diameter of the fitting groove 46A particularly is set to be larger than an outer diameter of the front rib 68 (particularly substantially by the same dimension). Further, an inner diameter of the semicircular fitting hole 45B on the rear surface side of the housing 30 particularly is set to be larger than an outer diameter of the semicylindrical portion 63 of the sub-housing 60 (particularly substantially by the same dimension), and/or an inner diameter of the fitting groove 46B particularly is set to be larger than an outer diameter of the rear rib 69 (particularly substantially by the same dimension).

**[0052]** Next, an example of an assembling procedure of the terminal block T according to this embodiment and a use example of this terminal block T are described.

**[0053]** As partly already described, the housing main body 31 integrally including the one or more (e.g. three) terminals 10 is formed by two moldings as shown in FIG. 6. The outer connecting portion 14 of each terminal 10 is placed on the corresponding seat 41 right above the accommodating chamber 43 for the nut 42 while being substantially held in a forward facing posture. Further, the socket terminal 20 as the inner connecting portion of the (particularly each) terminal 10 particularly is located on the substantially same axis as the fitting hole 45A (precisely, upper half of this fitting hole 45A) behind the fitting hole 45A while being similarly substantially held in a forward facing posture.

**[0054]** Next, the one or more sub-housings 60 are mounted on the one or more socket terminals 20 as the inner connecting portion(s) of the one or more (e.g. three) terminals 10 integrally provided in the housing main body 31 in a manner already described above. Subsequently, the cover 50 is mounted on (particularly the lower surface opening of) the housing main body 31. The lock frame(s) 51 move(s) onto the lock projection(s) 38, is/are displaced or pushed up from below while being resiliently displaced, and is/are fitted to the lock projection(s) 38 while being restored into or towards an original shape when the upper edge of the cover 50 comes into contact with the lower edge of the housing main body 31, whereby the cover 50 is integrally joined and the housing 30 is formed as shown in FIG. 5.

**[0055]** At this time, as shown in FIG. 5, the (particularly each) sub-housing 60 is fitted with a specified (predetermined or predeterminable) radial clearance formed between a front end part thereof and the fitting hole 45A on the front surface side of the housing 30 while the front rib 68 at least partly is fitted into the fitting groove 46A. Further, the semicylindrical portion 63 of the sub-housing 60 is fitted with a specified (predetermined or predeterminable) radial clearance formed in the semicircular fitting hole 46B on the rear surface side of the housing 30 while the rear rib 69 at least partly is fitted into the fitting groove 46B. Specifically, each sub-housing 60 is mounted in a lower end part of the housing 30 with movements thereof in an axial direction (front-back direction) restricted and with loose movements thereof in a direction (radial direction) intersecting with an axis allowed in the clear-

ances.

**[0056]** The nut 42 at least partly is inserted into the accommodating chamber 43 of each seat 41 on such a housing 30, and the surface packing 36 is mounted into the packing mounting groove 35 on the lower surface of the flange 32, whereby the terminal block T is completed.

**[0057]** The terminal block T assembled as described above is mounted on (particularly the upper wall 2 of) the transmission case 1 as shown in FIG. 5. Specifically, the lower end part of the housing 30 at least partly is inserted into a through hole 3 open on the case upper wall 2 from above and, thereafter, one or more bolts are inserted into the mounting hole(s) 33 of the flange 32 and screwed into bolt hole(s) on the case upper wall 2, whereby the flange 32, i.e. the terminal block T is fixed to the case upper wall 2. Particularly simultaneously, the surface packing 36 is compressed and pressed against the hole edge of the through hole 3, thereby sealing the through hole 3.

**[0058]** When the terminal block T is mounted in this way, the outer connecting portion 14 of each terminal 10 is exposed on (particularly an upper or lateral surface side (outer side) of) the case upper wall 2 while being arranged on (particularly the upper surface of) the housing 30 (seat block 40). On the other hand, the socket terminal 20 as the inner connecting portion of each terminal 10 at least partly is accommodated in the sub-housing 60 supported loosely movably in the radial direction relative to the housing 30. In other words, the sub-housing 60 is arranged in a floating structure allowing for a displacement of the sub-housing 60 with respect to the housing 30 in a direction intersecting with a longitudinal axis of the socket terminal 20 so that a relative position of the socket terminal 20 with respect to the pin terminal p can be achieved.

**[0059]** Next, a procedure of connecting the one or more conductive members with one or more respective mating conductive members, particularly of connecting the three conductive members of the three-phase alternating current motor and those of the inverter utilizing the terminal block T is described. It should be understood that the terminal block T may be utilized for connecting any kind of conductive member with a respective mating conductive member irrespective of the given specific example of the three-phase alternating current motor and inverter.

**[0060]** First, the one or more, particularly three inner conductive members (enamel wires) of the motor side are connected to the inner connecting portions of the corresponding terminals 10 by inserting the (particularly substantially round) pin terminal(s) p provided on the tip(s) of the (enamel) wire(s) into the socket terminal(s) 20 behind the terminal insertion opening(s) 65 of the sub-housing(s) 60 mounted in the lower end part of the housing 30 through the terminal insertion opening(s) 65 as indicated by an arrow in FIG. 5.

**[0061]** At this time, even if the (round) pin terminal(s) p is/are misaligned with the socket terminal(s) 20, it/they is/are inserted while being aligned by the guiding por-

tion(s) 66.

**[0062]** Further, if there is a variation in the arrangement position(s) of the respective (round) pin terminal(s) p and misalignment(s) is/are particularly large, the sub-housing(s) 60 is/are moved in the radial direction for alignment while slightly deforming the (strip-like) piece(s) 12 of the terminal(s) 10 as the (round) terminal pin(s) p is/are inserted along the guiding portion(s) 66.

**[0063]** Subsequently, the (particularly round) pin terminal(s) p is/are pushed or displaced while resiliently displacing the resilient contact piece(s) 23 of the louver terminal portion(s) 21. When the pushing or displacement of the (round) pin terminal(s) p is stopped, the resilient contact piece(s) 23 at least partly is/are restored in a diameter reducing direction, whereby the (round) pin terminal(s) p and the socket terminal(s) 20 are resiliently fitted into contact with each other and the one or more (e.g. three) inner conductive members (particularly enamel wires) of the motor side are connected to the inner connecting portion(s) (particularly socket terminal(s) 20) of the corresponding terminal(s) 10.

**[0064]** Thereafter, the motor-side case is adjacently assembled to at least partly cover a front surface opening of the transmission case 1.

**[0065]** Subsequently, the one or more, particularly three outer conductive members (busbars) of the inverter side are connected to the one or more respective outer connecting portions 14 of the one or more corresponding terminals 10. Although not shown, the respective busbars particularly are placed on the outer connecting portions 14 arranged substantially side by side on the upper surface of the housing 30, one or more bolts at least partly are inserted through the insertion holes of the busbars and the insertion holes 15 of the outer connecting portions 14 and threadably tightened into the respective nut(s) 42 at least partly accommodated in the accommodating chambers 43 with the displacement/rotation thereof prevented, whereby the one or more, particularly three outer conductive members (busbars) of the inverter side are connected to the one or more respective outer connecting portions 14 of the one or more corresponding terminals 10.

**[0066]** Thereafter, the inverter-side case is assembled on the lateral or upper surface(s) of the transmission case 1 and the motor-side case integrally joined as described above.

**[0067]** In the above manner, specifically the three conductive members provided in the three-phase alternating current motor and those provided in the inverter are electrically connected via the terminal block T and a terminal connection structure of a type in which the motor and the inverter are directly coupled is constructed.

**[0068]** In this embodiment, parts for connecting the inner conductive member(s) of the motor side to the inner connecting portion(s) of the terminal(s) 10 mounted in or on the terminal block T are so structured that the (particularly round) pin terminal(s) p is/are provided on the inner conductive member(s) and, on the other hand, the inner

connecting portion(s) of the terminal(s) 10 is/are formed by the socket terminal(s) 20. Thus, the connection of the inner conductive member(s) to the inner connecting portion(s) of the terminals 10 is realized by at least partly fitting the (round) pin terminal(s) p into the mating socket terminal(s) 20.

**[0069]** For example, as compared with connection by bolting, the connecting operation itself is simple since it suffices to at least partly fit the (round) pin terminal(s) p into the socket terminal(s) 20. Further, space saving can be realized and, for example, the miniaturization of the motor case can be realized since a need for an operation space for bolting can be eliminated.

**[0070]** Further, in this embodiment, the socket terminal(s) 20 of the respective terminal(s) 10 particularly is/are individually at least partly accommodated in the sub-housing(s) 60, whereas the respective sub-housing(s) 60 is/are mounted in the housing 30, loosely movably in the radial direction, i.e. adopting a so-called floating structure. For example, such as when there is a variation in the arrangement position(s) of the respective inner conductive member(s), i.e. the respective (round) pin terminal(s) p, i.e. misalignment(s) is/are large, the individual (round) pin terminal(s) p and socket terminal(s) 20 can be precisely aligned with and fitted or connected to each other while loosely moving the sub-housing(s) 60.

**[0071]** This is particularly effective when the rigidity of the inner conductive member(s) provided with the (round) pin terminal(s) p is high and there is a limit in the amount of deflection deformation of the inner conductive member(s).

**[0072]** Accordingly, to provide a terminal block capable of realizing space saving and improving operability in connecting conductive members and terminals, a terminal block T for connecting one or more, particularly a plurality of inner conductive members and one or more, particularly a plurality of outer conductive members arranged inside and outside a device includes a housing 30 which is provided to penetrate through a case 2 of the device in an in-out direction, one or more terminals 10 each of which is mounted in the housing and includes a connecting portion 14 to be connected to the outer conductive member and provided on an outer end part and a (particularly substantially tubular) socket terminal 20 to be at least partly fitted and connected to a pin terminal p provided on the inner conductive member and provided on an inner end part, and one or more sub-housings in which the one or more socket terminals 20 at least partly are to be accommodated and on which one or more terminal insertion openings, into which the one or more respective pin terminals p at least partly are insertable, are open. The sub-housings 60 are to be mounted in the housing 30 loosely movably in a direction intersecting with an axis.

<Second Embodiment>

**[0073]** A second particular embodiment of the present

invention is described with reference to FIG. 7. A terminal block T1 of this second embodiment is a modification of the first embodiment and similar to the first embodiment in that a terminal 70 is composed of or comprises a busbar 11 and a (particularly substantially strip-like) portion 71, but an easily bendable portion 72 projecting forward while being curved is formed at an intermediate position of the (strip-like) portion 71 in the height or extension direction. Other structures are similar or substantially the same as in the first embodiment.

**[0074]** In this embodiment, a sub-housing 60 can loosely move while deforming the terminal 70 at the easily bendable portion 72 and a floating function can be more reliably exhibited.

<Third Embodiment>

**[0075]** FIG. 8 shows a third particular embodiment of the present invention. In a terminal block T2 of this third embodiment, a change is made in the structure of a part where an easily bendable portion is provided on a terminal 80.

**[0076]** Points of difference from the first embodiment are mainly described below and members and parts having the similar or same structure and/or functions as in the first embodiment are denoted by the same reference signs and described only briefly or not at all.

**[0077]** The terminal 80 is so structured that at least one flexible conductor 81, which serves as the easily bendable portion, is connected to a hanging or projecting end of a busbar 11 particularly substantially bent into an L shape. This flexible conductor 81 particularly is structured by bending a braided wire into a substantially S shape or meander shape. On the other hand, a coupling piece 24 (particularly having a low height) is erected or projects from a base portion 22 of a louver terminal portion 21 in a socket terminal 20A which serves as an inner connecting portion.

**[0078]** Specifically, after the (particularly substantially L-shaped) busbar 11 forming the terminal 80 is set in a posture different from (e.g. substantially opposite to) that in the first embodiment in a front-back direction, (particularly an upper end part of) the flexible conductor 81 is placed in contact with (particularly the rear surface of a lower end part of) this busbar 11, and (particularly a lower end part of) this flexible conductor 81 is placed in contact with (particularly the front surface of an upper end part of) the coupling piece 24 erected or projecting from the base portion 22 of the louver terminal portion 21. The both end parts are fixed particularly by spot welding, soldering, gluing, bolting, or the like. Thus, in the terminal 80 of the third embodiment, a bending direction of an outer connecting portion 14 and a facing direction of the socket terminal 20AA particularly substantially are opposite in the front-back direction.

**[0079]** As in the first embodiment, this terminal 80 is mounted in a housing 30 after the socket terminal 20A as the inner connecting portion at least partly is accom-

modated in a sub-housing 60, and the sub-housing 60 is supported loosely movably substantially in a radial direction. Note that, to ensure a space for accommodating the substantially meander- or S-shaped flexible conductor 81 in the housing 30, the outer connecting portion of each terminal 80 is structured to be arranged in a backward facing posture on the upper surface of the housing 30 (seat block 40). However, this structure substantially is not functionally different from a case where each terminal 80 is set in a forward facing posture.

**[0080]** In this third embodiment, the sub-housing 60 can loosely move while deforming the flexible conductor 81 of the terminal 80 and, similarly, the floating function can be more reliably exhibited.

**[0081]** Further, in the case of connecting inner and outer conductive members via the terminal block T2 (terminal(s) 80), the flexible conductor(s) 81 provided in the terminal(s) 80 function(s) as vibration absorbing portion(s). If vibration acts on the inner or outer conductive member, this vibration is absorbed by the flexible conductor 81 and the transmission thereof to the opposite conductive member side is suppressed.

<Other Embodiments>

**[0082]** The present invention is not limited to the above described and illustrated embodiments. For example, the following embodiment is also included in the technical scope of the present invention.

(1) Although the round pin terminal is provided on the tip of the inner conductive member in the above embodiments, a pin terminal having a different cross-section (particularly an irregular cross-section other than a right circular cross-section) may be used. In that case, the socket terminal as the inner connecting portion of the terminal provided in the terminal block may have a tubular shape having such a cross-sectional shape that the pin terminal is tightly fitted.

(2) Although the enamel wires solidified by the adhesive are illustrated as the inner conductive members extending from the motor in the above embodiments, busbars may be applied to the inner conductive members.

**[0083]** The present invention is more effective when members having a high rigidity such as busbars are applied to the inner conductive members.

(3) Although the terminal block is mounted in the case of the other device other than the motor case and the inverter case in the above embodiments, the terminal block may be provided, for example, in the motor case and such a mode is also included in the technical scope of the present invention.

(4) Although the motor and the inverter are directly coupled in the above embodiments, the present invention can be similarly applied when a motor and

an inverter are separately disposed.  
 (5) The present invention can be widely applied to terminal blocks in general for electrically connecting conductive members extending from two electric devices which are not limited to a motor and an inverter.

Reference Signs

[0084]

T, T1, T2	terminal block
1	transmission case
2	case upper wall
3	through hole
10	terminal
11	busbar
12	strip-like piece
14	outer connecting portion
15	insertion hole
20, 20A	socket terminal
30	housing
31	housing main body
45A, 45B	fitting hole
46A, 46B	fitting groove
50	cover
60	sub-housing
61	front wall
63	semicylindrical portion
65	terminal insertion opening
66	guiding portion
68	front rib
69	rear rib
70	terminal
71	strip-like piece
72	easily bendable portion
80	terminal
81	flexible conductor (easily bendable portion)
p	round pin terminal (pin terminal)

Claims

1. A terminal block (T; T1; T2) for connecting at least one inner conductive member and at least one outer conductive member arranged inside and outside a device, comprising:

a housing (30) which is provided to penetrate through a case (1) of the device in an in-out direction;

at least one terminal (10; 70; 80) mountable in the housing (30) and including a connecting portion (14) to be connected to the outer conductive member and provided on an outer end part and a socket terminal (20; 20A) to be fitted and connected to a pin terminal (p) provided on the inner conductive member and provided on an inner end part; and

at least one sub-housing (60) in which the socket terminal (20; 20A) is to be at least partly accommodated and on which at least one terminal insertion opening (65), into which the pin terminal (p) is insertable, is open;

wherein the sub-housing (60) is to be mounted in the housing (30) loosely movably in a direction intersecting with an axis of the socket terminal (20; 20A).

2. A terminal block (T; T1; T2) according to claim 1, provided for connecting a plurality of inner conductive members and a plurality of outer conductive member arranged inside and outside a device, comprising plural terminals (10; 70; 80) each of which is mountable in the housing (10).
3. A terminal block according to any one of the preceding claims, wherein:
  - an easily bendable portion (72; 81) is provided at an intermediate position of the terminal (10; 70; 80) in a length direction.
4. A terminal block according to claim 3, wherein:
  - the terminal (10; 70; 80) includes at least one substantially strip-like portion (12; 71) and the easily bendable portion (72; 81) is formed or provided at an intermediate position of the strip-like portion (12; 71) in the length direction.
5. A terminal block according to claim 3 or 4, wherein the easily bendable portion (72; 81) in the terminal (10; 70; 80) comprises at least one flexible conductor (81) preferably formed by a braided wire.
6. A terminal block according to any one of the preceding claims, wherein the socket terminal (20; 20A) is accommodated in an inner end part of the housing (30); and wherein at least one terminal insertion opening (45), into which the pin terminal (p) is insertable, is provided on an outer surface of the housing (30) to communicate with the socket terminal (20; 20A).
7. A terminal block according to claim 6, wherein at least one tapered guiding portion (46) is formed on or near an opening edge part of the terminal insertion opening (45).
8. A terminal block according to claim 6 or 7, wherein:
  - the housing (30) includes a housing main body (31) molded with an opening formed on the side of the socket terminal (20; 20A) of the terminal (10; 70; 80) and a cover (50) to be mounted on the opening of the housing main body (31) to at

- least partly cover the socket terminal (20; 20A)
9. A terminal block according to claim 8, wherein the terminal insertion opening (45) is formed over the housing main body (31) and the cover (50). 5
10. A terminal block according to any one of the preceding claims, wherein the connecting portion (20; 20A) has such a plural- or two-piece structure that a substantially tubular body (25) is fitted on the outer periphery of a louver terminal portion (21). 10
11. A terminal block according to claim 10, wherein the louver terminal portion (21) is shaped such that a plurality of resilient contact pieces (23), each particularly including a contact portion (23A) on or near a tip side and substantially extending forward, at least partly are arranged in a ring shape while being circumferentially spaced apart on the front edge of an annular base portion (22). 15  
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12. A method of connecting an inner conductive member and an outer conductive member arranged inside and outside a device, comprising the following steps: 25
- providing a housing (30) to penetrate through a case (1) of the device in an in-out direction; mounting at least one terminal (10; 70; 80) in the housing (30) and including a connecting portion (14) to be connected to the outer conductive member and provided on an outer end part and a socket terminal (20; 20A) 30
- at least partly accommodating the socket terminal (20; 20A) at least one sub-housing (60), on which at least one terminal insertion opening (65) is open, into which a pin terminal (p) provided on the inner conductive member and provided on an inner end part is insertable, wherein the sub-housing (60) is mounted in the housing (30) loosely movably in a direction intersecting with an axis of the socket terminal (20; 20A); and fitting and connecting the at least one terminal (10; 70; 80) to the pin terminal (p). 35  
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13. A method according to claim 12, wherein a plurality of inner conductive members and a plurality of outer conductive member arranged inside and outside a device are connected by means of plural terminals (10; 70; 80) each of which is mountable in the housing (10). 45  
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14. A method according to claim 12 or 13, wherein an easily bendable portion (72; 81) is provided at an intermediate position of the terminal (10; 70; 80) in a length direction. 55
15. A method according to claim 14, wherein the terminal (10; 70; 80) includes at least one substantially strip-

like portion (12; 71) and the easily bendable portion (72; 81) is formed or provided at an intermediate position of the strip-like portion (12; 71) in the length direction and/or wherein the easily bendable portion (72; 81) in the terminal (10; 70; 80) comprises at least one flexible conductor (81) preferably formed by a braided wire.

FIG. 1

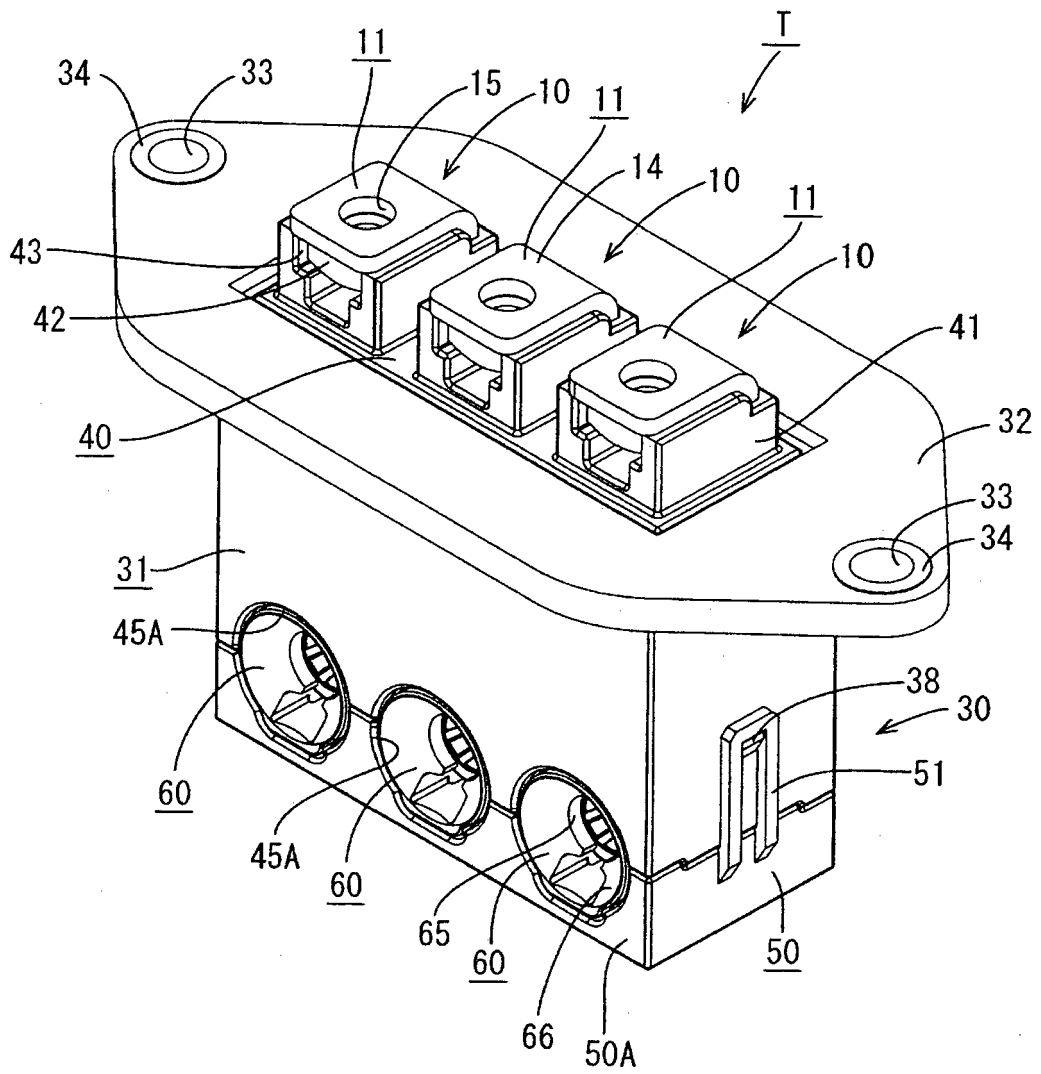




FIG. 3

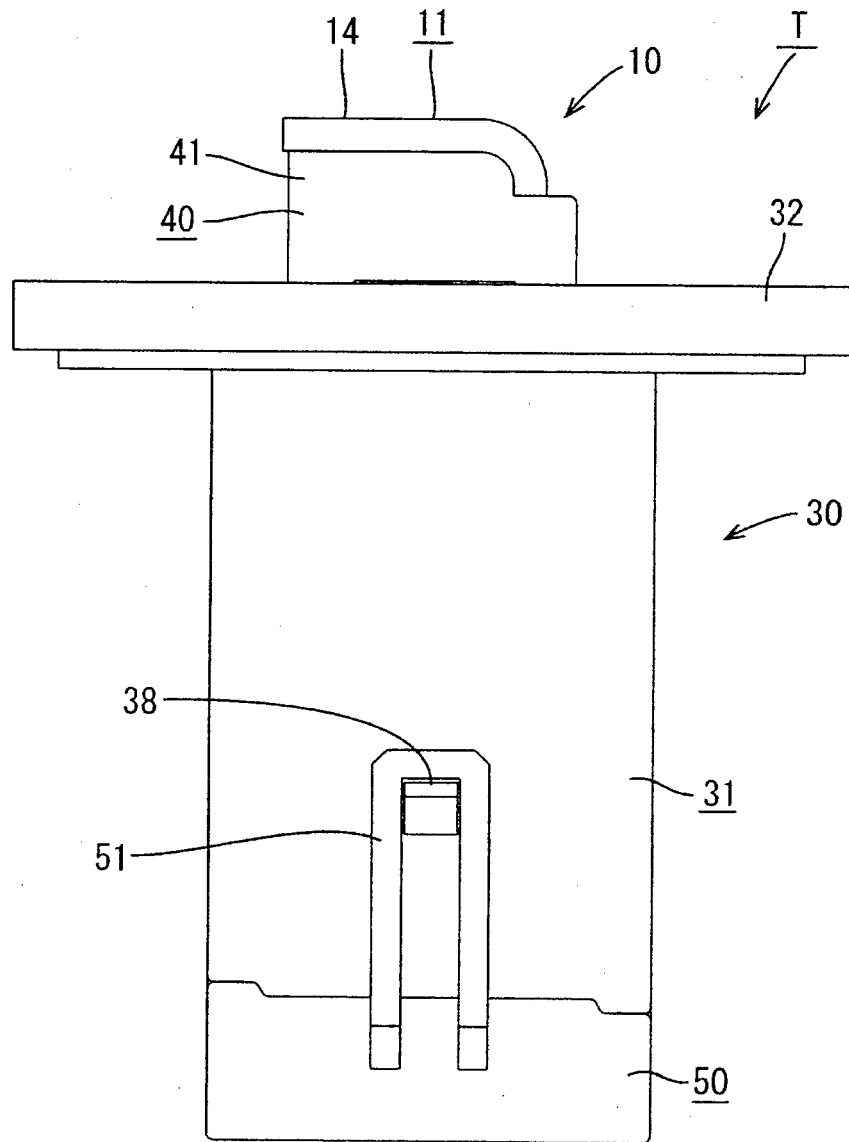


FIG. 4

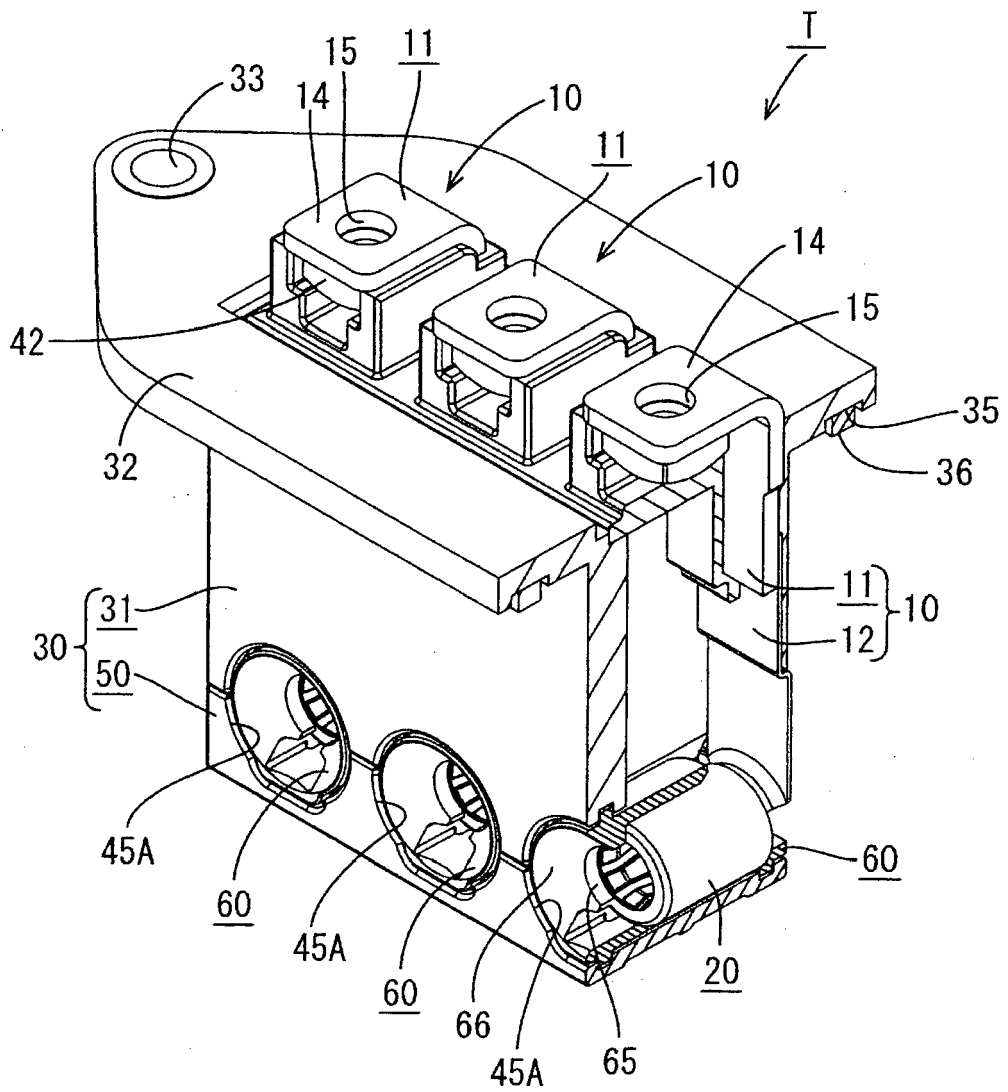


FIG. 5

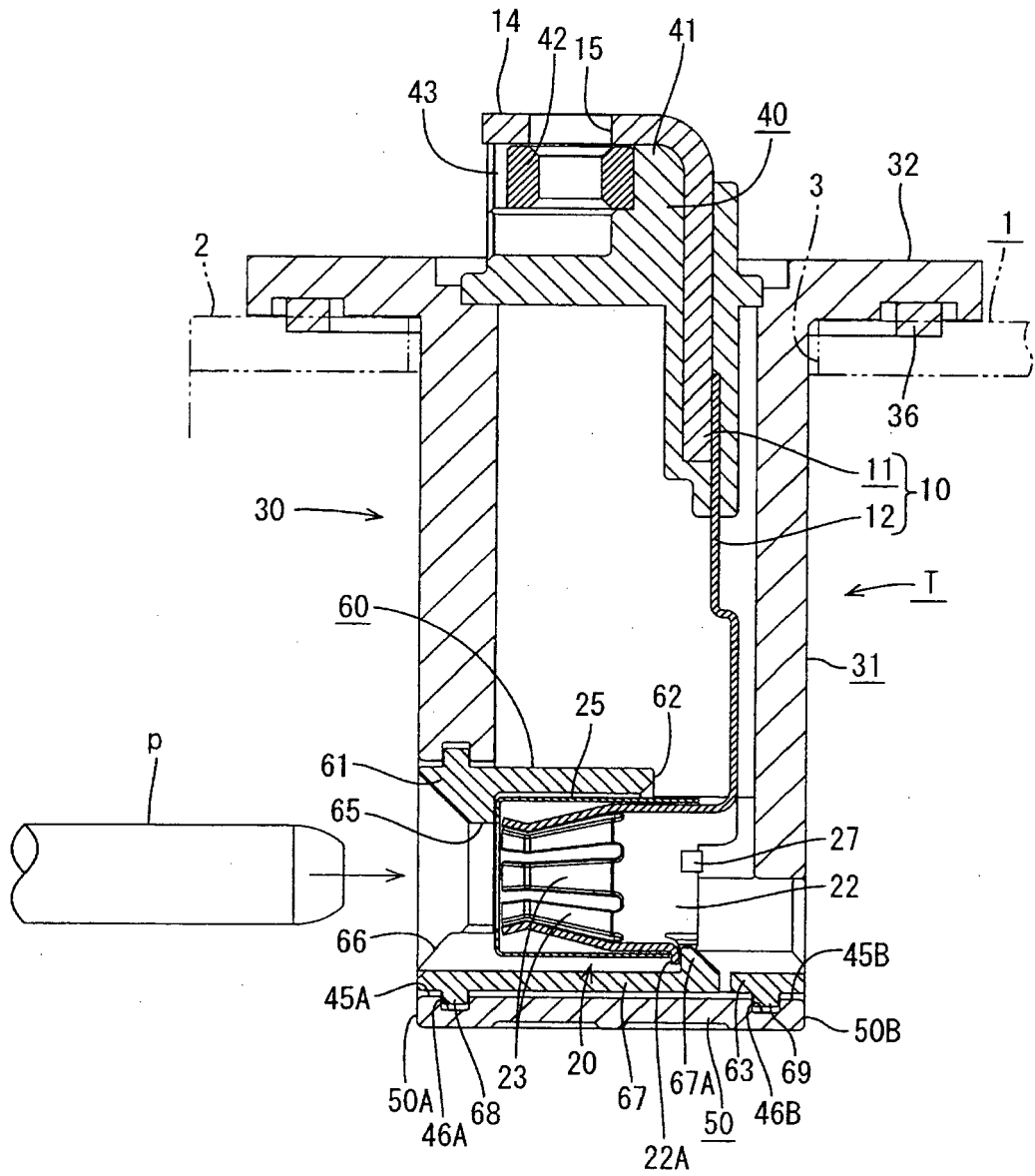


FIG. 6

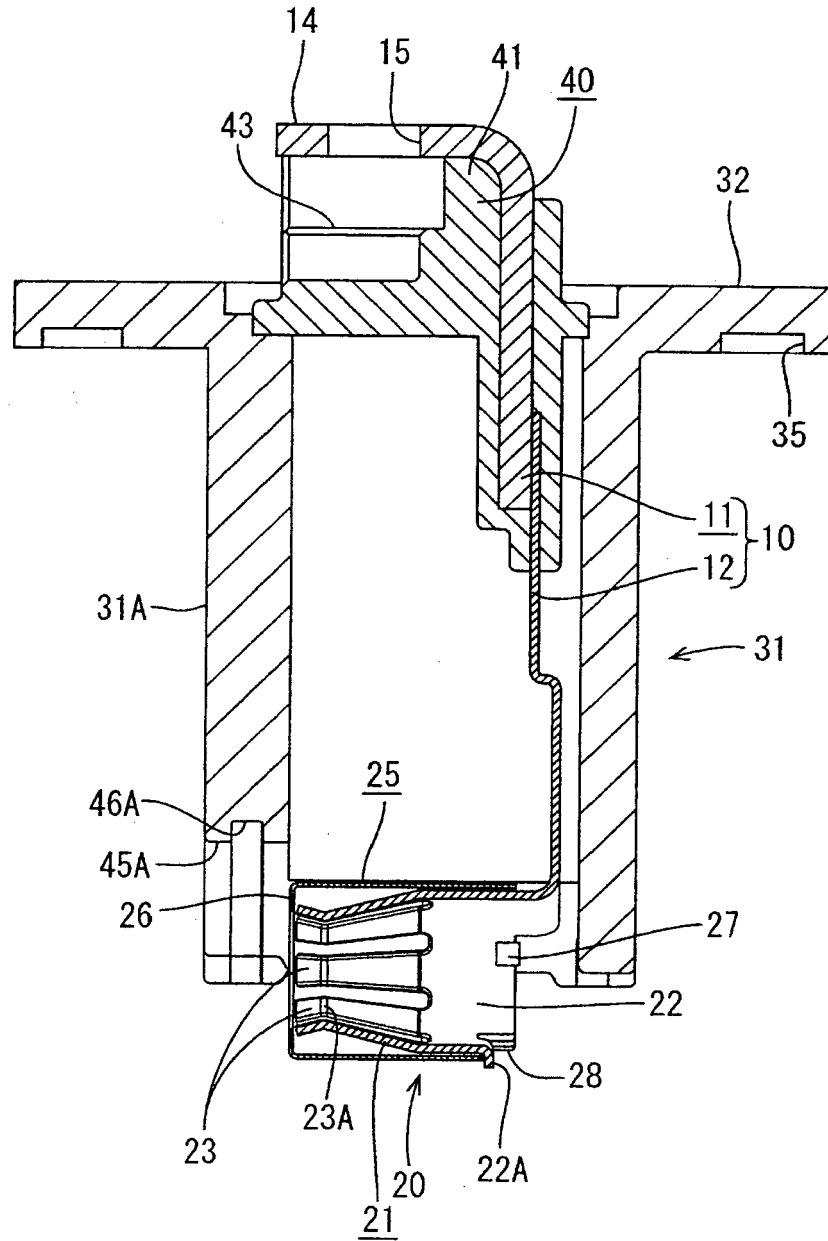


FIG. 7

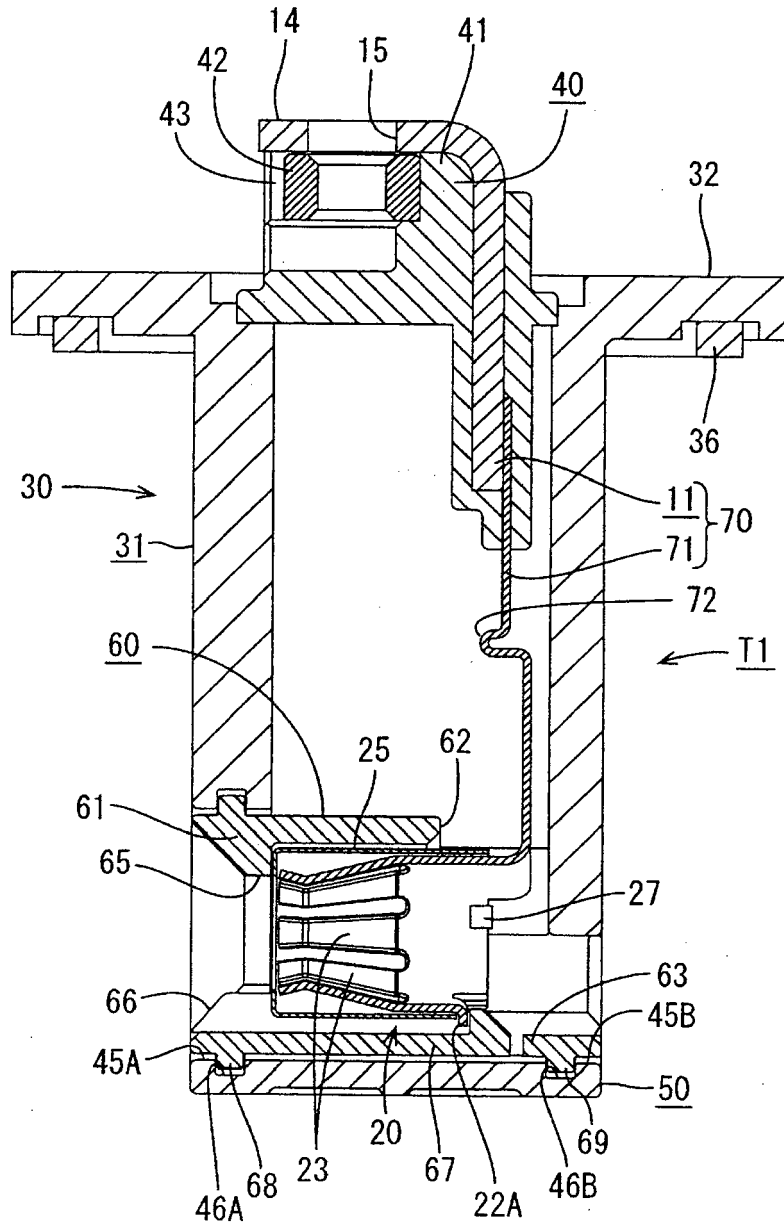
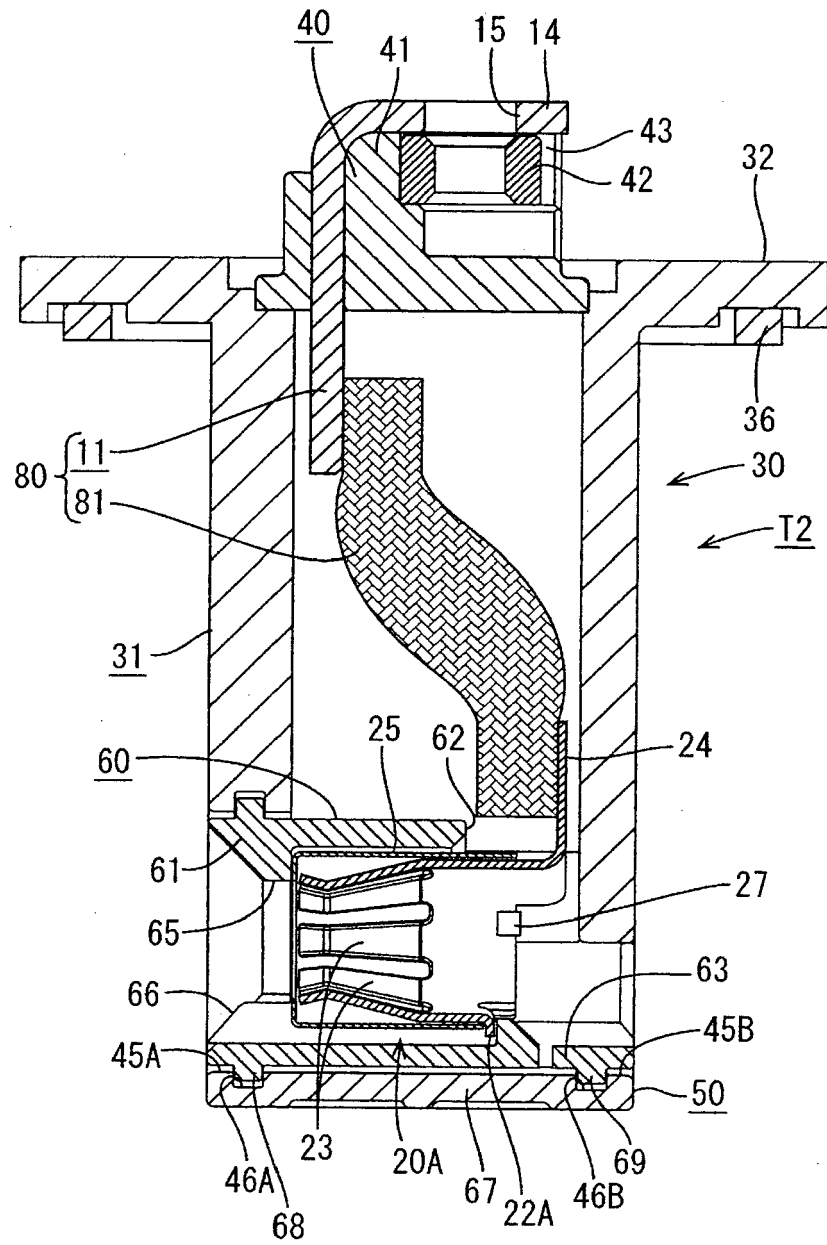


FIG. 8





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