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(54) SAFETY SHUT OFF DEVICE FOR GAS BURNER

SICHERHEITSABSPERRVORRICHTUNG FÜR GASBRENNER

DISPOSITIF DE COUPURE DE SECURITE POUR BRULEUR A GAZ

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Description

TECHNICAL FIELD

[0001] The present invention relates to a gas burner safety device which is employed to a gas cooking stove, a gas water heater, and the like. More particularly, it relates to a gas burner safety device to which a thermo-couple unit and an electromagnetic valve unit which is operated by electricity generated with thermoelectric power are integrally coupled.

BACKGROUND ART

[0002] In the related art, a gas cooking stove system as shown in Fig. 11 for example is known. This system comprises a main burner 2 disposed at the upper end of a gas supply conduit 1, a lighting burner 4 disposed at the top end of an assist supply conduit 3 which separates from the gas supply conduit 1, a gas burner safety device 8 to which an electromagnetic valve unit 6 having a valve body 5 to open and close the passage of the gas supply conduit 1 and a thermo-couple unit 7 having cables 7a', 7b' connected to the electromagnetic unit 6 are integrally arranged, an operating shaft 9, and so on, as disclosed in Japanese Patent Laid-open 2000-18591 and 118-178296.

[0003] With the system for a gas cooking stove, when the main burner 2 is lighted by the flame of the lighting burner 4 by pushing the operating shaft 9 and introducing the gas into the gas supply conduit 1 and the assist supply conduit 3, the flame of the main burner 2 heats the top end (a thermal sensitive portion) of the thermo-couple unit 7. Then, thermoelectric power is generated at the thermo-couple unit 7, and the electricity generated by the thermoelectric power flows in a coil of the electromagnetic valve unit 6 to generate electromagnetic power. In this manner, the valve body 5 is sucked and maintains the gas passage at an opened state. On the contrary, when the flame of the main burner 2 is extinguished by blow-off, boil-spill or the like, the heating to the thermo-couple unit 7 is interrupted and the thermoelectric power, namely the electromagnetic force, is extinguished. Then, the valve body 5 is returned by a return spring and the gas passage is closed. In this manner, emission of unburned gas is prevented.

[0004] Here, as shown in Fig. 12(a) (b), the electronic valve unit 6 and the thermo-couple unit 7 are electrically connected by connecting two male terminals 6a, 6b disposed at the electromagnetic valve unit 6 side with two female terminals 7a, 7b disposed at the thermo-couple unit 7 side. Accordingly, two pairs of male terminals 6a, 6b and female terminals 7a, 7b which are almost the same shape are disposed in parallel with each other for coupling freely to be attached and detached.

[0005] Further, as shown in Fig. 11 through 13, the thermo-couple unit 7 comprises cables 7a', 7b' which are respectively connected to the female terminal 7a, 7b, a

pole-shaped conductive member 7a" as the thermal sensitive portion which is disposed at the top end of the cables 7a', 7b', a pipe-shaped conductive member 7b" which is disposed around and connected to the pole-shaped conductive member 7a" with the top end portion which is formed as a tapered cone-shape, and a pipe-shaped conductive member 7b'" which diameter is ϕ D. A hot junction part P1 is formed at the top end portion at which the pole-shaped conductive member 7a" and the pipe-shaped conductive member 7b" are connected, and a cold junction part P2, P3 is formed at a specific distance apart from the hot junction part P1.

[0006] Here, with the abovementioned conventional gas burner safety device, in the case of adopting a connecting structure as shown in Fig. 14(a), (b), the male terminals 6a, 6b and the female terminals 7a, 7b which are almost the same shape are disposed in parallel and fitted respectively. Therefore, the case to electrically insulate and cover the terminals needs to be larger, and thus, it is difficult to downsize the device. Further, since the cover direction is predetermined, when the terminals are fitted and connected, the assembling needs to be performed with previous checking of the cover direction. Therefore, the assembling operation cannot be performed easily.

[0007] Furthermore, performances, such as high thermoelectric power, quick response, etc, are needed for the thermo-couple unit 7 to be able to precisely detect the extinguishment of the gas flame. Therefore, to achieve downsizing, cost-reduction and the like as the whole device, the performance has to be obtained without enlargement, cost-up and the like of the thermal sensitive portion (7a", 7b", 7b''').

[0008] EP 0 619 460 A1 relates to a coaxial coupling of the thermocouple to the magnetic group controlling gas flow in burners. The said coupling is fitted at the end of the tube or bipolar electric conductor with a heat insulating head within which there is provided an axial housing for a female terminal terminating the lead wire that lies at the centre of the thermocouple tube, the said head being covered with a metallic sheath that in turn establishes electric continuity with the metallic sheath of the coaxial conductor or tube, which is the electric earth in the thermocouple. It has been specifically designed to electrically connect a thermocouple to the respective magnetic group in a gas tap.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide an improved and useful gas burner safety device in which the above-mentioned problems are eliminated. In order to achieve the above-mentioned object, there is provided a gas burner safety device according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0010] Advantageously, a gas burner safety device comprises a thermo-couple unit having two terminals

connected to a thermal sensitive portion, and an electromagnetic valve unit having two terminals connected to a coil for magnetizing and respectively connected to the two terminals of the thermo-couple unit and a valve body driven by electromagnetic force generated by powering to the coil, and either two terminals of the thermo-couple unit or the electromagnetic valve unit comprise a pipe shaped male terminal having at least an arc-shaped portion of a cylinder and an inner male terminal which is disposed inside the pipe-shaped male terminal, and the other two terminals of the thermo-couple unit or the electromagnetic valve unit comprise an outer female terminal connected to at least one side of the inside and the outside of the wall face of the pipe shaped male terminal and an inner female terminal which is disposed inside the pipe-shaped male terminal, and the unit having two female terminals comprises a fit portion which retains said inner female terminal and is fitted inside said pipe-shaped male terminal, and a sandwich piece which retains said outer female terminal and sandwiches said pipe shaped male terminal from the outside in cooperation with the outer circumference of said fit portion.

[0011] With this structure, when the thermo-couple unit and the electromagnetic unit are integrally connected, the pipe shaped male terminal which is disposed in either of the thermo couple unit and the electromagnetic valve unit is connected to the outer female terminal which is disposed in the other of the thermo-couple unit and the electromagnetic valve unit. Either of the inner female terminal and the inner male terminal which is disposed in the axis direction at the center axis position of the pipe-shaped male terminal is connected to the other of the inner female terminal and the inner male terminal which is disposed in the unit without the pipe-shaped male terminal. In this manner, for connecting and fitting the thermo-couple unit and the electromagnetic valve unit, the terminals can be disposed in parallel to the axis direction of the pipe-shaped male terminal. Then, the device can be downsized in width and in size. Further, since the pipe-shaped male terminal can be connected to the outer female terminal at any position in the arc direction of the pipe-shaped male terminal, the attaching angle between the thermo-couple unit and the electromagnetic valve unit can be flexible when connecting. Further, the following occurs when the thermo-couple unit and the electromagnetic valve unit are connected. The fit portion is fitted inside the pipe-shaped male terminal, and the pin-shaped male terminal is connected to the inner female terminal which is surrounded by the fit portion. The sandwich piece sandwiches the pipe shaped male terminal in cooperation with the outer circumference of the fit portion, and the inner face and the outer face of the pipe-shaped male terminal are connected to the outer female terminal. In this manner, reliable electric connection can be obtained.

[0012] In the abovementioned structure, it is possible that the inner female terminal has a pair of spring pieces which can sandwich the inner male terminal, and the out-

er female terminal has a pair of spring pieces which can sandwich the wall face of the pipe-shaped male terminal both from the inside and the outside.

[0013] With this structure, in the connecting state, the pin-shaped male terminal is sandwiched by the spring pieces of the inner female terminal, and the wall face of the pipe-shaped male terminal is sandwiched by the spring pieces of the outer female terminal both from the inside and outside. Therefore, reliable electrical connection can be obtained.

[0014] In the abovementioned structure, it is possible that the inner female terminal and the outer female terminal are folded approximately in a V-shape to have a flexible piece, and the pipe-shaped male terminal and the inner male terminal are inserted and detached in the direction approximately perpendicular to the deforming direction of the flexible piece.

[0015] With this structure, the connecting pressure between the male terminal (the pipe-shaped male terminal and the inner male terminal) and the female terminal (the inner female terminal and the outer female terminal) is exerted approximately even in the direction of inserting and detaching. Therefore, stable electrical contact can be obtained reliably.

[0016] In the abovementioned structure, it is possible that the pipe-shaped male terminal is formed longer than the terminal disposed inside the pipe-shaped male terminal

[0017] With this structure, since the pin-shaped male terminal does not project from the pipe-shaped male terminal and stays inside at the state that the electromagnetic valve unit and the thermo-couple unit are separated, breakage etc. of the pin-shaped male terminal can be prevented.

[0018] In the abovementioned structure, it is possible that the thickness of the pipe-shaped male terminal is the same dimension as the outer diameter of the inner male terminal.

[0019] With this structure, since the same part can be used for both the inner female terminal and the outer female terminal which constitute a pair of female terminals, cost-reduction of the device can be obtained due to the commonality of parts.

[0020] In the abovementioned structure, it is possible that the pipe-shaped male terminal is formed with almost even thickness and the fit portion is formed approximately cylindrical to match with the pipe-shaped male terminal.

[0021] With this structure, the pipe-shaped male terminal (the electromagnetic valve unit) which is formed cylindrical and the fit portion (the thermo-couple unit) which is formed approximately cylindrical to match with the pipe-shaped male terminal are fitted to be point symmetry around the axis. Therefore, the thermo-couple unit and the electromagnetic valve unit can be fitted in the direction of any angle without caring about the orientation, and the assembling operation can be easily performed.

[0022] In the abovementioned structure, it is possible

that the pipe-shaped male terminal has a folded portion which top end portion is folded inside, and the fit portion has a pawl portion for latching with the folded portion.

[0023] With this structure, when the fit portion (the thermo-couple unit) is fitted to the pipe shaped male terminal (the electromagnetic valve-unit), the pawl portion of the fit portion latches the folded portion of the pipe-shaped male terminal. Accordingly, detachment of the fit portion from the pipe-shaped male terminal can be prevented.

[0024] In the abovementioned structure, it is possible that the fit portion has a deform portion which can elastically deform in the direction perpendicular to the direction of fitting to the pipe-shaped male terminal, and the pawl portion is formed at the top end of the deform portion.

[0025] With this structure, at the time of inserting the fit portion to the pipe-shaped male terminal, after the fit portion is inserted to a specific position with the deform portion deforming to the inside, the deform portion elastically returns and the pawl portion disposed at the top end thereof latches the folded portion of the pipe-shaped male terminal. Accordingly, the fitting operation of the fit portion (the thermo-couple unit) and the pipe-shaped male terminal (the electromagnetic valve unit) can easily be performed, and easy detachment of the fit portion from the pipe-shaped male terminal can be prevented.

[0026] In the abovementioned structure, it is possible that the pipe-shaped male terminal integrally has an attachment flange for fixing the electromagnetic valve unit at a desired position.

[0027] With this structure, by fixing the pipe-shaped male terminal at a specific position as an attachment flange while grounding, the gas burner safety device which comprises the electromagnetic valve unit and the thermo-couple unit can be fixed.

[0028] In the abovementioned structure, it is possible that the pipe-shaped male terminal integrally has a screw cap for fixing the electromagnetic valve unit at a desired position.

[0029] With this structure, by screwing the screw cap to a desired position while grounding the pipe-shaped male terminal, the gas burner safety device which comprises the electromagnetic valve unit and the thermo-couple unit can be fixed.

[0030] In the abovementioned structure, it is possible that the electromagnetic valve unit has a movable core which is integrally movable with the valve body and a fixed core on which the coil is wound, and the pipe-shaped male terminal integrally has a holder for retaining the fixed core.

[0031] With this structure, since the pipe-shaped male terminal serves as a holder to retain the fixed core as well as the second connector, the parts count can be reduced and the structure can be simplified.

[0032] Advantageously, a gas burner safety device comprises a thermo-couple unit having a thermal sensitive portion at the top end thereof, and an electromagnetic valve unit which is driven by electromagnetic force based on thermoelectric power generated at the thermo-couple

unit, and the thermal sensitive portion of the thermo-couple unit includes a pole-shaped conductive member and a pipe-shaped conductive member which is cylindrically disposed around and connected to the pole-shaped conductive member with the top end portion which is formed as a cone shape, and the pipe-shaped conductive member is formed so that the thickness at a cold junction part of the rear end side is larger than that at a hot junction part of the top end to which the pole-shaped conductive member is connected.

[0033] With this structure, the cold junction side of the pipe-shaped conductive member is thickly formed. Therefore, even though the diameter is smaller than that of the related art, the same thermoelectric power characteristics and response can be maintained. If the diameter is kept as the related art, the thermoelectric power characteristics and response can be improved.

[0034] In the abovementioned structure, it is possible that a top end thin portion which outer diameter is the smallest is formed at the top end connecting region of the pole-shaped conductive member and the pipe-shaped conductive member, and the length of the top end thin portion is formed at about 30 through 50 percent of the distance from the hot junction part to the cold junction part.

[0035] With this structure, by setting the top end thin portion longer than the related art, the thermoelectric power characteristics and response can be improved (namely obtaining higher thermoelectric power and quicker response).

EFFECTS OF THE INVENTION

[0036] As mentioned above, with the gas burner safety device of the present invention, the two terminals at the electromagnetic valve unit side and the two terminals at the thermo-couple unit side are disposed in the same axis direction. Therefore, the device can be aggregated and the device can be brought down in width and in size. Further, in the unit having the pipe-shaped male terminal, by disposing the other terminal is at the center axis position of the pipe-shaped male terminal, the pipe-shaped male terminal can be fitted and connected to the outer female terminal of the other unit at any angle having the center axis as the center. In this manner, flexibility of the attaching angle between the thermo-couple unit and the electromagnetic valve unit at the time of connecting can be improved, and assembling operation can easily be performed.

[0037] Further, at the thermal sensitive portion of the thermo-couple unit, a pipe-shaped conductive member which is cylindrically disposed around and connected to the pole-shaped conductive member with the top end portion which is formed as a cone shape is formed so that the thickness at a cold junction part of the rear end side is larger than that at the hot junction part to which the pole-shaped conductive member is connected. Therefore, even though the diameter is smaller than that

of the related art, the same thermoelectric power characteristics and response can be maintained. If the diameter is kept as the related art, the thermoelectric power characteristics and response can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038]

Fig. 1 shows an embodiment of a gas burner safety device of the present invention; (a) is a front view of the device and (b) is a side view of the device.

Fig. 2 is a sectional view of the device shown in Fig. 1 in the fitting direction (the axis direction).

Fig. 3 is a sectional view showing the state that an electromagnetic valve unit and a thermo-couple unit which constitute the device shown in Fig. 1 are separated.

Fig. 4 (a) is a sectional view at E1-E1 in Fig. 2. Fig. 4 (b) is a sectional view at E2-E2 in Fig. 2.

Fig. 5 is a sectional view showing a part of the first connector of the thermo-couple unit.

Fig. 6 shows the relation between an inner female terminal of the thermocouple unit and a pin-shaped male terminal of the electromagnetic valve unit; (a) is a side view, (b) is a front view, (c) is an enlarged front view of one part, and (d) is a sectional view at E3-E3 in Fig. 6 (c).

Fig. 7 shows a thermal sensitive portion of the thermo-couple unit; (a) is an outline drawing and (b) is a sectional view.

Fig. 8 shows another embodiment of the thermal sensitive portion of the thermo-couple unit; (a) is an outline drawing and (b) is a sectional view.

Fig. 9 is a sectional view showing another embodiment of the gas burner safety device of the present invention.

Fig. 10 is a sectional view further showing another embodiment of the gas burner safety device of the present invention.

Fig. 11 is a system diagram showing a system of a gas cooking stove to which a conventional gas burner safety device is adopted.

Fig. 12 shows a conventional gas burner safety device; (a) is a sectional view of the device and (b) is an end face view of the device.

Fig. 13 shows a thermal sensitive portion of a thermo-couple unit which constitutes a part of the conventional gas burner safety device; (a) is an outline drawing and (b) is a sectional view.

BEST MODE FOR CARRYING OUT THE INVENTION

[0039] The preferred embodiments of the present invention are explained in the following with reference to the attached drawings.

[0040] Fig. 1 through 7 show an embodiment of a gas burner safety device of the present invention. Fig. 1

shows a front view and a side view of the whole device. Fig. 2 is a sectional view of the device in the axis direction. Fig. 3 is a sectional view showing the state that an electromagnetic valve unit and a thermo-couple unit are separated. Fig. 4 is sectional view of the device in the direction perpendicular to the axis of the device. Fig. 5 is a sectional view showing a part of the device. Fig. 6 is a partial view showing the structure of the terminals. Fig. 7 has a side view and a sectional view showing a thermal sensitive portion of the thermo-couple unit.

[0041] As shown in Fig. 1 through 3, in this device, the electromagnetic valve unit 100 and the thermo-couple unit 200 are coupling freely to be attached and detached.

[0042] As shown in Fig. 1 through 3, the electromagnetic valve unit 100 comprises a fixed core 101, a resin-made bobbin 102 to support the fixed core 101, a coil 103 for magnetization which integrally winds on the fixed core 101 and the bobbin 102, a conductive holder 104 to fix the bobbin 102 by calking, a pin-shaped male terminal 105 which is connected to one end 103a of the coil 103 and constitutes one portion of a pair of male terminals, an insulate member 106 to retain the pin-shaped male terminal 105 at the center of the holder 104 while performing electrical insulation therebetween, a pipe-shaped male terminal 107 made of conductive material which is connected to the holder 104 and constitutes the other portion of the pair of male terminals, a resin-made case 108 to cover the fixed core 101, a movable core 110 fixed at one end of a shaft 109 which is slidably supported by the case 108, a rubber-made valve body 111 fixed at the other end of the shaft 109, a spring 112 to urge the valve body 111 outward, and so on.

[0043] The fixed core 101 is made of magnetic material, such as permalloy, and is formed approximately into a U-shape. The bobbin 102 is made of isolating material (non-conductive material), and is formed approximately into an inverted U-shape. At the state that the fixed core 101 is supported by the bobbin 102, the bobbin 102 and the fixed core 101 are formed approximately into an H-shape, and the coil 103 is wound thereon as the longitudinal winding.

[0044] The holder 104 is made of conductive material, such as brass, and the top end portion thereof is calked to fix the bobbin 102. The other end 103b of the coil 103 is electrically connected to the top end of the holder 104 by hot welding, cold welding, and so on.

[0045] The pin-shaped male terminal 105 is made of conductive material, and formed as a tapered cylindrical shape (a needle shape) which top end is closed. Then, it is retained at the center of the holder 104 without any contact thereto by the isolate member 106.

[0046] The pipe-shaped male terminal 107 is made of conductive material, such as a metal plate which is of a specific thickness, and is formed cylindrical having an approximately rhomboid attachment flange 107a integrally at the top end. Further, a folded portion 107b is formed by folding the end edge portion inside. Then, the pipe-shaped male terminal 107 functions as the second

connector which is fitted to (the below-mentioned first connector 206 of) the thermo-couple unit 200.

[0047] The relation between the pipe-shaped male terminal 107 and the pin-shaped male terminal 105 is shown in Fig. 3. The pin-shaped male terminal 105 is disposed at the inside center of the pipe-shaped male terminal 107. The pipe-shaped male terminal 107 is formed to be longer than the pin-shaped male terminal by dimension L, so that the pin-shaped male terminal 105 does not project from the pipe-shaped male terminal 107.

[0048] With this structure, when the electromagnetic valve unit 100 is handled by itself, the pin-shaped male terminal does not directly contact anything, even if it drops or hits other parts. Therefore, bending, breakage and the like can be prevented.

[0049] Here, the pipe-shaped male terminal 107 is formed so that the thickness including the folded portion 107b is the same as the diameter of the pin-shaped male terminal 105. With this structure, the same parts can be used for both an inner female terminal 204 and an outer female terminal 205, which is described later.

[0050] As shown in Fig. 1 through 4, the thermo-couple unit 200 comprises a thermal sensitive portion 201 formed at the top end, a first cable 202 and a second cable 203 which are drawn from the thermal sensitive portion 201, the inner female terminal 204 which is connected to an end portion of the first cable 202 and constitutes one portion of a pair of female terminals, the outer female terminal 205 which is connected to an end portion of the second cable 203 and constitutes the other portion of the pair of female terminals, the first connector 206 to retain the inner female terminal and the outer female terminal 205, a seal member 207 to seal an end portion of the first connector 206, and so on.

[0051] Here, since the same part can be used for both the inner female terminal 204 and the outer female terminal 205, cost-reduction of the device can be obtained due to the commonality of parts.

[0052] As shown in Fig. 1 and Fig. 7 (a) (b), the thermal sensitive portion 201 comprises a pole-shaped conductive member 201a which is connected to the first cable 202, a pipe-shaped conductive member 201b which is disposed cylindrically around the pole-shaped conductive member 201a and connected to the pole-shaped conductive member 201a at the top end which is formed conical, a second pipe-shaped conductive member 201c which connects the pipe-shaped conductive member 201b to the first cable 203, and so on.

[0053] The pole-shaped conductive member 201a is made of alloy material of Ni, Cu and Mn, and forms a solid shape. The pipe-shaped conductive member 201b is made of alloy material of Ni, Cr and Fe, and the top end is formed conical and the bottom end is formed cylindrical. Here, the thickness at the conical region is thinner than that at the cylindrical region. Further, the outer diameter at the cylindrical region of the pipe-shaped conductive member 201b is smaller than that of the related art shown in Fig. 13. Furthermore, the second pipe-

shaped conductive member 201c is formed cylindrical with a diameter $\phi D1$ which is smaller than the diameter of the related art in Fig. 13 ($\phi D1 < \phi D$).

[0054] Then, as shown in Fig. 7 (b), a hot junction part P1 is formed at the top end region at which the pole-shaped conductive member 201a and the pipe-shaped conductive member 201b are connected, and a cold junction part P2, P3 is formed at a position which is apart from the hot junction part P1 toward the rear by a specific distance.

[0055] Here, the rear side of the pipe-shaped conductive member 201b, namely the cold junction part P2, is formed thicker than the warm junction P1. Therefore, even though the diameter of the pipe-shaped conductive member 201b is smaller than that of the related art, the same thermoelectric power characteristics and response can be maintained. In this manner, downsizing and cost-reduction can be achieved.

[0056] Further, at the connecting region of the pole-shaped conductive member 201a and the pipe-shaped conductive member 201b, the top end thin portion which outer diameter ϕd is the smallest is defined. The length L1 of the top end thin portion is formed at about 30 through 50 percent of the distance between the hot junction part P1 and the cold junction part P2. The dimension L1 is set to be longer than the dimension L of the related art shown in Fig. 13, and contributes to high thermoelectric power and quick response.

[0057] Here, as shown in Fig. 8 (a) (b), it is possible to adopt the pipe-shaped conductive member 201b' with the same diameter as the related art shown in Fig. 13, the second pipe-shaped conductive member 201c' with the same diameter ϕD as the related art, and the top end thin portion with the same diameter ϕd and the length L as the related art as another thermal sensitive portion 201', and to form the rear side of the pipe-shaped conductive member 201b', namely the cold junction part P2, thicker than the warm junction P1. In this case, with the same size as the related art, the thermoelectric power characteristics and response improve further.

[0058] As shown in Fig. 3, Fig. 4 and Fig. 6 (a) (b) (c) (d), the inner female terminal 204 has a pair of spring pieces 204a, 204a which is formed to be able to sandwich the pin-shaped male terminal 105 along the axis from both outer sides in the diameter direction of the circumference face. As shown in Fig. 6 (d), the pair of spring pieces 204a, 204a is respectively folded approximately in a V-shape, and has a pair of flexible pieces 204a', 204a' which can contact both sides of the circumference face of the pin-shaped male terminal 105 while facing each other.

[0059] Then, the pin-shaped male terminal 105 is free to be inserted and detached in the direction (the direction being perpendicular to the paper face of Fig.4 (a), (b)) which is approximately perpendicular to the deforming direction (the direction being horizontal to Fig.4 (a), (b)) of the pair of flexible pieces 204a', 204a'.

[0060] With this structure, since the contact pressure

between the pin-shaped male terminal 105 and the inner female terminal 204 acts approximately even in the insert and detach direction, the electrical contact can properly be obtained at a stable condition.

[0061] The outer female terminal 205 is formed as approximately the same shape as the inner female terminal 204. As shown in Fig. 3 and Fig. 4, the outer female terminal 205 has a pair of spring pieces 205a, 205a which is formed to be able to sandwich the wall face of the pipe-shaped male terminal 107 from both the inside and the outside. As shown in Fig. 4 (b), the pair of spring pieces 205a, 205a is respectively folded approximately in a V-shape, and has a pair of flexible pieces 205a', 205a' which can contact to both sides of the inner circumference and the outer circumference of the pipe-shaped male terminal 107 as facing each other.

[0062] Then, the pipe-shaped male terminal 107 is free to be inserted and detached in the direction (the direction being perpendicular to the paper face of Fig.4 (a), (b)) which is approximately perpendicular to the deforming direction (the direction being horizontal to Fig.4 (a), (b)) of the pair of flexible pieces 204a', 204a'.

[0063] With this structure, since the contact pressure between the pipe-shaped male terminal 107 and the outer female terminal 205 acts approximately even in the insert and detach direction, the electrical contact can properly be obtained at a stable condition.

[0064] As shown in Fig. 3 and Fig. 4, the first connector 206 comprises a fit portion 206a which is fitted to the inside of the pipe-shaped male terminal 107 to retain the inner female terminal 204, a sandwich piece 206b which retains the outer female terminal 205 in cooperation with the outer circumference of the fit portion 206a and which sandwiches the pipe-shaped male terminal 107 from the outside.

[0065] Further, the fit portion 206a is formed to include a deform portion 206a' which can elastically deform in the direction perpendicular to the fitting direction by forming an incision in the fitting direction at a part thereof. Then, as shown in Fig. 5, a pawl portion 206a" is integrally formed at the top end of the deform portion 206a' to latch with the folded portion 107b of the pipe-shaped male terminal 107.

[0066] In this construction, at the time of fitting the fit portion 206a to the pipe-shaped male terminal 107, after the fit portion 206a' is fitted to a specific position with the deform portion 206a' deforming to the inside, the deform portion 206a' elastically returns and the pawl portion 206a" disposed at the top end thereof is latched with the folded portion 107b of the pipe-shaped male terminal 107. Accordingly, the fitting operation of the fit portion 206a (the first connector 206) and the pipe-shaped male terminal (the second connector) 107 can easily be performed, and the unexpected detaching of the fit portion 206a from the pipe-shaped male terminal 107 can reliably be prevented.

[0067] In the abovementioned structure, the fit portion 206a' is formed approximately cylindrical being integral

with the deform portion 206a', so as to match with the pipe-shaped male terminal 107 as the second connector which shape is cylindrical. Accordingly, when the first connector 206 and the second connector (the pipe-shaped male terminal) 107 are fitted together, the fit portion 206a is fitted to the inside of the pipe-shaped male terminal 107. The pin-shaped male terminal 105 is fitted into and connected to the inner female terminal 204 which is surrounded by the fit portion 206a. The sandwich piece 206b sandwiches the pipe-shaped male terminal 107 in cooperation with the outer circumference of the fit portion 206a. Then, the pipe-shaped male terminal 107 is fitted into and connected to the outer female terminal 205 with which the inside face and the outside face of the pipe-shaped male terminal 107 contact. In this manner, the electrical contact can reliably be obtained.

[0068] In addition, since the pipe-shaped male terminal (the second connector) 107 and the fit portion 206a (the first connector 206) are fitted to be point symmetry around the axis, the first connector 206 and the second connector (the pipe-shaped male terminal) 107 can be fitted in the direction at any angle without caring the orientation. Therefore, the assembling operation can easily be performed.

[0069] The assembling process of the electromagnetic valve unit 100 and the thermo-couple unit 200 having the abovementioned structure is shown in Fig. 3. The pin-shaped male terminal 105 is positioned to face the inner female terminal 204, and both are brought close to each other. The fit portion 206a (and the deform portion 206a') of the first connector 206 is inserted to the pipe-shaped male terminal (the second connector) 107. After the fitting is performed with the deform portion 206a' deforming to the center side, the pawl portion 206a" is latched with the folded portion 107b. In this manner, the electromagnetic valve unit 100 and the thermo-couple unit 200 are reliably connected.

[0070] Further, at the same time of this fitting operation, the pin-shaped male terminal 105 is inserted to the inner female terminal 204 and is sandwiched by the pair of spring pieces 204a, 204a. Then, the pipe-shaped male terminal 107 is inserted to the outer female terminal 205, and sandwiched by the pair of spring pieces 205a, 205a at the inner circumference and the outer circumference. In this manner, the pair of male terminals (the pin-shaped male terminal and the pipe-shaped male terminal 107) and the pair of female terminals (the inner female terminal 204 and the outer female terminal 205) are electrically connected reliably.

[0071] Next, the operation when this gas burner safety device is utilized to a gas cooking stove system as shown in Fig. 11 is explained. First, an operating shaft 9 is pushed to introduce gas to a gas supply conduit 1 and an assist supply conduit 3, and a main burner 2 is lighted with a flame of a lighting burner 4. Then, the flame of the main burner heats the thermal sensitive portion 201 of the thermo-couple unit 200.

[0072] With this heating, thermoelectric power is gen-

erated at the thermo-couple unit 200. The electricity generated by the thermoelectric power flows in a coil 103 via the first cable 202 and the second cable 203, and the electromagnetic power is generated. Then, with this electromagnetic power, a movable core 110 is sucked to a fixed core 101, and the state that a valve body 111 keeps the gas passage opened is maintained.

[0073] On the contrary, when the flame of the main burner 2 is extinguished by blow-off, boil-spill or the like, the heating to the thermo-couple unit 200 is interrupted and the thermoelectric power, namely the electromagnetic force, is extinguished. Then, the valve body 111 is returned by a return spring 112 and the gas passage is closed. In this manner, emission of unburned gas is prevented.

[0074] Fig. 9 shows another embodiment of the gas burner safety device of the present invention. The same numerical is given to the same structure of the above-mentioned embodiment to omit explanation.

[0075] As shown in Fig. 9, in this device, a part of the electromagnetic valve unit 100' is modified from the above-mentioned embodiment. A pipe-shaped male terminal 107' is adopted as the second connector instead of the pipe-shaped male terminal 107 and the holder 104 shown in Fig. 2.

[0076] Specifically, a holder 107a' to retain the fixed core 101 and a bobbin 102 is integrally formed at the pipe-shaped male terminal 107'. A stepped portion 107b' for being latched with the pawl portion 206a" is formed at the inside of the cylindrical portion to which the fit portion 206a is fitted.

[0077] In this device, since the pipe-shaped male terminal 107' serves as the holder to retain the fixed core 101 as well as the second connector to be connected to the first connector 206 of the thermo-couple unit 200, the parts count can be reduced accordingly. Therefore, the device can be simplified in structure and can be downsized.

[0078] Fig. 10 further shows another embodiment of the gas burner safety device of the present invention. The same numerical is given to the same structure of the above mentioned embodiment to omit explanation.

[0079] As shown in Fig. 10, in this device, a part of the electromagnetic valve 100" is modified from the above-mentioned embodiment. A pipe-shaped male terminal 107" is adopted as the second connector instead of the pipe-shaped male terminal 107 shown in Fig. 2.

[0080] Specifically, a screw cap 107a" to be screwed to the gas supply conduit 1 etc, is formed at the pipe-shaped male terminal 107". A stepped portion 107b" for being latched with the pawl portion 206a" is formed inside the cylindrical portion to which the fit portion 206a is fitted.

[0081] In this device, the pipe-shaped male terminal 107" serves as the screw cap 107a" to be screwed to a screw portion of a piping etc. as well as the second connector to be connected to the first connector 206 of the thermo-couple unit 200. Therefore, by screwing the screw cap 107a" to a desired position (for example, the

gas supply passage) while grounding the pipe-shaped male terminal 107", the gas burner safety device can be fixed without using any separate fix member.

[0082] In the abovementioned embodiment, the pipe-shaped male terminal 107, 107', 107" as the second connector is formed cylindrical, and the fit portion 206a to form the first connector is formed approximately cylindrical. However, not limited to this structure, the pipe-shaped male terminal and the fit portion do not have to be circular, for example, rectangular. In this case, the device can also be brought down in width and in size. Further, the pair of male terminals and the pair of female terminals can reliably be connected.

[0083] In the abovementioned embodiment, the inner female terminal 204 and the outer female terminal 205 which constitute the pair of female terminals have the pair of spring pieces 204a, 204a, 205a, 205a, respectively. However, not limited to this structure, it is possible to adopt a structure with one spring piece respectively, or with three or more spring pieces respectively.

INDUSTRIAL APPLICABILITY

[0084] As mentioned above, with the gas burner safety device of the present invention, downsizing in width and in size, structure simplification, cost reduction, flexibility of the attaching angle when connecting, etc. can be obtained. Therefore, not limited to a gas cooking stove, the device can be adopted to a gas water heater and other gas applications, which need a system to dose the gas passage when the burning gas flame extinguishes unexpectedly.

Claims

1. A gas burner safety device, comprising:

a thermo-couple unit (200) having two terminals connected to a thermal sensitive portion (201; 201'); and
an electromagnetic valve unit (100; 100'; 100") having two terminals connected to a coil (103) for magnetizing and respectively connected to said two terminals of said thermo-couple unit (200), and a valve body (111) driven by electromagnetic force generated by powering to said coil (103);
wherein either two terminals of said thermo-couple unit (200) or said electromagnetic valve unit (100; 100'; 100") comprise a pipe-shaped male terminal (107) having at least an arc-shaped portion of a cylinder, and an inner male terminal (105) which is disposed inside said pipe-shaped male terminal (107); and
wherein the other two terminals of said thermo-couple unit (200) or said electromagnetic valve unit (100; 100'; 100") comprise an outer female

terminal (205) connected to at least one side of the inside and the outside of the wall face of said pipe-shaped male terminal (107), and an inner female terminal (204) which is disposed inside said pipe-shaped male terminal (107),

characterized in that the unit having two female terminals comprises a fit portion (206a) which retains said inner female terminal (204) and is fitted inside said pipe-shaped male terminal (107), and a sandwich piece (206b) which retains said outer female terminal (205) and sandwiches said pipe-shaped male terminal (107) from the outside in cooperation with the outer circumference of said fit portion (206a).

2. The gas burner safety device according to claim 1, wherein said inner female terminal (204) has a pair of spring pieces (204a) which can sandwich said inner male terminal (105), and said outer female terminal (205) has a pair of spring pieces (205a) which can sandwich the wall face of said pipe-shaped male terminal (107) both from the inside and the outside.
3. The gas burner safety device according to claim 2, wherein said inner female terminal (204) and said outer female terminal (205) are folded approximately in a V-shape to have a flexible piece, and said pipe-shaped male terminal (107) and said inner male terminal (105) are inserted and detached in the direction approximately perpendicular to the deforming direction of said flexible piece.
4. The gas burner safety device according to claim 1, wherein said pipe-shaped male terminal (107) is formed longer than the terminal disposed inside said pipe-shaped male terminal (107).
5. The gas burner safety device according to claim 1, wherein the thickness of said pipe-shaped male terminal (107) is the same dimension as the outer diameter of said inner male terminal (105).
6. The gas burner safety device according to claim 1, wherein said pipe-shaped male terminal (107) is formed with almost even thickness and said fit portion (206a) is formed approximately cylindrical to match with said pipe-shaped male terminal (107).
7. The gas burner safety device according to claim 1, wherein said pipe-shaped male terminal (107) has a folded portion (107b) which top end portion is folded inside, and said fit portion (206a) has a pawl portion (206a") for latching with said folded portion (107b).
8. The gas burner safety device according to claim 7, wherein said fit portion (206a) has a deform portion (206a') which can elastically deform in the direction

perpendicular to the direction of fitting to said pipe-shaped male terminal (107), and said pawl portion (206a") is formed at the top end of said deform portion (206a').

9. The gas burner safety device according to claim 1, wherein said pipe-shaped male terminal (107) integrally has an attachment flange (107a) for fixing said electromagnetic valve unit (100) at a desired position.
10. The gas burner safety device according to claim 1, wherein said pipe-shaped male terminal (107) integrally has a screw cap (107a") for fixing said electromagnetic valve unit (100) at a desired position.
11. The gas burner safety device according to claim 1, wherein said electromagnetic valve unit (100) has a movable core (110) which is integrally movable with said valve body (111) and a fixed core (101) on which said coil (103) is wound, and said pipe-shaped male terminal (107) integrally has a holder (104) for retaining said fixed core (101).

Patentansprüche

1. Gasbrenner-Sicherheitsvorrichtung, aufweisend:

eine Thermoelementeinheit (200), die zwei Terminals bzw. Anschlüsse hat, die mit einem thermisch empfindlichen Abschnitt (201; 201') verbunden sind; und

eine elektromagnetische Ventileinheit (100; 100'; 100"), die zwei Terminals bzw. Anschlüsse hat, die mit einer Spule (103) zum Magnetisieren verbunden sind, und jeweils mit den zwei Terminals bzw. Anschlüssen von der Thermoelementeinheit (200) verbunden sind, und einen Ventilkörper (111) hat, der durch elektromagnetische Kraft angetrieben wird, die durch Antreiben bzw. mit Energieversorgung der Spule (103) erzeugt wird;

wobei entweder zwei Terminals bzw. Anschlüsse von der Thermoelementeinheit (200) oder der elektromagnetischen Ventileinheit (100; 100'; 100") einen rohrförmigen männlichen Terminal bzw. Anschluss (107) aufweisen, der wenigstens einen bogenförmigen Abschnitt von einem Zylinder hat, und einen inneren männlichen Terminal bzw. Anschluss (105) aufweisen, welcher innerhalb des rohrförmigen männlichen Terminals bzw. Anschlusses (107) angeordnet ist; und

wobei die anderen zwei Terminals bzw. Anschlüsse von der Thermoelementeinheit (200) oder der elektromagnetischen Ventileinheit (100; 100'; 100") einen äußeren weiblichen Ter-

minal bzw. Anschluss (205) aufweisen, der mit wenigstens einer Seite von der Innenseite und der Außenseite von der Wandfläche von dem rohrförmigen männlichen Terminal bzw. Anschluss (107) verbunden ist, und einen inneren weiblichen Terminal bzw. Anschluss (204) aufweisen, welcher innerhalb des rohrförmigen männlichen Terminals bzw. Anschlusses (107) angeordnet ist,

dadurch gekennzeichnet, dass die Einheit, die zwei weibliche Terminals bzw. Anschlüsse hat, einen Einfügungs- bzw. Passabschnitt (206a) aufweist, welcher den inneren weiblichen Terminal bzw. Anschluss (204) hält und innerhalb des rohrförmigen männlichen Terminals bzw. Anschlusses (107) eingefügt ist, und einen Sandwich-Teil (206b) aufweist, welcher den äußeren weiblichen Terminal bzw. Anschluss (205) hält und den rohrförmigen männlichen Terminal bzw. Anschluss (107) von der Außenseite einlegt bzw. dazwischen legt, und zwar in Kooperation mit der äußeren Peripherie bzw. dem äußeren Umfang von dem Einfügungs- bzw. Passabschnitt (206a).

2. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei der innere weibliche Terminal bzw. Anschluss (204) ein Paar von Federteilen (204a) hat, welche den inneren männlichen Terminal bzw. Anschluss (105) einlegen bzw. dazwischen legen können, und wobei der äußere weibliche Terminal bzw. Anschluss (205) ein Paar von Federteilen (205a) hat, welche die Wandfläche von dem rohrförmigen männlichen Terminal bzw. Anschluss (107) einlegen bzw. dazwischen legen können, und zwar sowohl von der Innenseite als auch der Außenseite.
3. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 2, wobei der innere weibliche Terminal bzw. Anschluss (204) und der äußere weibliche Terminal bzw. Anschluss (205) annähernd in einer V-Form umgebogen bzw. abgekantet sind, um einen flexiblen Teil zu haben, und wobei der rohrförmige männliche Terminal bzw. Anschluss (107) und der innere männliche Terminal bzw. Anschluss (105) in der Richtung annähernd senkrecht zu der Verformungsrichtung von dem flexiblen Teil eingefügt und abgenommen werden.
4. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei der rohrförmige männliche Terminal bzw. Anschluss (107) länger als der Terminal bzw. Anschluss gebildet ist, der innerhalb des rohrförmigen männlichen Terminals bzw. Anschlusses (107) angeordnet ist.
5. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei die Dicke von dem rohrförmigen

männlichen Terminal bzw. Anschluss (107) dieselbe Dimension ist wie der Außendurchmesser von dem inneren männlichen Terminal bzw. Anschluss (105).

6. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei der rohrförmige männliche Terminal bzw. Anschluss (107) mit nahezu ausgeglichener Dicke gebildet ist und der Einfügungs- bzw. Passabschnitt (206a) annähernd zylindrisch gebildet ist, um mit dem rohrförmigen männlichen Terminal bzw. Anschluss (107) zusammenzupassen.
7. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei der rohrförmige männliche Terminal bzw. Anschluss (107) einen umgebogenen bzw. abgekanteten Abschnitt (107b) hat, von welchem der obere Endabschnitt nach innen umgebogen bzw. abgekantet ist, und wobei der Einfügungs- bzw. Passabschnitt (206a) einen Klinken- bzw. Klauenabschnitt (206a") zum Einrasten bzw. Einklinken mit dem umgebogenen bzw. abgekanteten Abschnitt (107b) hat.
8. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 7, wobei der Einfügungs- bzw. Passabschnitt (206a) einen Verformungsabschnitt (206a') hat, welcher sich elastisch in der Richtung senkrecht zu der Richtung des Einfügens bzw. Einpassens in den rohrförmigen männlichen Terminal (107) verformen kann, und wobei der Klinken- bzw. Klauenabschnitt (206a") an dem oberen Ende von dem Verformungsabschnitt (206a') gebildet ist.
9. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei der rohrförmige männliche Terminal bzw. Anschluss (107) integral bzw. integriert einen Anbringungsflansch (107a) zum Fixieren bzw. Befestigen der elektromagnetischen Ventileinheit (100) in einer gewünschten Position hat.
10. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei der rohrförmige männliche Terminal bzw. Anschluss (107) integral bzw. integriert eine Schraubkappe (107a") zum Fixieren bzw. Befestigen der elektromagnetischen Ventileinheit (100) in einer gewünschten Position hat.
11. Gasbrenner-Sicherheitsvorrichtung gemäß Anspruch 1, wobei die elektromagnetische Ventileinheit (100) einen bewegbaren Kern (110) hat, welcher zusammen bzw. integriert mit dem Ventilkörper (111) bewegbar ist und einen fixierten bzw. feststehenden Kern (101) hat, auf welchen die Spule (103) gewickelt bzw. gewunden ist, und wobei der rohrförmige männliche Terminal bzw. Anschluss (107) integral bzw. integriert eine Halteeinrichtung (104) zum Halten des fixierten bzw. feststehenden Kerns (101) hat.

Revendications

1. Dispositif de sécurité de brûleur à gaz, comprenant :

une unité de thermo-couple (200) ayant deux extrémités connectées à une partie thermosensible (201 ; 201') ; et
 une unité de vanne électromagnétique (100 ; 100' ; 100'') ayant deux extrémités connectées à une bobine (103) de magnétisation et respectivement connectées auxdites deux extrémités de ladite unité de thermo-couple (200), et un corps de vanne (111) entraîné par une force électromagnétique générée par l'alimentation dudit rouleau (103) ;
 les deux extrémités de ladite unité de thermo-couple (200) ou de ladite unité de vanne électromagnétique (100 ; 100' ; 100'') comprenant une extrémité mâle de forme tubulaire (107) ayant au moins une partie en arc de cercle d'un cylindre, et une extrémité mâle interne (105) disposée à l'intérieur de ladite extrémité mâle de forme tubulaire (107) ; et
 les deux autres extrémités de ladite unité de thermo-couple (200) ou de ladite unité de vanne électromagnétique (100 ; 100' ; 100'') comprenant une extrémité femelle extérieure (205) connectée à au moins un côté de l'intérieur et de l'extérieur de la face de paroi de ladite extrémité mâle de forme tubulaire (107), et une extrémité femelle interne (204) disposée à l'intérieur de ladite extrémité mâle de forme tubulaire (107).

caractérisé en ce que l'unité ayant deux extrémités femelles comprend une partie de fixation (206a) qui retient ladite extrémité femelle interne (204) et est montée à l'intérieur de ladite extrémité mâle de forme tubulaire (107), et une pièce en sandwich (206b) qui retient ladite extrémité femelle externe (205) et prend en sandwich ladite extrémité mâle de forme tubulaire (107) depuis l'extérieur en coopération avec la circonférence externe de ladite partie de fixation (206a).

2. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite extrémité femelle interne (204) a une paire de pièces à ressort (204a) qui peuvent prendre en sandwich ladite extrémité mâle interne (105), et ladite extrémité femelle externe (205) a une paire de pièces à ressort (205a) qui peuvent prendre en sandwich la face de paroi de ladite extrémité mâle de forme tubulaire (107) à la fois depuis l'intérieur et depuis l'extérieur.

3. Dispositif de sécurité de brûleur à gaz selon la revendication 2, dans lequel ladite extrémité femelle interne (204) et ladite extrémité femelle externe (205) sont pliées approximativement en V pour avoir

une pièce flexible, et ladite extrémité mâle de forme tubulaire (107) et ladite extrémité mâle interne (105) sont insérées et détachées dans la direction approximativement perpendiculaire à la direction de déformation de ladite pièce flexible.

4. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite extrémité mâle de forme tubulaire (107) est plus longue que l'extrémité disposée à l'intérieur de ladite extrémité mâle de forme tubulaire (107).

5. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel l'épaisseur de ladite extrémité mâle de forme tubulaire (107) possède les mêmes dimensions que le diamètre externe de ladite extrémité mâle interne (105).

6. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite extrémité mâle de forme tubulaire (107) est formée avec une épaisseur presque homogène et ladite partie de fixation (206a) est formée de manière approximativement cylindrique pour correspondre à ladite extrémité mâle de forme tubulaire (107).

7. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite extrémité mâle de forme tubulaire (107) a une partie repliée (107b) dont la partie d'extrémité supérieure est repliée à l'intérieur, et ladite partie de fixation (206a) a une partie de cliquet (206a'') pour verrouiller ladite partie pliée (107b).

8. Dispositif de sécurité de brûleur à gaz selon la revendication 7, dans lequel ladite partie de fixation (206a) a une partie déformable (206a') qui peut se déformer élastiquement dans la direction perpendiculaire à la direction de montage de ladite extrémité mâle de forme tubulaire (107), et ladite partie de cliquet (206a'') est formée à l'extrémité supérieure de ladite partie déformable (206a').

9. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite extrémité mâle de forme tubulaire (107) a une bride de fixation intégrée (107a) pour fixer ladite unité de vanne électromagnétique (100) à une position souhaitée.

10. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite extrémité mâle de forme tubulaire (107) a un bouchon à vis intégré (107a'') pour fixer ladite unité de vanne électromagnétique (100) à une position souhaitée.

11. Dispositif de sécurité de brûleur à gaz selon la revendication 1, dans lequel ladite unité de vanne électromagnétique (100) a un noyau mobile (110) qui est

solidairement mobile avec ledit corps de vanne (111) et un noyau fixe (101) sur lequel ladite bobine (103) est enroulée, et ladite extrémité mâle de forme tubulaire (107) a un support intégré (104) pour retenir ledit noyau fixe (101).

5

10

15

20

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30

35

40

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50

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FIG. 1

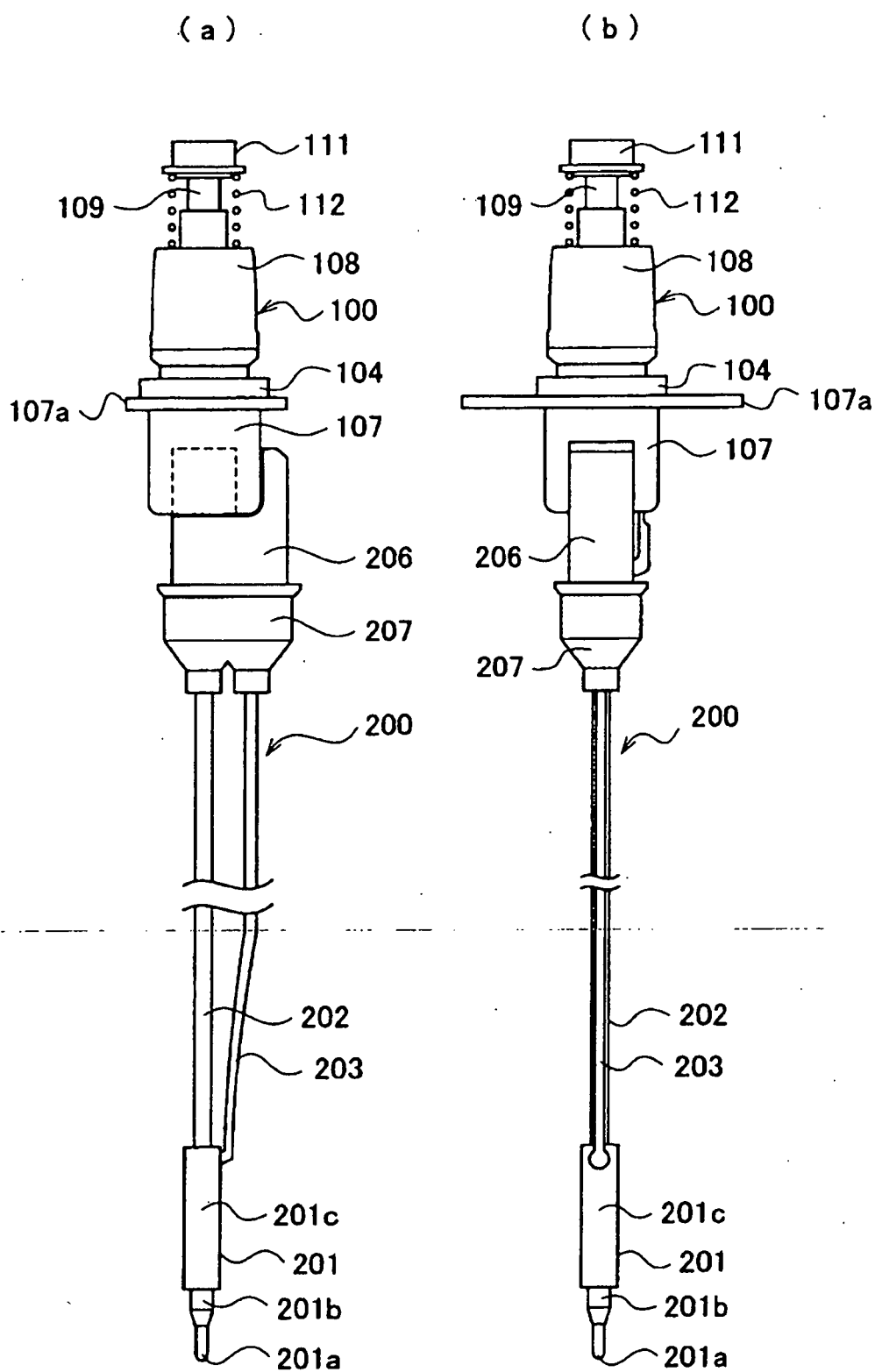


FIG. 2

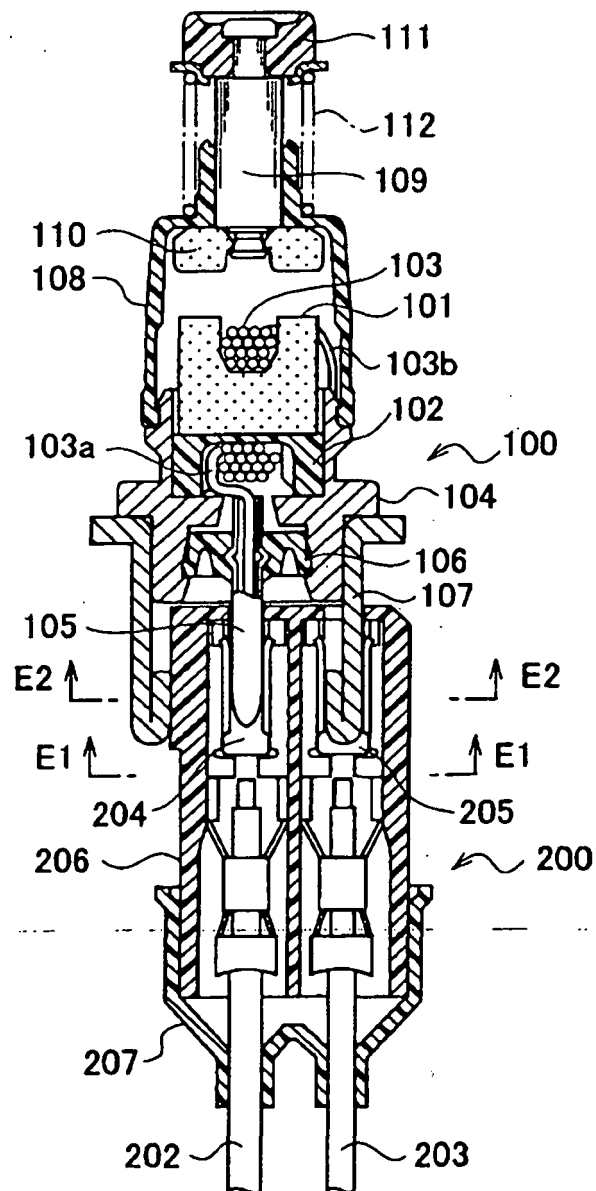


FIG.3

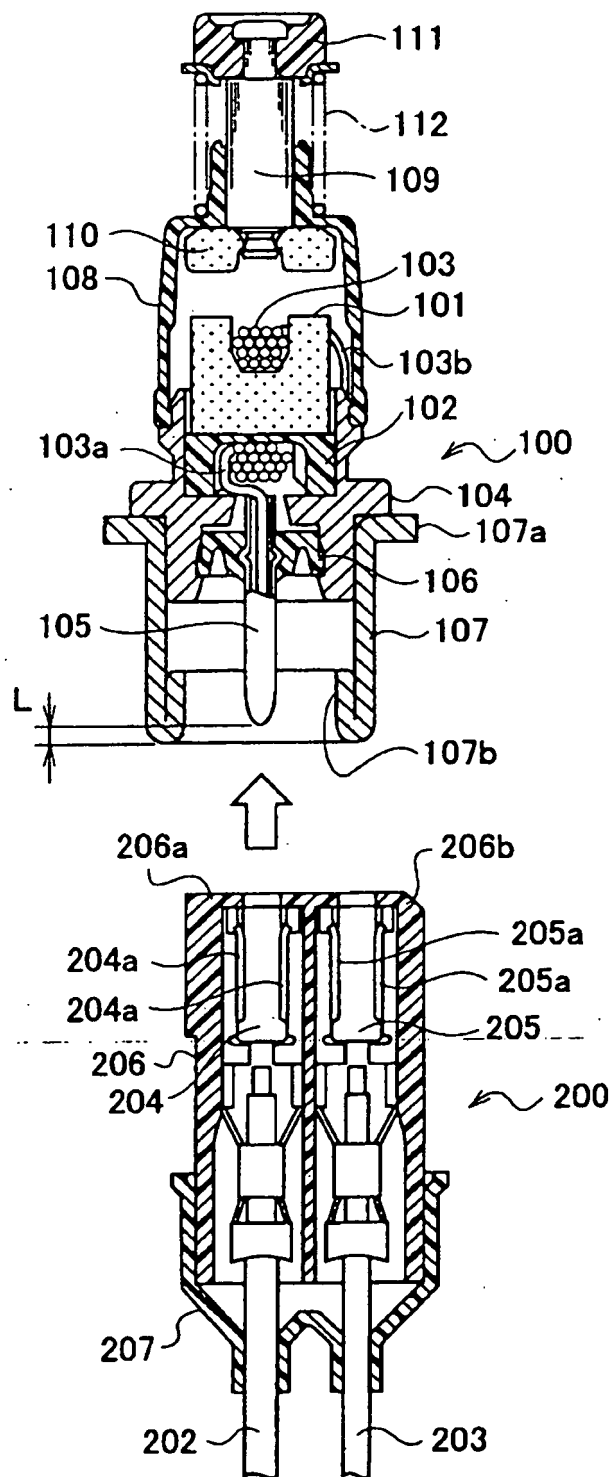


FIG.4

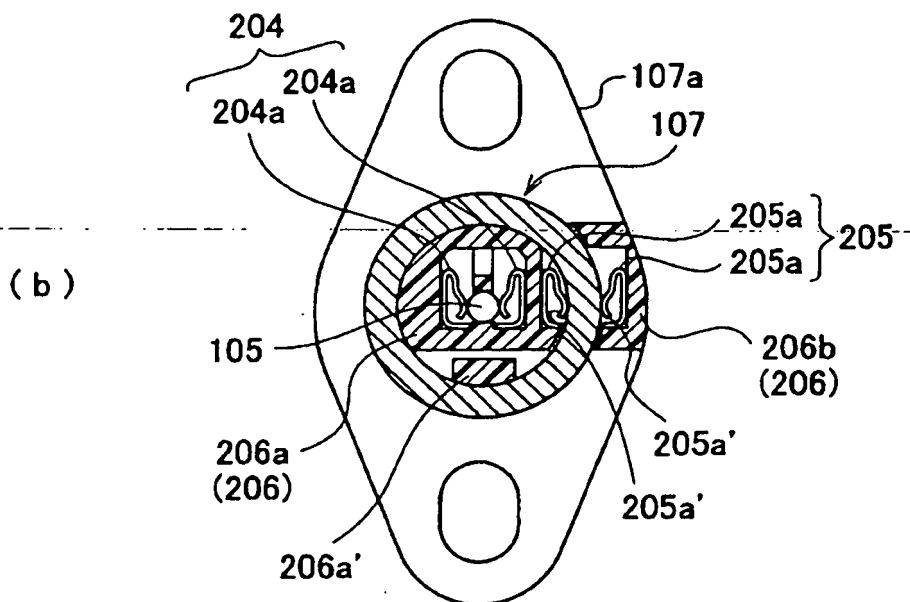
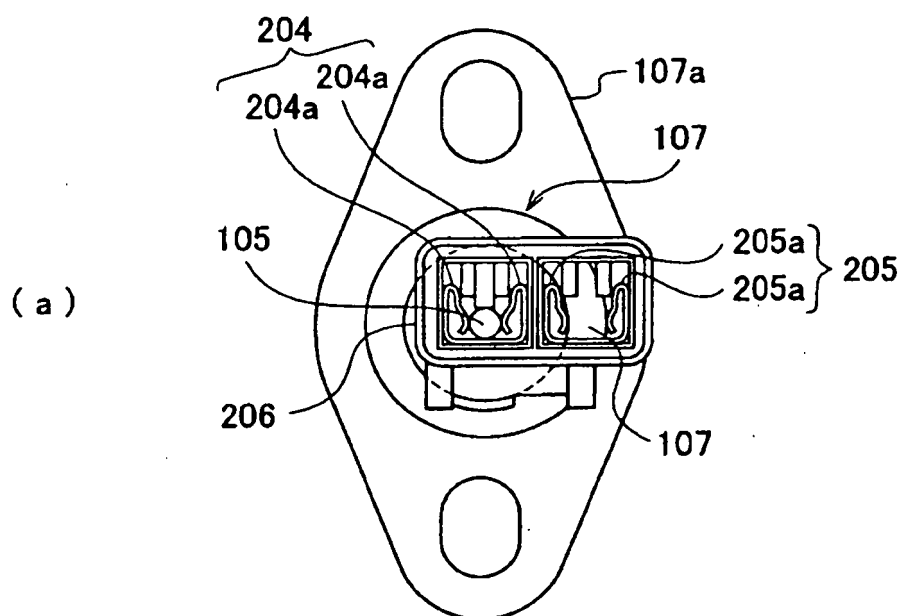


FIG.5

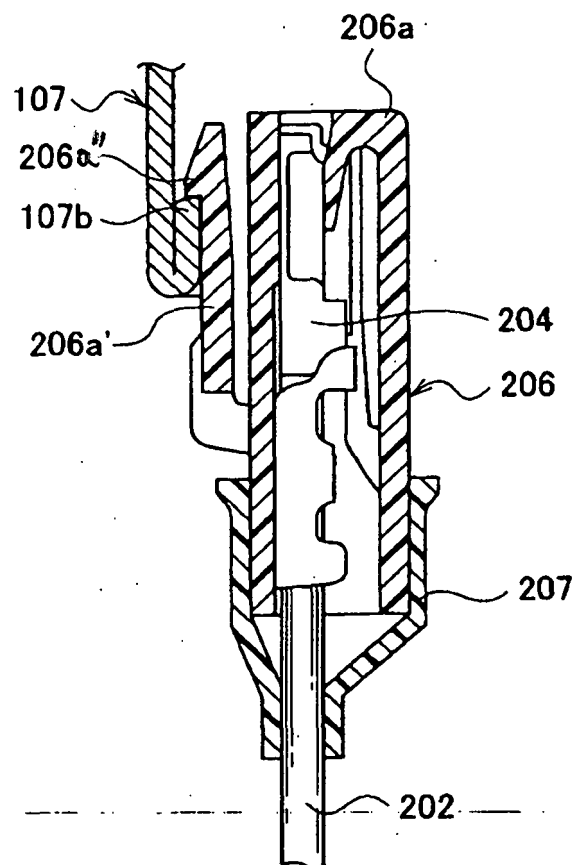


FIG. 6

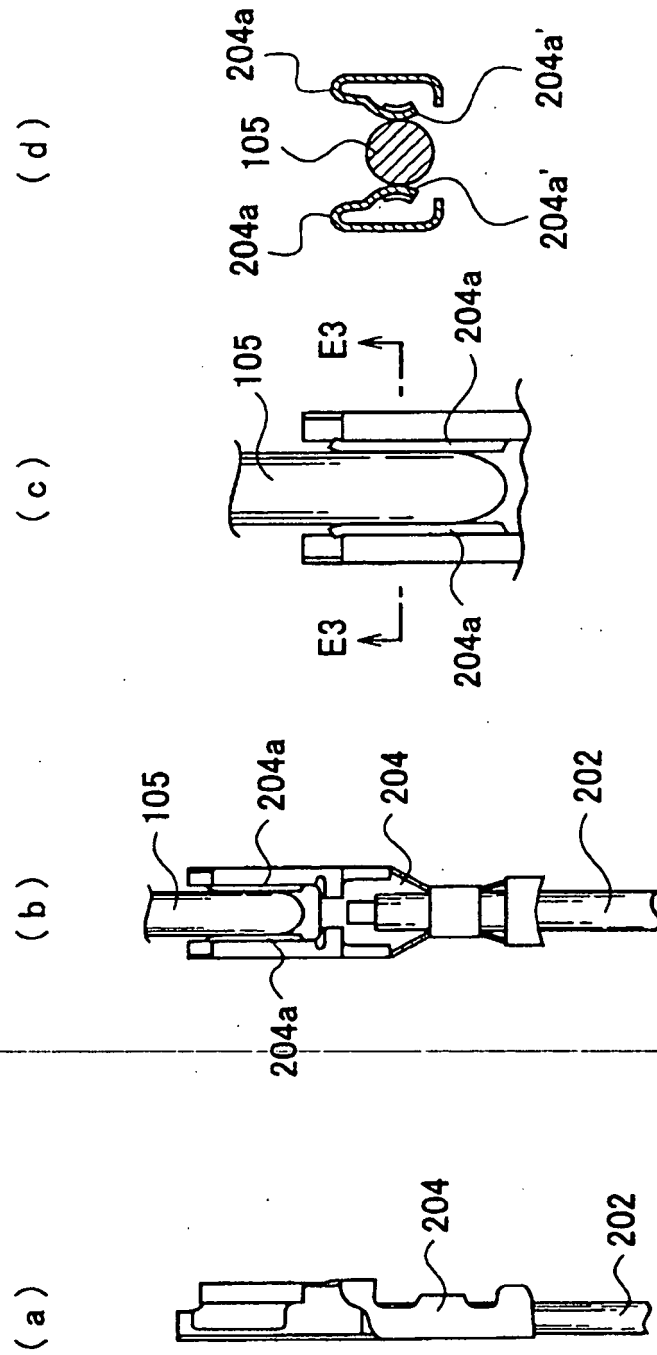
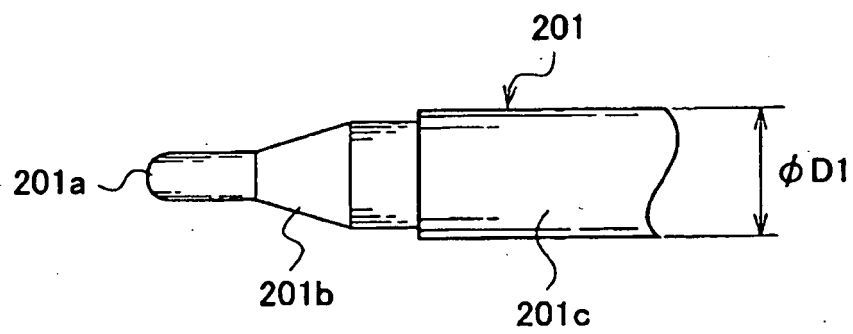


FIG.7

(a)



(b)

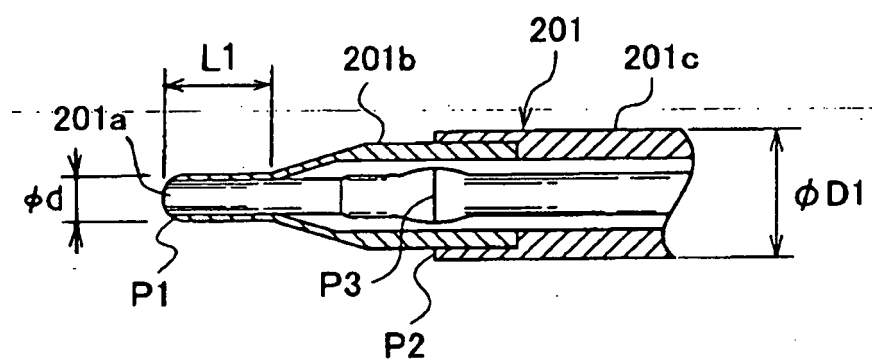
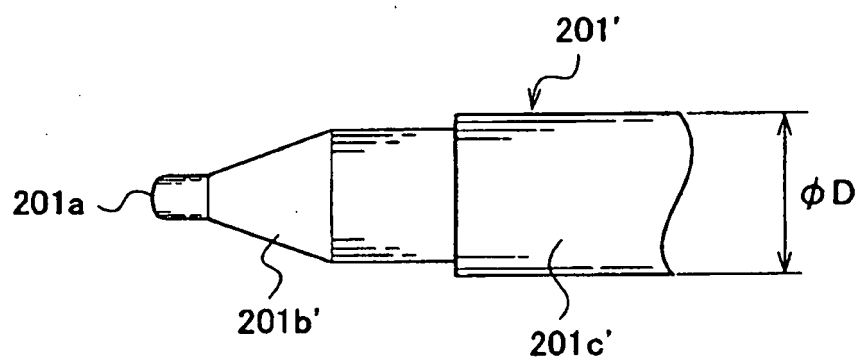


FIG.8

(a)



(b)

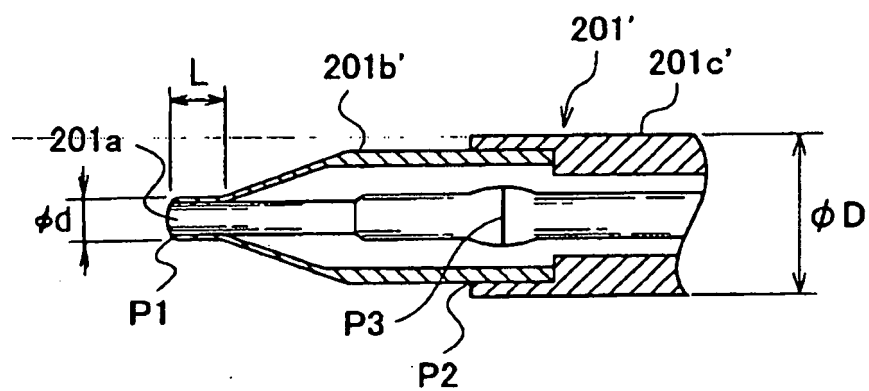


FIG.9

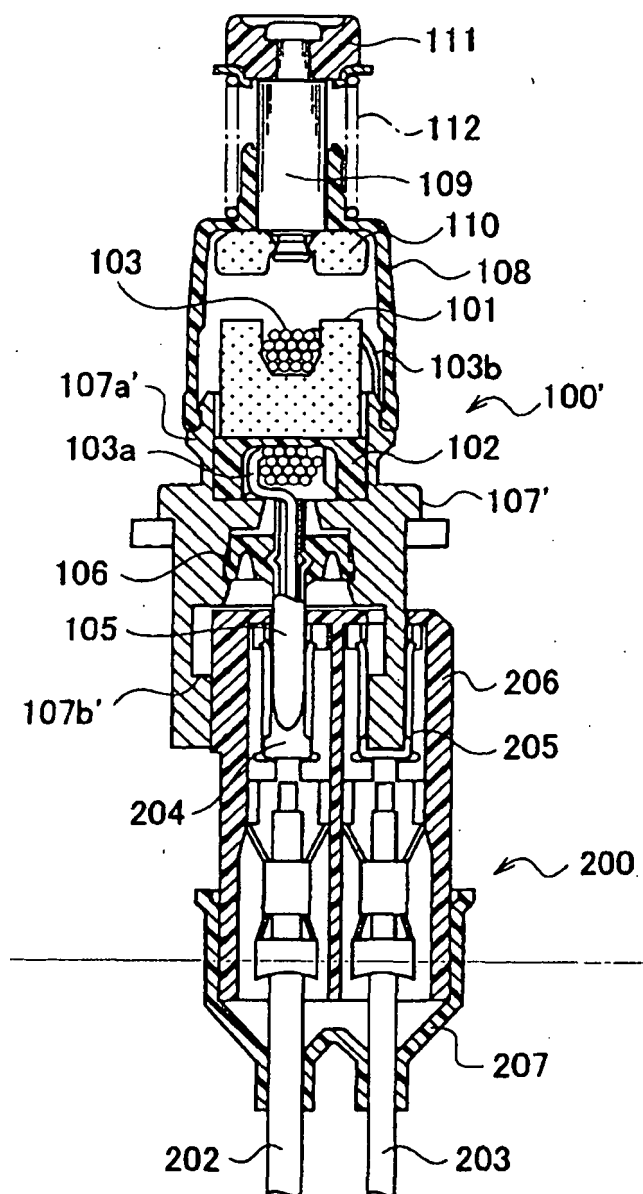


FIG. 10

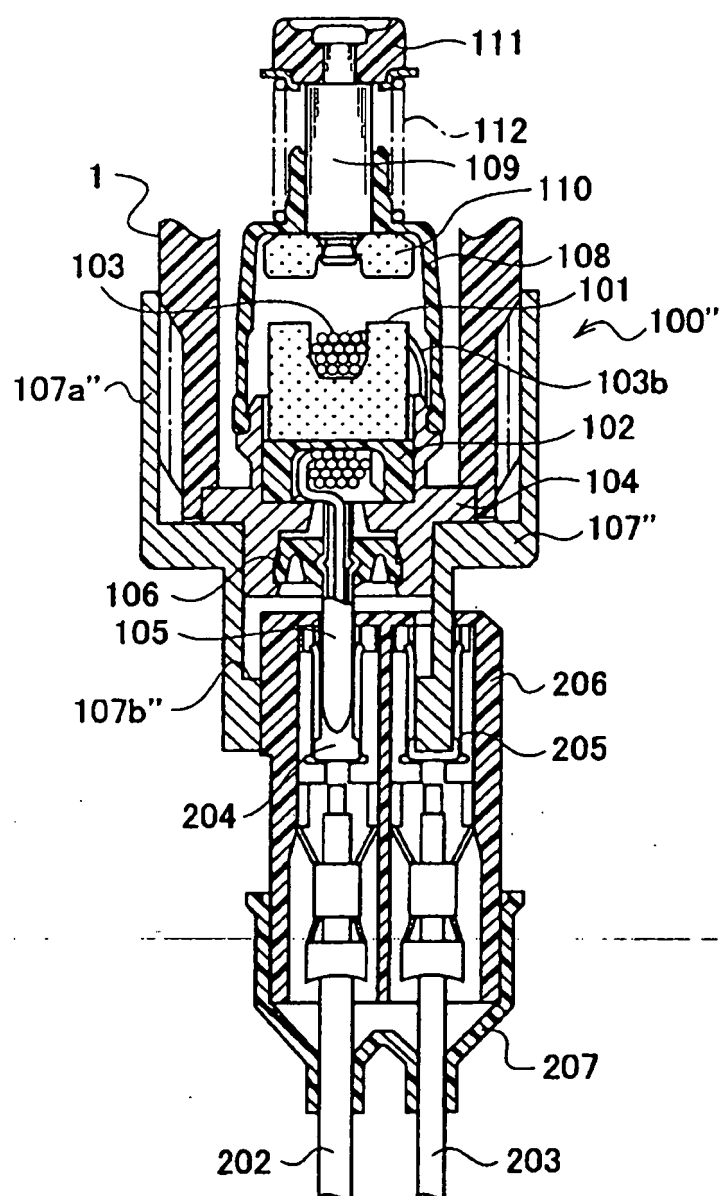


FIG. 11

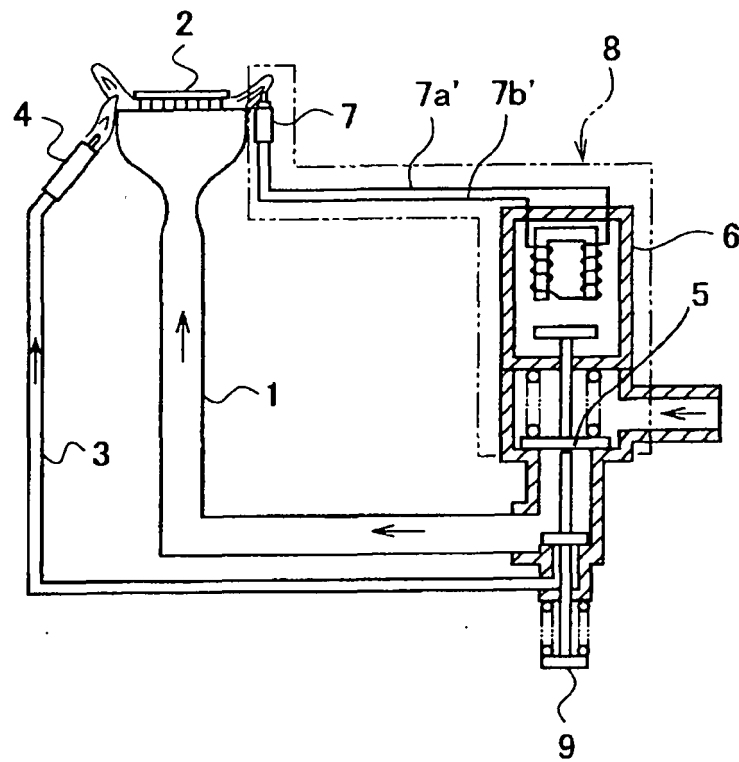


FIG.12

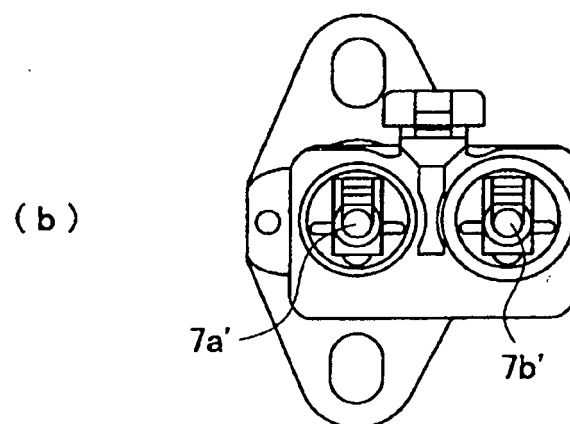
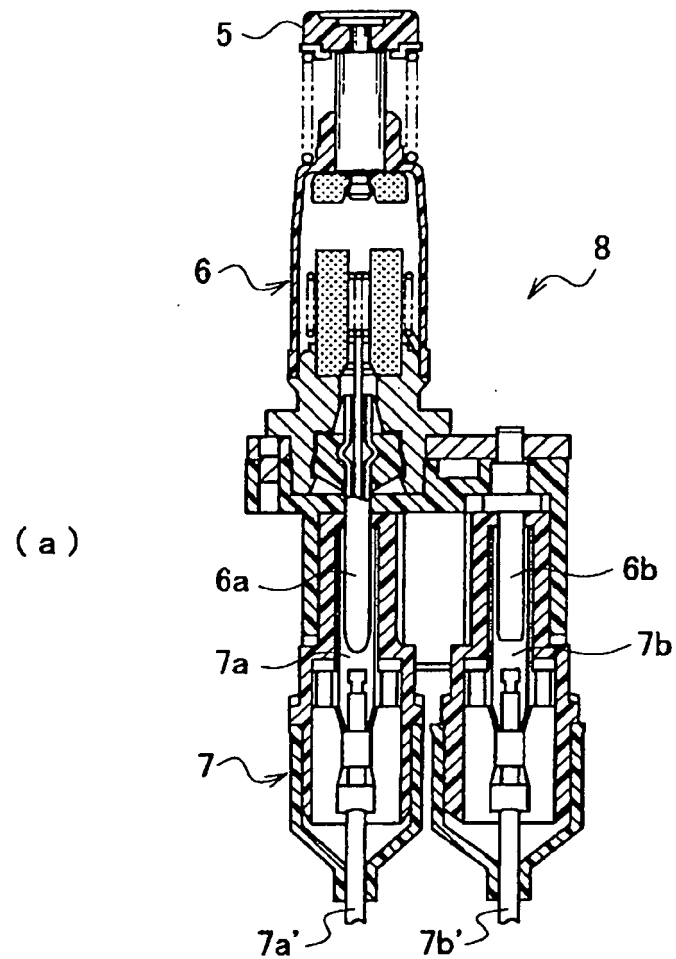
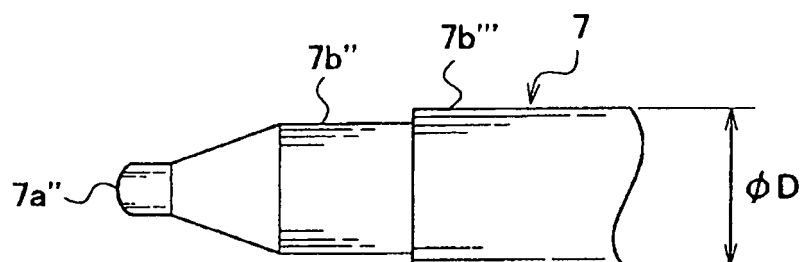
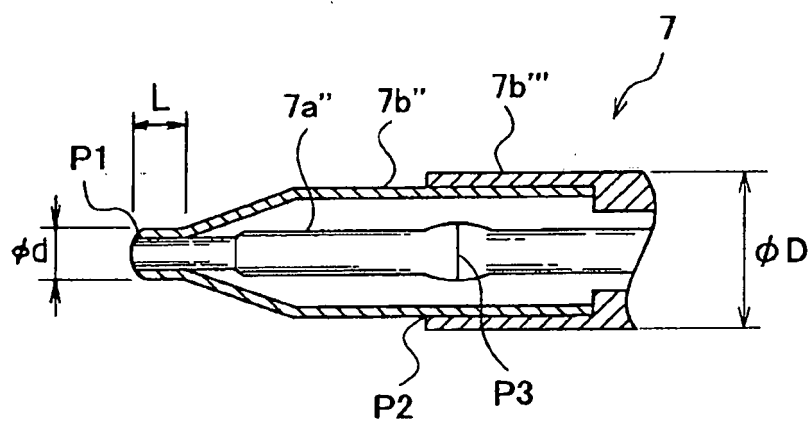


FIG. 13

(a)



(b)



REFERENCES CITED IN THE DESCRIPTION

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