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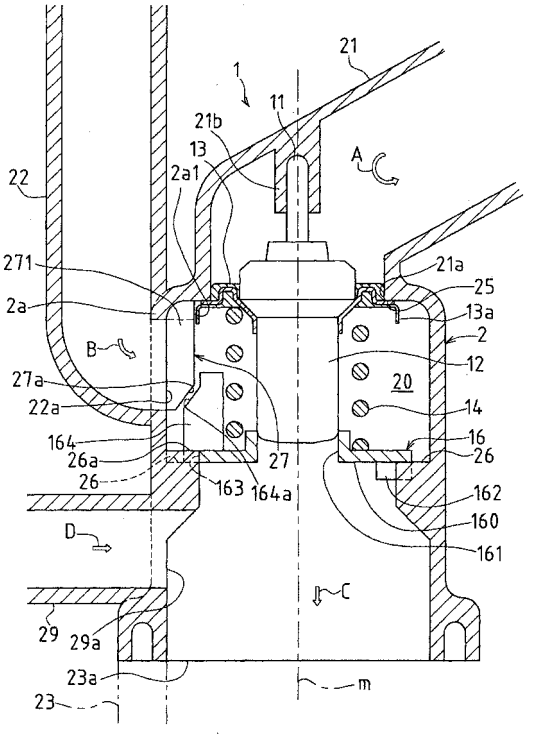
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(54) THERMOSTAT DEVICE

(57) In a thermostat device that operates a valve body to open and close pursuant to a temperature sensitive movable portion that moves due to a change in cooling water temperature of a mixing chamber of a valve housing, a high-temperature cooling water inlet that introduces high-temperature cooling water from a bypass path that has been heated by an engine and has bypassed a radiator is provided at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and a heater path inlet that introduces cooling water from a heater path that has been supplied to a heater core is provided at a lower end portion of the valve housing. The high-temperature cooling water inlet is provided with a plurality of guide portions protruding from the right and left sides of the inlet along the lower face of a cut-off portion toward the temperature sensitive movable portion, and the high-temperature cooling water introduced from the high-temperature cooling water inlet by the guide portions is guided toward the temperature sensitive movable portion.

FIG.1



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Description

THERMOSTAT DEVICE

[Technical Field]

[0001] The present invention relates to a thermostat device that automatically controls cooling water that cools an internal combustion engine provided in an automobile or the like, and more particularly to a housing-integrated type thermostat device that is incorporated in a valve housing through which cooling water flows.

[Background Art]

[0002] Generally, in an internal combustion engine (hereinafter referred to as an "engine") used in an automobile or the like, in order to cool the engine, a water-cooled cooling system including, for example, a cooling portion such as a heat exchanger (hereinafter referred to as a "radiator") for cooling the cooling water from the engine is used. In order to control the temperature of cooling water introduced into the engine, this type of cooling system includes, for example, a thermostat equipped with a valve body that adjusts the amount of cooling water introduced from the radiator side in accordance with the movement of a temperature sensitive movable portion.

[0003] Specifically, such a thermostat including a temperature sensitive movable portion and a valve body is built in, for example, a valve housing through which cooling water flows on the engine's inlet side, and is configured to close the valve body to allow cooling water to circulate via a bypass path without passing through the radiator when the temperature of cooling water in the valve housing is low, and to open the valve body to introduce cooling water from the radiator into the valve housing when the temperature of cooling water in the valve housing is high, so that the cooling water temperature can be controlled to a desired condition.

[0004] The opening and closing operation of the valve body that controls the amount of cooling water introduced from the radiator is dependent on the temperature sensitivity of the temperature sensitive movable portion that moves by sensing the temperature of cooling water in the valve housing where low-temperature cooling water from the radiator and high-temperature cooling water from the bypass path are mixed. Because the rotational speed of the engine varies sequentially according to the operating conditions, the amount of high-temperature cooling water from the bypass path introduced into the valve housing also varies. For this reason, it is difficult to sufficiently mix the high-temperature cooling water whose amount introduced from the bypass path sequentially varies with the low-temperature cooling water from the radiator in the valve housing, and the temperature sensitivity of the temperature sensitive movable portion to the cooling water temperature decreases.

[0005] To address this, conventionally, a thermostat device is known in which a substantially tubular guide portion that surrounds the temperature sensitive movable portion from the outside is provided at the inlet of the bypass path so that the high-temperature cooling water from the bypass path can be guided to the temperature sensitive movable portion by the guide portion and the temperature sensitive movable portion can sense the high-temperature cooling water, without sensing the temperature of cooling water resulting from mixing the high-temperature cooling water from the bypass path and the low-temperature cooling water from the radiator in the valve housing, thereby increasing the temperature sensitivity of the temperature sensitive movable portion to the temperature of cooling water in the valve housing (see, for example, Patent Literature 1).

[PTL 1]

[Summary of Invention]

[Technical Problem]

[0006] However, with the conventional thermostat device, a heater path inlet portion that introduces cooling water from a heater path supplied from a heater core is open at a side position of the valve housing that is substantially orthogonal to the direction in which the temperature sensitive movable portion moves. Accordingly, the cooling water from the heater path inlet portion that is open at the side position of the valve housing is easily guided to the temperature sensitive movable portion, and due to the problem that cooling water is not sufficiently mixed in the valve housing as described above, there is a possibility that the cooling water from the heater path inlet portion might be guided to the temperature sensitive movable portion without being sufficiently mixed with the high-temperature cooling water from the bypass path, decreasing the temperature sensitivity of the temperature sensitive movable portion to the cooling water temperature. In addition, as with the high-temperature cooling water introduced from the bypass path, the amount of cooling water from the heater path inlet portion introduced into the valve housing varies sequentially according to variations in the rotational speed of the engine. Accordingly, if a large amount of cooling water introduced from the heater path inlet portion is guided to the temperature sensitive movable portion without being sufficiently mixed with the high-temperature cooling water from the bypass path, the temperature sensitivity of the temperature sensitive movable portion to the cooling water temperature decreases due to the large amount of cooling water introduced from the heater path inlet portion.

[0007] The present invention has been conceived in view of the above problems, and it is an object of the present invention to provide a thermostat device in which the temperature sensitivity of the temperature sensitive movable portion to the temperature of cooling water in

the valve housing can be improved.

[Solution to Problem]

[0008] In order to achieve the above object, the present invention is premised on a thermostat device that is incorporated in a valve housing through which cooling water from an engine (internal combustion engine) flows, that has a temperature sensitive movable portion that moves due to a change in cooling water temperature, and that is configured to control a temperature of cooling water introduced into the engine by operating a valve body to open and close with respect to a valve seat formed in the valve housing together with movement of the temperature sensitive movable portion. In the thermostat device according to the present invention, an inlet that introduces cooling water from a bypass path that has been heated by the engine and has bypassed a radiator (cooling portion) is provided at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and a heater path inlet portion that introduces cooling water from a heater path that has been supplied to a heater core is provided on a side of the valve housing that is located further to an opening direction side of the valve body than the temperature sensitive movable portion, and the inlet includes a guide portion that guides cooling water introduced from the inlet toward the temperature sensitive movable portion.

[0009] According to the specific matter of the thermostat device of the present invention, the cooling water from the bypass path that has been heated by the engine and has bypassed the radiator can be introduced from the inlet that is open at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and guided toward the temperature sensitive movable portion by the guide portion provided in the inlet.

[0010] In this case, because the heater path inlet portion that introduces cooling water from the heater path is provided on a side of the valve housing that is located further to an opening direction side of the valve body than the temperature sensitive movable portion, even when the amount of cooling water from the heater path that is introduced from the heater path inlet portion varies sequentially according to variations in the rotational speed of the engine, the cooling water from the heater path inlet portion is not guided to the temperature sensitive movable portion. Accordingly, only the cooling water from the bypass path that is introduced from the inlet can be efficiently guided to the temperature sensitive movable portion, and the temperature sensitivity of the temperature sensitive movable portion to the cooling water temperature can be improved.

[0011] Another solving means conceived to achieve the above object is also premised on a thermostat device that is incorporated in a valve housing through which cooling water from an engine flows, that has a temperature sensitive movable portion that moves due to a change in cooling water temperature, and that operates a valve body to open and close with respect to a valve seat formed in the valve housing together with movement of the temperature sensitive movable portion. In the thermostat device, an inlet that introduces cooling water from a bypass path in which cooling water that has been heated by the engine and has bypassed the radiator and cooling water that has been supplied to a heater core are mixed is provided at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and the inlet includes a guide portion that guides cooling water introduced from the inlet toward the temperature sensitive movable portion.

[0012] According to the specific matter of the thermostat device of the present invention, the cooling water that has been heated by the engine and has bypassed the radiator and the cooling water that has been supplied to the heater core can be mixed in the bypass path, then introduced from the inlet that is open at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and guided toward the temperature sensitive movable portion by the guide portion provided in the inlet.

[0013] Accordingly, even if the amount of cooling water supplied to the heater core varies sequentially according to variations in the rotational speed of the engine, the cooling water can be mixed sufficiently with the cooling water that has bypassed the radiator in the bypass path 22 and efficiently guided from the inlet to the temperature sensitive movable portion. This prevents the cooling water supplied to the heater core from being guided to the temperature sensitive movable portion without being sufficiently mixed, and only the cooling water from the bypass path introduced from the inlet is efficiently guided to the temperature sensitive movable portion, and thus it is possible to improve the temperature sensitivity of the temperature sensitive movable portion to the cooling water temperature.

[0014] Furthermore, because the cooling water in which the cooling water that has been supplied to the heater core and the cooling water that has bypassed the radiator are sufficiently mixed is guided to the temperature sensitive movable portion from the bypass path via the inlet, the temperature sensitive movable portion can accurately sense the temperature of the cooling water from the bypass path including the cooling water supplied to the heater core, and therefore the temperature sensitivity of the temperature sensitive movable portion to the temperature of cooling water in the valve housing can be further improved.

[0015] In addition, because the cooling water supplied to the heater core and the cooling water that has bypassed the radiator are blended in a single bypass path, the cooling water path configuration can be reduced to a simple path configuration.

[0016] In particular, the following configuration can be

used to easily mold the guide portion. In the above-described configuration, the valve housing may be molded by casting and using a plurality of movable cores that form a cavity in a die, and the guide portion may be formed from a periphery of the inlet along a die parting line of the valve housing in which back ends in a direction in which the movable cores are withdrawn are located.

[0017] According to this specific matter, because the guide portion is formed along the die parting line of the valve housing from the periphery of the inlet, a wall face extending along the die parting line of the valve housing is formed in a peripheral portion of the inlet. With this configuration, cooling water from the bypass path that is introduced from the inlet can be efficiently and reliably guided to the temperature sensitive movable portion by the wall face extending from the periphery of the inlet along the die parting line of the valve housing, and thus it is possible to improve the temperature sensitivity of the temperature sensitive movable portion to the cooling water temperature and achieve the accuracy of temperature adjustment of the thermostat device.

[0018] Furthermore, because the wall face is formed along the die parting line of the valve housing, it is only necessary to form the guide portion in a portion excluding the wall face, and therefore the guide portion can be easily formed at low cost, reducing the production cost of the guide portion and simplifying the production process.

[0019] The following configuration can be used to more easily mold the guide portion. In the above-described configuration, the movable core that is last withdrawn from the die may be withdrawn in a backward direction after being moved toward an empty space created by a movable core that is withdrawn before in the backward direction from the die, and the guide portion may protrude from the periphery of the inlet in a direction in which the movable core that is last withdrawn from the die is moved toward the empty space.

[0020] According to this specific matter, by utilizing the fact that a movable core that is withdrawn last can be moved to an empty space created by a movable core that is withdrawn before from the die, the guide portion that protrudes from the periphery of the inlet in a direction in which the movable core withdrawn last is moved toward the empty space can be easily molded integrally with the valve housing. Accordingly, it is unnecessary to use a separate member to provide the guide portion that protrudes in a direction different from the backward direction, or in other words, the withdrawing direction of the movable cores, and therefore the number of components can be reduced, and the production cost of the guide portion can be further reduced.

[0021] In the above-described configuration, a proximity guide portion that guides cooling water guided by the guide portion closer to the temperature sensitive movable portion may be provided between the temperature sensitive movable portion and the guide portion. In this case, the cooling water that is introduced from the inlet and guided by the guide portion is guided closer to the temperature sensitive movable portion by the proximity guide portion, and therefore it is possible to further improve the temperature sensitivity of the temperature sensitive movable portion to the temperature of the cooling water introduced from the inlet.

[0022] In particular, the following configuration can be used to specify the guide portion. In the above-described configuration, the guide portion may include lateral guide pieces that guide the cooling water introduced from the inlet toward the temperature sensitive movable portion, while laying off the cooling water from two side edges that are substantially orthogonal to a direction of the opening and closing operation, in the peripheral edges of the inlet.

[0023] According to this specific matter, the cooling water introduced from the inlet can be smoothly guided toward the temperature sensitive movable portion while being defined from both sides of the inlet by the lateral guide pieces, and therefore this is very advantageous to improve the temperature sensitivity of the temperature sensitive movable portion to the temperature of the cooling water introduced from the inlet.

[0024] In the above-described configuration, the guide portion may include a valve opening-side guide piece that guides the cooling water introduced from the inlet toward the temperature sensitive movable portion, while laying off the cooling water from a side edge to a valve opening direction of the valve body in the peripheral edges of the inlet. In this case, the cooling water introduced from the inlet can be smoothly guided toward the temperature sensitive movable portion while being defined from the valve opening direction edge of the inlet by the valve opening-side guide piece, and therefore this is very advantageous to improve the temperature sensitivity of the temperature sensitive movable portion to the temperature of the cooling water introduced from the inlet.

[0025] In the above-described configuration, the valve opening direction edge of the inlet and a support member for supporting a biasing portion that biases the valve body in a closing direction that is disposed in the valve opening direction edge of the inlet may extend continuously such that they are substantially flush with each other, and the valve opening-side guide piece may be provided in the support member. In this case, the cooling water introduced from the inlet can be smoothly guided toward the temperature sensitive movable portion while effectively being defined from the valve opening direction edge by the valve opening-side guide piece that is continuous without a step from the valve opening direction edge of the inlet, and therefore this is very advantageous to further improve the temperature sensitivity of the temperature sensitive movable portion to the temperature of the cooling water introduced from the inlet. Furthermore, because the valve opening-side guide piece can be easily disposed in the valve opening direction edge of the inlet by using the support member, it is possible to easily dispose the valve opening-side guide piece.

[0026] Furthermore, in the above-described configu-

ration, the valve opening-side guide piece may be disposed between the lateral guide pieces. In this case, the cooling water introduced from the inlet can be smoothly guided toward the temperature sensitive movable portion while being effectively defined from the both sides and the valve opening direction edge of the inlet by the lateral guide pieces and the valve opening-side guide piece, and therefore this is very advantageous to even further improve the temperature sensitivity of the temperature sensitive movable portion to the temperature of the cooling water introduced from the inlet. Furthermore, because the valve opening-side guide piece is disposed between the lateral guide pieces, the flow resistance of cooling water introduced by opening of the valve of the temperature sensitive movable portion against the guide portion (the valve opening-side guide piece and the lateral guide pieces) can be minimized.

[Advantageous Effects of Invention]

[0027] According to the thermostat device of the present invention, it is possible to improve the temperature sensitivity of the temperature sensitive movable portion to the temperature of cooling water in the valve housing.

[0028] Specifically, by providing a heater path inlet portion that introduces cooling water from a heater path on a side of the valve housing that is located further to an opening direction side of the valve body than the temperature sensitive movable portion, or by mixing the cooling water from the heater core and the cooling water that has bypassed the radiator and guiding the cooling water from the bypass path toward the temperature sensitive movable portion by the guide portion from the inlet that is open at a side position of the valve housing substantially orthogonal to the direction in which the temperature sensitive movable portion moves, only the cooling water from the bypass path that is introduced from the inlet can be efficiently guided to the temperature sensitive movable portion, and the temperature sensitivity of the temperature sensitive movable portion to cooling water temperature can be improved.

[0029] Furthermore, in the case of introducing cooling water from the bypass path in which the cooling water from the heater core and the cooling water that has bypassed the radiator are mixed, the cooling water from the heater path and the cooling water from the bypass path are sufficiently mixed, and the sufficiently mixed cooling water is guided to the temperature sensitive movable portion via the inlet to allow the temperature sensitive movable portion to accurately sense the temperature of the cooling water from the bypass path and the heater path, and therefore it is possible to further improve the temperature sensitivity of the temperature sensitive movable portion to cooling water in the valve housing. Furthermore, by mixing the cooling water from the heater core in the bypass path, the cooling water path configuration can be reduced to a simple path configuration.

[Brief Description of Drawings]

[0030]

[FIG. 1]
FIG. 1 is a schematic cross-sectional view of an overall configuration of a thermostat device according to Embodiment 1 of the present invention as viewed from the front side of a valve housing.

[FIG. 2]
FIG. 2 is a cross-sectional view of the valve housing of the thermostat device according to Embodiment 1 of the present invention as viewed from one base seat side.

[FIG. 3]
FIG. 3 is a perspective view of a support plate of the thermostat device according to Embodiment 1 of the present invention.

[FIG. 4]
FIG. 4 is a perspective view of another base seat by which one end in the longitudinal direction of the support plate of the thermostat device according to Embodiment 1 of the present invention is supported.

[FIG. 5]
FIG. 5 is a plan view of a die and first to fifth movable cores used for casting of the valve housing of the thermostat device according to Embodiment 1 of the present invention as viewed from a cooling water outlet side.

[FIG. 6]
FIG. 6 is a schematic cross-sectional view of an overall configuration of a thermostat device according to Embodiment 2 of the present invention as viewed from the front side of a valve housing.

[FIG. 7]
FIG. 7 is a schematic cross-sectional view of an overall configuration of a thermostat device according to Embodiment 3 of the present invention as viewed from the front side of a valve housing.

[FIG. 8]
FIG. 8 is a cross-sectional view of the valve housing of the thermostat device according to Embodiment 3 of the present invention as viewed from a side opposite to a high-temperature cooling water inlet.

[FIG. 9]
FIG. 9 is a perspective view of a support plate of the thermostat device according to Embodiment 3 of the present invention.

[FIG. 10]
FIG. 10 is a schematic cross-sectional view of an overall configuration of a thermostat device according to Embodiment 4 of the present invention as viewed from the front side of a valve housing.

[FIG. 11]
FIG. 11 is a cross-sectional view of the valve housing of the thermostat device according to Embodiment 4 of the present invention as viewed from a side opposite to a high-temperature cooling water inlet.

[FIG. 12]
FIG. 12 is a perspective view of a support plate of the thermostat device according to Embodiment 4 of the present invention.
[FIG. 13]
FIG. 13 is a plan view of a die and first to fifth movable cores used for casting of the valve housing of the thermostat device according to Embodiment 4 of the present invention as viewed from a cooling water outlet side.

[Explanation of Reference]

[0031]

1	Thermostat Device
12	Temperature sensitive movable portion
13	Valve Body
164	Proximity Guide portion
17	Support Plate (Support Member)
174	Proximity Guide portion
18	Support Plate (Support Member)
184	Proximity Guide portion
2	Valve Housing
22	Bypass Path
22a	High-Temperature Cooling Water Inlet (Inlet)
25	Valve Seat
27	Guide portion
27'	Guide portion
271	Lateral Guide Piece
271'	Lateral Guide Piece
272	Cooling Water Outlet-Side Guide Piece
272'	Cooling Water Outlet-Side Guide Piece
29	Heater Path
29a	Heater Path Inlet (Heater Path Inlet portion)
X	Die
X0	Cavity
X1 to X5	First to Fifth Movable Cores

[Best Mode for Carrying Out the Invention]

[0032] Hereinafter, a best mode for carrying out the invention will be described in detail with reference to the drawings.

[Embodiment 1]

[0033] FIG. 1 shows an overall configuration of a thermostat device according to Embodiment 1 of the present invention. The thermostat device 1 is incorporated in a valve housing 2 through which cooling water from an engine as an internal combustion engine flows. The thermostat device 1 is provided at the intersection of a radiator-side path 21 through which cooling water from a radiator as a cooling portion is introduced and a bypass path 22 through which cooling water discharged from the engine is introduced bypassing the radiator, and is used to control the temperature of cooling water flowing into an engine inlet-side path 23 that is introduced to the engine inlet side by selectively switching the flow of cooling water from the radiator-side path 21. In other words, the valve housing 2 incorporating the thermostat device 1 includes a low-temperature cooling water inlet 21a through which low-temperature cooling water A produced by cooling a part of high-temperature cooling water that has passed through the engine by the radiator is introduced via the radiator-side path 21, a substantially rectangular high-temperature cooling water inlet 22a serving as an inlet through which high-temperature cooling water B that has passed through the engine is directly introduced via the bypass path 22, a mixing chamber 20 in which the low-temperature cooling water A introduced from the low-temperature cooling water inlet 21a and the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a are mixed with each other, and a cooling water outlet 23a that discharges cooling water C mixed in the mixing chamber 20 to the engine inlet-side path 23. A water pump is provided in the engine inlet-side path 23 to discharge the cooling water C flowing from the mixing chamber 20 of the valve housing 2 via the cooling water outlet 23a to the engine inlet side. In this case, the low-temperature cooling water inlet 21a of the radiator-side path 21 and the cooling water outlet 23a of the engine inlet-side path 23 are open at positions vertically opposed to each other on the axis m of movement of a temperature sensitive movable portion 12, which will be described later. As used herein, "upward" in the vertical direction corresponds to the side in which the low-temperature cooling water inlet 21a is located in the valve housing 2, and "downward" corresponds to the side in which the cooling water outlet 23a is located. The same applies to the following description.

[0034] The thermostat device 1 also includes a piston shaft supporting portion 21b that is provided on the inner wall of the radiator-side path 21 and protrudes to the low-temperature cooling water inlet 21a, a piston shaft 11 that is fixed to the piston shaft supporting portion 21b at one end (the upper end in FIG. 1) and extends downward on the axis *m* of movement of the temperature sensitive movable portion 12, which will be described later, at the other end (the lower end in FIG. 1), the temperature sensitive movable portion 12 having a substantially cylindrical shape that is provided at the other end of the piston shaft 11, a valve body 13 that is integrally attached to the outer periphery of the temperature sensitive movable portion 12, and a bias spring 14 that biases the valve body 13 in a valve closing direction (upward).

[0035] The temperature sensitive movable portion 12 includes a cup, a thermally expansible material that is sealed within the cup, a sleeve that is provided between the piston shaft 11 and the thermally expansible material, a cap, a sealant, and so on. The thermally expansible material of the temperature sensitive movable portion 12 is configured to be capable of detecting the temperature of high-temperature cooling water B and vertically mov-

ing the temperature sensitive movable portion 12 toward and away from the piston shaft 11 on the movement axis m by the increase and decrease of volume according to the detected temperature.

[0036] The valve body 13 is configured to close the low-temperature cooling water inlet 21a by seating on a valve seat 25 provided on an upper end portion of the valve housing 2, and is provided at an upper end position of the outer periphery of the temperature sensitive movable portion 12.

[0037] The bias spring 14 is compressed between an annular support portion 13a provided on a lower face of the valve body 13 and a support plate 16 having the shape of a stay that is attached to the lower end portion of the valve housing 2. The support plate 16 is disposed spanning between stepped base seats 26 whose inner walls protrude radially inwardly at positions 180° circumferentially apart from each other at the lower end portion of the valve housing 2 as shown in FIGS. 2 and 3. An annular spring supporting portion 160 is provided in a center portion in the longitudinal direction of the support plate 16, and a guide hole 161 that insertably guides the temperature sensitive movable portion 12 is provided at the center of the annular spring supporting portion 160 to guide the temperature sensitive movable portion 12 to move in vertical direction. Holding portions 162 that are bent downward to hold one base seat 26 (on the right side in FIG. 1) from circumferential sides of the base seat 26 are provided integrally with one end in the longitudinal direction (the right end in FIG. 1) of the support plate 16. As shown in FIG. 4, a notch hole 163 in which a protrusion 26a in the form of a rectangular prism protruding upward from the other base seat 26 (on the left side in FIG. 1) is fitted is provided at the other end in the longitudinal direction (the left end in FIG. 1) of the support plate 16. In this case, the support plate 16 can be positioned and attached onto the base seats 26 by holding one base seat 26 from the circumferential sides by the holding portions 162 at one end, and fitting the protrusion 26a of the other base seat 26 in the notch hole 163 at the other end.

[0038] As shown in FIG. 1, the high-temperature cooling water inlet 22a of the bypass path 22 is provided at a side position of the valve housing 2 that is substantially orthogonal to the vertical movement direction of the temperature sensitive movable portion 12. The high-temperature cooling water inlet 22a has a substantially rectangular shape. On the right and left sides of the high-temperature cooling water inlet 22a, a guide portion 27 is provided that guides high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a toward the temperature sensitive movable portion 12. The guide portion 27 includes lateral guide pieces 271 that, while laying off the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a from both side edges (the front and rear sides in the paper plane of FIG. 1) of the peripheral edges of the high-temperature cooling water inlet 22a that are substantially orthogonal to the direction of the opening and closing operation of the valve body 13, guide the high-temperature cooling water B toward the temperature sensitive movable portion 12. The valve housing 2 is molded by casting and using five movable cores, namely, first to fifth movable cores X1 to X5 that form a cavity X0 within a die X as shown in FIG. 5. The valve housing 2 can be made of a material such as die cast aluminum or a plastic material. In this case, because a die parting line is at a lower end position of a partition wall 2a that separates the mixing chamber 20 and the bypass path 22 (an upper edge of the high-temperature cooling water inlet 22a), the valve housing 2 is molded separately from the bypass path 22 at the lower end position of the partition wall 2a. A lower end portion of the bypass path 22 located below the die parting line is integrally molded with the valve housing 2. As shown in FIG. 2, the other base seat 26 is located between the lateral guide pieces 271, and the protruding direction thereof corresponds to the protruding direction of the lateral guide pieces 271.

[0039] The lateral guide pieces 271 protrude from the right and left sides of the high-temperature cooling water inlet 22a toward the temperature sensitive movable portion 12, and are integrally molded with the valve housing 2. Specifically, the lateral guide pieces 271 are integrally molded with the valve housing 2 when molding the valve housing 2 by casting. In other words, the first to fifth movable cores X1 to X5 that form the cavity X0 are placed in the die X. When die cast aluminum or a plastic material poured into the cavity X0 cures, first, the first movable core X1 placed at the center is withdrawn straight in a backward direction (to the front of the paper plane in FIG. 5). Next, the fourth movable core X4 and the fifth movable core X5 are slid together into the empty space (the space from which the first movable core X1 has been withdrawn) created by withdrawing the first movable core X1 between the second and third movable cores X2 and X3 that have a substantially semicircular shape and are located circumferentially outside the lateral guide pieces 271, and then the second to the fifth movable cores X2 to X5 are collectively withdrawn straight in the backward direction at the same time. At this time, the fourth movable core X4 is moved toward the empty space of the first movable core X1 so as to avoid contact with one base seat 26, and the fifth movable core X5 is moved toward the empty space of the first movable core X1 so as to avoid contact with the other base seat 26, as well as the lower end portion of the bypass path 22 and the lateral guide pieces 271. In this manner, the lateral guide pieces 271 and the two base seats 26 are integrally molded with the valve housing 2 when molding the valve housing 2 by casting.

[0040] Proximity guide portions 164 that guide cooling water guided by the lateral guide pieces 271 closer to the temperature sensitive movable portion 12 are provided between the temperature sensitive movable portion 12 and the lateral guide pieces 271. The proximity guide portions 164 protrude upward from the other end in the longitudinal direction of the support plate 16, and are

formed integrally with the support plate 16 by being bent from the circumferentially right and left side ends of the support plate 16. Each lateral guide piece 271 and each proximity guide portion 164 respectively have facing faces 27a and 164a where the lateral guide piece 271 and the proximity guide portion 164 face each other with a small gap therebetween, so that high-temperature cooling water B guided from the bypass path 22 to the lateral guide pieces 271 via the high-temperature cooling water outlet 22a can be smoothly taken over to the proximity guide portions 164 and can be smoothly guided closer to the temperature sensitive movable portion 12.

[0041] A cut-off portion 2a1 facing the outer end of the support portion 13a on the lower face of the valve body 13 is provided on the partition wall 2a, and the flowing of the low-temperature cooling water A, which is introduced from the low-temperature cooling water inlet 21a into the mixing chamber 20 when the valve body 13 is open, to the high-temperature cooling water inlet 22a side is suppressed by the cut-off portion 2a1 to the lowest degree possible. In this case, the lateral guide pieces 271 are integrally molded with the right and left side portions of a lower face of the cut-off portion 2a1 such that they are formed from the right and left sides of the high-temperature cooling water inlet 22a along the die parting line of the valve housing 2 in which the back ends in the withdrawing direction of the movable cores X1 to X5 (the rear side end in the paper plane of FIG. 5) are located.

[0042] Furthermore, a heater path inlet 29a (heater path inlet portion) that introduces cooling water D from a heater path 29 that is supplied from the engine outlet side to a heater core is provided on a side of the valve housing 2 that is located further to the opening direction side of the valve body 13 than the temperature sensitive movable portion 12, or in other words, in the lower end portion of the valve housing 2 (below the base seat 26). In this case, the cooling water D from the heater path inlet 29a is introduced from the most downstream side in the flowing direction of cooling water C or high-temperature cooling water B in the valve housing 2 when the cooling water C mixed in the mixing chamber 20 or the high-temperature cooling water B introduced from the bypass path 22 via the high-temperature cooling water inlet 22a is discharged toward the cooling water outlet 23a, and therefore there is no effect on the temperature sensitive movable portion 12.

[0043] Accordingly, in Embodiment 1, the high-temperature cooling water B from the bypass path 22 that has been heated by the engine and has bypassed the radiator is introduced from the high-temperature cooling water inlet 22a that is open at a side position of the valve housing 2 that is substantially orthogonal to the direction of the axis m of movement of the temperature sensitive movable portion 12, flows along the lower face of the cut-off portion 2a1 by the side edges of the high-temperature cooling water inlet 22a, and is guided toward the temperature sensitive movable portion 12 by the lateral guide pieces 271 protruding toward the temperature sensitive movable portion 12.

[0044] In this case, because the heater path inlet 29a that introduces cooling water D from the heater path 29 is provided in the lower end portion of the valve housing 2 (below the base seat 26), and the cooling water D from the heater path inlet 29a is introduced from the most downstream side in the flowing direction of cooling water C or high-temperature cooling water B in the valve housing 2, even when the amount of cooling water D from the heater path 29 that is introduced from the heater path inlet 29a varies sequentially according to variations in the rotational speed of the engine, cooling water D is not guided from the heater path inlet 29a to the temperature sensitive movable portion 12. This allows only high-temperature cooling water B from the bypass path 22, which is introduced from the high-temperature cooling water inlet 22a, to be efficiently guided to the temperature sensitive movable portion 12, and thus it is possible to improve the temperature sensitivity of the temperature sensitive movable portion 12 to the cooling water temperature.

[0045] In addition, because the lateral guide pieces 271 are integrally molded with the right and left side portions of the lower face of the cut-off portion 2a1 such that they are formed from the right and left side edges of the high-temperature cooling water inlet 22a along the die parting line of the valve housing 2 in which the back ends in the withdrawing direction of the movable cores X1 to X5 (the rear side end in the paper plane of FIG. 5) are located, a lower face of the partition wall 2a as a wall face extending along the die parting line of the valve housing 2 is formed on a peripheral portion (upper edge) of the high-temperature cooling water inlet 22a. With this configuration, high-temperature cooling water B from the bypass path 22, which is introduced from the high-temperature cooling water inlet 22a, can be efficiently and reliably guided to the temperature sensitive movable portion 12 by the lower face of the partition wall 2a, which extends from the periphery of the high-temperature cooling water inlet 22a along the die parting line of the valve housing 2, and the lateral guide pieces 271, and thus it is possible to improve the temperature sensitivity of the temperature sensitive movable portion 12 to the temperature of high-temperature cooling water B and achieve the accuracy of temperature adjustment of the thermostat device 1.

[0046] Because the lower face of the partition wall 2a is formed along the die parting line of the valve housing 2, it is only necessary to form the lateral guide pieces 271 on the right and left side edges of the high-temperature cooling water inlet 22a excluding the lower face of the partition wall 2a, and therefore the lateral guide pieces 271 can be easily formed at low cost, reducing the production cost of the lateral guide pieces 271 and simplifying the production process. In addition, because the lateral guide pieces 271 protruding from the right and left sides of the high-temperature cooling water inlet 22a toward the temperature sensitive movable portion 12 along the lower face of the cut-off portion 2a1 are integrally

molded with the valve housing 2 by moving the fifth movable core X5 toward the empty space created by the first movable core X1 withdrawn first in the backward direction when withdrawing the fifth movable core X5 in backward direction from the die X, it is unnecessary to use a separate member to provide lateral guide pieces 271 protruding in a direction different from the backward direction, or in other words, the withdrawing direction of the fifth movable core X5, and therefore the number of components can be reduced, and the production cost of the lateral guide pieces 271 can be further reduced.

[0047] Furthermore, because the proximity guide portions 164 that guide the cooling water guided by the lateral guide pieces 271 closer to the temperature sensitive movable portion 12 are formed between the temperature sensitive movable portion 12 and the lateral guide pieces 271 by being bent upward from the circumferentially right and left sides of the other end in the longitudinal direction of the support plate 16, the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a and guided by the lateral guide pieces 271 can be guided closer to the temperature sensitive movable portion 12 by the proximity guide portions 164, and therefore it is possible to further improve the temperature sensitivity of the temperature sensitive movable portion 12 to the temperature of the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a.

[Embodiment 2]

[0048] Embodiment 2 of the present invention will be described next with reference to FIG. 6.

[0049] In this embodiment, the configuration of the heater path is changed. Configurations other than the heater path are the same as those of Embodiment 1 described above, and thus the same reference numerals are given to the same components, and a detailed description thereof is omitted.

[0050] Specifically, in this embodiment, as shown in FIG. 6, the cooling water from the heater path is not introduced into the lower end portion of the valve housing 2 via the heater path inlet, but instead is introduced to the upstream side of the bypass path 22. And, high-temperature cooling water that has been heated by the engine and has bypassed the radiator and cooling water supplied to the heater core are pre-mixed in the bypass path 22, and the mixed high-temperature cooling water B is introduced from the bypass path 22 into the valve housing 2 via the high-temperature cooling water inlet 22a.

[0051] Accordingly, in Embodiment 2, cooling water that has been heated by the engine and has bypassed the radiator and cooling water supplied to the heater core are mixed in the bypass path 22, introduced from the high-temperature cooling water inlet 22a that is open at a side position of the valve housing 2 that is substantially orthogonal to the direction of the axis m of movement of the temperature sensitive movable portion 12, and guided toward the temperature sensitive movable portion 12 by the lateral guide pieces 271 provided in the high-temperature cooling water inlet 22a.

[0052] Therefore, even if the amount of cooling water supplied to the heater core varies sequentially according to variations in the rotational speed of the engine, the cooling water is mixed sufficiently with the cooling water that has bypassed the radiator in the bypass path 22 and efficiently guided from the high-temperature cooling water inlet 22a to the temperature sensitive movable portion 12. This prevents the cooling water supplied to the heater core from being guided to the temperature sensitive movable portion 12 without being sufficiently mixed, and only the high-temperature cooling water B from the bypass path 22 that is introduced from the high-temperature cooling water inlet 22a can be efficiently guided to the temperature sensitive movable portion 12, and thus it is possible to improve the temperature sensitivity of the temperature sensitive movable portion 12 to the cooling water temperature and achieve the accuracy of temperature adjustment of the thermostat device 1.

[0053] Furthermore, because the cooling water in which the cooling water that has been supplied to the heater core and the cooling water that has bypassed the radiator are sufficiently mixed is guided from the bypass path 22 to the temperature sensitive movable portion 12 via the high-temperature cooling water inlet 22a, the temperature sensitive movable portion 12 can accurately sense the temperature of the cooling water from the bypass path 22 including the cooling water supplied to the heater core, and therefore the temperature sensitivity of the temperature sensitive movable portion 12 to the temperature of cooling water in the valve housing 2 can be further improved.

[0054] In addition, because the cooling water supplied to the heater core and the cooling water that has bypassed the radiator are put together in a single bypass path 22, the cooling water path configuration can be reduced to a simple path configuration. Furthermore, the need for the heater path inlet for introducing cooling water from the heater path provided at the lower end portion of the valve housing 2 can be eliminated, the valve housing 2 can be shortened in the direction of the axis m of movement of the temperature sensitive movable portion 12, and the valve housing 2 can be made compact.

[Embodiment 3]

[0055] Embodiment 3 of the present invention will be described next with reference to FIGS. 7 to 9.

[0056] In this embodiment, the configuration of the support plate and the base seats is changed. Configurations other than the support plate and the base seats are the same as those of Embodiment 1 described above, and thus the same reference numerals are given to the same components, and a detailed description thereof is omitted.

[0057] Specifically, in this embodiment, in consideration of a support plate 17 having the shape of a stay as a support member, as shown in FIGS. 7 and 8, base seats 24 are provided such that a surface thereof (upper end surface in FIG. 7) is located on the cooling water outlet 23a side (the lower side in FIGS. 7 and 8) from a cooling water outlet-side edge (the lower edge in FIGS. 7 and 8), serving as an edge in the opening direction of the valve body 13, of the peripheral edges of the high-temperature cooling water inlet 22a by an amount corresponding to the thickness of the support plate 17. As shown in FIG. 9, an annular spring supporting portion 170 that is recessed toward the cooling water outlet 23a is provided in a center portion in the longitudinal direction of the support plate 17, and a guide hole 171 that insertably guides the temperature sensitive movable portion 12 is open at the center of the spring supporting portion 170 to guide the temperature sensitive movable portion 12 to move vertically. Holding portions 172 that are bent downward to hold one base seat 24 (on the right side in FIG. 7) from circumferential sides of the base seat 24 are provided integrally with one end in the longitudinal direction (the right-side end in FIG. 1) of the support plate 17. A notch hole 173 in which a protrusion 24a in the form of a rectangular prism protruding upward from the surface of the other base seat 24 (on the left side in FIG. 7) is fitted is provided at the other end in the longitudinal direction (the left-side end in FIG. 7) of the support plate 17. In this case, the support plate 17 can be positioned and attached onto the base seats 24 by holding one base seat 24 from the circumferential sides by the holding portions 172 at one end, and fitting the protrusion 24a of the other base seat 24 in the notch hole 173 at the other end. Here, the support plate 17 and the cooling water outlet-side edge of the high-temperature cooling water inlet 22a are continuously made substantially flush with each other. In other words, a low-temperature cooling water inlet-side surface (the upper surface in FIGS. 7 and 8) of the support plate 17 substantially corresponds to the height of the cooling water outlet-side edge of the high-temperature cooling water inlet 22a when the support plate 17 is disposed spanning between the base seats 24.

[0058] A guide portion 27 includes lateral guide pieces 271 that, while laying off the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a from both side edges (on the right and left sides in FIG. 8) of the peripheral edges of the high-temperature cooling water inlet 22a that are substantially orthogonal to the direction of the opening and closing operation of the valve body 13, guide the high-temperature cooling water B toward the temperature sensitive movable portion 12. The guide portion 27 also includes a cooling water outlet-side guide piece 272 as a valve opening-side guide piece that, while laying off the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a from the cooling water outlet-side edge (the lower edge in FIGS. 7 and 8), serving as an edge in the opening direction of the valve body 13, of the peripheral edges of the high-temperature cooling water inlet 22a, guides the high-temperature cooling water B toward the temperature sensitive movable portion 12. The cooling water outlet-side guide piece 272 is provided extended between base ends that connect proximity guide portions 174 that protrude upward from the other end of the support plate 17. In other words, the proximity guide portions 174 protrude upward from right and left side ends of the cooling water outlet-side guide piece 272, and are formed integrally with the support plate 17 together with the cooling water outlet-side guide piece 272 by being bent from the right and left side ends of the cooling water outlet-side guide piece 272. Each lateral guide piece 271 and each proximity guide portion 17 respectively have facing faces 27a and 174a where the lateral guide piece 271 and the proximity guide portion 174 face each other with a small gap therebetween, so that high-temperature cooling water B guided from the bypass path 22 to the lateral guide pieces 271 via the high-temperature cooling water outlet 22a can be smoothly taken over to the proximity guide portions 174 and can be smoothly guided closer to the temperature sensitive movable portion 12. In this case, the guide portion 27 is formed by lateral guide pieces 271 and a cooling water outlet-side guide piece 272.

[0059] Accordingly, in Embodiment 3, the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a is smoothly guided toward the temperature sensitive movable portion 12 while being defined from both sides and the cooling water outlet 23a side of the high-temperature cooling water inlet 22a by the lateral guide pieces 271 and the cooling water outlet-side guide piece 272. The high-temperature cooling water B guided by the lateral guide pieces 271 and the cooling water outlet-side guide piece 272 is guided closer to the temperature sensitive movable portion 12 by the proximity guide portions 174. With this configuration, it is possible to further improve the temperature sensitivity of the temperature sensitive movable portion 12 to the temperature of the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a.

[0060] In addition, because the cooling water outlet-side guide piece 272 is provided at the other end of the support plate 17 in which the low-temperature cooling water inlet-side surface of the support plate 17 substantially corresponds to the height of the cooling water outlet-side edge of the high-temperature cooling water inlet 22a, the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a can be smoothly guided toward the temperature sensitive movable portion 12 while being effectively defined from the cooling water outlet-side edge by the cooling water outlet-side guide piece 272 that is continuous without a step from the cooling water outlet-side edge of the high-temperature cooling water inlet 22a, and therefore this is very advantageous to further improve the temperature sensitivity of the temperature sensitive movable portion 12 to

the temperature of the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a. Furthermore, the cooling water outlet-side guide piece 272 can be easily disposed in the cooling water outlet-side edge of the high-temperature cooling water inlet 22a by using the support plate 17, and therefore it is possible to easily dispose the cooling water outlet-side guide piece 272.

[0061] Moreover, because the cooling water outlet-side guide piece 272 is provided extended between the base ends that connect the proximity guide portions 174, the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a can be more smoothly guided toward the temperature sensitive movable portion 12 while being effectively defined from the both sides and the cooling water outlet-side edge of the high-temperature cooling water inlet 22a by the lateral guide pieces 271 and the cooling water outlet-side guide piece 272, and therefore this is very advantageous to even further improve the temperature sensitivity of the temperature sensitive movable portion 12 to the temperature of the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a. Furthermore, because the cooling water outlet-side guide piece 272 is disposed between base ends of the lateral guide pieces 271, the flow resistance of low-temperature cooling water A introduced from the low-temperature cooling water inlet 21a by opening of the valve body 13 against the guide portion 27 (the lateral guide pieces 271 and the cooling water outlet-side guide piece 272) can be minimized.

[Embodiment 4]

[0062] Embodiment 4 of the present invention will be described next with reference to FIGS. 10 to 13.

[0063] In this embodiment, the configuration of the support plate and the base seats is changed. Configurations other than the support plate and the base seats are the same as those of Embodiment 3 described above, and thus the same reference numerals are given to the same components, and a detailed description thereof is omitted.

[0064] Specifically, in this embodiment, as shown in FIGS. 10 and 11, base seats 24 are provided facing each other at the positions 90° circumferentially apart from the high-temperature cooling water inlet 22a of the valve housing 2. A support plate 18 is disposed spanning between the base seats 24. As shown in FIG. 12, an annular spring supporting portion 180 that is recessed toward the cooling water outlet 23a (downward in FIGS. 10 and 11) is provided in a center portion in the longitudinal direction of the support plate 18, and a guide hole 181 that insertably guides the temperature sensitive movable portion 12 is open at the center of the spring supporting portion 180 to guide the temperature sensitive movable portion 12 to move vertically. Holding portions 182 that are bent downward to hold the base seat 24 from circumferential sides of the base seat 24 are provided integrally with both side ends in the longitudinal direction (the right and left side ends in FIG. 11) of the support plate 18. As shown in FIG. 12, a notch hole 183 in which a protrusion 24a in the form of a rectangular prism protruding upward from the surface (the upper end surface in FIG. 11) of the other base seat 24 (the left side in FIG. 11) is fitted is provided at the other end in the longitudinal direction (the left-side end in FIG. 11) of the support plate 18. In this case, the support plate 18 can be positioned and attached onto the base seats 24 by holding the base seats 24 from the circumferential sides by the holding portions 182 provided at the right and left side ends, and fitting the protrusion 24a of the other base seat 24 in the notch hole 183 at the other end.

[0065] A guide portion 27' includes lateral guide pieces 271' that, while laying off the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a from both side edges (on the right and left sides in FIG. 11) of the peripheral edges of the high-temperature cooling water inlet 22a that are substantially orthogonal to the direction of the opening and closing operation of the valve body 13, guide the high-temperature cooling water B toward the temperature sensitive movable portion 12. The guide portion 27' also includes a cooling water outlet-side guide piece 272' as a valve opening-side guide piece that, while laying off the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a from the cooling water outlet 23a side (the lower edge in FIG. 11), serving as an edge in the opening direction of the valve body 13, of the peripheral edges of the high-temperature cooling water inlet 22a, guides the high-temperature cooling water B toward the temperature sensitive movable portion 12. The cooling water outlet-side guide piece 272' is a flat plate protruding from a facing portion the spring supporting portion 180 of the support plate 18 that faces the cooling water outlet-side edge of the high-temperature cooling water inlet 22a toward the cooling water outlet-side edge, and is formed integrally with the support plate 18 by being extended substantially horizontally from the facing portion of the spring supporting portion 180. In this case, a low-temperature cooling water inlet-side surface (the upper surface in FIGS. 10 and 11) of the cooling water outlet-side guide piece 272' substantially corresponds to the height of the cooling water outlet-side edge of the high-temperature cooling water inlet 22a when the support plate 18 is disposed spanning between the base seats 24.

[0066] Proximity guide portions 184 that guide cooling water guided by the lateral guide pieces 271' and the cooling water outlet-side guide piece 272' closer to the temperature sensitive movable portion 12 are provided between the temperature sensitive movable portion 12 and the lateral guide pieces 271'. The proximity guide portions 184 protrude upward from both side ends of the cooling water outlet-side guide piece 272' of the support plate 18 (the right and left side ends in FIG. 11), and are

formed integrally with the support plate 18 by being bent from the circumferentially right and left side ends of the cooling water outlet-side guide piece 272'. Each lateral guide piece 271' and each proximity guide portion 18 respectively have facing faces 27a' and 184a where the lateral guide piece 271' and the proximity guide portion 184 face each other with a small gap therebetween, so that high-temperature cooling water B guided from the bypass path 22 to the lateral guide pieces 271' via the high-temperature cooling water outlet 22a can be smoothly taken over to the proximity guide portions 184 and can be smoothly guided closer to the temperature sensitive movable portion 12. In this case, the guide portion 27' is formed by the lateral guide pieces 271' and a cooling water outlet-side guide piece 272'.

[0067] As shown in FIG. 13, the base seats 24 protrude facing toward each other (toward the temperature sensitive movable portion 12) at the positions 90° circumferentially apart from the high-temperature cooling water inlet 22a, and are molded integrally with the valve housing 2 when molding the valve housing 2 by casting. Specifically, first to fifth movable cores X1 to X5 that form a cavity X0 are placed in a die X. When die cast aluminum or plastic material poured into the cavity X0 cures, first, the first movable core X1 placed at the center is withdrawn straight in a backward direction (to the front of the paper plane in FIG. 5). Next, the fifth movable core X5 is slid into an empty space (a space from which the first movable core X1 has been withdrawn) created by withdrawing the first movable core X1 between the second and third movable cores X2 and X3 that have a substantially semicircular shape and are located circumferentially outside the lateral guide pieces 271' to the position where it is possible to avoid contact with the lower end portion of the bypass path 22 and the lateral guide pieces 271', and the fourth movable core X4 and the fifth movable core X5 are withdrawn straight in the backward direction at a time. Then, the third movable core X3 and the second movable core X2 are slid together into an empty space (a space from which the first, fourth and fifth movable cores X1, X4 and X5 have been withdrawn) created by withdrawing the first movable core X1, the fourth movable core X4 and the fifth movable core X5, and the third movable core X3 and the second movable core X2 are withdrawn straight in the backward direction at a time. At this time, the third movable core X3 is moved toward the space from which the first, fourth and fifth movable cores X1, X4 and X5 have been withdrawn so as to avoid contact with one base seat 24, and the second movable core X2 is moved toward the space from which the first, fourth and fifth movable cores X1, X4 and X5 have been withdrawn so as to avoid contact with the other base seat 24. In this manner, the lateral guide pieces 271' and the two base seats 24 are integrally molded with the valve housing 2 when molding the valve housing 2 by casting.

[0068] Accordingly, in Embodiment 4, the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a is smoothly guided toward the temperature sensitive movable portion 12 while being defined from both sides and the cooling water outlet 23a side of the high-temperature cooling water inlet 22a by the lateral guide pieces 271' and the cooling water outlet-side guide piece 272'. The high-temperature cooling water B guided by the lateral guide pieces 271' and the cooling water outlet-side guide piece 272' is guided closer to the temperature sensitive movable portion 12 by the proximity guide portions 184. With this configuration, it is possible to further improve the temperature sensitivity of the temperature sensitive movable portion 12 to the temperature of the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a.

[0069] In addition, because the cooling water outlet-side guide piece 272' is a flat plate protruding from the facing portion of the spring supporting portion 180 of the support plate 18 in which the low-temperature cooling water inlet-side surface of the support plate 18 substantially corresponds to the height of the cooling water outlet-side edge of the high-temperature cooling water inlet 22a toward the cooling water outlet-side edge of the high-temperature cooling water inlet 22a regardless of the circumferential position in the valve housing 2 of the high-temperature cooling water inlet 22a, the high-temperature cooling water B introduced from the high-temperature cooling water inlet 22a can be reliably defined from the cooling water outlet-side edge of the high-temperature cooling water inlet 22a by the cooling water outlet-side guide piece 272' and guided toward the temperature sensitive movable portion 12 regardless of the position, and therefore this is very advantageous to carry out the invention.

[0070] Furthermore, because the base seats 24 that support the support plate 18 are molded integrally with the valve housing 2 by moving the second and third movable cores X2 and X3 toward the empty space created by the first, fourth and fifth movable cores X1, X4 and X5 withdrawn before in the backward direction when withdrawing the second and third movable cores X2 and X3 from the die X, it is unnecessary to use separate members to provide base seats 24 protruding in a direction different from the backward direction, or in other words, the withdrawing direction of the second and third movable cores X2 and X3, and therefore the number of components can be reduced, and the production cost of the base seats 24 can be further reduced.

[0071] It is needless to say that the present invention is not limited to the embodiments described above, and modifications and changes can be made to the shape, structure and the like of the components that constitute the thermostat device 1. For example, in the above embodiments, the proximity guide portions 164 (174 or 184) are provided on the circumferentially right and left sides of the other end in the longitudinal direction of the support plate 16 (17, 18), but it is also possible to employ a configuration in which the cooling water from the high-tem-

perature cooling water inlet is guided to the temperature sensitive movable portion only by a guide portion that includes at least either the lateral guide pieces or the cooling water outlet-side guide piece.

[0072] In Embodiments 3 and 4 described above, the guide portion 27, 27' includes the lateral guide pieces 271, 271' and the cooling water outlet-side guide piece 272, 272', but the guide portion may include only the cooling water outlet-side guide piece.

[0073] The present invention may be embodied in various other forms without departing from the gist or essential characteristics thereof. Therefore, the embodiments described above are to be considered in all respects as illustrative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing description, and all modifications or changes that come within the meaning and range of equivalency of the claims are intended to be embraced therein.

[0074] In addition, this application claims priority on Japanese Patent Application No. 2008-39311 filed in Japan on February 20, 2008 and Japanese Patent Application No. 2008-130750 filed in Japan on May 19, 2008, the entire contents of which are incorporated herein by reference.

[Industrial Applicability]

[0075] The present invention is suitable for a housing-integrated type thermostat device that is incorporated in a valve housing through which cooling water flows among thermostat devices that automatically control cooling water for cooling an internal combustion engine for an automobile or the like.

Claims

1. A thermostat device that is incorporated in a valve housing through which cooling water from an internal combustion engine flows, that has a temperature sensitive movable portion that moves due to a change in cooling water temperature, and that is configured to control a temperature of cooling water introduced into the internal combustion engine by operating a valve body to open and close with respect to a valve seat formed in the valve housing together with movement of the temperature sensitive movable portion,
   wherein an inlet that introduces cooling water from a bypass path that has been heated by the internal combustion engine and has bypassed a cooling portion is provided at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and a heater path inlet portion that introduces cooling water from a heater path that has been supplied to a heater core is provided on a side of the valve housing that is located further to an opening direction side of the valve body than the temperature sensitive movable portion, and
   the inlet includes a guide portion that guides cooling water introduced from the inlet toward the temperature sensitive movable portion.

2. A thermostat device that is incorporated in a valve housing through which cooling water from an internal combustion engine flows, that has a temperature sensitive movable portion that moves due to a change in cooling water temperature, and that is configured to control a temperature of cooling water introduced into the internal combustion engine by operating a valve body to open and close with respect to a valve seat formed in the valve housing together with movement of the temperature sensitive movable portion,
   wherein an inlet that introduces cooling water from a bypass path in which cooling water that has been heated by the internal combustion engine and has bypassed a cooling portion and cooling water that has been supplied to a heater core are mixed is provided at a side position of the valve housing that is substantially orthogonal to a direction in which the temperature sensitive movable portion moves, and
   the inlet includes a guide portion that guides cooling water introduced from the inlet toward the temperature sensitive movable portion.

3. The thermostat device according to claim 1 or 2,
   wherein the valve housing is molded by casting and using a plurality of movable cores that form a cavity in a die, and
   the guide portion is formed from a periphery of the inlet along a die parting line of the valve housing in which back ends in a direction in which the movable cores are withdrawn are located.

4. The thermostat device according to claim 3,
   wherein the movable core that is last withdrawn from the die is withdrawn in a backward direction after being moved toward an empty space created by a movable core that is withdrawn before in the backward direction from the die, and
   the guide portion protrudes from the periphery of the inlet in a direction in which the movable core that is last withdrawn from the die is moved toward the empty space.

5. The thermostat device according to any one of claims 1 to 4,
   wherein a proximity guide portion that guides cooling water guided by the guide portion closer to the temperature sensitive movable portion is provided between the temperature sensitive movable portion and the guide portion.

6. The thermostat device according to any one of claims 1 to 5,
wherein the guide portion includes lateral guide pieces that guide the cooling water introduced from the inlet toward the temperature sensitive movable portion, while laying off the cooling water from two side edges that are substantially orthogonal to a direction of the opening and closing operation, in the peripheral edges of the inlet.

7. The thermostat device according to any one of claims 1 to 6,
wherein the guide portion includes a valve opening-side guide piece that guides the cooling water introduced from the inlet toward the temperature sensitive movable portion, while laying off the cooling water from a side edge to a valve opening direction of the valve body in the peripheral edges of the inlet.

8. The thermostat device according to claim 7,
wherein a support member for supporting a biasing portion that biases the valve body in a closing direction is disposed in the valve opening direction edge of the inlet, and the valve opening direction edge of the inlet and the support member extend continuously such that they are substantially flush with each other, and
the valve opening-side guide piece is provided in the support member.

9. The thermostat device according to claim 7 or 8,
wherein the valve opening-side guide piece is disposed between the lateral guide pieces.

FIG.1

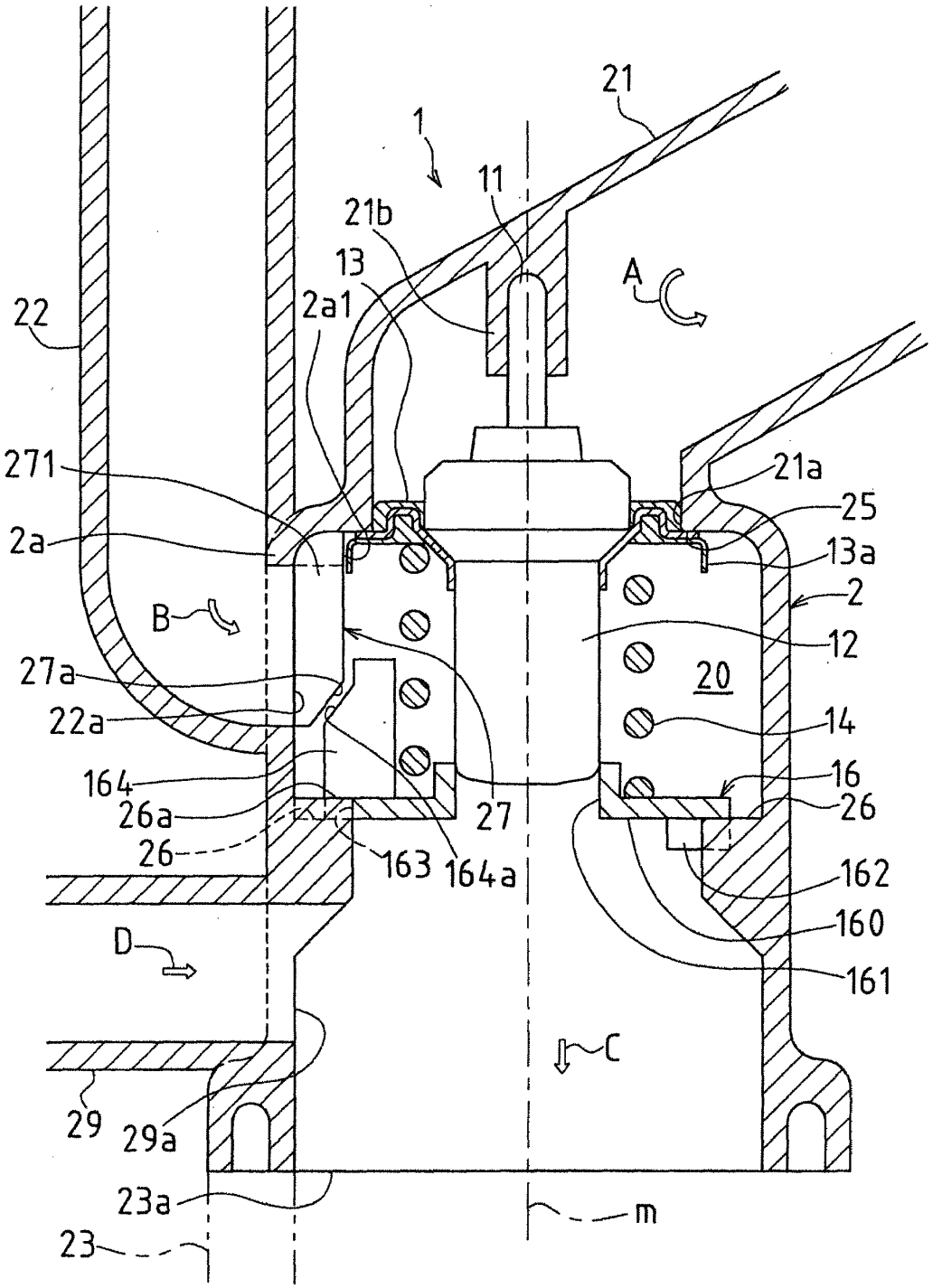

21
1
11
21b
13
A
22
2a1
271
21a
25
2a
13a
2
B
12
27a
20
22a
14
164
16
26a
27
26
26
163
164a
162
160
D
161
C
29
29a
23a
m
23

FIG.2

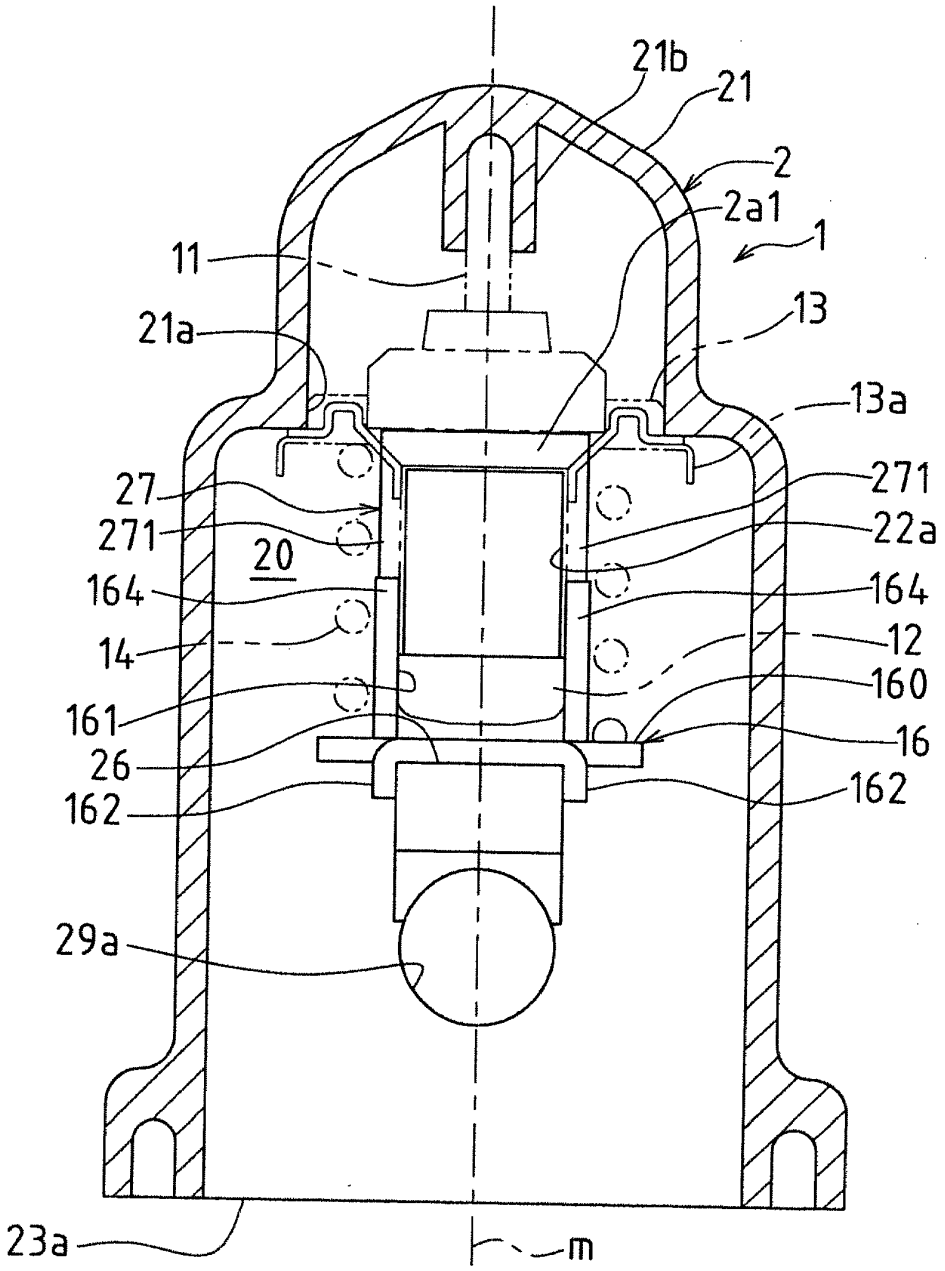

21b
21
2
2a1
1
11
13
21a
13a
27
271
271
22a
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164
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162
29a
23a
m

FIG.3

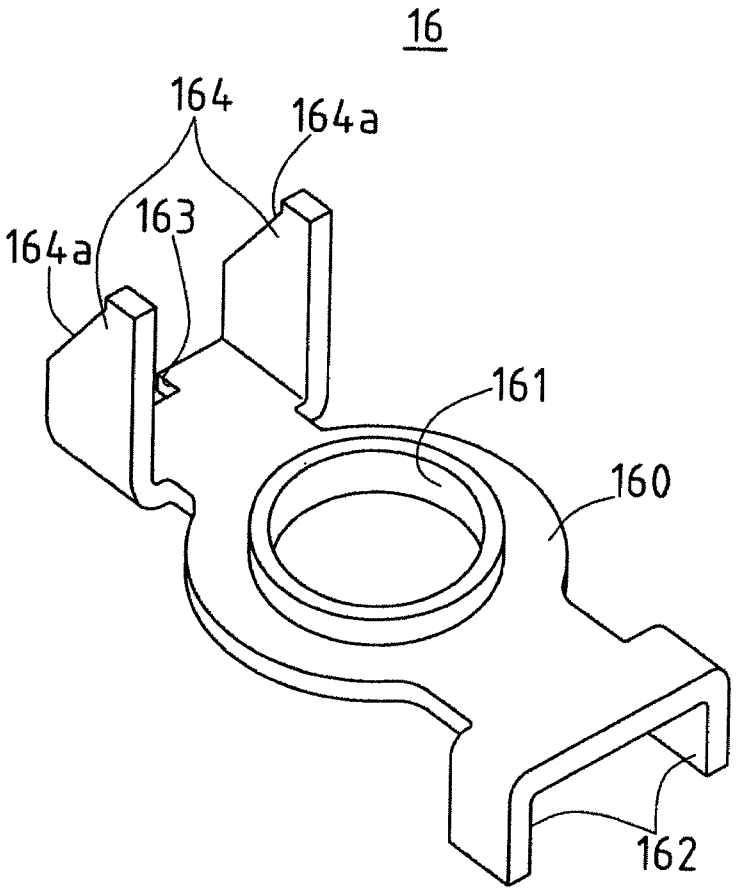


FIG.4

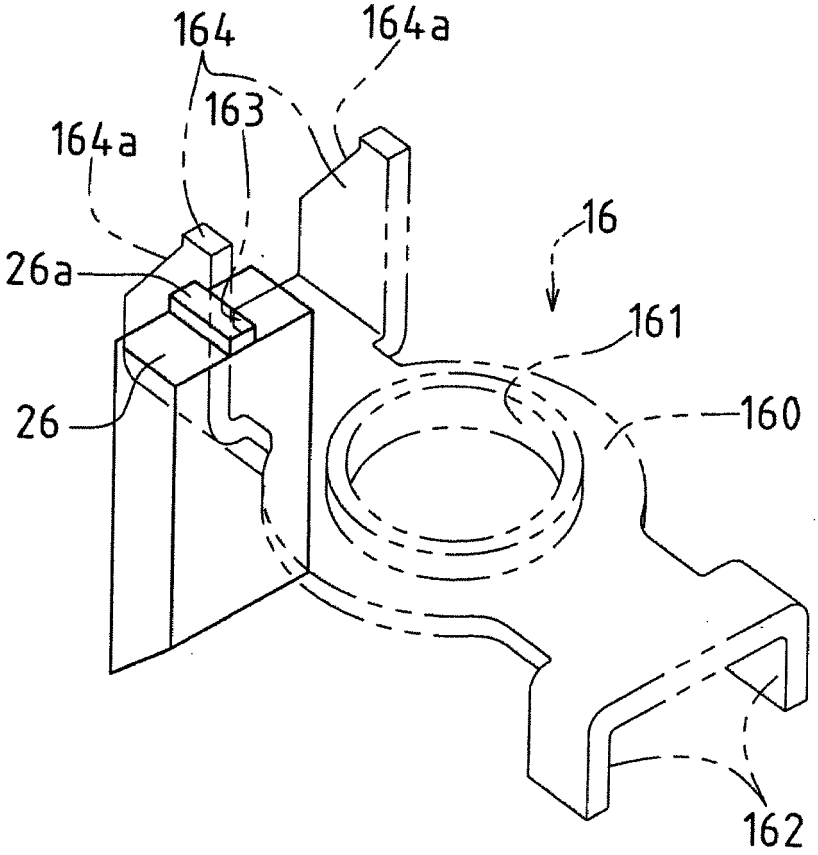


FIG.5

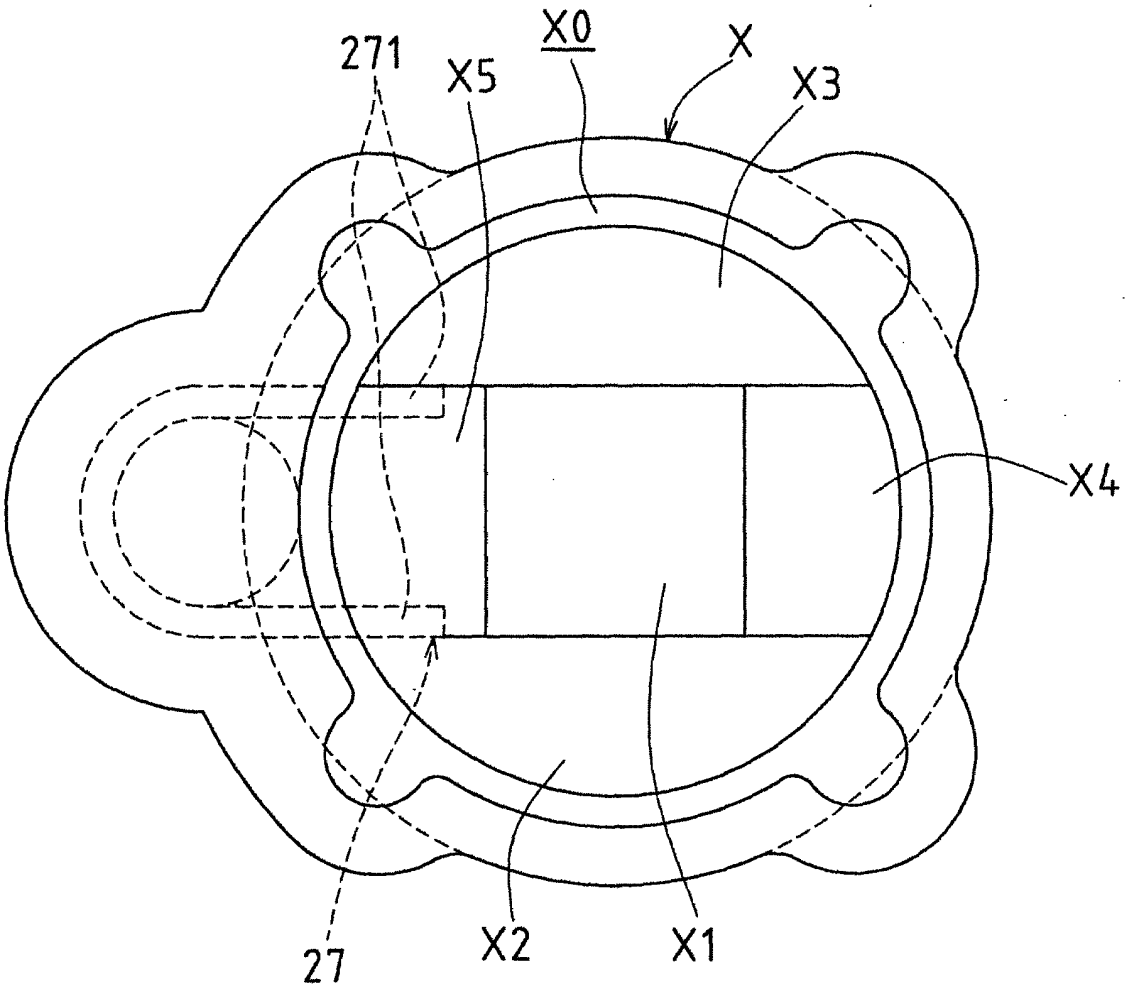


FIG.6

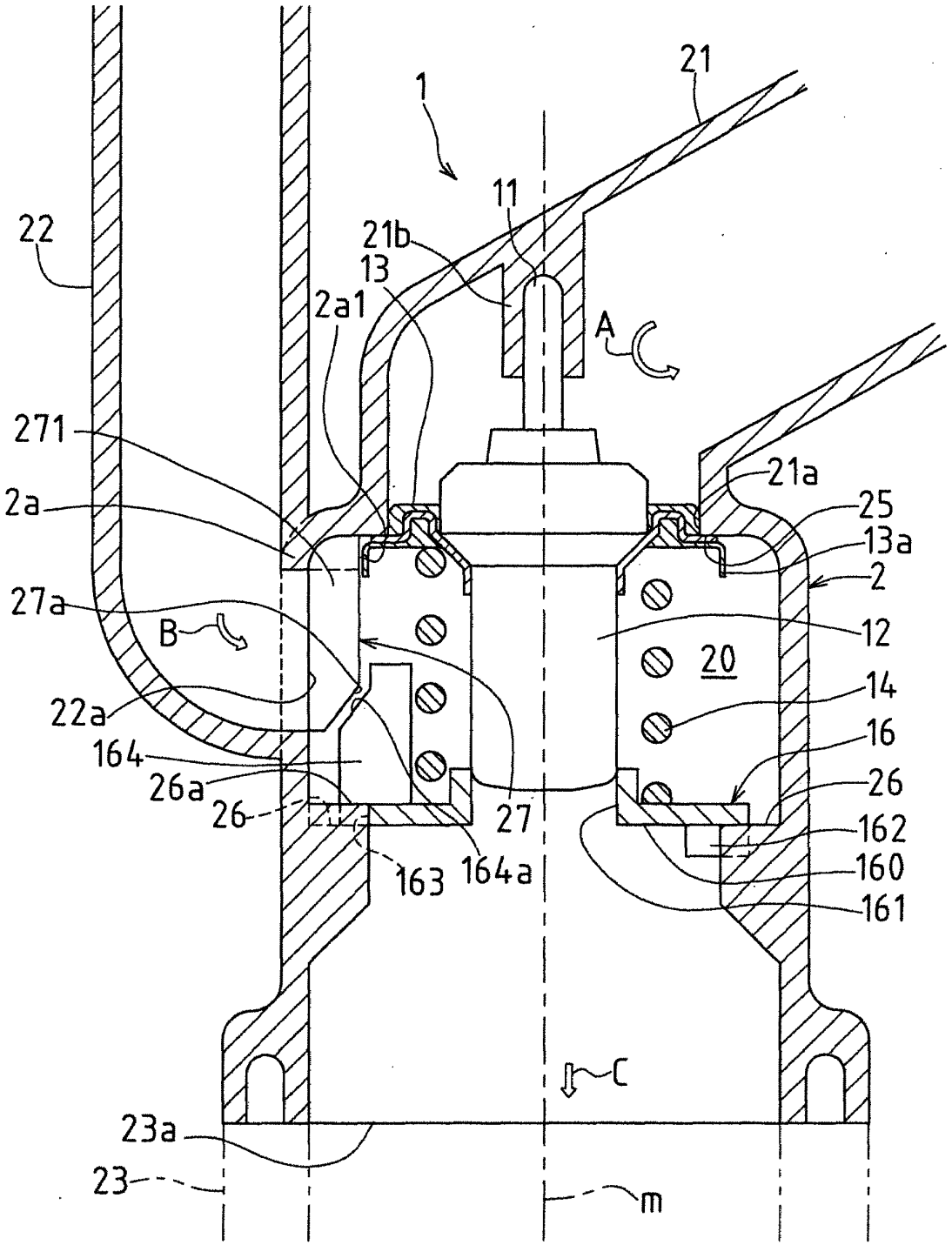

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164a
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FIG.7

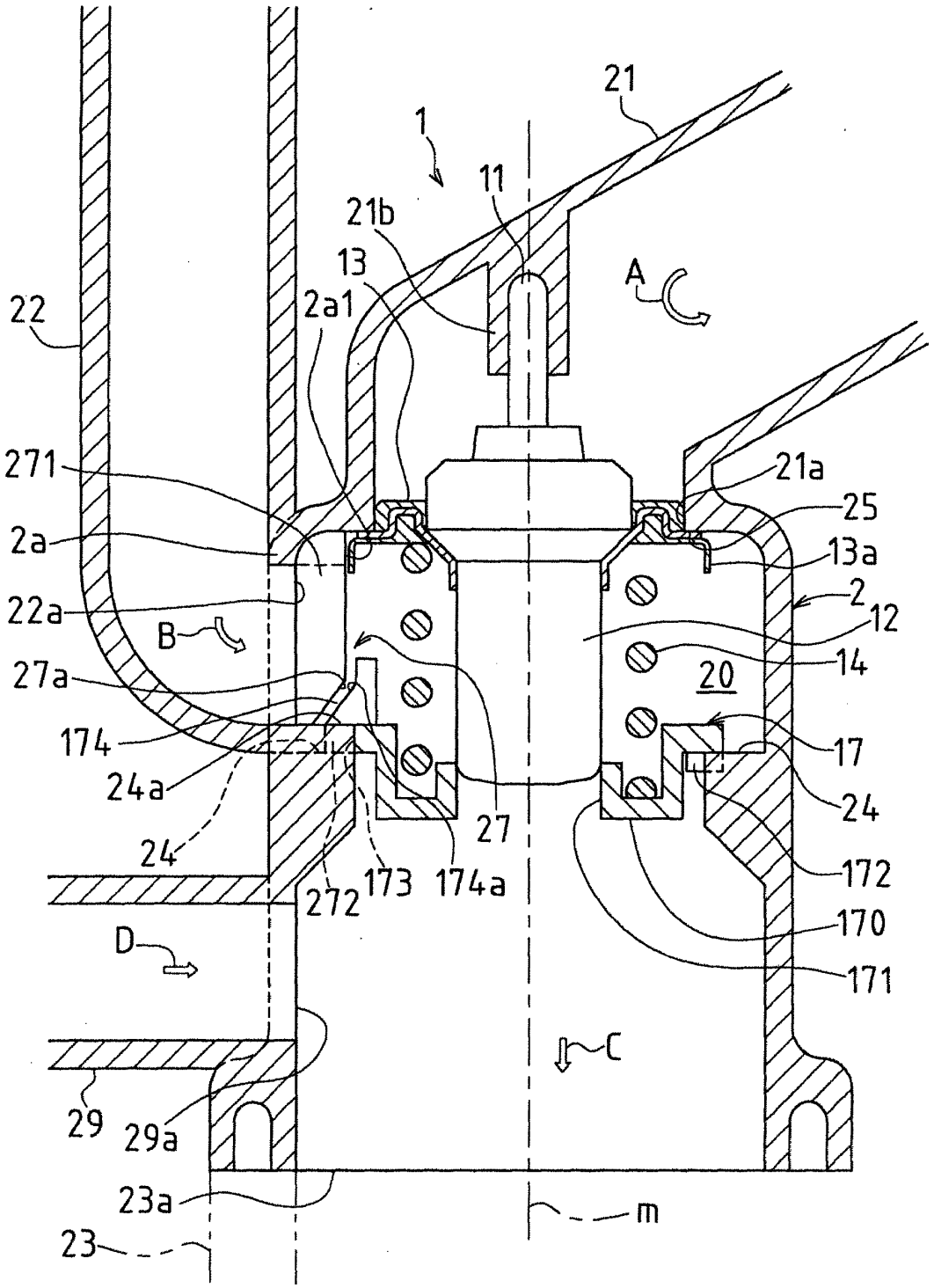

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FIG.8

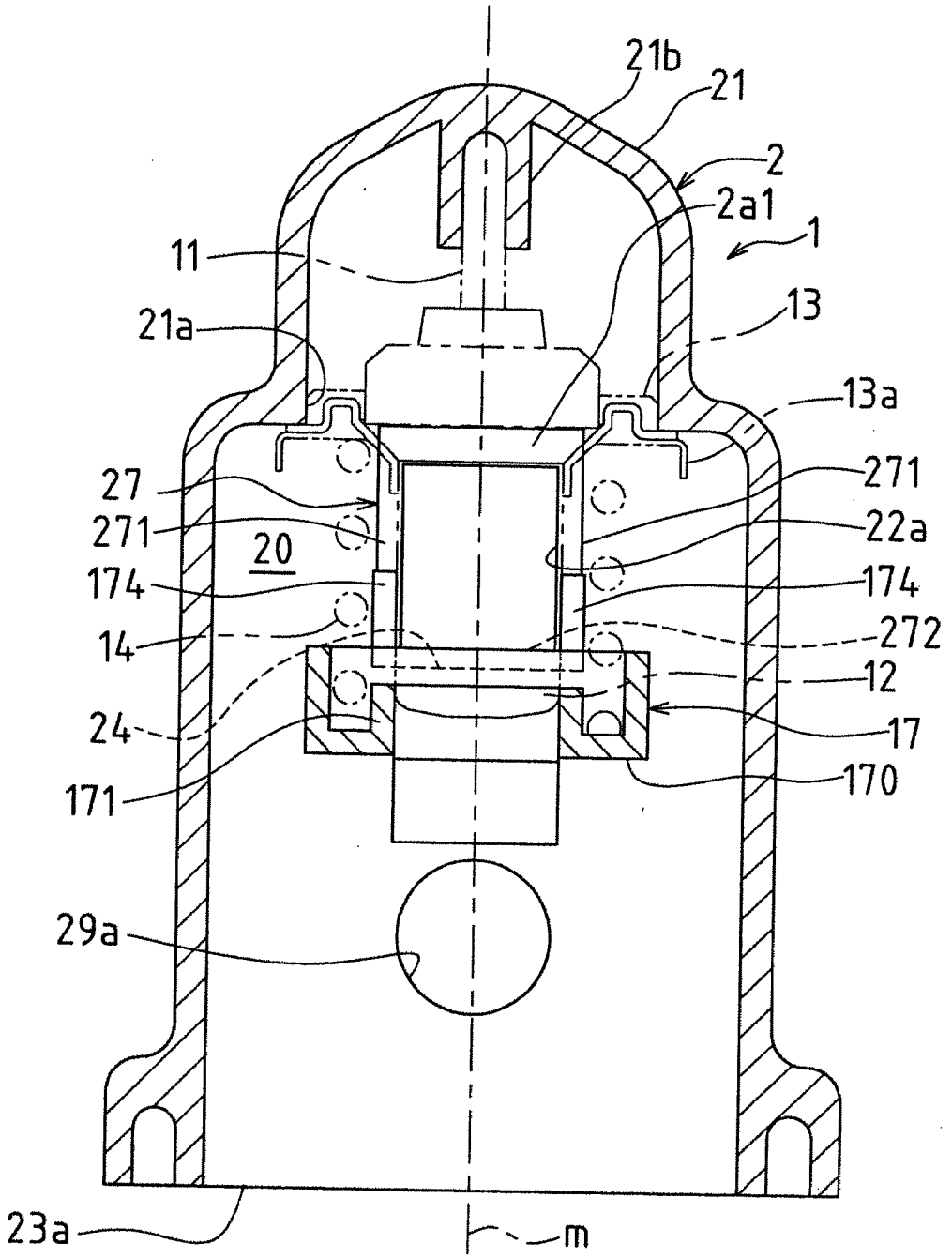

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FIG.9

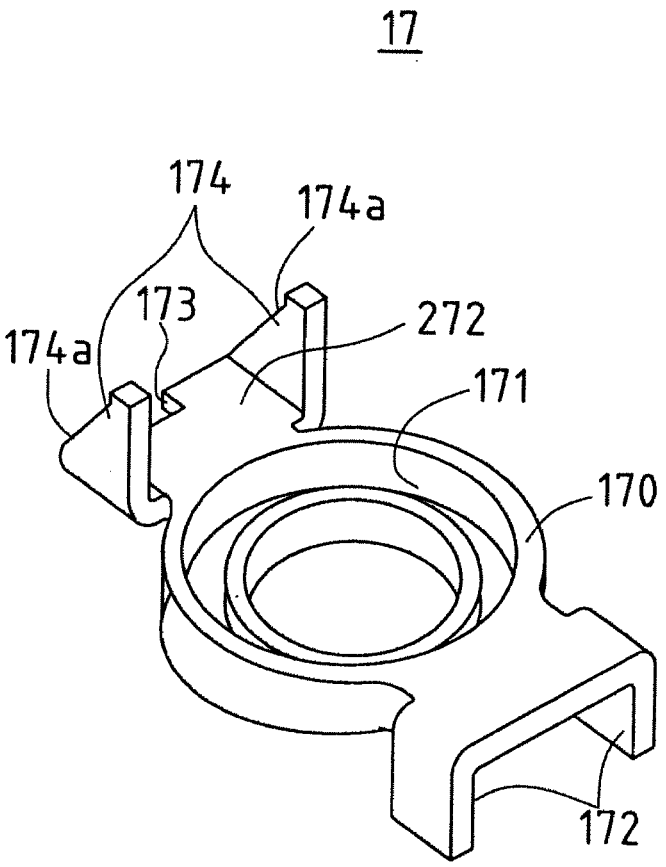


FIG.10

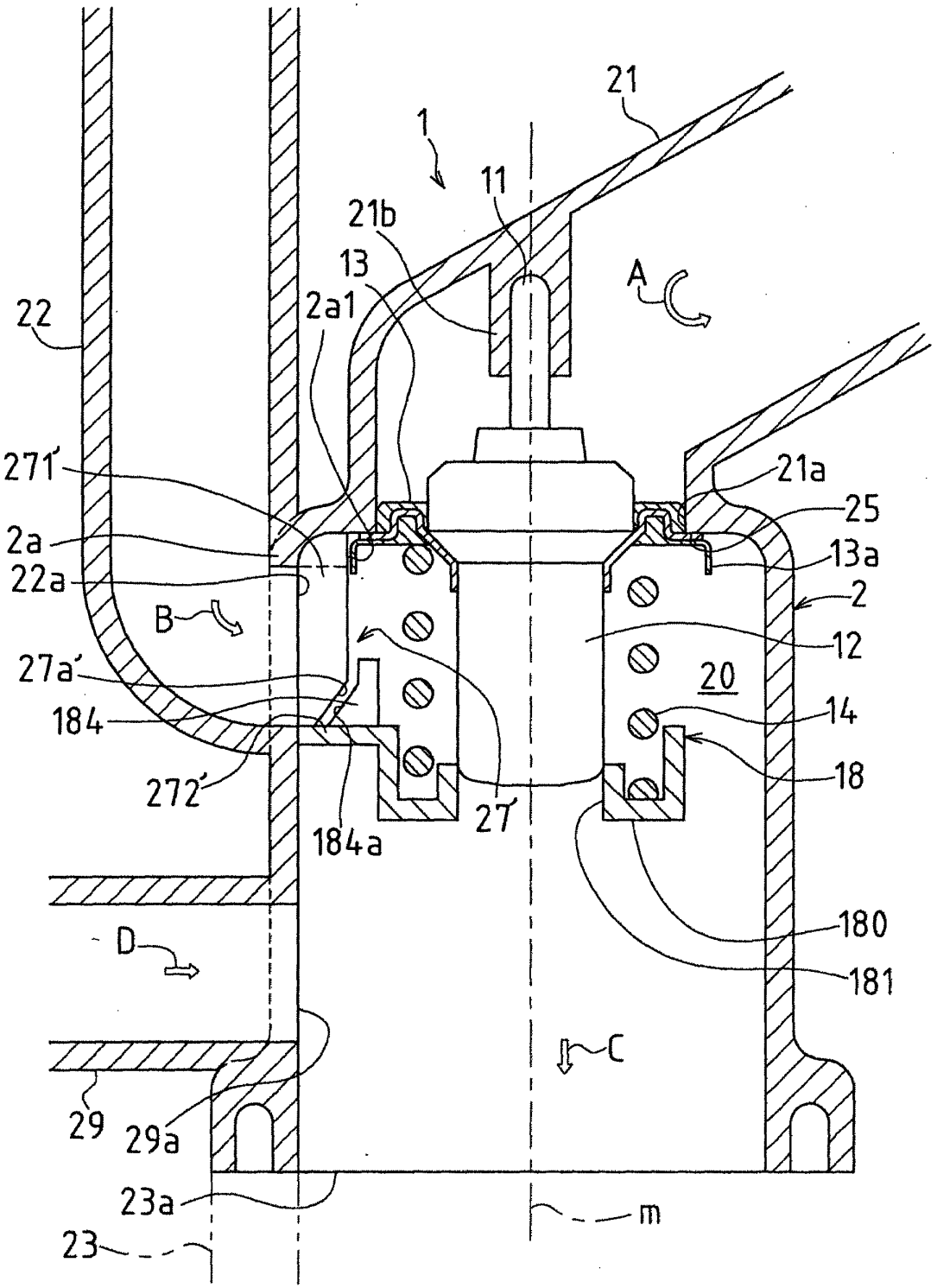

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13a
22a
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B
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272'
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27'
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180
D
181
C
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29a
23a
m
23

FIG.11

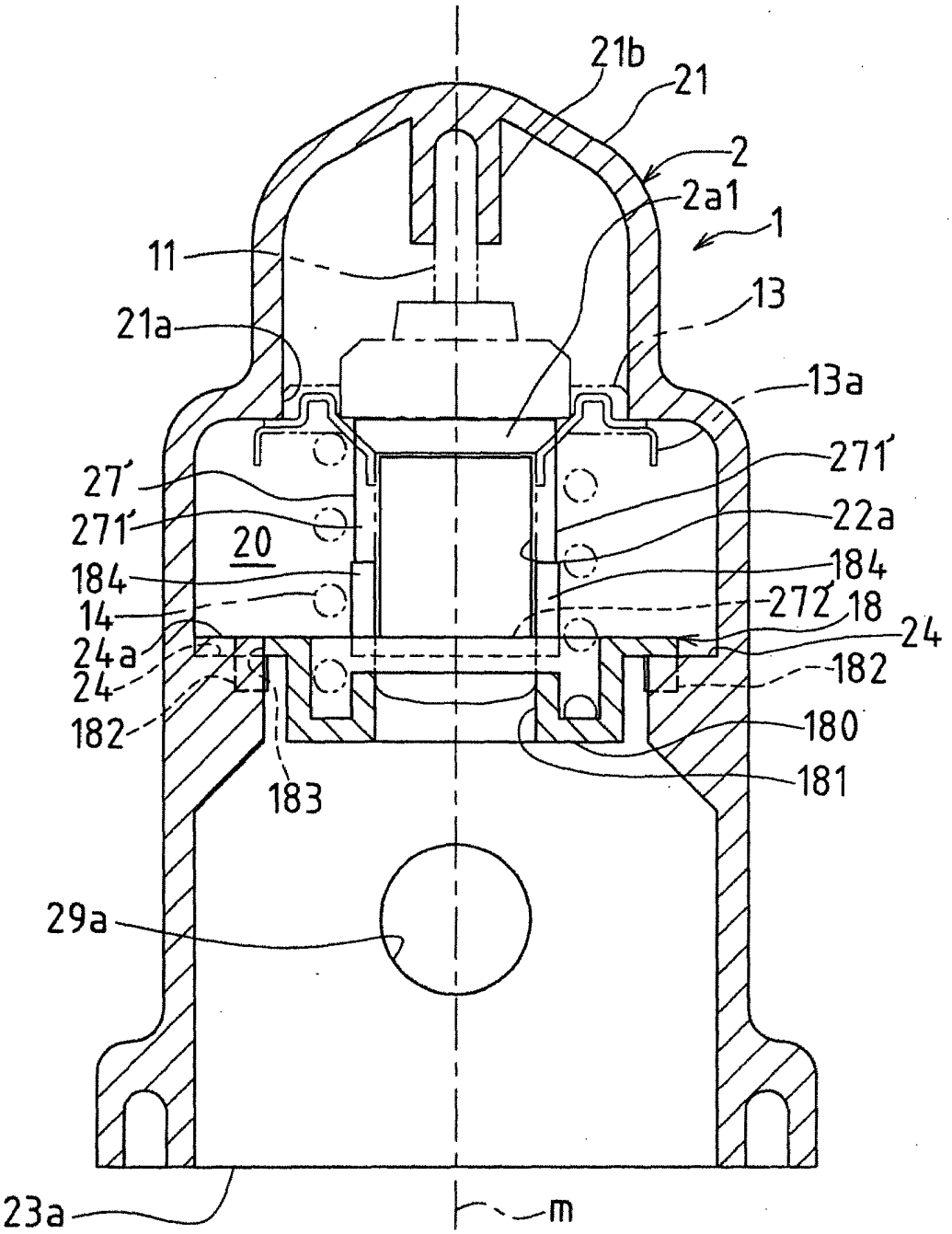

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13a
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27'
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272'
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29a
23a
m

FIG.12

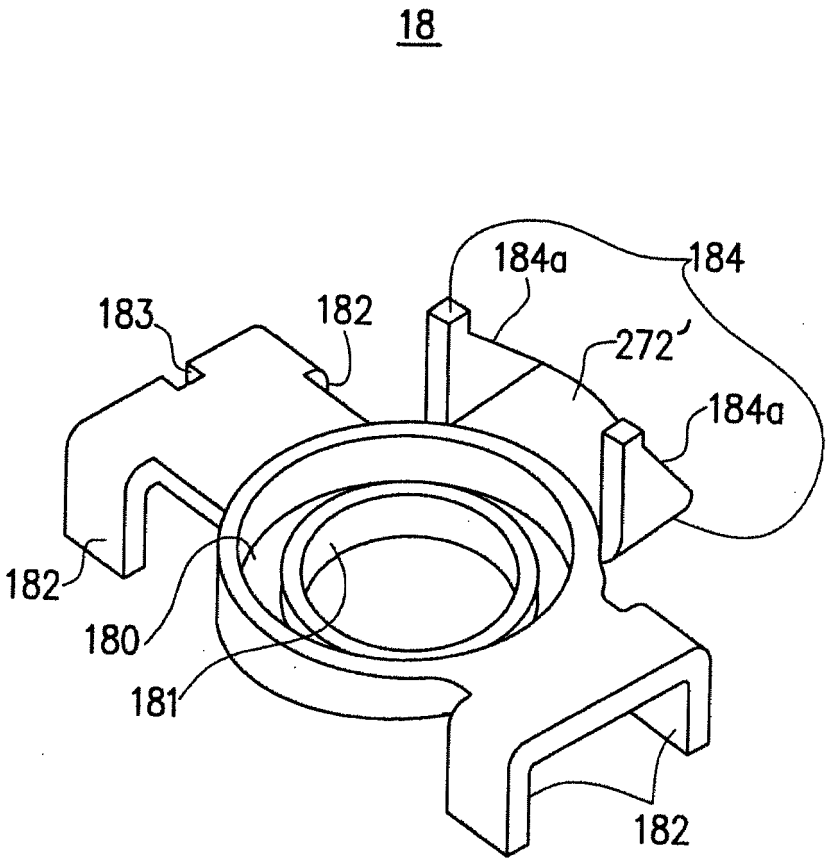
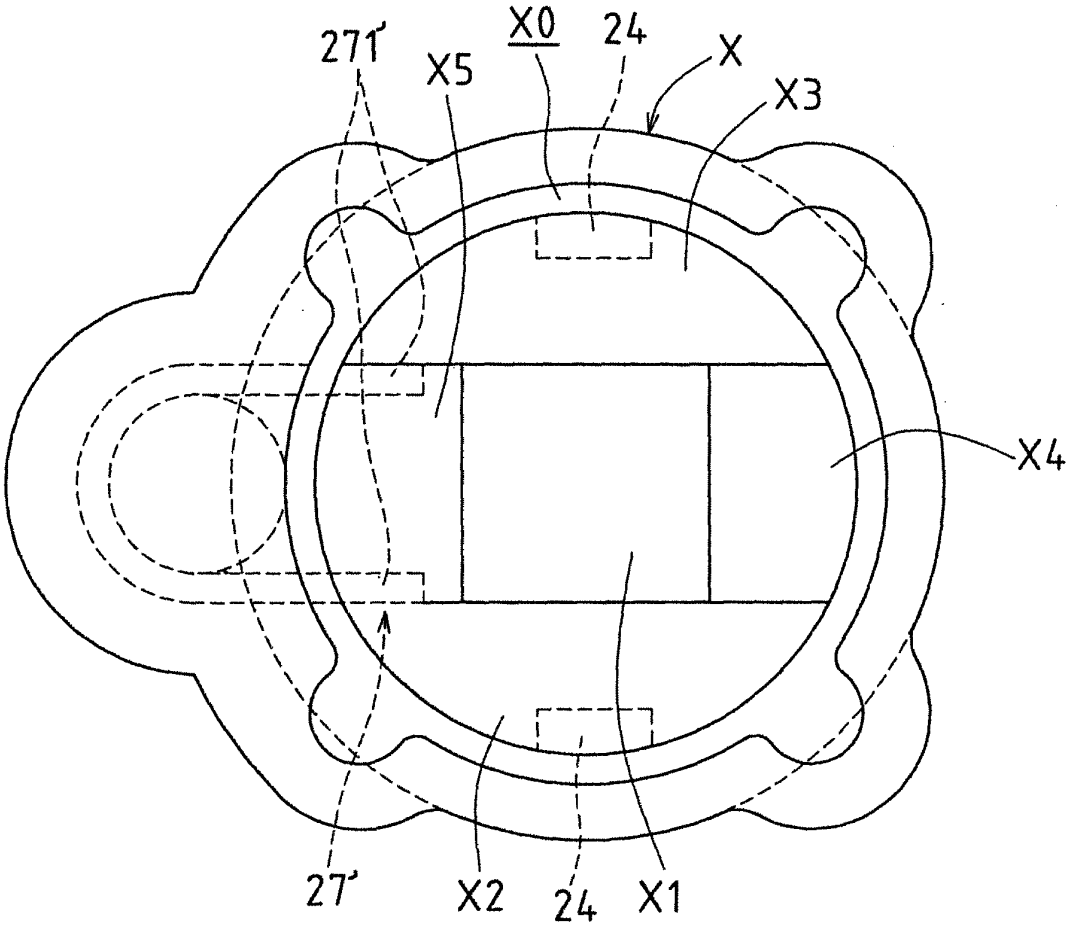


FIG.13



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/052730

A. CLASSIFICATION OF SUBJECT MATTER
F01P7/16(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01P7/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2009
Kokai Jitsuyo Shinan Koho 1971-2009 Toroku Jitsuyo Shinan Koho 1994-2009

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2004-263587 A (Aisin Seiki Co., Ltd., Nippon Thermostat Co., Ltd.), 24 September, 2004 (24.09.04), Full text; Figs. 2, 6 & US 2004/0169090 A1 & DE 102004009713 A	1-9
Y	JP 2007-120380 A (Aisin Seiki Co., Ltd., Nippon Thermostat Co., Ltd.), 17 May, 2007 (17.05.07), Fig. 1 (Family: none)	1,3-9

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 May, 2009 (12.05.09)	26 May, 2009 (26.05.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2009/052730

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2007/108273 A1 (Fuji Seiko Ltd., Corea Electronics Corp.), 27 September, 2007 (27.09.07), Fig. 1 & EP 1998019 A1 & KR 10-0755264 B1 & CA 2646233 A	1-9
Y	JP 2005-169400 A (Ryobi Ltd.), 30 June, 2005 (30.06.05), Claim 1 (Family: none)	3-9

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008039311 A **[0074]**
- JP 2008130750 A **[0074]**