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(71) Applicant: **mitsubishi heavy industries, ltd.**
Tokyo 108-8215 (JP)

(72) Inventors:
• **SUMIYA, Atsuyuki**
TOKYO, 108-8215 (JP)
• **OONO, Kenzo**
TOKYO, 108-8215 (JP)
• **SHIMIZU, Kenji**
TOKYO, 108-8215 (JP)

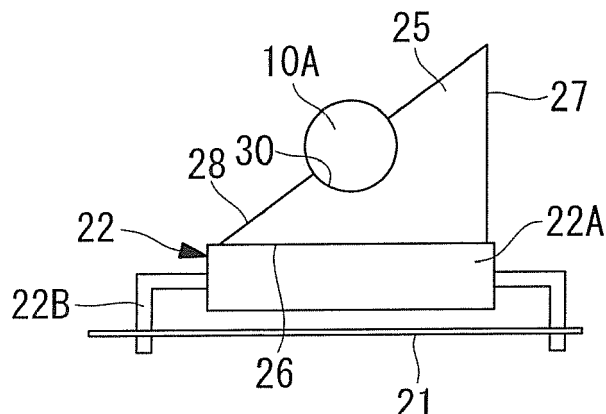
(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) **CONTROLLER PROVIDED WITH HEATING ELECTRONIC COMPONENTS, AND AIR CONDITIONER**

(57) An object of the invention is to provide a controller in which the number of mounting holes on a substrate side is reduced to suppress reduction in a pattern width, and workability during substrate installation can be improved, and an air conditioner comprising the same. The controller includes a block 25 made of a heat transfer material; and heating electronic components 22, 23 and 24 that are mounted on a substrate 21, and are fixed in

contact with the block 25. The block 25 includes at least two surfaces including a first surface 26 located along the substrate 21, and a second surface 27 intersecting with the first surface 26. One part of the electronic components is dispersed and disposed on the first surface 26. At least one SIP type electronic components 23 and 24 of the electronic components is dispersed and disposed on the second surface 27.

FIG. 7B



Description

{Technical Field}

[0001] The present invention relates to a controller provided with a substrate having heating electronic components such as a power transistor mounted thereon, and an air conditioner mounted with the same.

{Background Art}

[0002] A controller having a substrate with heating electronic components such as an active converter, a diode module, and a power transistor, which configure an inverter, is mounted on an air conditioner incorporated with an inverter-driven apparatus. Recently, with increase in capacity of the inverter or power devices thereof, there is need to improve cooling performance of the controller. As the cooling system, a refrigerant cooling system for performing cooling by utilizing a refrigerant is being employed in place of an air cooling system for providing a cooling fin to perform cooling.

[0003] Patent Literature (PTL) 1 discloses an apparatus, in which a refrigerant jacket configured by an aluminum block having high thermal conductivity is disposed to face DIP (Dual Inline Package) type electronic components or SIP (Single Inline Package) type electronic components mounted on a wiring substrate, and a plurality of the electronic components are screwed and fixed on the facing surface to be installed, a refrigerant pipe is disposed along on an opposite facing surface in a contact manner, and a plurality of the heating electronic components are cooled by a refrigerant through the refrigerant jacket.

{Patent Literature}

[0004] {PTL 1} Publication of Japanese Patent No. 5472364

{Summary of Invention}

{Technical Problem}

[0005] When the refrigerant cooling system is employed as the cooling system of a controller as described above, the following problems are caused.

(1) Since a heat radiation surface is reduced due to miniaturization of an aluminum block, the heating electronic components need to be collected on one part of the substrate. In order to fix the electronic components to the aluminum block, mounting holes for the electronic components need to be provided on the substrate. However, a substrate occupancy area is reduced by the collection of the electronic components, and therefore the pattern width of the substrate is reduced by the mounting holes, thereby

making it difficult to secure current capacity.

(2) Although a silicon sheet for heat radiation or the like is mounted between the refrigerant pipe and the aluminum block, the mounting surface becomes a vertical surface, and therefore the sheet is easily peeled, and workability is deteriorated.

(3) When the substrate is fixed, pressure needs to be uniformly applied to the sheet so as not to cause wrinkles. However, wrinkles are easily caused by the deterioration of workability as described above, and heat transfer performance may be lowered.

[0006] The present invention has been made in view of such circumstances, and an object of the invention is to provide a controller provided with heating electronic components, in which a plurality of the electronic components are disposed and dispersed on two faces of a block made of a heat transfer material, and the number of mounting holes provided in a substrate is reduced, so that reduction in the pattern width can be suppressed, and workability during installation of the substrate can be improved, and to provide an air conditioner mounted with the same.

{Solution to Problem}

[0007] In order to solve the above problems, a controller provided with heating electronic components, and an air conditioner of the present invention employ the following solutions.

[0008] That is, a controller provided with heating electronic components according to the present invention includes: a block made of a heat transfer material that is cooled through a refrigerant pipe; and a plurality of heating electronic components that are mounted on a substrate, and are fixed and installed in contact with the block made of a heat transfer material to be capable of being cooled by using the block made of a heat transfer material as a heat sink, wherein the block made of a heat transfer material is a block body that includes at least two surfaces including a first surface located along the substrate, and a second surface intersecting with the first surface, and one part of the electronic components is disposed on the first surface of the block body, and at least one SIP type electronic component of the electronic components is disposed on the second surface.

[0009] According to the present invention, in the controller provided with heating electronic components including: the block made of a heat transfer material that is cooled through the refrigerant pipe; and the plurality of heating electronic components that are mounted on the substrate, and are capable of being cooled by using the block made of a heat transfer material as a heat material, the block made of a heat transfer material is the block body that includes at least the two surface including the first surface located along the substrate, and the second surface intersecting with the first surface, and one part of the electronic components is disposed on the first

surface of the block body, and at least the one SIP type electronic component is disposed on the second surface. Therefore, mounting holes for fixing and installing the SIP type electronic components dispersed and disposed on the second surface intersecting with the substrate surface of the block body do not need to be provided on the substrate side, and it is possible to reduce the number of the electronic component mounting holes provided on the pattern of the substrate. Accordingly, even when the heating electronic components are collected on one part of the substrate in order to miniaturize the block made of a heat transfer material, it is possible to sufficiently secure current capacity without reducing the pattern width of the substrate due to the mounting holes.

[0010] Furthermore, according to the controller provided with heating electronic components of the present invention, in the above controller provided with heating electronic components, in a case where a plurality of the SIP type electronic components are provided, all of the SIP type electronic components are disposed on the second surface, or one part of the SIP type electronic components is disposed on the second surface and other part of the SIP type electronic component is disposed on the first surface.

[0011] According to the present invention, in a case where a plurality of the SIP type electronic components are provided, all of the SIP type electronic components are disposed on the second surface, or one part of the SIP type electronic components is disposed on the second surface, and other part of the SIP type electronic components are disposed on the first surface. Therefore, the mounting holes, the number of which corresponds to the number of the SIP type electronic components dispersed and disposed on the second surface side, among a plurality of the SIP type electronic components provided, do not need to be provided on the substrate side, and it is possible to reduce the number of electronic component mounting holes provided on the pattern of the substrate. Consequently, the pattern width of the substrate is not reduced by the mounting holes, and it is possible to sufficiently secure current capacity on the substrate side.

[0012] Furthermore, according to the controller provided with heating electronic components of the present invention, in any of the above controllers provided with heating electronic components, the block made of a heat transfer material is a block body that includes at least one surface having a recessed groove in which the refrigerant pipe is contact with, other than the two surfaces.

[0013] According to the present invention, the block made of a heat transfer material is the block body that includes at least one surface having the recessed groove in which the refrigerant pipe is contact with, in addition to the two surfaces. Therefore, the block made of a heat transfer material is made to be a block body that includes at least three surfaces including the two surfaces intersecting with each other and allowing one part of the plurality of electronic components and at least the one SIP

type electronic component to be dispersed and disposed, and one surface having a recessed groove in which the refrigerant pipe is contact with, so that it is possible to reduce the volume as small as possible to attain miniaturization, and to reduce heat resistance by the block made of a heat transfer material. Accordingly, it is possible to enhance a cooling effect by a refrigerant to improve the cooling performance of the controller while attaining the miniaturization of the block made of a heat transfer material.

[0014] Furthermore, according to the controller provided with heating electronic components of the present invention, in the above controller provided with heating electronic components, the block made of a heat transfer material is a block body including the two surfaces, and the one surface having the recessed groove, wherein the one surface having the recessed groove is formed with any of an inclined surface, a bending surface, and a curved surface having a predetermined inclination in a horizontal direction to a vertical surface.

[0015] According to the present invention, the block made of a heat transfer material includes the two surfaces, and the one surface having the recessed groove, and is a block body in which the one surface having the recessed groove is formed with any of the inclined surface, the bending surface, and the curved surface having the predetermined inclination in the horizontal direction to the vertical surface. Therefore, the one surface having the recessed groove in which the refrigerant pipe is contact with is made to be any of the inclined surface, the bending surface, and the curved surface having the predetermined inclination in the horizontal direction to the vertical surface, so that it is possible to reduce the volume of the block body configuring the block made of a heat transfer material by an amount corresponding to an amount removed by any of the inclined surface, the bending surface, and the curved surface. Accordingly, it is possible to reduce heat resistance of the block made of a heat transfer material, and improve a heat radiation property from the electronic components to enhance cooling performance, and it is possible to further miniaturize the block made of a heat transfer material to reduce cost.

[0016] Furthermore, according to the controller provided with heating electronic components of the present invention, in the above controller provided with heating electronic components, a supporting surface of a supporting member supporting the refrigerant pipe along the block made of a heat transfer material on a side of the controller is formed of any of the inclined surface, the bending surface, and the curved surface corresponding to the one surface having the recessed groove of the block body configuring the block made of a heat transfer material.

[0017] According to the present invention, the supporting surface of the supporting member supporting the refrigerant pipe along the block made of a heat transfer material on the controller side is formed with any of the

inclined surface, the bending surface, and the curved surface corresponding to the one surface having the recessed groove of the block body configuring the block made of a heat transfer material. Therefore, any of the inclined surface, the bending surface, and the curved surface of the block body on the side of the block made of a heat transfer material can be supported by using the supporting surface being any of the inclined surface, the bending surface, and the curved surface on the supporting member side as mating surfaces, and the refrigerant pipe supported by the supporting member can be disposed in contact with the block made of a heat transfer material. Consequently, it is possible to position the refrigerant pipe by using the supporting surface of the supporting member, and any of the inclined surface, the bending surface and the curved surface of the block made of a heat transfer material as mutual mating surfaces, to easily and reliably dispose the refrigerant pipe and the block made of a heat transfer material in a contact manner. Also in a case where the heat radiation sheet or the like is interposed between the refrigerant pipe and the block made of a heat transfer material, it is possible to prevent the sheet from peeling or dropping during construction, to improve workability.

[0018] Furthermore, according to the controller provided with heating electronic components of the present invention, in any of the above controllers provided with heating electronic components, in the block made of a heat transfer material, a lower end of the first surface extends downward than a lower end of a package body of the one part of the electronic components.

[0019] According to the present invention, the lower end of the first surface extends downward than the lower end of the package body of the part of the electronic components. Therefore, even when dew condensation occurs on the surface of the block made of a heat transfer material cooled by the refrigerant pipe, the dew condensation water can pass through the lower end of the block made of a heat transfer material, which extends downward than the lower end of the package body of one part of the electronic components, to quickly drop downward. Accordingly, it is possible to prevent the dew condensation water from staying on the controller, and it is possible to prevent generation of breakdown or damage of electronic components due to dropping of the dew condensation water on the electronic component, to protect the controller.

[0020] Furthermore, according to the controller provided with heating electronic components of the present invention, in any of the above controllers provided with heating electronic components, the substrate is supported by a controller body through a supporting tool, and the supporting tool supporting a lower side of the substrate rotatably supports the substrate with the lower side as a supporting point.

[0021] According to the present invention, the substrate is supported by the controller body through the supporting tool, and the supporting tool supporting the

lower side of the substrate rotatably supports the substrate with the lower side as a supporting point. Therefore, when the substrate is fixed and supported by the controller body through the supporting tool, the substrate is first supported to the supporting tool rotatably supporting the lower side of the substrate, the upper part of the substrate is rotated with the lower side as a supporting point, and the upper side is supported by the supporting tool, so that the substrate can be fixed and supported by the controller body. At this time, the recessed groove provided in the one surface of the block made of a heat transfer material can be fitted to the refrigerant pipe supported by the supporting member while being rotated from the circumferential direction. Accordingly, the recessed groove of the block made of a heat transfer material and the refrigerant pipe can be smoothly fitted while avoiding mutual interference, generation of wrinkles can be prevented by uniformly applying pressure to the heat radiation sheet or the like interposed between the refrigerant pipe and the block made of a heat transfer material, and workability can be improved.

[0022] Furthermore, a controller provided with heating electronic components according to the present invention includes: a block made of a heat transfer material that is cooled through a refrigerant pipe; and a plurality of heating electronic components that are mounted on a substrate, and are fixed and installed in contact with the block made of a heat transfer material to be capable of being cooled by using the block made of a heat transfer material as a heat sink, wherein the block made of a heat transfer material is a block body that includes a surface on which a plurality of the electronic components are fixed and installed in a contact manner, and a surface having a recessed groove allowing the refrigerant pipe to be fitted in a contact manner, and the surface having the recessed groove of the block body is formed with any of an inclined surface, a bending surface, and a curved surface having a predetermined inclination in a horizontal direction to a vertical surface.

[0023] According to the present invention, in the controller provided with heating electronic components including the block made of a heat transfer material that is cooled by the refrigerant pipe; and a plurality of the heating electronic components that are mounted on the substrate, and are capable of being cooled by using the block made of a heat transfer material as a heat sink, the block made of a heat transfer material is the block body that includes the surface on which a plurality of the electronic components are fixed and installed in the contact manner, and the surface having the recessed groove allowing the refrigerant pipe to be fitted in the contact manner, and the surface having the recessed groove of the block body is formed with any of the inclined surface, the bending surface, and the curved surface having the predetermined inclination in the horizontal direction to the vertical surface. Therefore, when the recessed grooves on the side of the block made of a heat transfer material being the block body is fitted in contact with the refrigerant pipe,

any of the inclined surface, the bending surface, and the curved surface having the predetermined inclination in the horizontal direction can be used as a mating surface corresponding to the supporting surface of the supporting member supporting the refrigerant pipe, to position the refrigerant pipe, and the block made of a heat transfer material can be disposed in contact with the refrigerant pipe. Accordingly, it is possible to position the block made of a heat transfer material and the refrigerant pipe to easily and reliably dispose the block made of a heat transfer material and the refrigerant pipe in a contact manner. Additionally, also in a case where the heat radiation sheet or the like is interposed between the block made of a heat transfer material and the refrigerant pipe, it is possible to hold the heat radiation sheet by the surface having the predetermined inclination in the horizontal direction, and it is possible to prevent the sheet from peeling or dropping during construction, to improve workability.

[0024] Furthermore, according to the controller provided with heating electronic components of the present invention, in the above controller provided with heating electronic components, the block made of a heat transfer material is a block body that includes two surfaces intersecting with each other and enabling a plurality of the electronic components to be fixed and installed, and the surface having the recessed groove, formed with any of the inclined surface, the bending surface, and the curved surface such that a corner of the block body having the two surfaces is cut out.

[0025] According to the present invention, the block made of a heat transfer material is a block body that includes the two surfaces intersecting with each other and enabling a plurality of the electronic components to be fixed and installed, and the surface having the recessed groove, formed with any of the inclined surface, the bending surface, and the curved surface such that the corner of the block body having the two surfaces is cut out. Therefore, the surface having the recessed groove of the block made of a heat transfer material is formed by any of the inclined surface, the bending surface, and the curved surface having the cut-out corner of the block body, so that it is possible to minimize the volume of the block body. Accordingly, it is possible to reduce the heat resistance of the block made of a heat transfer material, to improve a heat radiation property from the heating electronic components, and it is possible to further miniaturize the block made of a heat transfer material to reduce cost. Additionally, the surface having the recessed groove is made to be any of the inclined surface, the bending surface, and the curved surface, so that the refrigerant pipe can be easily fitted in contact with the recessed groove, and workability in assembly of the controller can be improved.

[0026] Furthermore, according to the controller provided with heating electronic components of the present invention, in any of the above controllers provided with heating electronic components, the refrigerant pipe is supported by a supporting member having a supporting

surface corresponding to any of the inclined surface, the bending surface, and the curved surface having the recessed groove of the block body.

[0027] According to the present invention, the refrigerant pipe is supported by the supporting member having the supporting surface corresponding to any of the inclined surface, the bending surface, and the curved surface having the recessed groove of the block body. Therefore, the surface having the recessed groove of the block made of a heat transfer material can be supported by using the supporting surface being any of the inclined surface, the bending surface, and the curved surface on the supporting member side as a mating surface, and the refrigerant pipe supported by the support member can be disposed in contact with the block made of a heat transfer material. Accordingly, it is possible to position the block made of a heat transfer material and the refrigerant pipe, to easily and reliably dispose the block made of a heat transfer material and the refrigerant pipe in a contact manner. Also in a case where the heat radiation sheet or the like is interposed between the refrigerant pipe and the block made of a heat transfer material, it is possible to hold the heat radiation sheet by the supporting surface having the predetermined inclination in the horizontal direction, and it is possible to prevent the sheet from peeling or dropping during construction, to improve workability.

[0028] Furthermore, an air conditioner according to the present invention includes any of the above controllers as a controller on a side of an outdoor machine, the controller being a controller of a system for cooling a plurality of heating electronic components by a refrigerant pipe.

[0029] According to the present invention, any of the above controllers is mounted as a controller on a side of an outdoor machine, and is the controller of the system for cooling the plurality of heating electronic components by the refrigerant pipe. Therefore, even when the heating electronic components are collected on the substrate, and the block made of a heat transfer material and the controller are miniaturized, it is possible to sufficiently secure the current capacity of the substrate, to improve cooling performance to the heating electronic components on the substrate, and to attain the air conditioner mounted with the controller having excellent workability during assembly.

[0030] Accordingly, it is possible to provide the air conditioner with high quality, which attains improvement of reliability to the controller, improvement of an assembly property, miniaturization, and cost reduction.

{Advantageous Effects of Invention}

[0031] According to the controller provided with heating electronic components of the present invention, mounting holes for fixing and installing SIP type electronic components dispersed and disposed on the second surface intersecting with the substrate of the block body as the block made of a heat transfer material do not need

to be provided on the substrate side, and it is possible to reduce the number of the mounting holes for the electronic components provided on the pattern of the substrate. Therefore, even when the heating electronic components are collected on one part of the substrate in order to miniaturize the block made of a heat transfer material, it is possible to sufficiently secure current capacity without reducing the pattern width of the substrate due to the mounting holes.

[0032] According to the controller provided with heating electronic components of the present invention, when the recessed groove on the side of the block made of a heat transfer material being the block body is fitted in contact with the refrigerant pipe, any of the inclined surface, the bending surface, and the curved surface having the predetermined inclination in the horizontal direction can be used as a mating surface to the supporting surface of the supporting member supporting the refrigerant pipe, to position the refrigerant pipe, and the block made of a heat transfer material can be disposed in contact with the refrigerant pipe. Therefore, it is possible to position the block made of a heat transfer material and the refrigerant pipe to easily and reliably dispose the block made of a heat transfer material and the refrigerant pipe in a contact manner. Additionally, also in a case where the heat radiation sheet or the like is interposed between the block made of a heat transfer material and the refrigerant pipe, it is possible to hold the heat radiation sheet by the supporting surface having the predetermined inclination in the horizontal direction, and to prevent the sheet from peeling or dropping during construction, to improve workability.

[0033] According to the air conditioner of the present invention, even when the heating electronic components are collected on the substrate, and the block made of a heat transfer material and the controller are miniaturized, it is possible to sufficiently secure the current capacity of the substrate, to improve cooling performance to the heating electronic components on the substrate, and to attain the air conditioner mounted with the controller having excellent workability during assembly. Accordingly, it is possible to provide the air conditioner with high quality, which attains improvement of reliability to the controller, improvement of an assembly property, miniaturization, and cost reduction.

{Brief Description of Drawings}

[0034]

{Fig. 1} FIG. 1 is a refrigerant circuit diagram of an air conditioner according to a first embodiment of the present invention;

{Fig. 2} FIG. 2 is a perspective view of a state where an outer peripheral panel of an outdoor machine of the air conditioner is detached;

{Fig. 3} FIG. 3 is a front view of an outdoor side controller of the air conditioner;

{Fig. 4} FIG. 4 is a longitudinal sectional view of the controller;

{Fig. 5} FIG. 5 is a longitudinal sectional view of the outdoor machine side support part that installs the controller;

{Fig. 6} FIG. 6 is a longitudinal sectional view of a state where the controller is installed in the outdoor machine; {Fig. 7A} FIG. 7A is a front view showing a placement configuration of a substrate and a plurality of electronic components of the controller, and a placement configuration of the substrate and a block made of a heat transfer material; {Fig. 7B} FIG. 7B is a sectional view at respective electronic component positions;

{Fig. 7C} FIG. 7C is a sectional view at respective electronic component positions;

{Fig. 8A} FIG. 8A is a front view according to another embodiment showing a placement configuration of a substrate and a plurality of electronic components of a controller, and a placement configuration of the substrate and a block made of a heat transfer material;

{Fig. 8B} FIG. 8B is a sectional view at respective electronic component positions;

{Fig. 8C} FIG. 8C is a sectional view at respective electronic component positions;

{Fig. 8D} FIG. 8D is a sectional view at respective electronic component positions;

{Fig. 9} FIG. 9 is a longitudinal sectional view according to another embodiment showing a state where the controller is installed in an outdoor machine;

{Fig. 10A} FIG. 10A is a front view according to another embodiment showing a placement configuration of a substrate and a plurality of electronic components of a controller, and a placement configuration of the substrate and a block made of a heat transfer material;

{Fig. 10B} FIG. 10B is a sectional views at a plurality of electronic component positions;

{Fig. 10C} FIG. 10C is a sectional views at a plurality of electronic component positions;

{Fig. 11A} FIG. 11A is a sectional view of a modification of the block made of a heat transfer material;

{Fig. 11B} FIG. 11B is a sectional view of a modification of the block made of a heat transfer material;

{Fig. 11C} FIG. 11C is a sectional view of a modification of the block made of a heat transfer material;

{Fig. 11D} FIG. 11D is a sectional view of a modification of the block made of a heat transfer material;

{Fig. 11E} FIG. 11E is a sectional view of a modification of the block made of a heat transfer material;

{Fig. 12A} FIG. 12A is a front view showing a placement configuration of a substrate and a plurality of electronic components, and a placement configuration of the substrate and a block made of a heat transfer material of a conventional controller;

{Fig. 12B} FIG. 12B is a sectional views at respective electronic component positions; and

{Fig. 12C} FIG. 12C is a sectional views at respective electronic component positions.

{Description of Embodiments}

[0035] Hereinafter, embodiments according to the present invention are described with reference to the drawings.

{First Embodiment}

[0036] Hereinafter, a first embodiment of the present invention is described with reference to FIGS. 1 to 7.

[0037] FIG. 1 is a refrigerant circuit diagram of an air conditioner according to the first embodiment. FIG. 2 is a perspective view of a state where an outer peripheral panel of an outdoor machine of the air conditioner is detached.

[0038] An air conditioner 1 includes a compressor 2 that compresses a refrigerant, a four-way selector valve 3 that switches the circulating direction of the refrigerant, an outdoor heat exchanger 5 that exchanges heat between the refrigerant and outdoor air from an outdoor fan 4, an electronic expansion valve (expansion valve; EEV) 6 that adiabatically expands the refrigerant, an indoor heat exchanger 8 that exchanges heat between the refrigerant and indoor air from an indoor fan 7, and accumulator 9, and the like, and is provided with a closed cycle refrigerating cycle 11 that connects these apparatuses by a refrigerant pipe 10.

[0039] The air conditioner 1 includes a controller 12 that controls operation of the air conditioner 1 on the basis of an operation command from a remote controller or the like. This controller 12 is mounted with an inverter that controls the number of revolutions of the compressor 2, and has a function of switching the four-way selector valve 3 in accordance with an operation mode, and further controlling the number of revolutions of the outdoor fan 4, the number of revolutions of the indoor fan 7, opening of the electronic expansion valve 6, and the like. The basic configuration of the controller 12 is not different from that of a known controller.

[0040] The controller 12 includes electronic components such as an active converter, a diode module, and a power transistor, which configure the inverter. These electronic components are heating electronic components, and therefore controller 12 needs to be cooled. In this embodiment, as shown in FIG. 1, for example, the refrigerant pipe 10A that is located between the electronic expansion valve (EEV) 6 and the indoor heat exchanger 8 and configures refrigerating cycle 11 is disposed in contact with the controller 12. In cooling, the controller 12 is cooled by low-pressure gas-liquid two-phase refrigerant flowing in the refrigerant pipe 10A and throttled by the electronic expansion valve 6, and in heating, the controller 12 is cooled by a high pressure liquid refrigerant flowing in the refrigerant pipe 10A and condensed and liquefied by the indoor heat exchanger 8.

[0041] The refrigerant pipe disposed in contact with the controller 12 does not always have to be a pipe disposed between the electronic expansion valve (EEV) 6 and the indoor heat exchanger 8 as described above.

5 The refrigerant pipe may be kept at a temperature level in a range where a cooling effect to the heating electronic components and the like provided on the controller 12 can be expected. The refrigerant pipe may be other pipe portion such as a refrigerant pipe disposed between the electronic expansion valve (EEV) 6 and the outdoor heat exchanger 5 and a low pressure gas refrigerant pipe.

10 **[0042]** As shown in FIG. 2, the controller 12 is disposed at a proper place inside an outdoor machine 13 in which the compressor 2, the four-way selector valve 3, the outdoor fan 4, the outdoor heat exchanger 5, the electronic expansion valve (EEV) 6, the accumulator 9, and the like configuring the air conditioner 1 are housed and installed. Herein, the inside of the outdoor machine 13 is partitioned into a heat exchanger chamber 14 in which the outdoor fan 4 and the outdoor heat exchanger 5 are installed, and a machine chamber 15 in which the compressor 2, the four-way selector valve 3, the electronic expansion valve (EEV) 6, the accumulator 9, and the like are installed by a partition plate 16. The controller 12 is installed in an upper part of the machine chamber 15 through a bracket 17.

[0043] A specific configuration of the controller 12 is shown in FIGS. 3 to 7.

20 **[0044]** The controller 12 includes a controller body 18, and is provided with a substrate 21 having an upper side part and a lower side part fixed and installed on the controller body 18 through supporting tools 19 and 20 respectively. On the substrate 21, various control circuits, a large number of electronic components configuring the circuits, and the like are mounted. Herein, a mounting structure and a cooling structure of a plurality of heating electronic components 22, 23 and 24 such as the active converter, the diode module, and the power transistor that are components of the inverter for driving an electric motor for the compressor 2 are hereinafter described in detail.

25 **[0045]** On the substrate 21, as shown in FIGS. 7A to 7C, the DIP type heating electronic component 22 having a plurality of lead pins 22B protruding from the both side surfaces of the package body 22A to extend downward, and the SIP type heating electronic components 23 and 24 having a plurality of lead pins 23B and 24B extending in a line from one side from the package bodies 23A and 24A, are collected at one place on the substrate 21. The DIP type heating electronic component 22 is mounted substantially parallel along a substrate surface of the substrate 21. The SIP type heating electronic components 23 and 24 are mounted substantially vertically to the substrate surface.

30 **[0046]** On the substrate 21, a block 25 made of a heat transfer material, which is formed by an aluminum alloy material and the like, is installed while maintaining a predetermined interval substantially parallel to the horizontal

direction along the substrate surface. The plurality of heating electronic components 22, 23 and 24 are disposed in contact with the block 25 made of a heat transfer material. That is, the block 25 made of a heat transfer material is a block body including a first surface (parallel surface) 26, a second surface (vertical surface) 27, and an inclined surface 28. The first surface 26 is located along the substrate surface, on which the DIP type heating electronic component 22 is disposed in a contact manner. The second surface (vertical surface) 27 intersects with the first surface 26 and the substrate surface, on which the SIP type heating electronic components 23 and 24 are disposed in a contact manner. The inclined surface 28 is another surface that connects the first surface 26 and the second surface 27. The package bodies 22A, 23A and 24A of the heating electronic components 22, 23 and 24 are dispersed and disposed while being in contact with the first surface 26 and the second surface 27, and are fixed and installed by screws and the like (not shown).

[0047] In a case where a plurality of the DIP type and SIP type heating electronic components 22, 23 and 24 are fixed and installed on the first surface 26, located along the substrate surface, of the block made of a heat transfer material (block body) 25 through the screws or the like, mounting holes 29 corresponding to the respective electronic components need to be provided on a side of the substrate 21 (see FIGS. 12A to 12C). However, the SIP type heating electronic components 23 and 24 are dispersed and disposed to be fixed and installed on the second surface 27, intersecting with the substrate surface, of the block made of a heat transfer material (block body) 25, so that the mounting holes 29 for mounting the electronic components do not need to be provided on the substrate 21 side. Therefore, it is possible to reduce the number of the mounting holes 29 for the plurality of electronic components 22, 23 and 24 provided on the substrate 21 side. In a case of this embodiment, the number of the holes can be reduced by half.

[0048] The block 25 made of a heat transfer material of this embodiment is a block body including the first surface 26, the second surface 27, and the inclined surface (another surface) 28 as described above, in which the inclined surface 28 is a surface having a predetermined inclination in the horizontal direction to the vertical surface, and the cross section having a removed corner of a quadrilateral is a triangle (rectangular equilateral triangle). The inclined surface 28 having an angle of inclination of 45° is provided with a semicircular recessed groove 30, and the refrigerant pipe 10A is fitted in contact with the recessed groove 30. In the block 25 made of a heat transfer material herein, as shown in FIG. 4, the inclined surface 28 having the recessed groove 30 is disposed obliquely downward. The first surface 26 on which the DIP type heating electronic component 22 is disposed is installed vertically, and the second surface 27 on which the SIP type heating electronic components 23 and 24 are disposed is installed horizontally.

[0049] The above first surface 26, second surface 27, and triangular cross section are preferably a parallel surface, a vertical surface, and a right-angled triangular (rectangular equilateral triangular) cross section, respectively, but are not limited to these. It is a matter of course that the size of an angle and inclination of the surface, shift, and the like should be allowed in a range in which action and effects of the present invention can be expected, and are included in the present invention.

[0050] The substrate 21 has the upper side part and the lower side part fixed and installed vertically on the controller body 18 through the supporting tools 19 and 20 as described above. The supporting tool 19 that supports the upper side part is the supporting tool 19 with a claw part 19A detachably supporting the upper side part. The supporting tool 20 that supports the lower side part is the supporting tool 20 with a hinge 20A capable of rotatably supporting the substrate 21 with the lower side part as a supporting point. As shown in FIG. 6, the lower side part of the substrate 21 is first inserted in the hinge 20A of the supporting tool 20 to be supported, and thereafter the upper side part is rotated in the arrow direction with the lower side part as the supporting point to be locked to the claw part 19A of the supporting tool 19, thereby resulting in detachable installation.

[0051] On the other hand, on a side of the bracket 17 supporting the controller 12, a supporting member 31 supporting the refrigerant pipe 10A fitted in the recessed groove 30 provided in inclined surface 28 of the block 25 made of a heat transfer material is provided at a predetermined height position of a surface facing the back surface of the controller body 18, as shown in FIG. 5. This supporting member 31 may have a constant length along the horizontal direction, or may be divided and disposed at least two places at a predetermined interval along the horizontal direction.

[0052] In the supporting member 31, a supporting surface 32 supporting the refrigerant pipe 10A is an inclined surface (inclined surface of 45° herein) facing the inclined surface 28 of the block 25 made of a heat transfer material. The inclined supporting surface 32 and the inclined surface 28 of the block 25 made of a heat transfer material are used as mutual mating surfaces to position the refrigerant pipe 10A. Additionally, the supporting surface 32 of the supporting member 31 is the inclined surface of 45°, and therefore the supporting surface 32 has a function as a holding surface holding so as not to drop a heat radiation silicon sheet (heat radiation sheet) 33 in a case where the silicon sheet 33 is interposed between the refrigerant pipe 10A and the recessed groove 30 of the block 25 made of a heat transfer material.

[0053] The inclined supporting surface 32 of the supporting member 31 is the surface inclined at 45° in the horizontal direction to a vertical surface. This inclined supporting surface 32 is a surface corresponding to the inclined surface 28 of the block 25 made of a heat transfer material with the refrigerant pipe 10A as the supporting surface. The surface shape and the inclined angle are

changed in various aspects in accordance with a sectional shape determined in consideration of facilitation of fitting of the block 25 made of a heat transfer material to the refrigerant pipe 10A, facilitation of holding of the heat radiation silicon sheet 33, or reduction in volume of the block 25 made of a heat transfer material that is a block body, as the following embodiments, and are not limited to this embodiment.

[0054] According to this configuration, the block 25 made of a heat transfer material is disposed in contact with the refrigerant pipe 10A, through which a low-pressure gas-liquid two-phase refrigerant passing through the electronic expansion valve 6 flows when cooling operation is performed by the air conditioner 1, and through which a high pressure liquid refrigerant condensed and liquefied by the indoor heat exchanger 8 when heating operation is performed. Thereby, the controller 12 of the refrigerant cooling system in which the block 25 made of a heat transfer material is cooled, and the plurality of heating electronic components 22, 23 and 24, which are mounted on the substrate 21 and disposed in contact with the block 25 made of a heat transfer material, are cooled through the refrigerant with the block 25 made of a heat transfer material as a heat sink can be configured.

[0055] According to this embodiment, the following action and effects are produced by the above-described configuration.

[0056] When the air conditioner 1 performs cooling operation by switching the four-way selector valve 3, a refrigerant circulates through a circuit starting from the compressor 2 to pass through the outdoor heat exchanger 5, the electronic expansion valve 6, the indoor heat exchanger 8, the four-way selector valve 3, and the accumulator 9, and to return to the compressor 2. Additionally, when the air conditioner 1 performs heating operation by switching the four-way selector valve 3, the refrigerant circulates through a circuit starting from the compressor 2 to pass through the indoor heat exchanger 8, the electronic expansion valve 6, the outdoor heat exchanger 5, the four-way selector valve 3, and accumulator 9, and to return to the compressor 2.

[0057] During cooling/heating operation of the air conditioner 1, the controller 12 controls various apparatuses. For example, the controller 12 controls the number of revolutions of a driving motor of the compressor 2 through the inverter. At this time, the electronic components 22, 23 and 24 such as the active converter, the diode module, and the power transistor of the inverter mounted in the controller 12 are driven to generate heat. In order to cause the inverter to stably operate and function for a long period of time, these heating electronic components 22, 23 and 24 need to be properly cooled so as not to overheat.

[0058] During the cooling/heating operation, the temperature of the refrigerant flowing in the refrigerant pipe 10A of the refrigerating cycle 11 is sufficiently lower than the heating temperatures of the heating electronic components 22, 23 and 24. Heat generated by the heating

electronic components 22, 23 and 24 is radiated, and the heating electronic components 22, 23 and 24 are cooled by using the block 25 made of a heat transfer material, which is in contact with the refrigerant pipe 10A and cooled, as a heat sink. Thereby, the electronic components 22, 23 and 24 such as the active converter, the diode module, and the power transistor can be reliably cooled to an allowable temperature or less. Therefore, it is possible to cause the inverter to stably function for a long period of time.

[0059] On the other hand, when the refrigerant cooling system is employed, the electronic components 22, 23 and 24 need to be collected on one part of the substrate 21 in order to miniaturize the block 25 made of a heat transfer material to reduce the heat radiation surface. At this time, in order to fix and install the block 25 made of a heat transfer material in the electronic components 22, 23 and 24, the mounting holes 29 for the electronic components 22, 23 and 24 generally need to be provided on the substrate 21 side. However, the substrate occupancy area is reduced by the collection of the electronic component, and therefore the pattern width of the substrate 21 is reduced by the mounting holes 29, and it becomes difficult to secure current capacity.

[0060] That is, as shown in the above-described Publication of Japanese Patent No. 5472364, and FIGS. 12(A) to 12(C), in a case where all the heating electronic components 22, 23 and 24 are disposed in contact with the first surface 26, located along the substrate 21, of the block 25 made of a heat transfer material, regardless of the DIP type and the SIP type, at least four mounting holes 29 for the electronic components 22, 23 and 24 need to be provided on the substrate 21 side, the pattern width of the substrate 21 is reduced, and it becomes difficult to secure current capacity.

[0061] In this embodiment, as shown in FIGS. 7A to 7C, the block 25 made of a heat transfer material is the block body including at least two surfaces including the first surface 26 located along the substrate surface of the substrate 21, and the second surface 27 intersecting with the first surface 26. The DIP type electronic component 22, and the SIP type electronic components 23 and 24 are dispersed and disposed on the first surface 26, located along the substrate 21, of the block body, and the second surface 27 intersecting with the first surface 26, respectively.

[0062] Therefore, the mounting holes 29 for fixing and installing the SIP type electronic components 23 and 24 dispersed and disposed on the second surface 27 intersecting with the substrate 21 of the block 25 made of a heat transfer material that is the block body do not need to be provided on the substrate 21 side, and it is possible to reduce the number of the electronic component mounting holes 29 provided on the pattern of the substrate 21. Consequently, even when the heating electronic components 22, 23 and 24 are collected on one part of the substrate 21 in order to miniaturize the block 25 made of a heat transfer material, it is possible to sufficiently secure

current capacity without reducing the pattern width of the substrate 21 due to the mounting holes 29.

[0063] The block 25 made of a heat transfer material is a block body including the above first and second surfaces 26 and 27, and the inclined surface 28 that is another surface having the recessed groove 30 in which the refrigerant pipe 10A is fitted, and having a triangular cross section with a removed corner of a quadrilateral. Thus, the one surface having the recessed groove 30 in which the refrigerant pipe 10A is in contact with is made to be the inclined surface 28, and the block 25 made of a heat transfer material is made to be the block body whose cross section is a triangle, so that the volume can be reduced and minimized. Accordingly, it is possible to reduce heat resistance by the block 25 made of a heat transfer material, and improve a heat radiation property from the heating electronic components 22, 23 and 24 to enhance cooling performance, and it is possible to further miniaturize the block 25 made of a heat transfer material to reduce cost.

[0064] In this embodiment, the supporting surface 32 of the supporting member 31 that supports the refrigerant pipe 10A cooling the controller 12 along the block 25 made of a heat transfer material located on the side of the controller 12 is an inclined surface corresponding to the inclined surface 28, which has the recessed groove 30 of the block 25 made of a heat transfer material that is the block body having a triangular cross section. Therefore, the inclined surface 28 of the block body, in which the cross section of the block 25 made of a heat transfer material on the side of the controller 12 is a triangle, can be supported by using the inclined supporting surface 32 on the side of the supporting member 31 as a mating surface, and the refrigerant pipe 10A supported on the side of the supporting member 31 can be disposed in contact with the block 25 made of a heat transfer material.

[0065] Consequently, the inclined supporting surface 32 of the supporting member 31 and the inclined surface 28 of the block 25 made of a heat transfer material are used as mutual mating surfaces to position the refrigerant pipe 10A, and the refrigerant pipe 10A and the block 25 made of a heat transfer material can be easily and reliably disposed in contact with each other. Also in a case where the heat radiation sheet 33 or the like is interposed between the refrigerant pipe 10A and the block 25 made of a heat transfer material, it is possible to prevent the heat radiation sheet 33 from peeling or dropping during construction, to improve workability.

[0066] Furthermore, the substrate 21 is supported to the controller body 18 through the supporting tools 19 and 20, the supporting tool 20 supporting the lower side of the substrate 21 is the supporting tool 20 rotatably supporting the substrate 21 with the lower side of the substrate 21 as a supporting point. Therefore, when the substrate 21 is fixed and supported to the controller body 18 through the supporting tools 19 and 20, the substrate 21 is first supported to the supporting tool 20 rotatably supporting the lower side of the substrate 21, and the

upper part of the substrate 21 is rotated with this lower side as the supporting point, and the upper side is supported by the supporting tool 19, so that the controller body 18 can be fixed and supported.

[0067] At this time, the recessed groove 30 provided in the inclined surface 28 that is one surface of the block 25 made of a heat transfer material can be fitted to the refrigerant pipe 10A supported by the supporting member 31 on the side of the bracket 17 supporting the controller 12 while being rotated from a circumferential direction. Accordingly, the refrigerant pipe 10A and the recessed groove 30 of the block 25 made of a heat transfer material can be smoothly fitted while avoiding mutual interference, generation of wrinkles can be prevented by uniformly applying pressure to the heat radiation sheet 33 and the like interposed between the refrigerant pipe 10A and the block 25 made of a heat transfer material, and workability can be improved.

[0068] The controller 12 on the side of the outdoor machine 13 is the controller 12 of a system for cooling the plurality of heating electronic components 22, 23 and 24 by the refrigerant pipe 10A. Therefore, even when the heating electronic components 22, 23 and 24 are collected on the substrate 21, and the block 25 made of a heat transfer material and the controller 12 are miniaturized, it is possible to sufficiently secure the current capacity of the substrate 21, to improve cooling performance to the heating electronic components 22, 23 and 24 on the substrate 21, and to attain the air conditioner 1 mounted with the controller 12 having excellent workability during assembly. Accordingly, it is possible to provide the air conditioner 1 with high quality, which attains improvement of reliability to the controller 12, improvement of an assembly property, miniaturization, and cost reduction.

{Other Embodiments}

[0069] Hereinafter, other embodiments of the present invention are described with reference to FIG. 4, and FIGS. 8 to 11.

(1) In the above first embodiment, all of the plurality of SIP type electronic components 23 and 24 that are provided are disposed on the second surface 27 as shown in FIGS. 7. However, as shown in FIGS. 8, an electronic component 24, which is one part of a plurality of SIP type electronic components 23 and 24, may be disposed on a second surface 27, and other part of an electronic component 23 may be disposed on the first surface 26 as is the case with a DIP type electronic component 22.

[0070] Thus, in a case where the plurality of the SIP type electronic components 23 and 24 are provided, also when the SIP type electronic component 24, which is one part of the plurality of the SIP type electronic components 23 and 24, is disposed on the second surface 27, and other part of the SIP type electronic component 23 is

disposed on the first surface 26, the number of the mounting holes 29 corresponding to the number of SIP type electronic components dispersed and disposed on the side of the second surface 27 do not need to be provided on a substrate 21 side, and it is possible to reduce the number of electronic component mounting holes 29 provided on the pattern of the substrate 21. Therefore, the pattern width of the substrate 21 is not reduced by the mounting holes 29, and it is possible to sufficiently secure current capacity on the substrate 21 side.

[0071] (2) In the above first embodiment, the first surface 26 of the block 25 made of a heat transfer material has substantially the same width as the package body 22A of the electronic component 22, as shown in FIG. 7B. However, as shown by the two-dot chain line in FIG. 4, a lower end 26A of a first surface 26, located along a substrate surface, of a block 25 made of a heat transfer material may extend below a lower end of a package body 22A of a DIP type electronic component 22.

[0072] With such a configuration, even when dew condensation occurs on the surface of the block 25 made of a heat transfer material cooled by a refrigerant pipe 10A, the dew condensation water can pass through the lower end 26A of the block 25 made of a heat transfer material, which extends further downward than the lower end of the package body 22A of the DIP type electronic component 22, to quickly drop downward. Therefore, it is possible to prevent the dew condensation water from staying on a controller 12, and to prevent generation of breakdown or damage of electronic components due to dropping of the dew condensation water on other electronic component including the electronic component 22 or a control circuit, to protect the controller 12.

[0073] (3) In the above first embodiment, the upper side part and the lower side part of the substrate 21 is fixed and installed on the controller body 18 through the supporting tools 19 and 20 respectively. Particularly, the supporting tool 20 supporting the lower side part is the supporting tool 20 with the hinge 20A capable of rotatably supporting the substrate 21 with the lower side part as a supporting point. However, as long as the refrigerant pipe 10A and a recessed groove 30 on the side of a block 25 made of a heat transfer material do not interfere even when a substrate 21 is mounted from the horizontal direction, the upper and lower supporting tools may be supporting tool 19 having the same configuration, and the substrate 21 may be detachably installed from the horizontal direction, as shown in FIG. 9.

[0074] In order to attain a configuration in which the refrigerant pipe 10A and the recessed groove 30 on the side of the block 25 made of a heat transfer material do not interfere when fitted, the sectional shapes of the block 25 made of a heat transfer material and the supporting member 31 should be the shape described in the following (4). At this time, in a case where it is concerned that a heat radiation sheet 33 drops or peels, the heat radiation sheet 33 may be replaced by heat conductive grease such as silicone grease, and the heat radiation sheet 33

do not need to be interposed. The present invention includes such an embodiment.

[0075] (4) In the above first embodiment, the block 25 made of a heat transfer material is the block body including the first surface 26, the second surface 27, and the inclined surface 28, and having a triangular cross section (rectangular equilateral triangular cross section in the first embodiment). However, as long as the block body includes at least two surfaces including the first surface 26 and the second surface 27, on which the plurality of electronic components 22, 23 and 24 are dispersed and disposed, another surface does not always have to be the inclined surface 28 having the triangular cross section. For example, a block 25A made of a heat transfer material having a rectangular cross section shown in FIGS. 10 may be employed.

[0076] Furthermore, the cross sections of the block made of a heat transfer material may have the shapes shown in FIGS. 11A to 11E in addition to the above.

[0077] A block 25B made of a heat transfer material shown in FIG. 11A has a shape formed by obliquely cutting out a corner of a quadrilateral so as to leave the first and second surfaces 26 and 27, and providing a recessed groove 30 for fitting a refrigerant pipe 10A to the inclined surface (another surface) 28B. A block 25C made of a heat transfer material shown in FIG. 11B has a shape formed by cutting out a corner of a quadrilateral so as to form a recessed bending surface (another surface) 28C in a similar manner, and providing a recessed groove 30 at a top position.

[0078] A block 25D made of a heat transfer material shown in FIG. 11C has a shape formed by cutting out a corner of a quadrilateral so as to form a recessed (or protruding) curved surface (another surface) 28D, and providing a recessed groove 30 at an intermediated position. A block 25E made of a heat transfer material shown in FIG. 11D has a shape formed by cutting out a corner of a quadrilateral so as to form a gentle inclined surface to be a trapezoid shape, and providing a recessed groove 30 in the inclined surface (another surface) 28E. A block 25F made of a heat transfer material shown in FIG. 11E has a shape formed by cutting out a corner of a quadrilateral so as to form a recessed bending surface (another surface) 28F in parallel with surfaces 26 and 27, and providing a recessed groove 30 at a top position.

[0079] The blocks 25A to 25F made of a heat transfer material are configured as described above, so that it is possible to enjoy an effect that the plurality of electronic components 22, 23 and 24 are dispersed and disposed on two surfaces intersecting with each other, and the number of the mounting holes 29 provided in the substrate 21 is reduced to enable suppression of reduction in a pattern width, in any case. In a case where the block 25A made of a heat transfer material is used, the volume is larger than the volume of the block of a heat transfer material of the first embodiment, and heat resistance in the block 25A made of a heat transfer material increases.

However, increase in heat resistance due to the increase of the volume can be covered by improvement of a cooling effect by reduction in contact heat resistance, and the like. Reduction in installation workability in employing of a heat radiation sheet can be covered by replacement by application of heat conductive grease, or the like.

[0080] Furthermore, the shape of the block made of a heat transfer material is changed to each of the blocks 25B to 25F made of a heat transfer material having various sectional shapes shown in FIGS. 11A to 11E, other than the block 25 made of a heat transfer material of the first embodiment, so that it is possible to select a block made of a heat transfer material enabling easier assembly when the recessed groove 30 of each of the blocks 25B to 25F made of a heat transfer material is fitted in contact with the refrigerant pipe 10A supported by the supporting member 31, and to improve workability in assembly of the controller 12. In this case, it goes without saying that the supporting surface 32 of the supporting member 31 is a supporting surface corresponding to each of another surface 28B to another surface 28F on the side of each of the blocks 25B to 25F made of a heat transfer material.

[0081] That is, each of the blocks 25B to 25F made of a heat transfer material is a block body including surfaces on which the plurality of electronic components 22, 23 and 24 are fixed and install in a contact manner, namely two surfaces called the first and second surfaces 26 and 27, and a surface having the recessed groove 30 in which the refrigerant pipe 10A is fitted in a contact manner, namely the inclined surface 28B or 28E, the bending surface 28C or 28F, the curved surface 28D, or the like. Each of the surfaces 28B to 28F having the recessed groove 30 of the block body is formed any of the inclined surface 28B or 28E, the bending surface 28C or 28F, and the curved surface 28D having a predetermined inclination in the horizontal direction to the vertical surface as a whole. Thereby, when the recessed groove 30 on the side of each of the blocks 25B to 25E made of a heat transfer material being a block body is fitted in contact with the refrigerant pipe 10A, any of the inclined surface 28B or 28E, the bending surface 28C or 28F, and the curved surface 28D having the predetermined inclination in the horizontal direction can be used as a mating surface to the supporting surface 32 corresponding to the supporting member 31 supporting the refrigerant pipe 10A, to position the refrigerant pipe 10A, and the blocks 25B to 25F made of a heat transfer material can be disposed in contact with the refrigerant pipe 10A.

[0082] Accordingly, it is possible to position each of the blocks 25B to 25F made of a heat transfer material and the refrigerant pipe 10A to easily and reliably dispose the blocks 25B to 25F made of a heat transfer material and the refrigerant pipe 10A in a contact manner. Additionally, also in a case where the heat radiation sheet 33 or the like is interposed between each of the blocks 25B to 25F made of a heat transfer material and the refrigerant pipe 10A, it is possible to hold the heat radiation sheet 33 by

the supporting surface having the predetermined inclination in the horizontal direction, and to prevent the sheet from peeling or dropping during construction, to improve workability.

[0083] Each of the blocks 25B to 25F made of a heat transfer material is a block body including the two surfaces 26 and 27 that intersect with each other, and are capable of fixing and installing the plurality of electronic components 22, 23 and 24, and the surface 28B to 28F having the recessed groove 30, namely any of the inclined surface 28B or 28E, the bending surface 28C or 28F, and the curved surface 28D, each of which is formed by cutting out a corner of the block body having the two surface 26 and 27, similarly to the block 25 made of a heat transfer material. Therefore, the surface of each of the blocks 25B to 25F made of a heat transfer material having the recessed groove 30 is formed by any of the inclined surfaces 28B or 28E, the bending surface 28C or 28F, and the curved surface 28D formed by cutting out a corner of the block body, so that it is possible to reduce each of the volume of the blocks 25B to 25F made of a heat transfer material being a block body, and to reduce in size and weight.

[0084] Consequently, it is possible to reduce heat resistance in the blocks 25B to 25F made of a heat transfer material, to improve heat radiation properties from the heating electronic components 22, 23 and 24, and to further miniaturize each of the blocks 25B to 25F made of a heat transfer material, to reduce cost. Additionally, the surface having the recessed groove 30 is made to be any of the inclined surface 28B or 28E, the bending surface 28C or 28F, and the curved surface 28D, so that the refrigerant pipe 10A can be easily fitted in contact with the recessed groove 30, and workability in assembly of the controller 12 can be improved.

[0085] Furthermore, the supporting surface 32 of the supporting member 31 supporting the refrigerant pipe 10A is made to be the supporting surface corresponding to any of the inclined surfaces 28B or 28E, the bending surfaces 28C or 28F, and the curved surface 28D having the recessed groove 30 on the block body side. Therefore, any of the inclined surface 28B or 28E, the bending surface 28C or 28F, and the curved surface 28D, having the recessed groove 30, of each of the blocks 25B to 25F made of a heat transfer material is supported by using the supporting surface corresponding thereto as a mating surface, and the refrigerant pipe 10A supported by the supporting member 31 can be disposed in contact with each of the blocks 25B to 25F made of a heat transfer material. Accordingly, it is possible to position each of the blocks 25B to 25F made of a heat transfer material and the refrigerant pipe 10A to easily and reliably dispose each of the blocks 25B to 25F made of a heat transfer material and the refrigerant pipe 10A in a contact manner. Additionally, also in a case where the heat radiation sheet 33 or the like is interposed between each of the blocks 25B to 25F made of a heat transfer material and the refrigerant pipe 10A, it is possible to hold the sheet 33 by

the supporting surface having the predetermined inclination in the horizontal direction, and to prevent the sheet 33 from peeling or dropping during construction, to improve workability.

[0086] The present invention is not limited to the above embodiments, and can be appropriately modified without departing from the scope of the present invention. For example, although the three heating electronic components 22, 23 and 24 are provided on the substrate 21 in the above embodiments, the number of the heating electronic components to be installed, the number of break-downs of the DIP type and the SIP type, and the like are not particularly limited.

{Reference Signs List}

1 Air conditioner

[0087]

10A Refrigerant pipe

12 Controller

13 Outdoor machine

17 Bracket

18 Controller body

19, 20 Supporting tool

19A Claw part

20A Hinge

21 Substrate

22 DIP type electronic component (heating electronic component)

22A, 23A, 24A Package body

23, 24 SIP type electronic component (heating electronic component)

25 Block made of a heat transfer material (block body) 25A, 25B, 25C, 25D, 25E, 25F Block made of heat transfer material (block body)

26 First surface

26A Lower end

27 Second surface

28 Inclined surface (another surface)

28B, 28C, 28D, 28E, 28F Another surface

30 Recessed groove

31 Supporting member

32 Supporting surface (inclined supporting surface)

Claims

1. A controller (12) provided with heating electronic components (22, 23, 24) **characterized by** comprising:

a block made of a heat transfer material (25) that is cooled through a refrigerant pipe (10A); and a plurality of heating electronic components (22, 23, 24) that are mounted on a substrate (21), and are fixed and installed in contact with the

block made of a heat transfer material (25) to be capable of being cooled by using the block (25) made of a heat transfer material as a heat sink, wherein

the block made of a heat transfer material (25) is a block body (25A, 25B, 25C, 25D, 25E, 25F) that includes at least two surfaces including a first surface (26) located along the substrate (21), and a second surface (27) intersecting with the first surface (26), and one part of the electronic components (22, 23, 24) is disposed on the first surface (26) of the block body (25A, 25B, 25C, 25D, 25E, 25F), and at least one electronic SIP type component of the electronic components (23, 24) is disposed on the second surface (27).

2. The controller (12) provided with heating electronic components (22, 23, 24) according to claim 1, wherein

in a case where a plurality of the SIP type electronic components (23, 24) are provided, all of the SIP type electronic components (23, 24) are disposed on the second surface (27), or one part of the SIP type electronic components (23, 24) is disposed on the second surface (27) and another part of the SIP type electronic components (23, 24) are disposed on the first surface (26).

3. The controller (12) provided with heating electronic components (22, 23, 24) according to claim 1 or 2, wherein

the block made of a heat transfer material (25) is a block body (25A, 25B, 25C, 25D, 25E, 25F) that includes at least one surface having a recessed groove (30) in which the refrigerant pipe (10A) is contact with, in addition to the two surfaces (26, 27).

4. The controller (12) provided with heating electronic components (22, 23, 24) according to claim 3, wherein

the block made of a heat transfer material (25) is a block body (25A, 25B, 25C, 25D, 25E, 25F) including the two surfaces (26, 27), and the one surface having the recessed groove (30), wherein the one surface having the recessed groove (30) is formed with any of an inclined surface, a bending surface, and a curved surface having a predetermined inclination in a horizontal direction to a vertical surface.

5. The controller (12) provided with heating electronic components (22, 23, 24) according to claim 4, wherein

a supporting surface (32) of a supporting member (31) supporting the refrigerant pipe (10A) along the block made of a heat transfer material (25) on a side of the controller (12), is formed with any of the in-

clined surface, the bending surface, and the curved surface corresponding to the one surface having the recessed groove (30) of the block body (25A, 25B, 25C, 25D, 25E, 25F) comprising the block made of a heat transfer material (25).

6. The controller (12) provided with heating electronic components (22, 23, 24) according to any of claims 1 to 5, wherein
in the block made of a heat transfer material (25), a lower end of the first surface (26) extends downward further than a lower end (26A) of a package body (22A, 23A, 24A) of the one part of the electronic components.
7. The controller (12) provided with heating electronic components (22, 23, 24) according to any of claims 1 to 6, wherein
the substrate (21) is supported by a controller body (18) through a supporting tool (19, 20), and the supporting tool (19, 20) supporting a lower side of the substrate (21) rotatably supports the substrate (21) with the lower side as a supporting point.
8. A controller (12) provided with heating electronic components (22, 23, 24) **characterized by** comprising:

a block made of a heat transfer material (25) that is cooled through a refrigerant pipe (10A); and
a plurality of heating electronic components (22, 23, 24) that are mounted on a substrate (21), and are fixed and installed in contact with the block made of a heat transfer material (25) to be capable of being cooled by using the block made of a heat transfer material (25) as a heat sink, wherein

the block made of a heat transfer material (25) is a block body (25A, 25B, 25C, 25D, 25E, 25F) that includes a surface (26; 27) on which a plurality of the electronic components (22, 23, 24) are fixed and installed in a contact manner, and a surface having a recessed groove (30) allowing the refrigerant pipe (10A) to be fitted in a contact manner, and
the surface having the recessed groove (30) of the block body (25A, 25B, 25C, 25D, 25E, 25F) is formed with any of an inclined surface, a bending surface, and a curved surface having a predetermined inclination in a horizontal direction to a vertical surface.

9. The controller (12) provided with heating electronic components (22, 23, 24) according to claim 8, wherein
the block made of a heat transfer material (25) is a block body (25A, 25B, 25C, 25D, 25E, 25F) that includes two surfaces (26, 27) intersecting with each

other and enabling a plurality of the electronic components (22, 23, 24) to be fixed and installed, and the surface having the recessed groove (30), formed with any of the inclined surface, the bending surface, and the curved surface such that a corner of the block body (25A, 25B, 25C, 25D, 25E, 25F) having the two surfaces (26, 27) is cut out.

10. The controller (12) provided with heating electronic components (22, 23, 24) according to claim 8 or 9, wherein
the refrigerant pipe (10A) is supported by a supporting member (31) having a supporting surface (32) corresponding to any of the inclined surface, the bending surface, and the curved surface having the recessed groove (30) of the block body (25A, 25B, 25C, 25D, 25E, 25F).
11. An air conditioner (1) comprising
the controller (12) according to any of claims 1 to 10 configured to act as a controller of an outdoor side machine (13), the controller (12) being further configured to control a system for cooling a plurality of heating electronic components (22, 23, 24) by a refrigerant pipe (10A).

FIG. 1

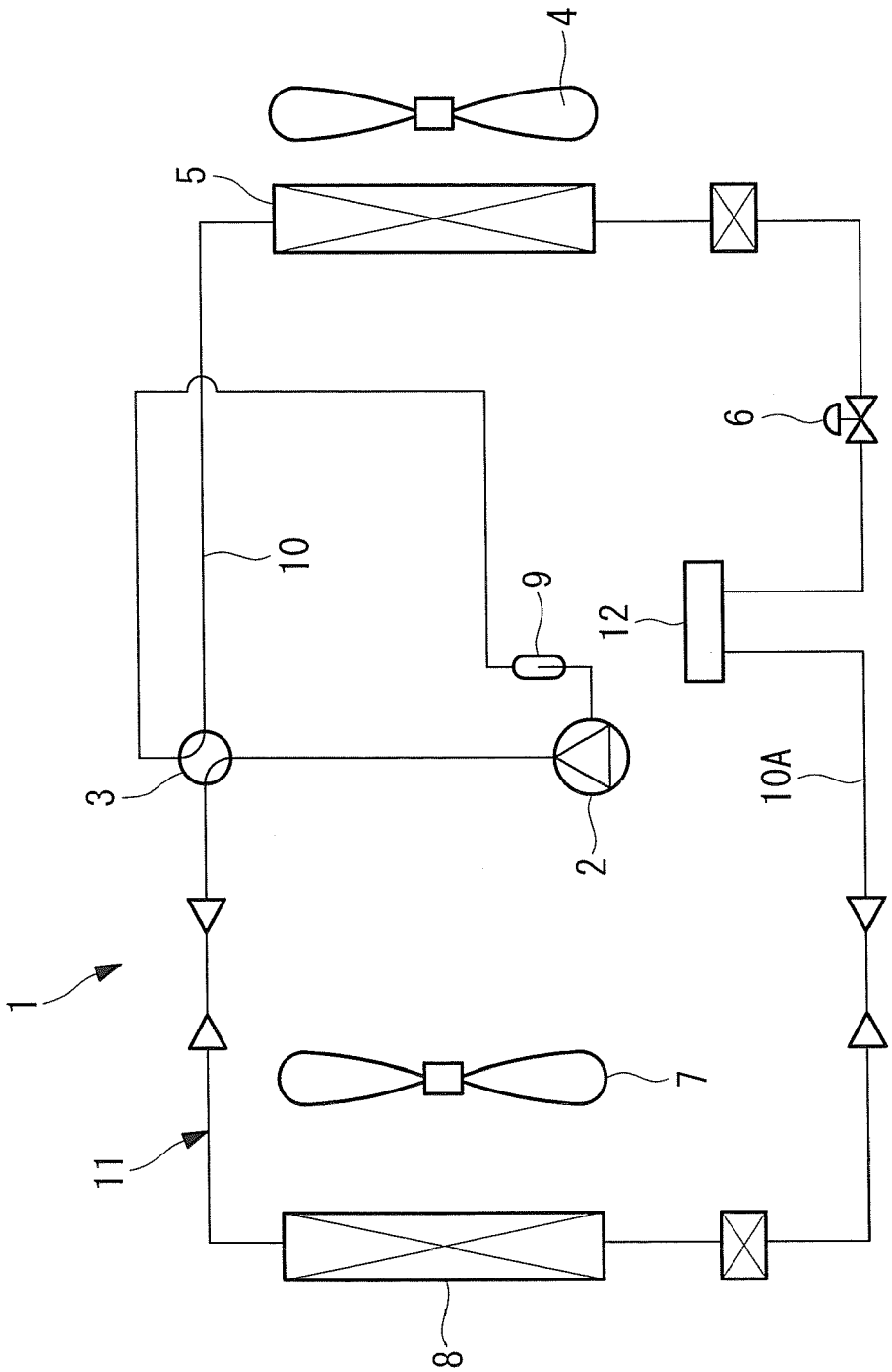


FIG. 2

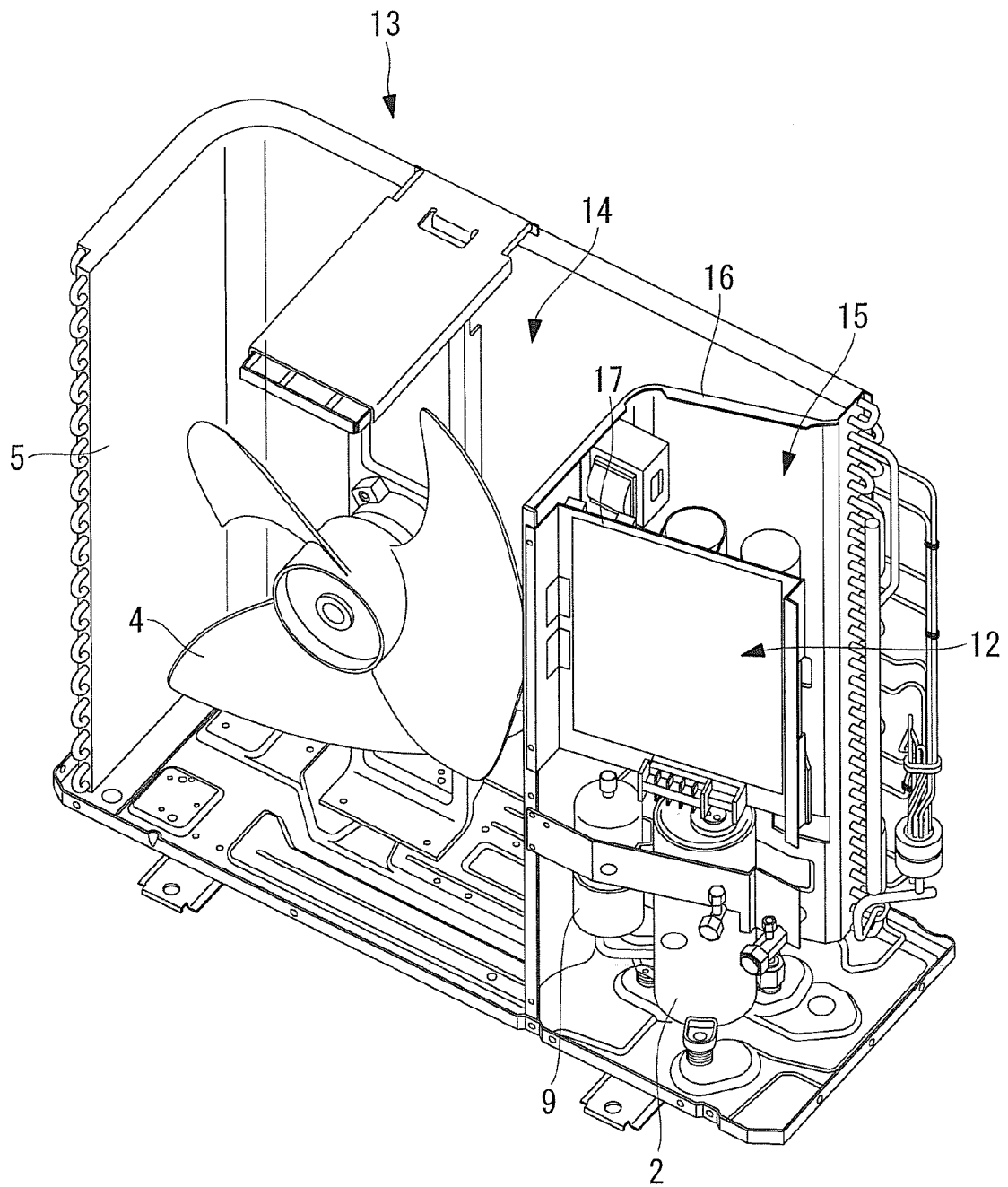


FIG. 3

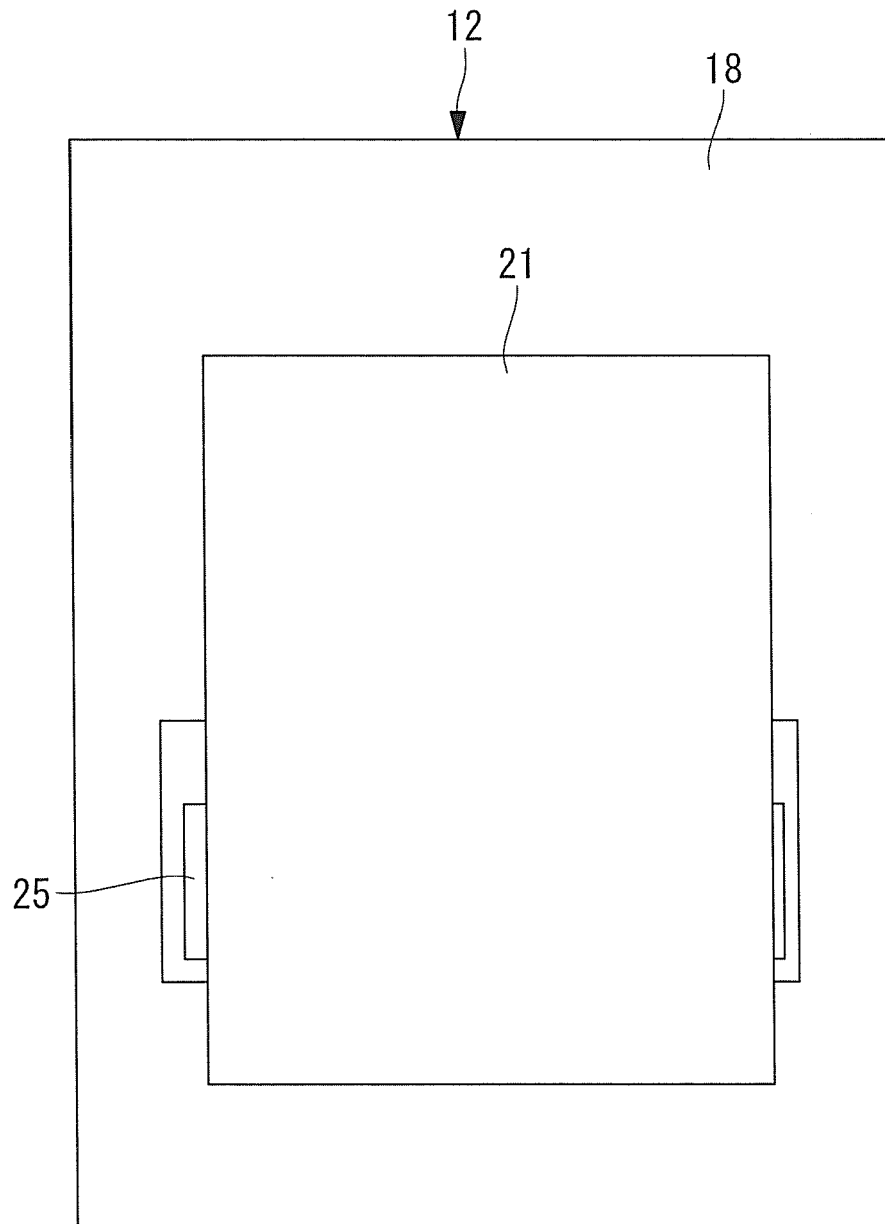


FIG. 4

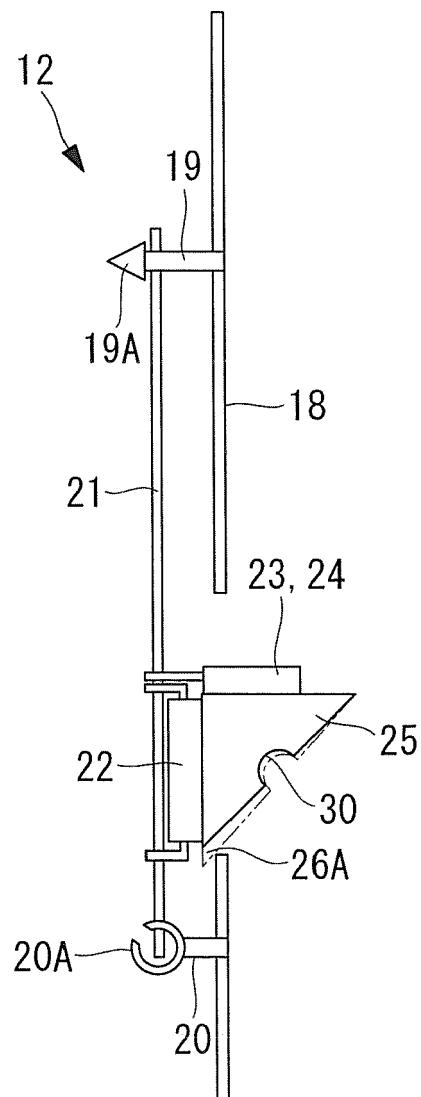


FIG. 5

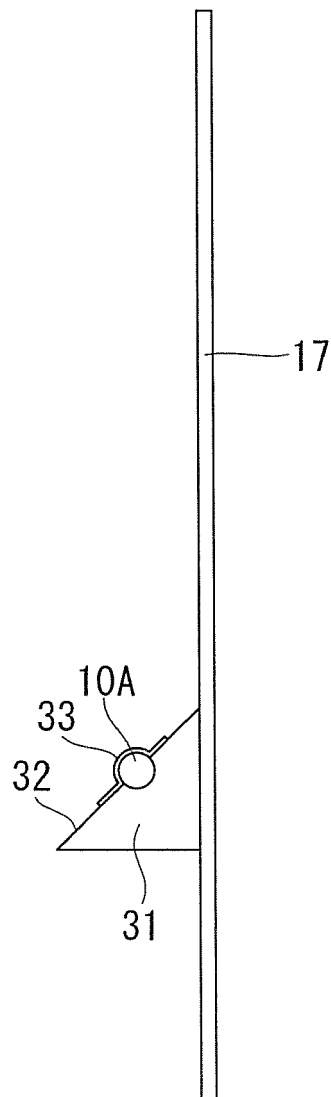
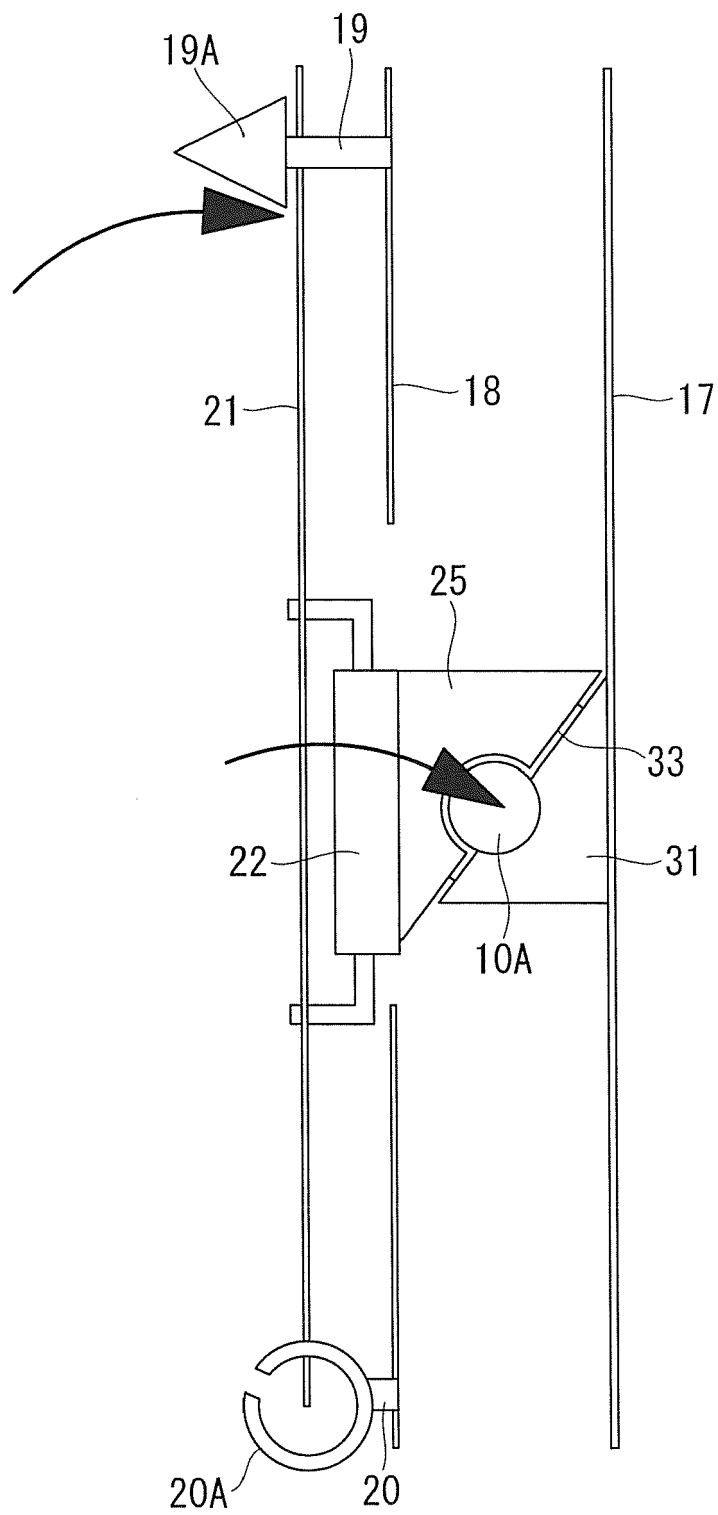


FIG. 6



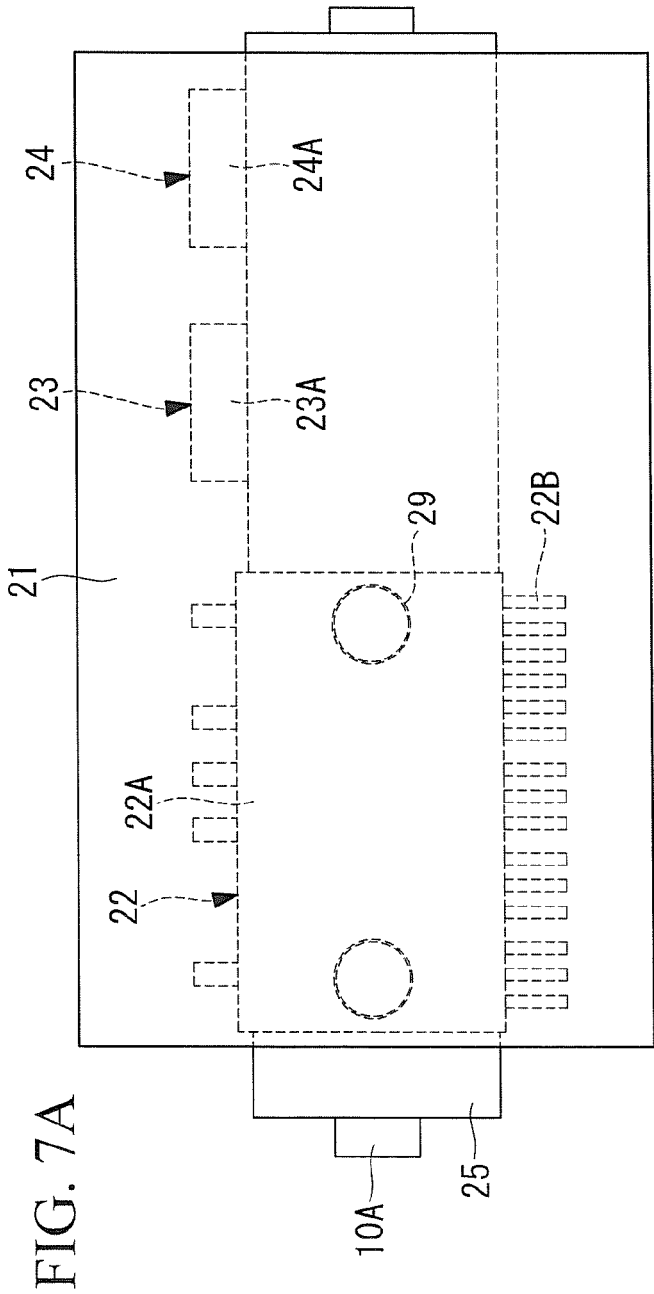
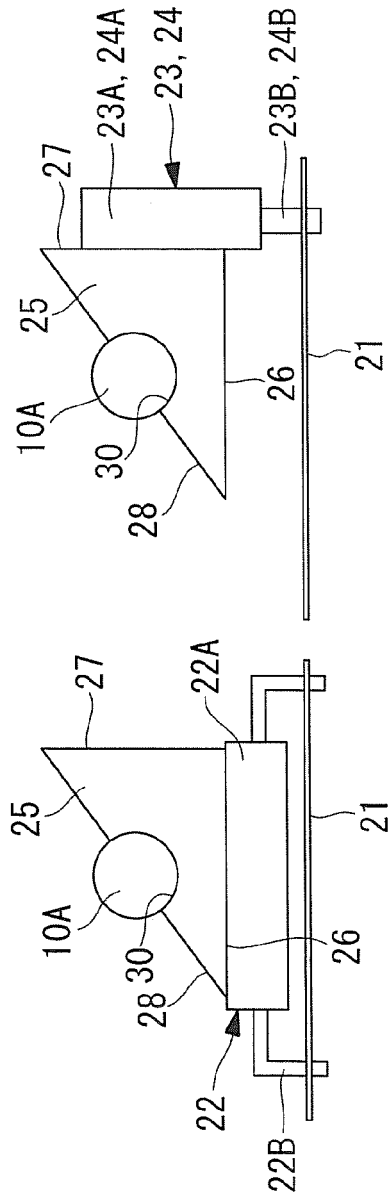


FIG. 7B

FIG. 7C



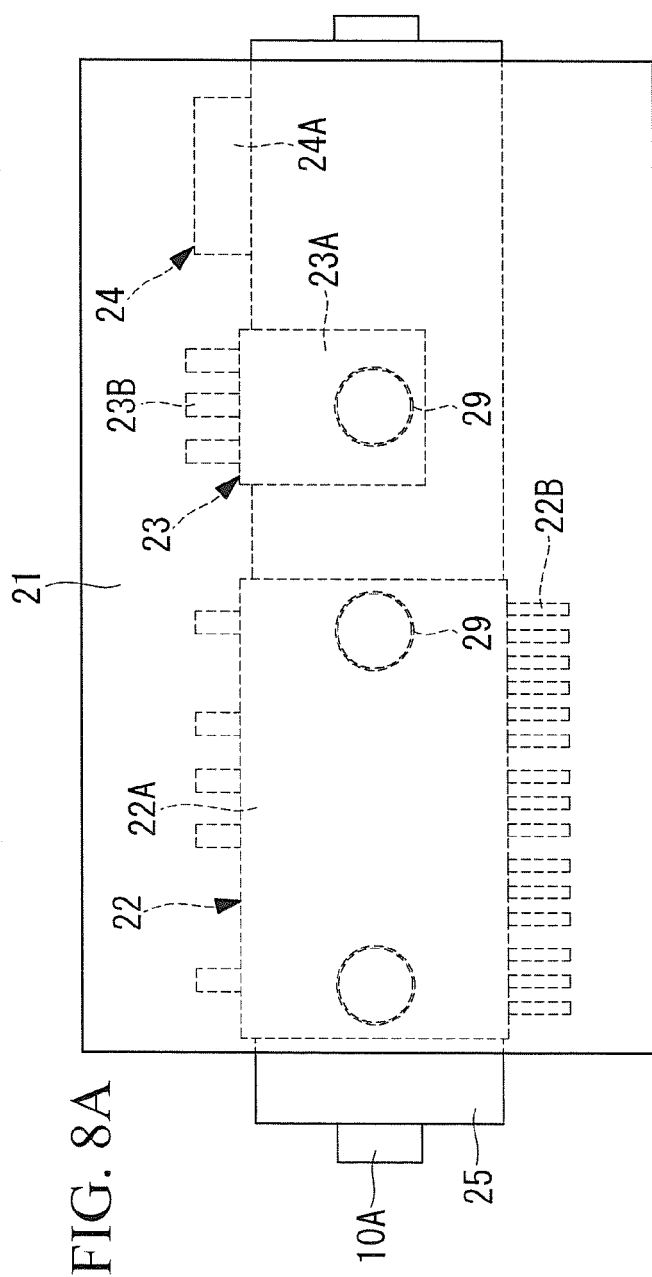


FIG. 8B

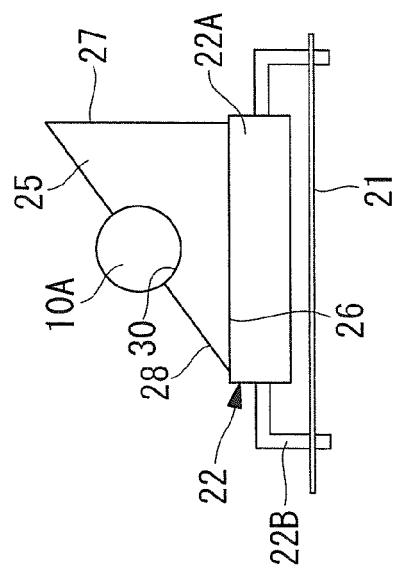


FIG. 8C

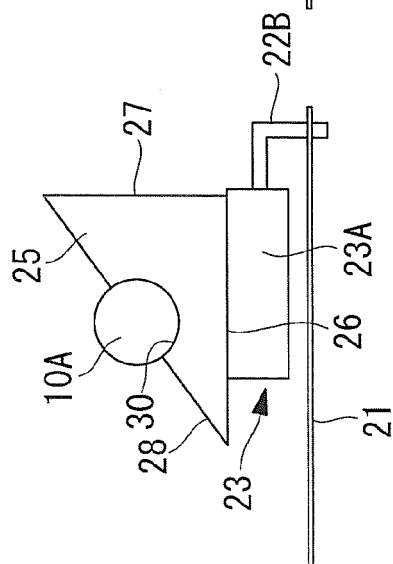


FIG. 8D

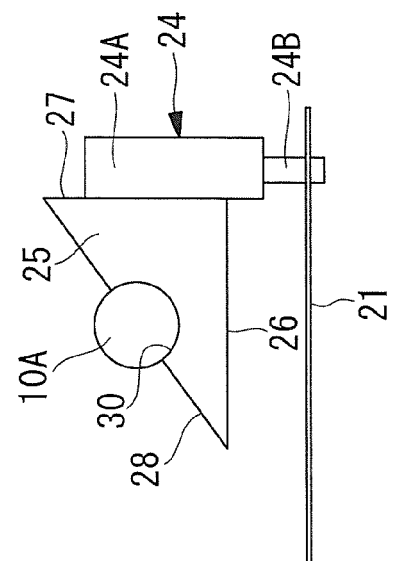
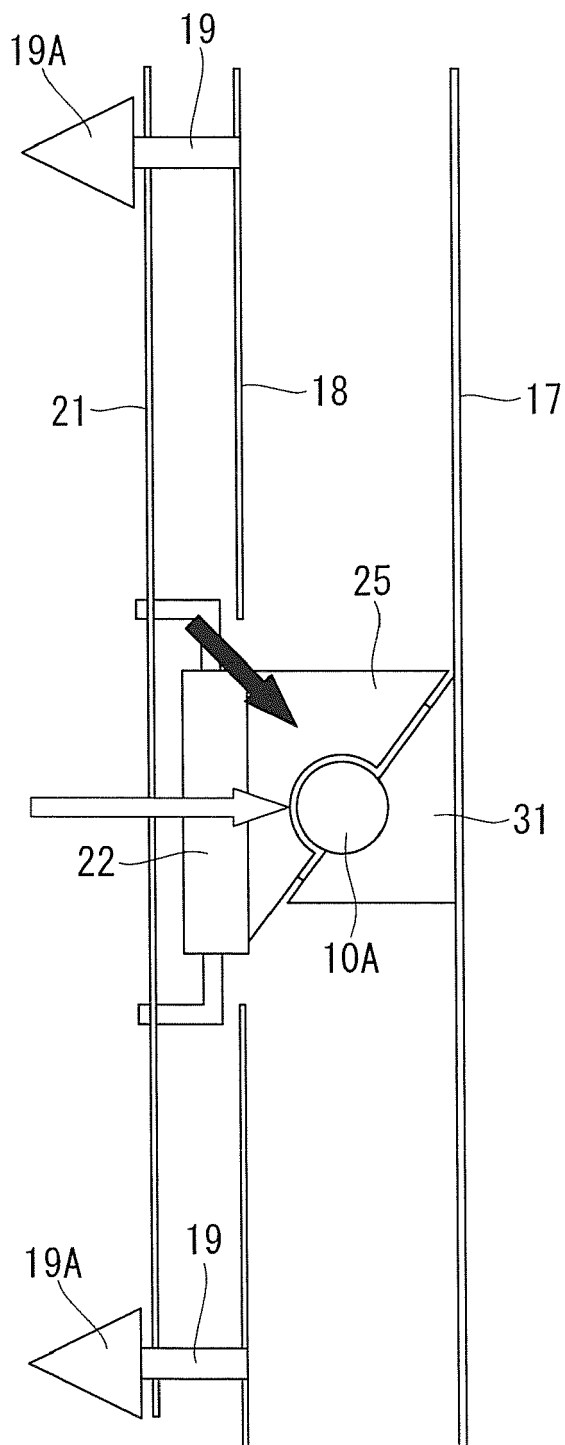


FIG. 9



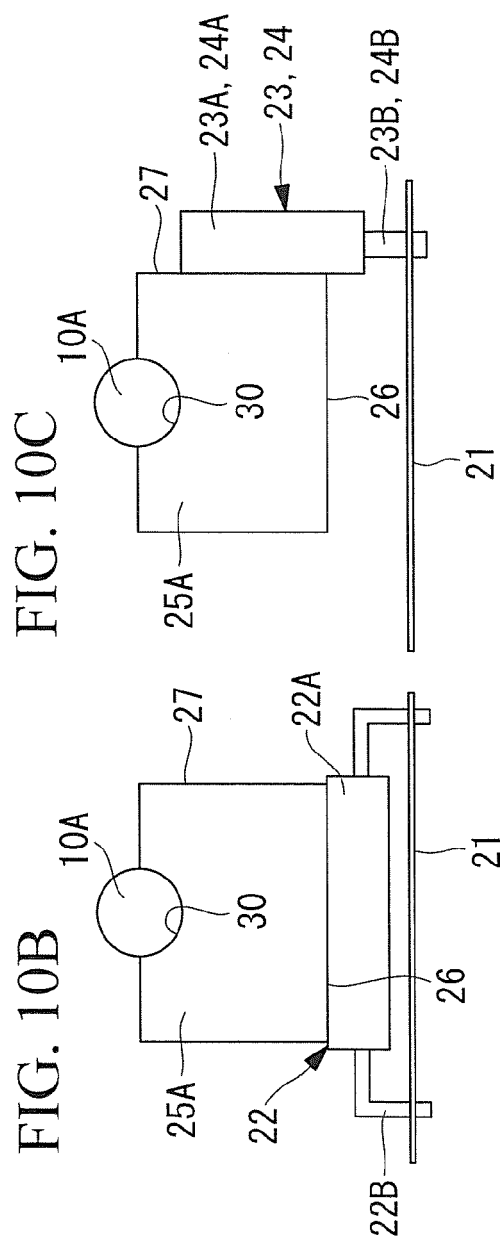
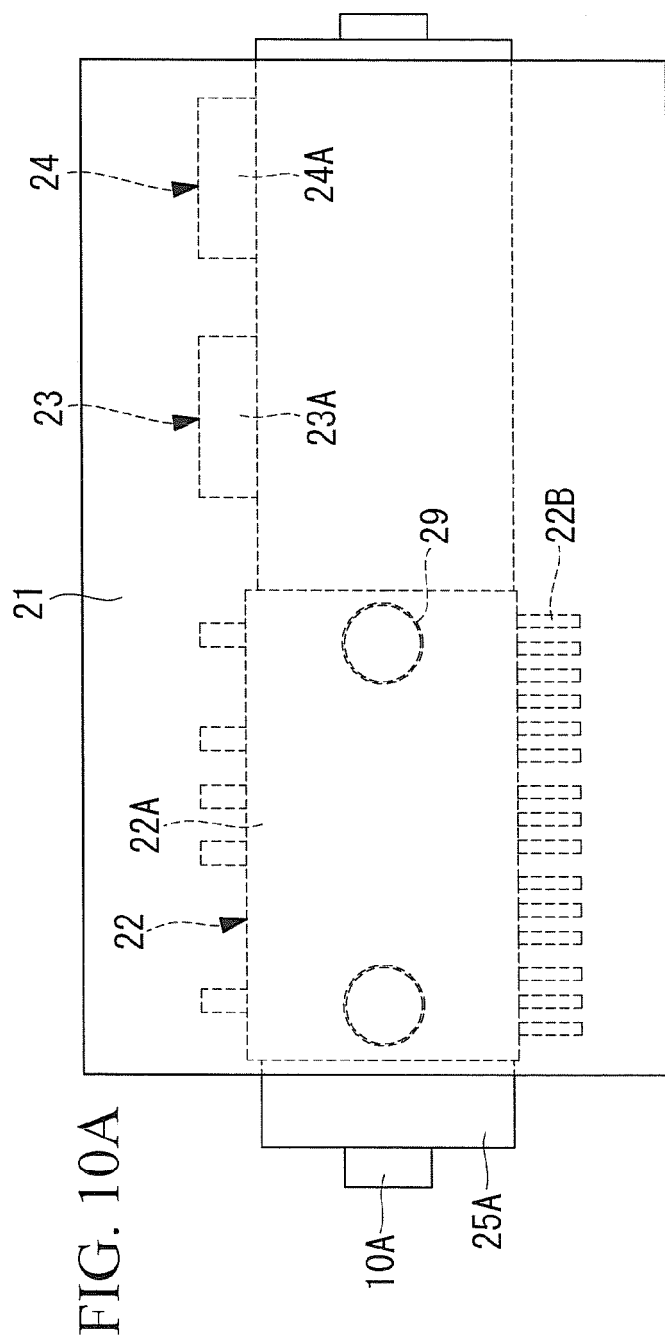


FIG. 11A

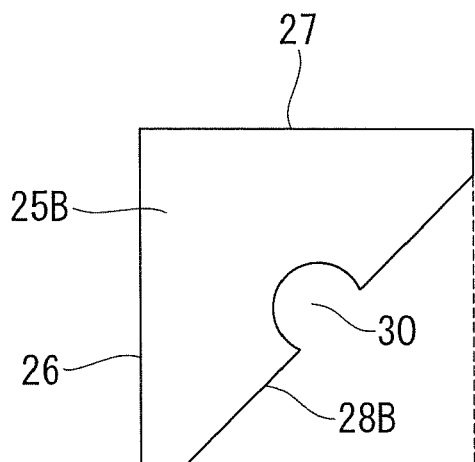


FIG. 11B

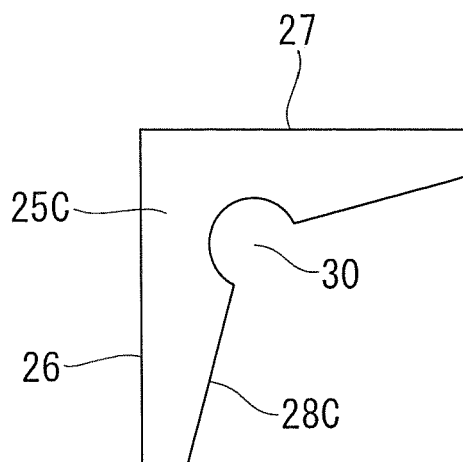


FIG. 11C

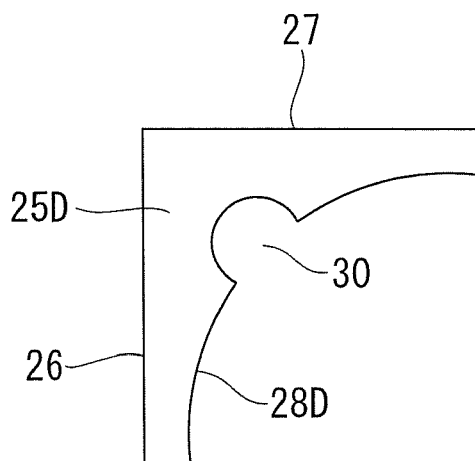


FIG. 11D

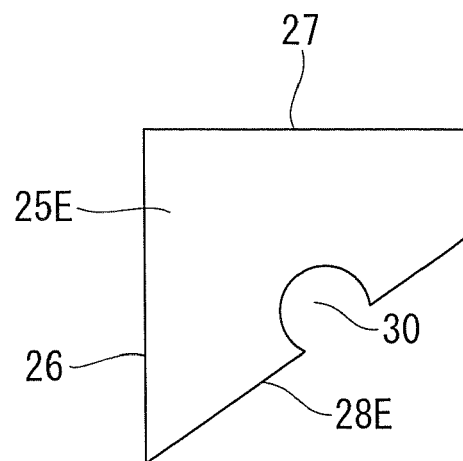
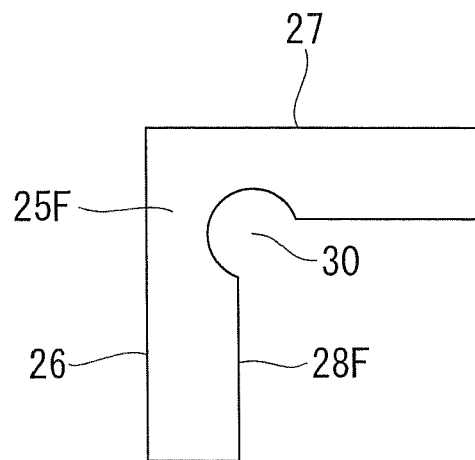
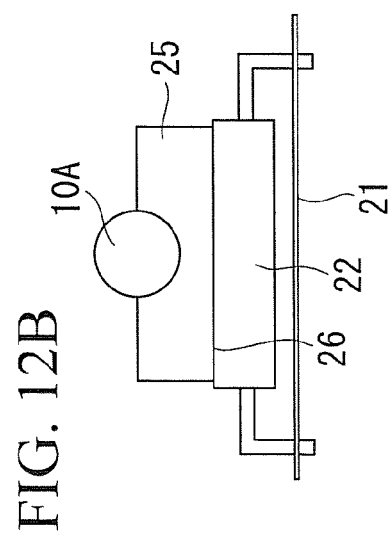
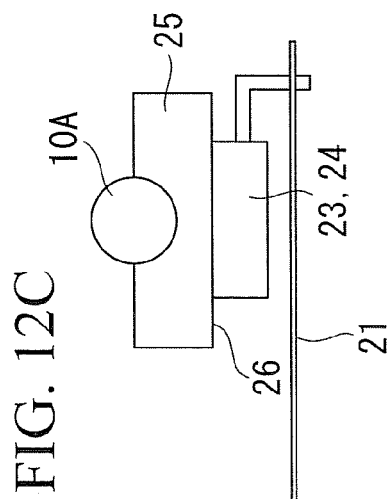
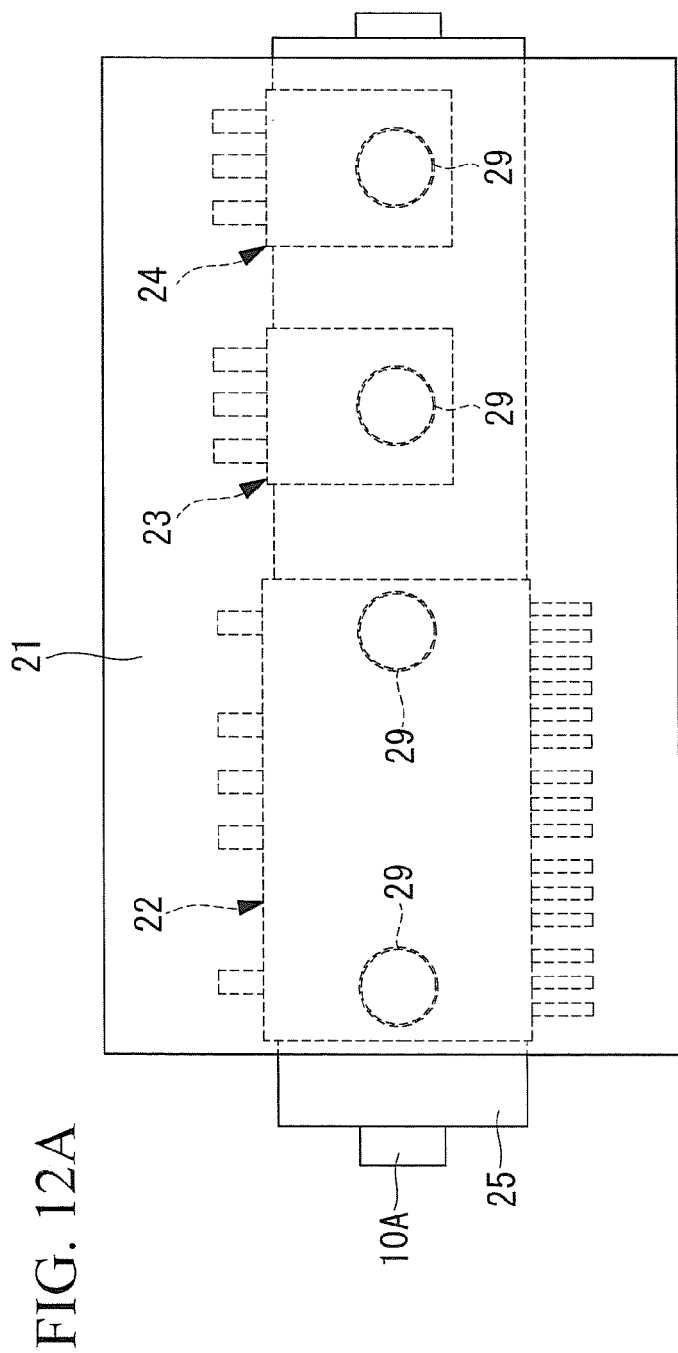


FIG. 11E





REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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