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(54) **Reactor unit with an electric connector**

Reaktoreinheit mit einem elektrischem Anschluss

Unité de réacteur avec un connecteur électrique

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Description

TECHNICAL FIELD

[0001] The present invention relates to a reactor unit having electrical connecting means between winding coils and copper wires using aluminum wires such as a reactor used in electric and electronic appliances.

BACKGROUND ART

[0002] FIG. 5 is a front view of a conventional reactor having electrical connecting means between winding coils and copper wires.

[0003] As shown in FIG. 5, iron core 2 made of iron is mounted on pedestal 1 made of iron. Winding coil 4 wound with aluminum wires 3 having an enamel film baked on the surface is inserted in iron core 2. Then, the entire reactor is impregnated in varnish. The material of winding coil 4 is composed of aluminum wires 3. Aluminum wires 3 are less expensive than copper wires, and are used widely in reactors and other windings recently.

[0004] The enamel parts are removed from the beginning and end of winding of winding coil 4 of aluminum wires 3, and aluminum core 5 is soldered and connected to other electric terminal 6 made of copper by means of solder 7.

[0005] In this configuration, a power supply input into reactor 8 from outside is supplied by inserting a tab terminal or the like connected to a lead wire or the like into electric terminal 6.

[0006] However, in the conventional configuration of electrical connecting means between winding coils of aluminum material and copper wires, aluminum wires cannot be fixed to the copper-made electric terminal by ordinary solder. Therefore, a special solder for aluminum wires is needed. Hence, the cost is higher as compared with the ordinary solder, and the manufacturing process is difficult.

[0007] Still worse, heat generation from the winding coil is transmitted to the terminal, and if a thermal stress is applied to the electric terminal, the soldered part may be cracked and defective in connection due to difference in coefficient of thermal expansion of aluminum and copper. Therefore, the reliability is inferior.

Prior art document

Patent document

[0008]

Patent document 1: Unexamined Japanese Patent Application Publication No. H7-22258

[0009] Document US 2007/0285852 A1 discloses an iron core transformer with at least one primary binding made of aluminum wire. A terminal with slot is provided

to be connected to the aluminum conductor.

[0010] Document EP 0 371 310 A2 discloses an electrically conductive connector for a flat conductor. The conductor comprises a sleeve for a round conductor and a flat part to which the flat conductor is soldered.

SUMMARY OF THE INVENTION

[0011] The present invention is intended to solve the problems of the conventional means, and it is hence an object thereof to present a reactor unit having electrical connecting part between winding coils of aluminum wires and copper wires, and more specifically an inexpensive and highly reliable reactor unit capable of preventing faulty contact in spite of sudden changes in the environmental temperature of the connection part.

[0012] To solve the problems of the conventional means, the reactor unit of the present invention includes a winding coil having aluminum wires wound around an iron core, and a copper-made electric terminal connected to end parts of the winding coil, in which the electric terminal has a pressing and connecting part for pressing and connecting aluminum wires of the winding coil at one end, and a welding part of a nearly flat shape at other end.

[0013] This configuration realizes an inexpensive and highly reliable reactor unit having electrical connecting means between winding coils and copper wires not causing faulty contact in spite of sudden changes in the environmental temperature.

BRIEF DESCRIPTION OF DRAWINGS

[0014]

FIG. 1 is a sectional view of a reactor unit in a preferred embodiment of the present invention.

FIG. 2 is a front view of the reactor unit.

FIG. 3A is side magnified view of connection part of the reactor unit.

FIG. 3B is a front magnified view.

FIG. 3C is a magnified sectional view of part 3C-3C.

FIG. 3D is a magnified sectional view of part 3D-3D.

FIG. 4 is an electrical characteristic graph of the reactor unit.

FIG. 5 is a front view of a conventional reactor having electrical connecting means between winding coils and copper wires.

PREFERRED EMBODIMENTS FOR CARRYING OUT THE INVENTION

Preferred Embodiment 1

[0015] This preferred embodiment is explained in FIG. 1 to FIG. 4, relating to a reactor unit having electrical connecting part between winding coils using aluminum wires and copper wires for power supply input for the purpose of suppression of harmonic currents from wash-

ing machine or the like of inverter control, or improvement of power factor. It must be noted, however, that the present invention is not limited to the illustrated preferred embodiment alone.

[0016] FIG. 1 is a sectional view of reactor unit in preferred embodiment 1 of the present invention. As shown in FIG. 1, thin electromagnetic steel plates blanked in a shape of letter E by a pressing die are laminated and welded to obtain E-core 9, to which winding coils 10 wound with aluminum wires having an enamel film baked on the surface are fitted from the upper part. Thin electromagnetic steel plates blanked in a shape of letter I by a pressing die are laminated and welded to obtain I-core 11, which is mounted on E-core 9, and the contact side surface of outer circumference is welded and fixed by means of welding member 12.

[0017] E-core 9 is welded and fixed to iron-made pedestal 13 by means of welding member 12 so as to be tightened with screws to washing machine or other machine to be applied.

[0018] Insulation tape 15 for insulation is wound on the outer circumference of winding coils 10.

[0019] The entire reactor is impregnated in varnish after completion of all processes of welding and fixing. The purpose of impregnation in varnish is rust prevention of iron cores of E-core 9 and I-core 11, suppression of magnetic distortion sound, and protection of coil insulation tape from moisture, among others.

[0020] FIG. 2 is a front view of the reactor unit. As shown in FIG. 2, winding coils 10 wound with aluminum wires 18 are fitted to iron core 16 formed of E-core 9 and I-core 11. Enamel parts are removed from start and end of winding of winding coils 10 of aluminum wires 18, and aluminum core wires 19 of aluminum wires 18 are exposed by about 10 mm, and pressed, connected and fixed to pressing and connecting part 25 of copper-made electric terminal 17, thereby composing reactor unit 14.

[0021] At other opposite side of electric terminal 17, the core wire of copper-made lead wire 21 with connector 22 for supplying power source to the reactor is welded and fixed to welding part 17c of a nearly flat shape of electric terminal 17 by spot welding.

[0022] Junction part 20 between aluminum core wire 19 and copper-made electric terminal 17 produces a potential difference because dissimilar metals of aluminum and copper are connected. Therefore if water or moisture sticks, an electrolytic corrosion occurs, and the contact resistance may be increased. Therefore, by applying silicone resin 23 to cover at least the entire area of the connection part of dissimilar metals by using a brush or the like, an electric connection can be assured appropriately.

[0023] Further, by coating the outer circumference of junction part 20 with heat shrink tube 24 which shrinks when exposed to high temperature, as insulation tape, the waterproof effect may be further heightened.

[0024] FIG. 3 shows the detail of the connection part. FIG. 3A is a side magnified view of the connection part.

FIG. 3B is a front magnified view of the connection part. FIG. 3C is a sectional view of part 3C-3C of FIG. 3A. FIG. 3D is a sectional view of part 3D-3D of FIG. 3A.

[0025] As shown in FIG. 3A and 3B, when pressing and connecting aluminum core wire 19 of aluminum wire 18 to electric terminal 17, first pressing and connecting part 17a of low pressing height, and second pressing and connecting part 17b of high pressing height are pressed and connected in two stages.

[0026] As shown in FIG. 3C and 3D, section 3C-3C shows first pressing and connecting part 17a of low pressing height, and the pressing crimp height (pressing and connecting height) is ΔA , and section 3D-3D shows second pressing and connecting part 17b of high pressing height, and the pressing crimp height is ΔB . Therefore, terminal end part 30 is processed by changing the pressing height so that the crimp height relation may be $\Delta A < \Delta B$.

[0027] In first pressing and connecting part 17a of section 3C-3C, terminal end part 30 is bent and processed to such an extent that inside aluminum core wire 19 may be compressed and deformed. By contrast, in second pressing and connecting part 17b of section 3D-3D, terminal end part 30 is bent and processed to such an extent that inside aluminum core wire 19 may not be deformed plastically.

[0028] Generally, unlike a copper wire, an aluminum wire is soft in surface hardness, and the aluminum itself is elongated by stress of pressing and connecting, and is deformed plastically. It is hence difficult to satisfy both the stability of contact resistance required in pressing and fixing and the assurance of tensile strength. To solve such problem, in the preferred embodiment, the pressing and connecting height is divided, and the contact resistance is stabilized in first pressing and connecting part 17a of section 3C-3C, and the tensile strength is assured in second pressing and connecting part 17b of section 3D-3D, and the required roles for connection are divided, and successive pressing and connecting may be achieved.

[0029] The opposite side of aluminum wire 18 of electric terminal 17 is welding part 17c for joining copper-made lead wire 21 and electric terminal 17 by spot welding.

[0030] This welding part 17c is welding between copper materials, and is free from difference in coefficient of thermal expansion, junction part 20 has a strong resistance to temperature changes.

[0031] FIG. 4 shows an electric characteristic graph of the reactor unit of the preferred embodiment. In the electric characteristic graph, the axis of abscissas denotes the pressing crimp height (pressing and connecting height) of the pressing and connecting part, and the axis of ordinates represents the electric contact resistance value of the pressing and connecting part. As shown in FIG. 4, when pressing and connecting an aluminum wire of, for example, 2.0 mm in diameter, in the range of crimp height value of about 1.8 mm to about 2.3 mm, the contact

resistance value is stable, about 0.2 mΩ or less, but the contact resistance increases gradually when the crimp height value is about 2.3 mm or more.

[0032] In other words, the aluminum core wire is low in contact resistance and is stable when compressed strongly and deformed plastically, but the tensile strength against pulling is lowered.

[0033] Similarly, as for the tensile strength, in the range of crimp height value of about 1.8 mm to about 2.3 mm, the tensile strength increases gradually, and in the range of crimp height value of about 2.3 mm to about 2.6 mm, the tensile strength is stable, about 300 N/m² or more.

[0034] Accordingly, in order to stabilize the contact resistance, first pressing and connecting part 17a is pressed and connected at a crimp height value of 1.9 mm to 2.1 mm, and in order to assure the tensile strength, second pressing and connecting part 17b is pressed and fixed at a crimp height value of 2.4 mm to 2.6 mm, so that both contact resistance and tensile strength can be satisfied.

[0035] Thus, in the preferred embodiment, dissimilar materials are fixed by pressing and connecting aluminum wire 18 of winding coil 10 to copper-made electric terminal 17, reactor unit 14 is composed, and similar materials of copper wire 21 and copper-made electric terminal 17 are connected by spot welding, thereby realizing an inexpensive and highly reliable reactor unit having electrical connecting means between aluminum winding coils and copper wires capable of preventing faulty contact in spite of sudden changes in the environmental temperature.

[0036] Further, by varying the crimp height when pressing and connecting first pressing and connecting part 17a and second pressing and connecting part 17b, both the tensile strength and the contact resistance of pressing and connecting part 25 can be stabilized at the same time. Therefore, a sufficient performance is assured in spite of aging effects, and the reliability may be further enhanced.

[0037] Moreover, by applying waterproof treatment with silicone resin on the contact surface of aluminum material and copper material, or by applying waterproof treatment by coating with a heat-shrink tube which shrinks when exposed to high temperature, electrolytic corrosion occurring between dissimilar metals can be prevented, and the reliability may be enhanced more over.

Claims

1. A reactor unit comprising a winding coil (10) having aluminum wires (18) wound around an iron core (16), and a copper-made electric terminal (17) connected to end parts of the winding coil (10), wherein the electric terminal (17) has a pressing and connecting part (25) for pressing and connecting aluminum wires of the winding coil at one end, **characterized by** a weld-

ing part (17c) of a nearly flat shape at other end, wherein the electric terminal (17) has the pressing and connecting part (25) divided into a first pressing and connecting part (17a) and a second pressing and connecting part (17b) both pressing an aluminum core wire (19) of the aluminum wires (18), and the pressing and connecting height differs between the first pressing and connecting part (17a) and the second pressing and connecting part (17b).

2. The reactor unit of claim 1, wherein the pressing and connecting part (25) is coated with a silicone resin for waterproof treatment.
3. The reactor unit of claim 1, wherein the pressing and connecting part (25) is covered with a heat-shrink tube for waterproof treatment.

Patentansprüche

1. Eine Induktoreinheit aufweisend eine Spulenwicklung (10) mit Aluminiumleitungen (18), die um einen Eisenkern (16) gewickelt sind, und eine aus Kupfer hergestellte Anschlussklemme (17), die an Endabschnitte der Spulenwicklung (10) angeschlossen ist, wobei die elektrische Anschlussklemme (17) an einem Ende einen Press- und Verbindungsteil (25) zum verpressen und anschließen der Aluminiumleitungen der Spulenwicklung hat, **gekennzeichnet durch** einen Schweißteil (17c) von annähernd flacher Form an dem anderen Ende, wobei der Press- und Verbindungsteil (25) der elektrischen Anschlussklemme (17) in einen ersten Press- und Verbindungsteil (17a) und einen zweiten Press- und Verbindungsteil (17b) unterteilt ist, die beide eine Aluminiumkernleitung (19) der Aluminiumleitungen (18) pressen, und die Press- und Verbindungshöhe zwischen dem ersten Press- und Verbindungsteil (17a) und dem zweiten Press- und Verbindungsteil (17b) differiert.
2. Die Induktoreinheit des Anspruchs 1, wobei der Press- und Verbindungsteil (25) für eine wasserdichte Handhabung mit einem Silikonharz beschichtet ist
3. Die Induktoreinheit des Anspruchs 1, wobei der Press- und Verbindungsteil (25) für eine wasserdichte Handhabung mit einem Schrumpfschlauch bedeckt ist.

Revendications

1. Unité de réacteur comprenant une bobine d'enroulement (10) comportant des fils d'aluminium (18) enroulés autour d'un noyau de fer (16) et une borne électrique en cuivre (17) connectée aux parties d'ex-

trémité de la bobine d'enroulement (10), dans laquelle la borne électrique (17) possède une partie de pression et de connexion (25) pour presser et connecter les fils d'aluminium de la bobine d'enroulement à une extrémité, **caractérisée par** une partie 5 de soudure (17c) d'une forme sensiblement plane à l'autre extrémité, dans laquelle la borne électrique (17) a la partie de pression et de connexion (25) divisée en une première partie de pression et de connexion (17a) et une deuxième partie de pression et 10 de connexion (17b), toutes deux pressant un fil à noyau d'aluminium (19) des fils d'aluminium (18), et la hauteur de pression et de connexion diffère entre la première partie de pression et de connexion (17a) et la seconde partie de pression et de connexion 15 (17b).

2. Unité de réacteur selon la revendication 1, dans laquelle la partie de pression et de connexion (25) est revêtue d'une résine silicone pour traitement hydrofuge. 20
3. Unité de réacteur selon la revendication 1, dans laquelle la partie de pression et de connexion (25) est recouverte d'un tube thermorétrécissable pour traitement hydrofuge. 25

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FIG. 1

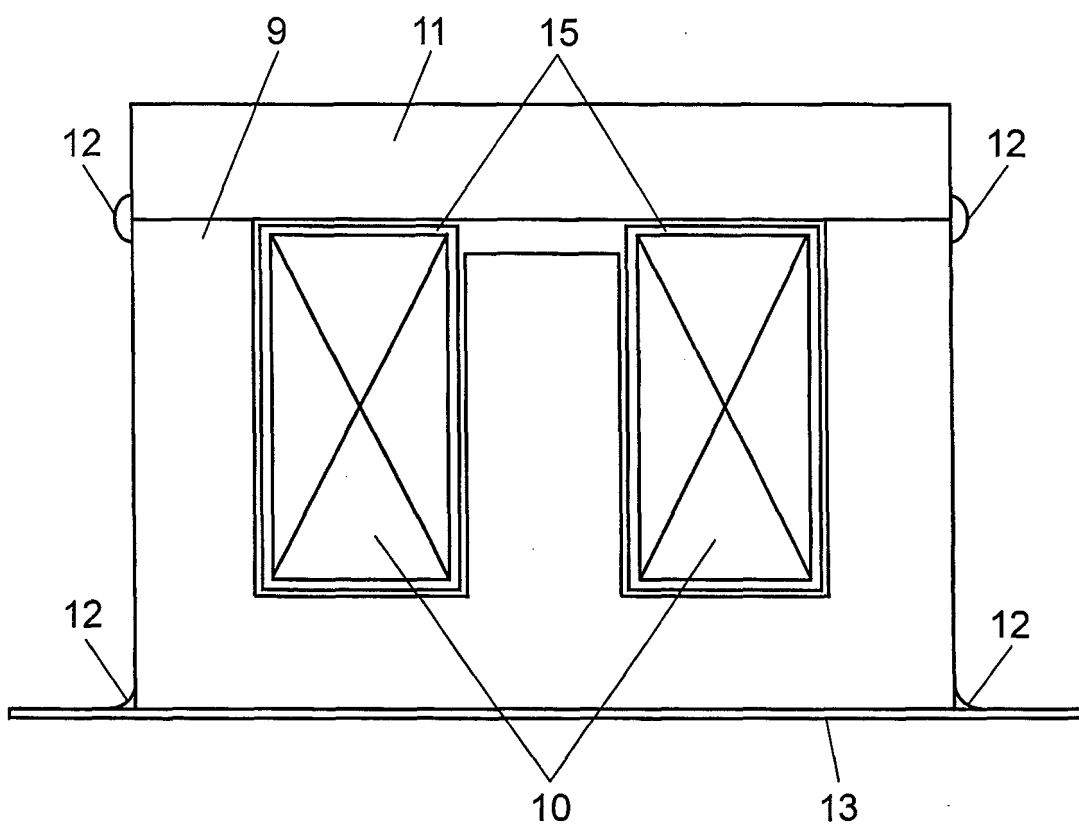


FIG. 2

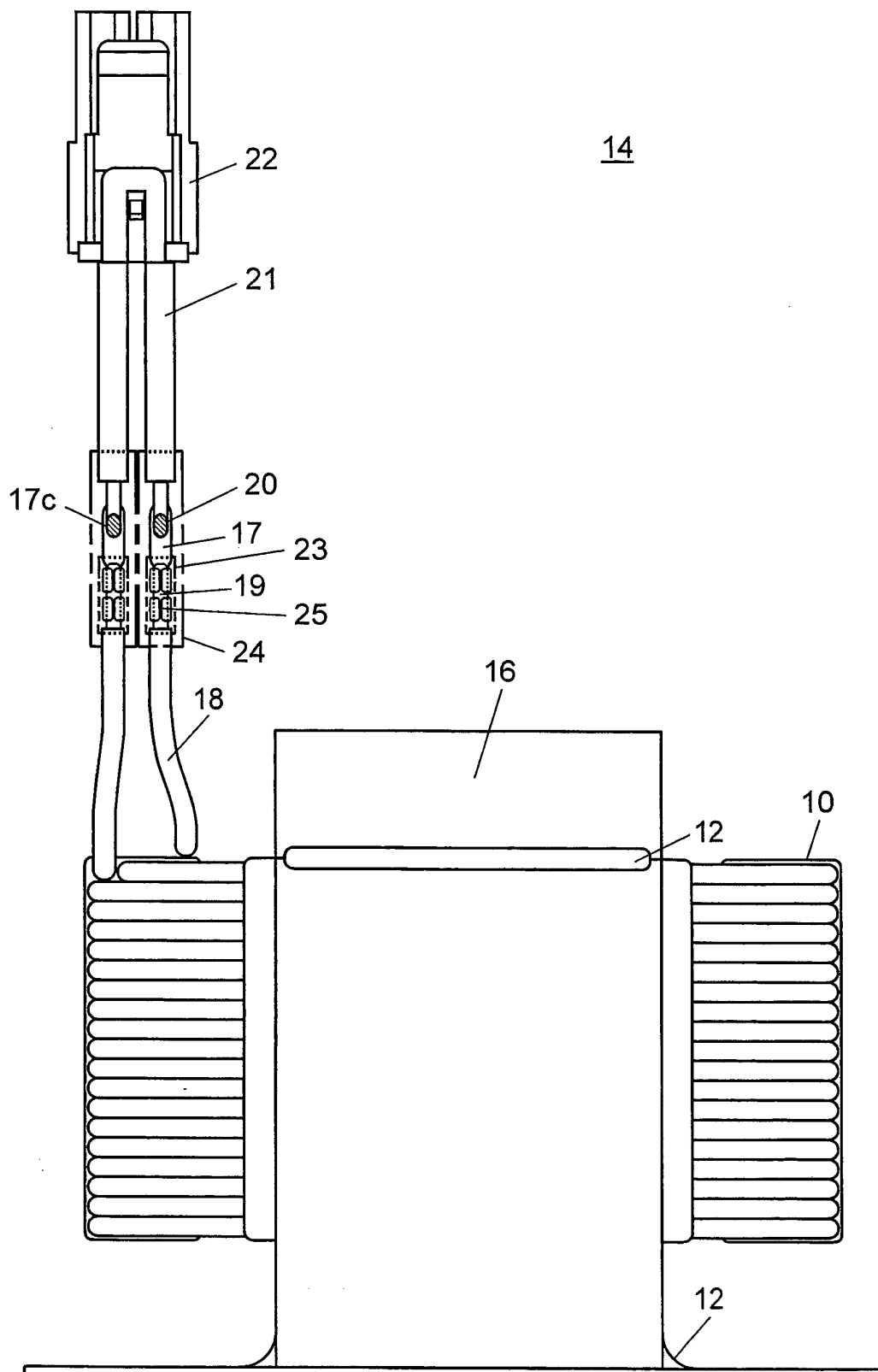


FIG. 3A

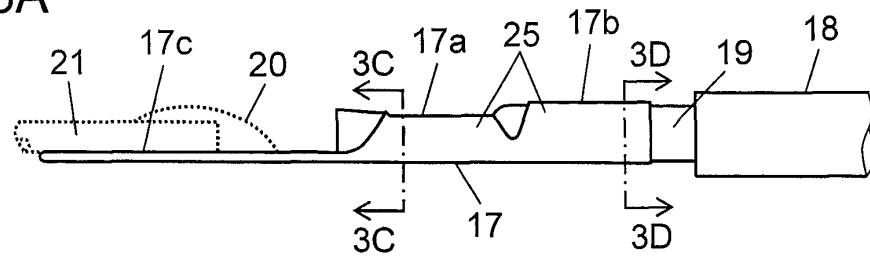


FIG. 3B

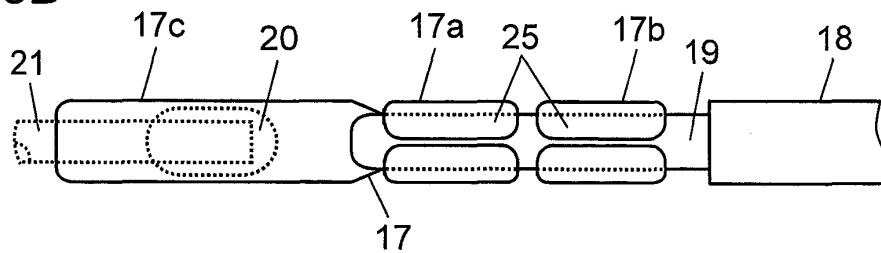


FIG. 3C

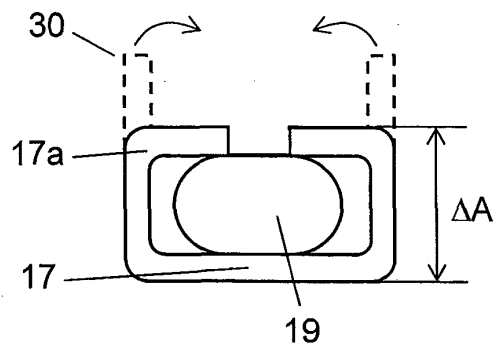


FIG. 3D

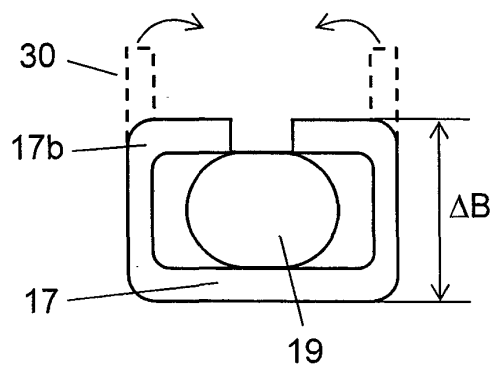


FIG. 4

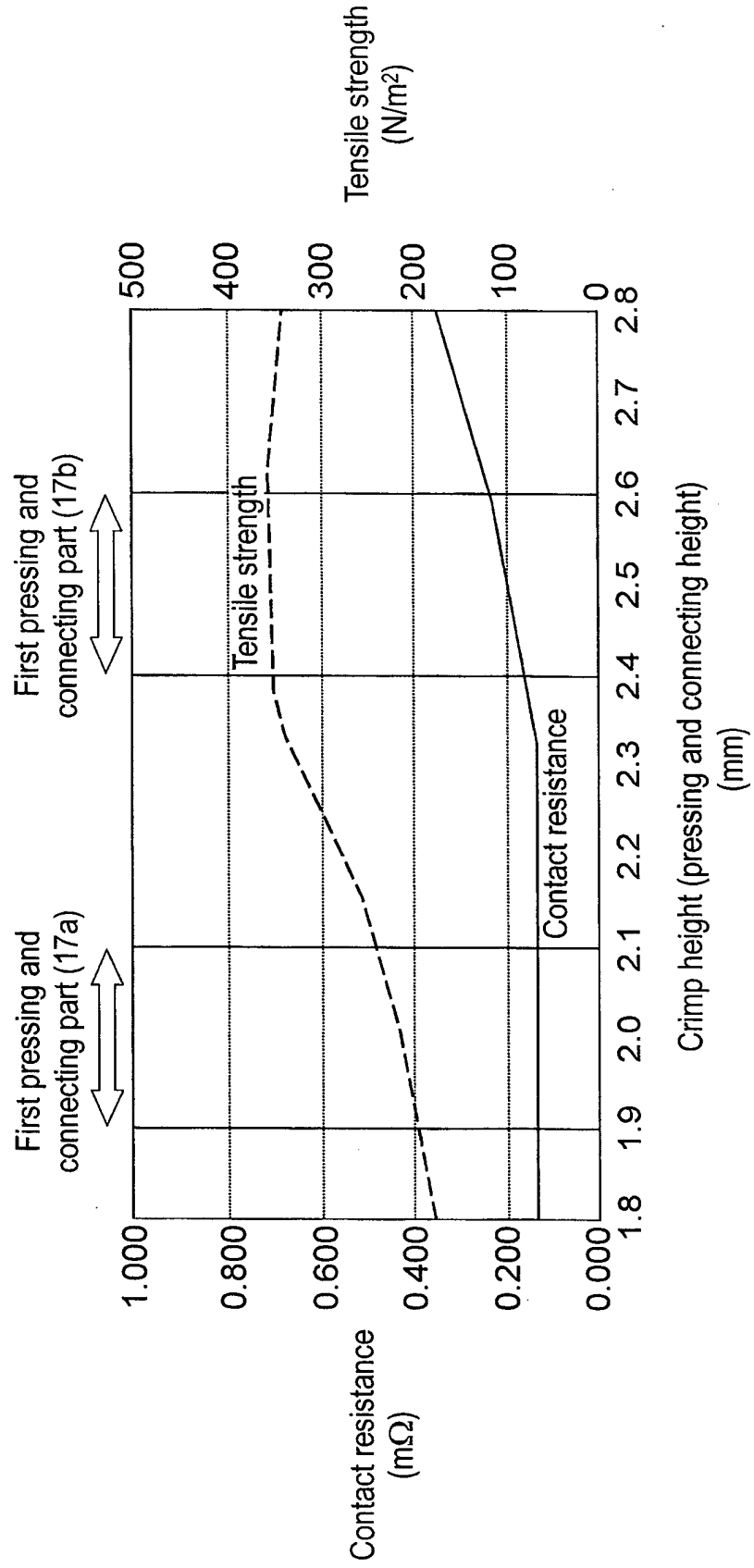
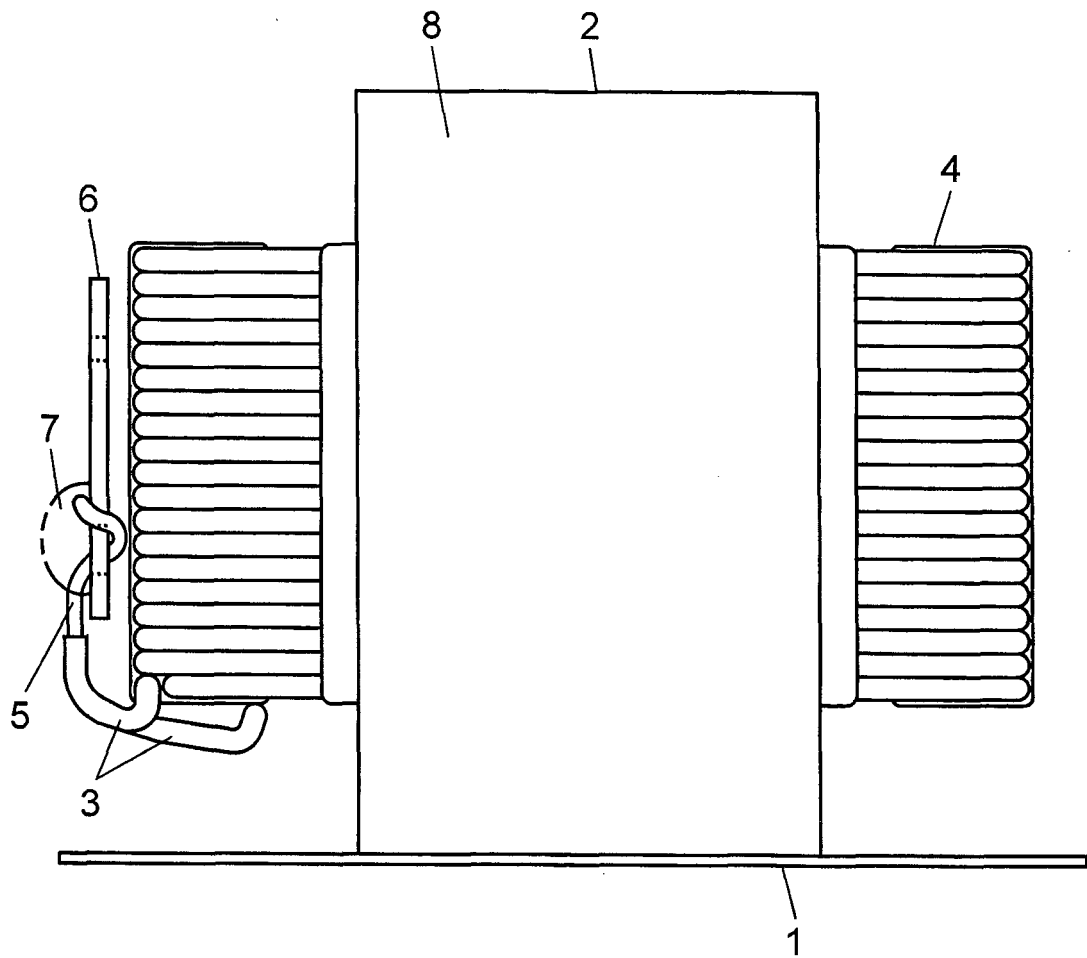


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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