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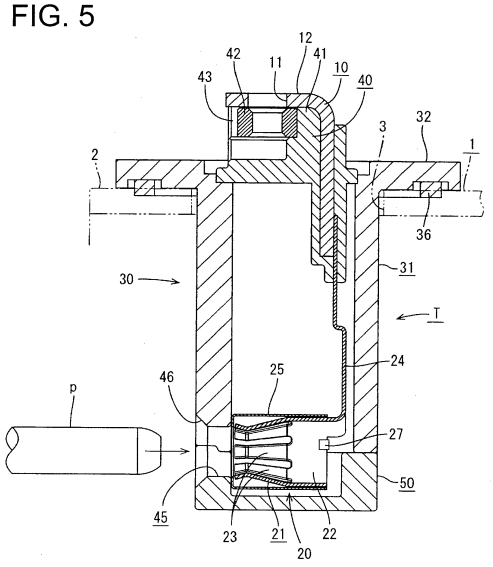
(54) Terminal block and method of connecting an inner conductive member and an outer conductive member

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

A terminal block T for connecting inner conductive members and outer conductive members arranged inside and outside a device includes a housing 30 provided to penetrate through a case 1 of the device in an in-out direction, and terminals 10 mounted in the housing 30 and each including connecting portions on inner and outer end parts to be connected to the inner and outer conductive members. The connecting portions of the terminals 10 on the inner end sides are formed by tubular socket terminals 20 to fitted and connected to pin terminals p provided on the inner conductive members.

FIG. 5



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Description

[0001] The present invention relates to a terminal block and to a method of connecting an inner conductive member and an outer conductive member.

[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 realizing space saving and improving operability in connecting a conductive member and a terminal.

[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 present invention, there is provided a terminal block for connecting an inner conductive member and an outer conductive member arranged inside and outside a device, including a housing provided to penetrate through a case of the device in an in-out direction; and at least one terminal mounted in the housing and including connecting portions on inner and outer end parts to be connected to the inner and outer conductive members; wherein the connecting portion of the terminal on the inner end side comprises (particularly is formed by) a (particularly substantially tubular) socket terminal to be fitted and connected to a pin terminal provided on the inner conductive member.

[0008] According to this configuration, the pin terminal is fitted into or to the mating socket terminal in connecting the inner conductive member to the connecting portion on the inner end side of the terminal. As compared with connection by bolting, it suffices to fit the pin terminal into or to 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.

[0009] Further, the following configurations may be adopted.

[0010] The socket terminal is accommodated in an inner end part of the housing; at least one terminal insertion opening, into which the pin terminal at least partly is insertable, is provided on an outer surface of the housing to communicate with the socket terminal.

[0011] A tapered guiding portion may be formed on an opening edge part of the terminal insertion opening.

[0012] In this configuration, the pin terminal is fitted into or to the corresponding socket terminal through the terminal insertion opening. Even if there is, for example, a misalignment at that time, the pin terminal is smoothly fitted while being aligned by the guiding portion. The connecting operation of the pin terminal and the socket terminal becomes simpler.

[0013] 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 mounted on the opening of the housing main body to at least partly cover the socket terminal.

[0014] The terminal insertion opening may be formed over the housing main body and the cover.

[0015] In this configuration, the housing is formed by mounting the cover on the housing main body and, simultaneously, the socket terminal is accommodated in the inner end side of the housing.

[0016] At least one flexible vibration absorbing portion is provided between the inner and outer connecting portions of the terminal.

[0017] In this configuration, if vibration acts on the inner or outer conductive member, this vibration is absorbed by the vibration absorbing portion and the transmission thereof to the opposite conductive member is suppressed.

[0018] 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.

[0019] 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.

[0020] An axis of the connecting portion substantially extends in the same direction as a bending direction of the outer connecting portion of the terminal.

[0021] According to another aspect of the invention, there is provided a method of connecting an inner con-

ductive member and an outer conductive member arranged inside and outside a device, in particular using the terminal block of the above aspect of the invention 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 connecting portions on inner and outer end parts to be connected to the inner and outer conductive members; and fitting a socket terminal of the connecting portion of the terminal on the inner end side to a pin terminal provided on the inner conductive member.

[0022] According to a particular embodiment, the method may further comprise accommodating the socket terminal in an inner end part of the housing; and providing at least one terminal insertion opening, into which the pin terminal is insertable, on an outer surface of the housing to communicate with the socket terminal.

[0023] Particularly, the method may further comprise forming at least one tapered guiding portion on or near an opening edge part of the terminal insertion opening.

[0024] Further particularly, the method may further comprise molding a housing main body of the housing with an opening formed on the side of the socket terminal of the terminal and mounting a cover on the opening of the housing main body to at least partly cover the socket terminal

[0025] Further particularly, the terminal insertion opening is formed over the housing main body and the cover.

[0026] Further particularly, at least one flexible vibration absorbing portion is provided between the inner and outer connecting portions of the terminal.

[0027] According to the above, it is possible to provide a terminal block capable of realizing space saving and improving operability in connecting a conductive member and a terminal.

[0028] 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, and

FIG. 7 is a vertical section of a terminal block according to a second embodiment.

<First Embodiment>

[0029] A first particular embodiment of the present invention is described with reference to FIGS. 1 to 6.

[0030] 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.

[0031] 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.

[0032] In this specific embodiment, the outer conductive member(s) extending from the inverter are one or more busbars, whereas the inner conductive member(s) 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.

[0033] The structure of the terminal block T is described in detail. As shown in FIG. 1, the terminal block T includes shown one or more, particularly 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 substantially side by side.

[0034] As shown in FIG. 6, the terminal 10 particularly is formed of a busbar particularly substantially bent into an L shape, and one end side thereof serves as an outer connecting portion 11 to be connected to the outer conductive member and particularly is formed with an insertion hole 12 for a bolt. This terminal 10 is so to be mounted into the housing 30 that the outer connecting portion 11 particularly substantially is in a horizontal posture and the other end side hangs down or projects towards the inside as described later. The other end side as a hanging or projecting end is provided with a socket terminal 20 which functions as an inner connecting portion to be connected to the inner conductive member.

[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.

[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 tubular body 25 is fitted onto the outer periphery of the louver terminal portion 21 substantially from front and retained and mounted by folding back, for example, one or more, particularly a pair of joining pieces 27 projecting from the rear edge onto the base portion 22.

[0037] A (particularly substantially strip-like) coupling piece 24 is integrally or unitarily projecting or erected from (particularly the upper edge of) the base portion 22 of the louver terminal portion 21, and an upper or distal end part of this coupling piece 24 is to be placed in contact with the hanging or projecting end of the terminal 10 and fixed such as by spot welding, soldering, bolting or the like. In this way, an axis of the socket terminal 20 substantially extends in the same direction (leftward direction of FIG. 6) as a bending direction of the outer connecting portion 11 of the terminal 10. The coupling piece 24 particularly is bent into a crank shape for reinforcement and the like at an intermediate position in a height direction. Additionally or alternatively, one or more reinforcing ribs may be provided on the coupling piece 24.

[0038] In this specific embodiment, a total of three terminals 10 are provided.

[0039] The housing 30 particularly is composed of or comprises a housing main body 31 and a cover 50.

[0040] 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.

[0041] A seat block 40 on which the outer connecting portion(s) 11 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 portion(s) 11 is/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.

[0042] 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 part(s) to the respective coupling piece(s) 24) 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.

[0043] 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 a lower half) of the (particularly each) socket terminal 20 projects laterally (particularly substantially downward) from the lateral edge (particularly lower edge) of (particularly a front wall 31A directly behind the front wall 31A of) the housing main body 31, and the (particularly each) coupling piece 24 is erected or projects before a rear wall 31 B of the housing main body 31.

[0044] Note that the one or more collars 34 particularly are also mounted.

[0045] 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.

[0046] As shown in FIGS. 1 and 5, one or more, particularly three terminal insertion openings 45 into which the aforementioned one or more (particularly substantially round) pin terminals p at least partly are insertable are formed at the substantially same position(s) (particularly substantially at the same intervals) as the one or more terminals 10 (one or more socket terminals 20) on a joint of (particularly the lower edge of) the housing main body 31 and the lateral or distal or upper edge of the cover 50 on the lateral or front surface of the housing 30. The (particularly each) terminal insertion opening 45 is located on the substantially same axis as the corresponding socket terminal 20, and/or at least one guiding portion 46 widened toward a front side is formed in a front end part of each terminal insertion opening 45.

[0047] Since the housing main body 31 and the cover 50 are integrally assembled later as described above, a second part (particularly substantially an upper half) of

the (particularly each) terminal insertion opening 45 is formed on the lateral or lower edge of the front wall 31A of the housing main body 31 and a second part (particularly substantially a lower half) thereof is formed on the upper or lateral or distal edge of a front wall 50A of the cover 50.

[0048] 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.

[0049] As partly already described, the housing main body 31 integrally including the one or more, particularly three terminals 10 is formed by a plurality of (e.g. two) moldings as shown in FIG. 6. The outer connecting portion 11 of each terminal 10 is placed on the corresponding seat 41 in a position substantially corresponding to (e.g. right above of) 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 each terminal 10 particularly is located on the substantially same axis as the terminal insertion opening 45 (precisely, upper half of this terminal insertion opening 45) directly behind the terminal insertion opening 45 while being similarly held in a substantially forward facing posture.

[0050] Subsequently, the cover 50 is mounted substantially on the lateral or lower surface opening of the housing main body 31 in which the one or more, particularly three terminals 10 are integrally provided in this way. The lock frame(s) 51 move(s) onto the lock projection(s) 38, is/are pushed (particularly substantially up from below) while being resiliently displaced, and is/are fitted to the lock projection(s) 38 while being restored towards or substantially into an original shape when (particularly the upper edge of) the cover 50 comes into contact with (particularly 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.

[0051] At this time, the socket terminal 20 as the inner connecting portion of each terminal 10 at least partly is accommodated in (particularly a lower end part of) the housing 30 and the terminal insertion opening 45 particularly substantially is concentrically open directly before the socket terminal 20.

[0052] 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.

[0053] The terminal block T assembled as described above is mounted on (particularly the lateral or 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.

[0054] When the terminal block T is mounted in this way, the outer connecting portion 11 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 projects inwardly, particularly substantially toward a lower surface side (inward) of the case upper wall 2 while being accommodated in the lower end part of the housing 30, but is open laterally or forward (leftward in FIG. 5) through the terminal insertion opening 45 formed in the lateral or front surface of the housing 30.

[0055] 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.

[0056] First, the one or more, particularly three inner conductive members (enamel wires) of the motor side are connected to the inner connecting portion(s) of the corresponding terminal(s) 10 by at least partly 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) 45 open on the front surface of the housing 30 through the terminal insertion opening(s) 45 as indicated by an arrow in FIG. 5. At this time, even if the (particularly substantially round) pin terminal(s) p is/are misaligned with the socket terminal(s) 20, it/they is/are inserted while substantially being aligned by the guiding portion(s) 46. The (round) pin terminal(s) p is/are displaced (particularly pushed) while resiliently displacing the resilient contact pieces 23 of the louver terminal portion(s) 21. When the displacement/pushing of the (round) pin terminal(s) p is stopped, the resilient contact pieces 23 at least partly 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, particularly three inner conductive members (enamel wires) of the motor side are connected to the one or more respective inner connecting portions (socket terminals 20) of the one or more corresponding terminals 10.

[0057] Thereafter, the motor-side case is adjacently assembled to cover a front surface opening of the transmission case 1.

[0058] 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 11 of the one or more corresponding terminals 10. Although not shown, the respective busbars particularly are placed on the outer connecting portions 11 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 12 of the outer connecting portions 11 and threadably tightened into the respective nut(s) 42 at least partly accommodated in the accommodating chamber(s) 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 11 of the one or more corresponding terminals 10.

[0059] Thereafter, the inverter-side case is assembled on the lateral or upper surface(s) of the transmission case 1 and/or the motor-side case integrally joined as described above.

[0060] 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.

[0061] 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 to 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 terminal(s) 10 is realized by fitting the (particularly substantially round) pin terminal(s) p into the mating socket terminal(s) 20.

[0062] 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.

[0063] In this embodiment, the (particularly substantially round) pin terminal(s) p provided on (particularly the tip(s) of) the inner conductive member(s) of the motor at least partly is/are inserted into the socket terminal(s) 20 at least partly at least partly accommodated in the housing 30 through the terminal insertion opening(s) 45 open on the lateral or front surface of the housing 30. The inner conductive member(s) of the motor possibly shake since it is formed by solidifying the enamel wire(s), wherefore the (round) pin terminal(s) p and the mating socket terminal(s) 20 may be misaligned with each other. However, since the one or more tapered guiding portions 46 particularly are formed on the entrance side(s) of the terminal insertion opening(s) 45, even if the (round) pin terminal(s) p is/are misaligned with the socket terminal(s) 20, the (round) pin terminal(s) p at least partly is/are inserted and smoothly fitted into the socket terminal(s) 20 while being aligned by the guiding portion(s) 46. The connecting operation of the (round) pin terminal(s) p and the socket terminal(s) 20 becomes simpler.

[0064] The housing 30 is composed of the housing main body 31 particularly molded with the opening formed on the side of the socket terminal(s) 20 of the terminal(s) 10, and the cover 50 mounted on the opening of the housing main body 31 to at least partly cover the socket terminal(s) 20. Particularly, sealing between the housing 30 and the terminal(s) 10 can be provided by molding the housing main body 31.

[0065] Accordingly, to provide a terminal block capable of realizing space saving and improving operability in connecting a conductive member and a terminal, a terminal block T for connecting one or more inner conductive members and one or more outer conductive members arranged inside and outside a device includes a housing 30 provided to penetrate through a case 1 of the device in an in-out direction, and one or more terminals 10 mounted in the housing 30 and each including connecting portions on inner and outer end parts to be connected to the inner and outer conductive members. The connecting portion(s) of the terminal(s) 10 on the inner end side(s) is/are formed by (particularly substantially tubular) socket terminal(s) 20 to fitted and connected to one or more respective pin terminals p provided on the inner conductive member(s).

<Second Embodiment>

[0066] A second particular embodiment of the present invention is described with reference to FIG. 7. This second embodiment differs from the first embodiment in that a vibration absorbing portion is provided between inner and outer connecting portions of a terminal 60 mounted in a terminal block T1.

[0067] Points of difference from the first embodiment are mainly described below and members and parts having the similar or substantially same functions as in the first embodiment are denoted by the same reference signs and described only briefly or not at all.

[0068] The terminal 60 is so structured that at least one flexible conductor 62, which serves as the vibration absorbing portion, is connected to a hanging or projecting end of a busbar 61 bent particularly substantially into an L shape. This flexible conductor 62 particularly is structured by bending (particularly a braided wire or flexible flat conductor) into a substantially S shape. On the other hand, a coupling piece 24A erected or projecting from (particularly a base portion 22 of) a louver terminal portion 21 has a short height in a socket terminal 20A which serves as an inner connecting portion.

[0069] Specifically, after the (particularly substantially L-shaped) busbar 61 forming (part of) the terminal 60 is set in a posture substantially opposite to that in the first

embodiment in a front-back direction, an upper end part of the flexible conductor 62 is placed in contact with (particularly the rear surface of) a lower or projecting end part of this busbar 61 and fixed particularly by spot welding or the like, and a lower end part of this flexible conductor 62 is placed in contact with the front surface of an upper end part of the coupling piece 24A erected from the base portion 22 of the louver terminal portion 21 and likewise fixed particularly by spot welding or the like. In the terminal 60 of the second embodiment, a bending direction of an outer connecting portion 11 and that of the socket terminal 20A are substantially opposite in the front-back direction.

[0070] The housing 30 is similarly composed of or comprises a housing main body 31 and a cover 50, and the housing main body 31 integrally or unitarily including three terminals 60 is formed particularly by two moldings. The cover 50 is mounted on the lower surface opening of this housing main body 31, whereby the housing 30 is formed and, as a result, the terminal block T1 is completed.

[0071] At this time, the substantially S-shaped flexible conductors 62 forming parts of the terminal 60 are accommodated in most of an upper area in the housing 30, the socket terminals 20A as the inner connecting portions of the terminals 60 are accommodated in a lower end part of the housing 30 and terminal insertion openings 45 are concentrically open directly before the socket terminals 20A.

[0072] Such a terminal block T1 is similarly mounted on the upper wall 2 of the transmission case 1. Thereafter, as in the first embodiment, one or more pin terminals p provided on the one or more respective wires, particularly on the tips of the enable wires, at least partly are inserted into the one or more socket terminals 20A as the inner connecting portions in connecting the one or more, particularly three inner conductive members (particularly enamel wires) of the motor side to the inner connecting portions of the terminals 60, and the one or more, particularly three outer conductive members (particularly busbars) of the inverter side and the outer connecting portions 11 of the corresponding terminals 60 are connected particularly by bolting. In addition, the motor and the inverter are directly coupled.

[0073] According to this second embodiment, as in the first embodiment, it is possible to improve operability in the case of connecting the inner conductive member(s) of the motor side to the inner connecting portion(s) of the terminal(s) 60 mounted in the terminal block T1 and realize space saving.

[0074] In addition, since the flexible conductor 62 as the vibration absorbing portion is provided for the terminal 60 mounted in the terminal block T1, if vibration acts on the inner or outer conductive member, this vibration is absorbed by the flexible conductor 62 and the transmission thereof to the opposite conductive member side is suppressed.

<Other Embodiments>

[0075] 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 terminal insertion opening(s) open on the housing is/are separately provided on the housing main body and the cover in the above embodiments, it/they may be provided on either one of them.

(3) Although the terminal(s) are integrally mounted in the housing main body by molding the housing main body in the above embodiments, it/they may be mounted into the housing later on such as by being press-fitted.

(4) 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.

(5) 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.

(6) 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

[0076]

T, T1	terminal block
1	transmission case
2	case upper wall
3	through hole
10	terminal
11	outer connecting portion
12	insertion hole
20, 20A	socket terminal (inner connecting portion)
30	housing
31	housing main body
45	terminal insertion opening
46	guiding portion
50	cover

60 terminal
62 flexible conductor (vibration absorbing portion)
p round pin terminal (pin terminal)

Claims

1. A terminal block (T) for connecting an inner conductive member and an outer conductive member arranged inside and outside a device, comprising:

a housing (30) provided to penetrate through a case (1) of the device in an in-out direction; and at least one terminal (10) mounted in the housing (30) and including connecting portions (11, 20; 20A) on inner and outer end parts to be connected to the inner and outer conductive members; wherein the connecting portion (20; 20A) of the terminal (10) on the inner end side comprises a socket terminal (20; 20A) to be fitted and connected to a pin terminal (p) provided on the inner conductive member.

2. A terminal block according to claim 1, wherein:

the socket terminal (20; 20A) is accommodated in an inner end part of the housing (30); and 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).

3. A terminal block according to claim 2, wherein at least one tapered guiding portion (46) is formed on or near an opening edge part of the terminal insertion opening (45).

4. A terminal block according to claim 2 or 3, 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) 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)

5. A terminal block according to claim 4, wherein the terminal insertion opening (45) is formed over the housing main body (31) and the cover (50).

6. A terminal block according to any one of the preceding claims, wherein at least one flexible vibration absorbing portion (62) is provided between the inner and outer connecting portions of the terminal (10).

7. 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).

8. A terminal block according to claim 7, 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).

9. A terminal block according to any one of the preceding claims, wherein an axis of the connecting portion (20; 20A) substantially extends in the same direction as a bending direction of the outer connecting portion (11) of the terminal (10).

10. A method of connecting an inner conductive member and an outer conductive member arranged inside and outside a device, comprising the following steps:

providing a housing (30) to penetrate through a case (1) of the device in an in-out direction;
mounting at least one terminal (10) in the housing (30) and including connecting portions (11, 20; 20A) on inner and outer end parts to be connected to the inner and outer conductive members; and
fitting a socket terminal (20; 20A) of the connecting portion (20; 20A) of the terminal (10) on the inner end side to a pin terminal (p) provided on the inner conductive member.

11. A method according to claim 10, further comprising accommodating the socket terminal (20; 20A) in an inner end part of the housing (30); and providing at least one terminal insertion opening (45), into which the pin terminal (p) is insertable, on an outer surface of the housing (30) to communicate with the socket terminal (20; 20A).

12. A method according to claim 11, further comprising forming at least one tapered guiding portion (46) on or near an opening edge part of the terminal insertion opening (45).

13. A method according to claim 11 or 12, further comprising molding a housing main body (31) of the housing (30) with an opening formed on the side of the socket terminal (20; 20A) of the terminal (10) and mounting a cover (50) on the opening of the housing main body (31) to at least partly cover the socket terminal (20; 20A)

14. A method according to claim 13, wherein the terminal insertion opening (45) is formed over the housing

main body (31) and the cover (50).

15. A method according to any one of the preceding claims 10 to 14, wherein at least one flexible vibration absorbing portion (62) is provided between the inner and outer connecting portions of the terminal (10).

FIG. 1

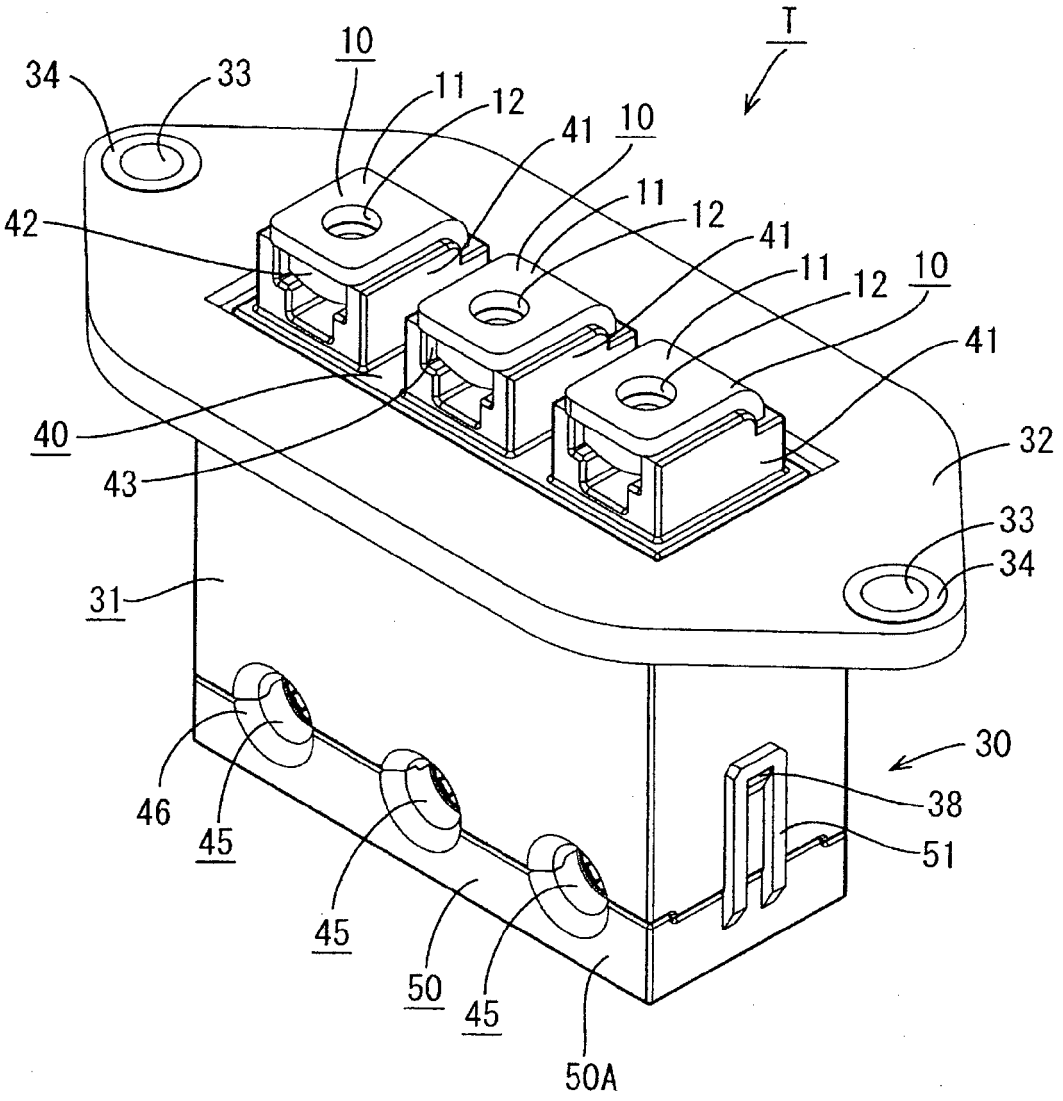
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FIG. 2

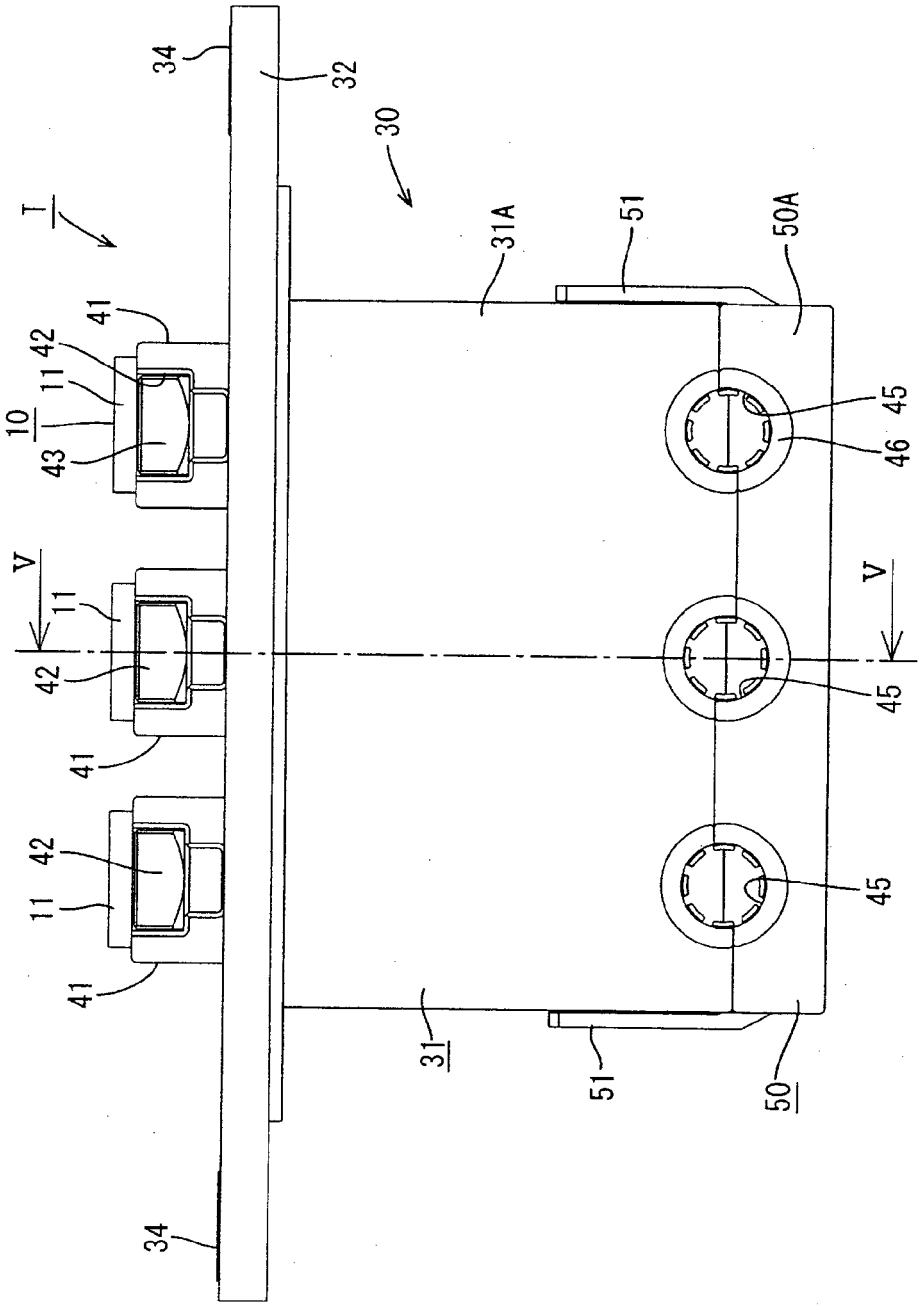
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FIG. 3

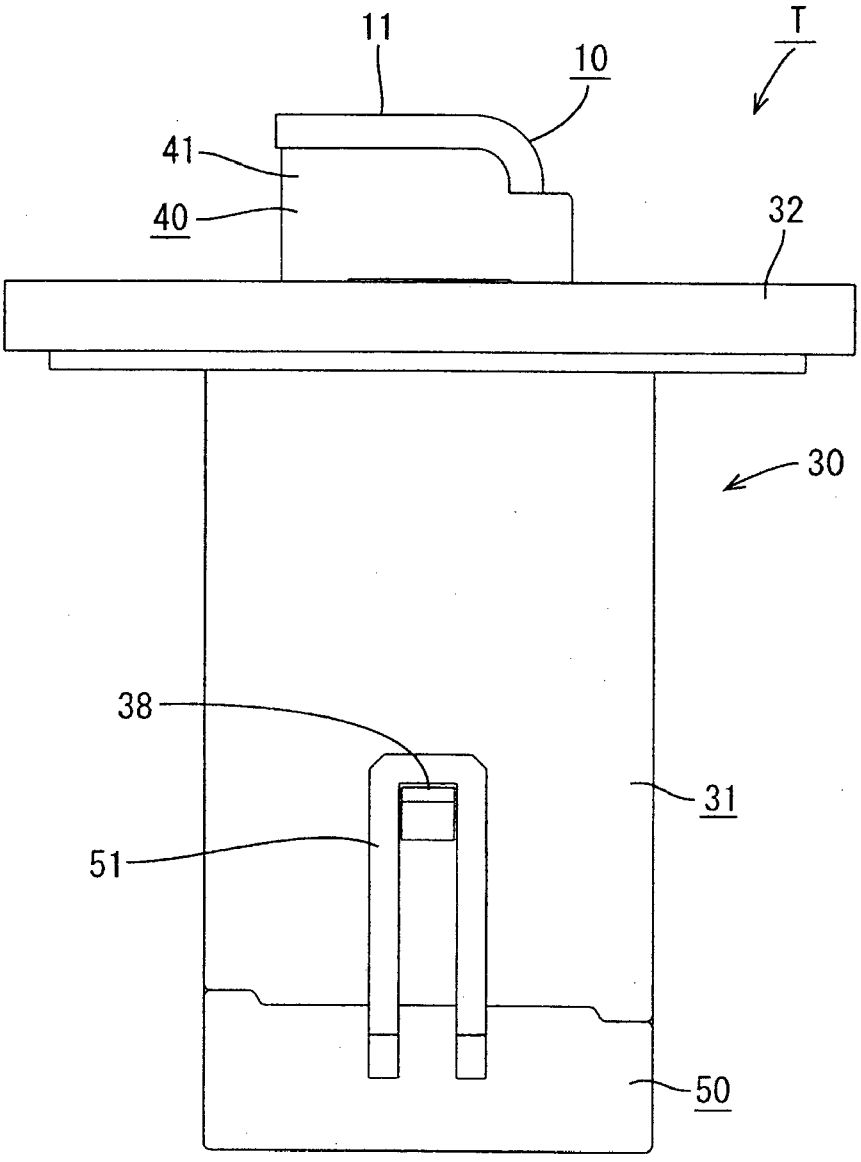

FIG. 4

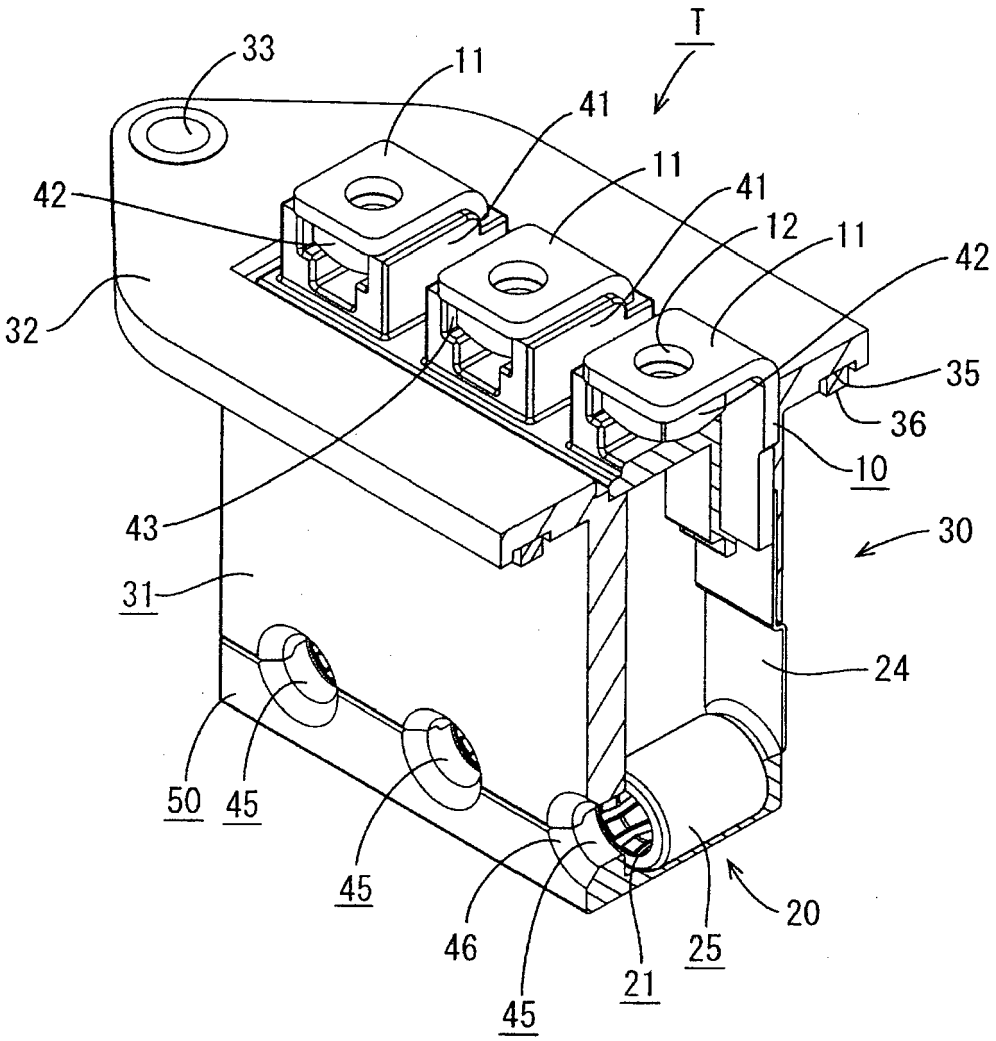
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FIG. 5

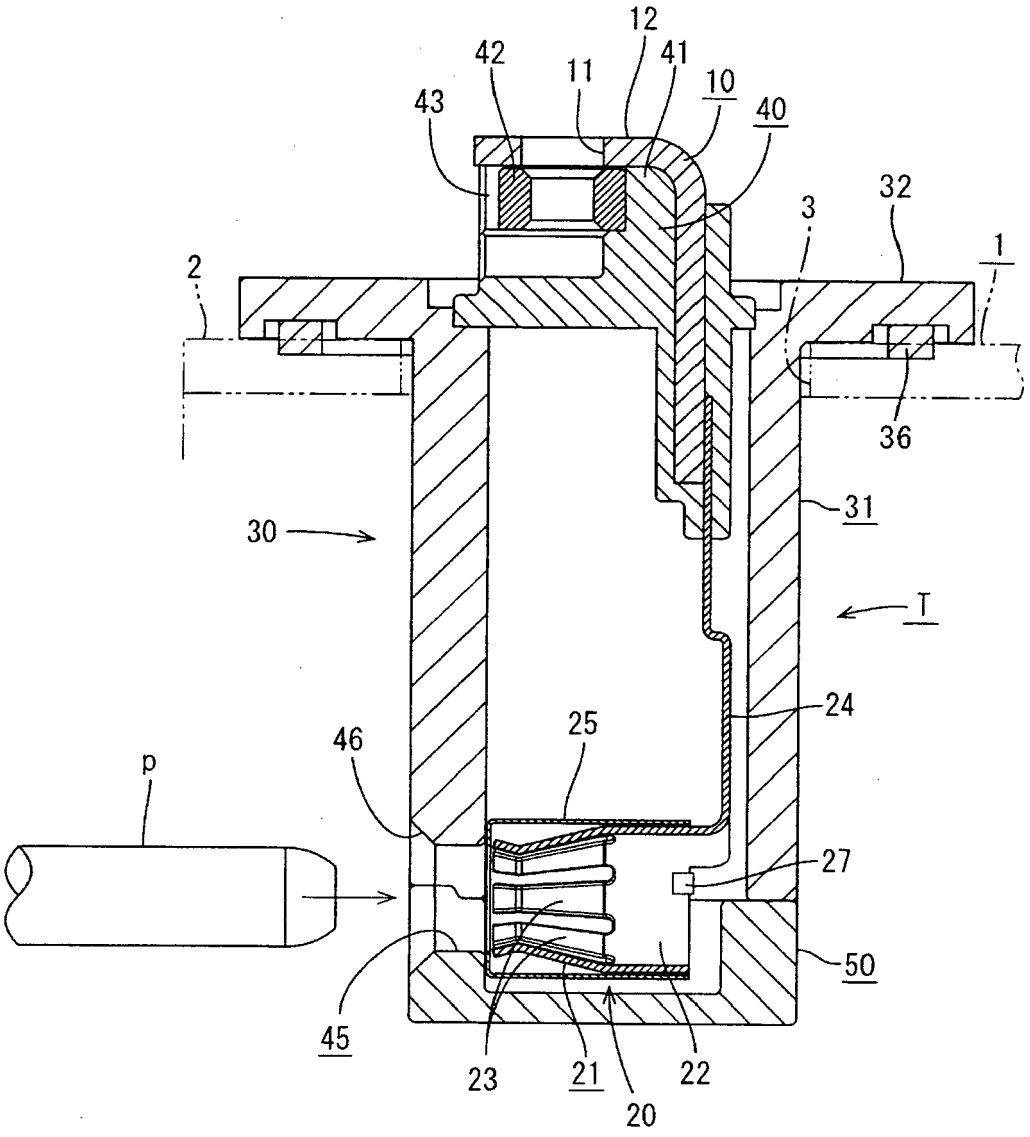


FIG. 6

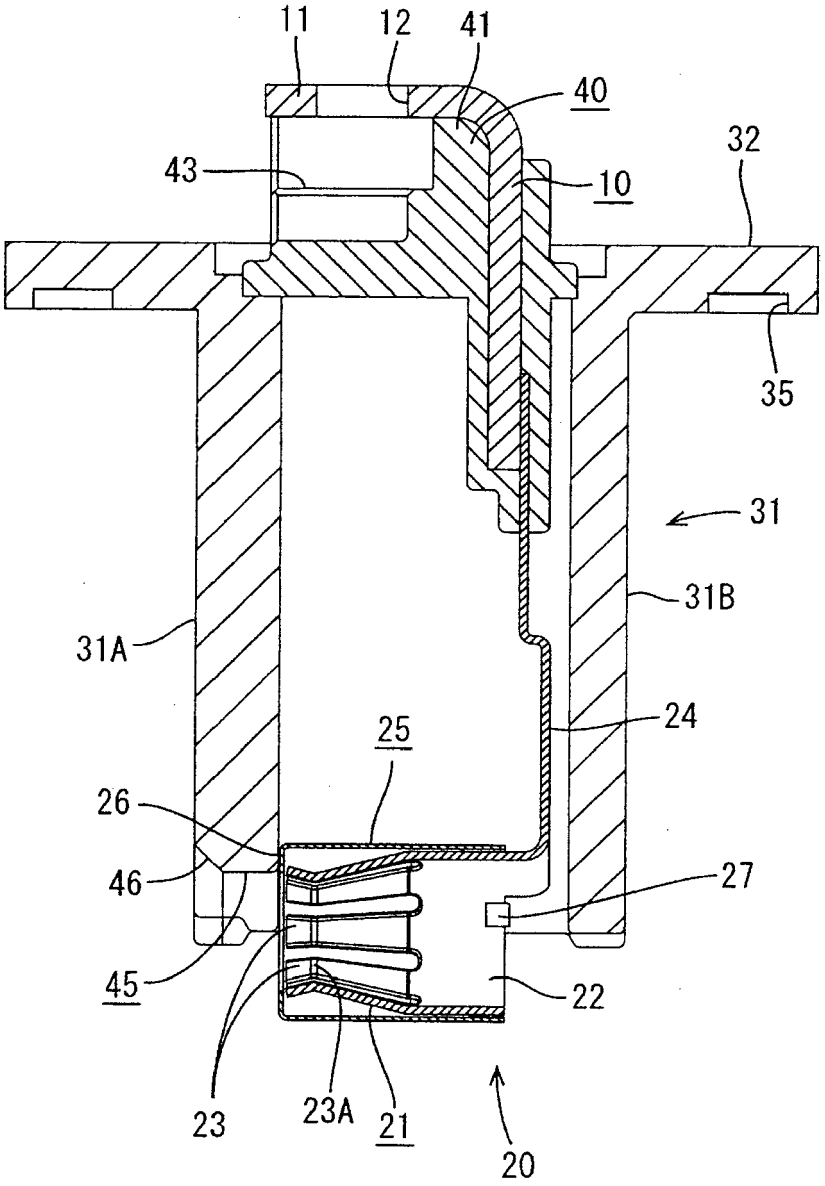
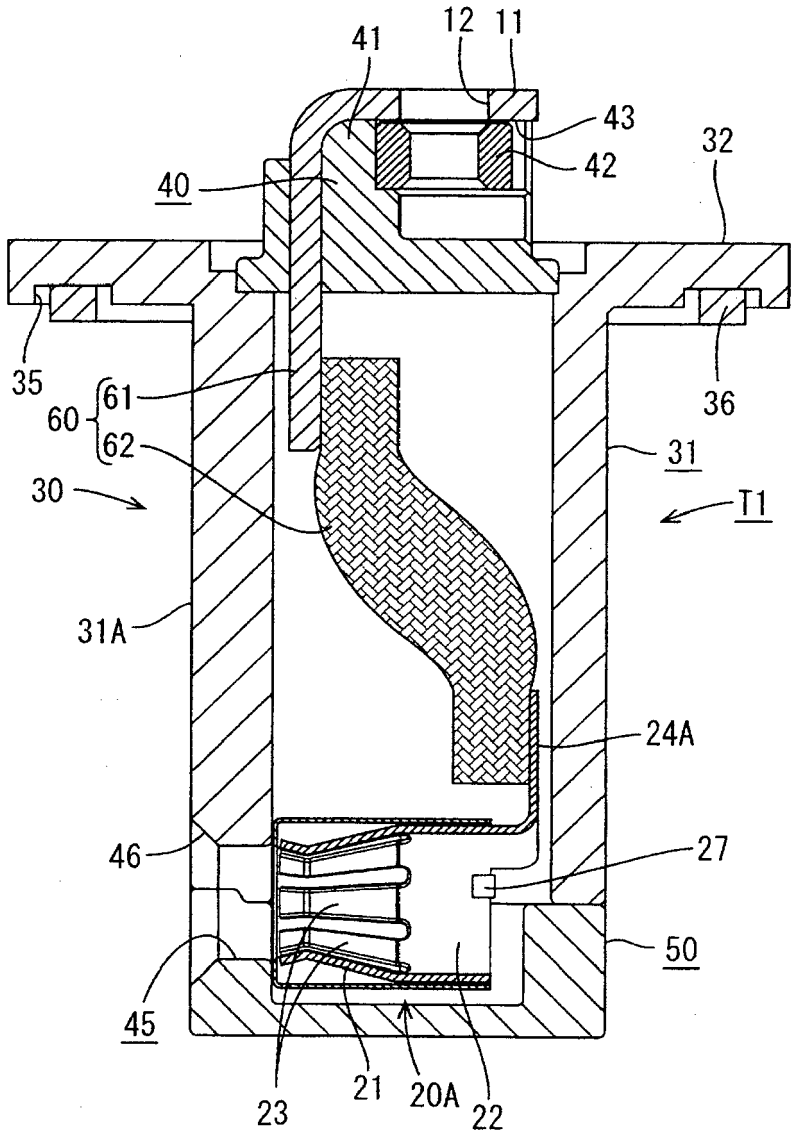


FIG. 7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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 1637

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 413 435 A1 (YAZAKI CORP [JP]) 1 February 2012 (2012-02-01) * figures 10,5 * * paragraph [0226]; claims 1,3 * -----	1-15	INV. H01R9/24 H01R13/11 H01R13/506
A	US 2012/040553 A1 (TASHIRO HARUNORI [JP]) 16 February 2012 (2012-02-16) * figures 2-11 * -----	1-15	ADD. H01R105/00 H01R4/48

TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 July 2014	Ferreira, João

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14-07-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2413435 A1	01-02-2012	CN 102341969 A	01-02-2012
		EP 2413435 A1	01-02-2012
		US 2012015546 A1	19-01-2012
		WO 2010110032 A1	30-09-2010
US 2012040553 A1	16-02-2012	CN 102449858 A	09-05-2012
		EP 2463965 A1	13-06-2012
		JP 5399804 B2	29-01-2014
		JP 2011034825 A	17-02-2011
		US 2012040553 A1	16-02-2012
		WO 2011016272 A1	10-02-2011

EPO FORM P0459

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Patent documents cited in the description

- JP 2010211933 A **[0002]**