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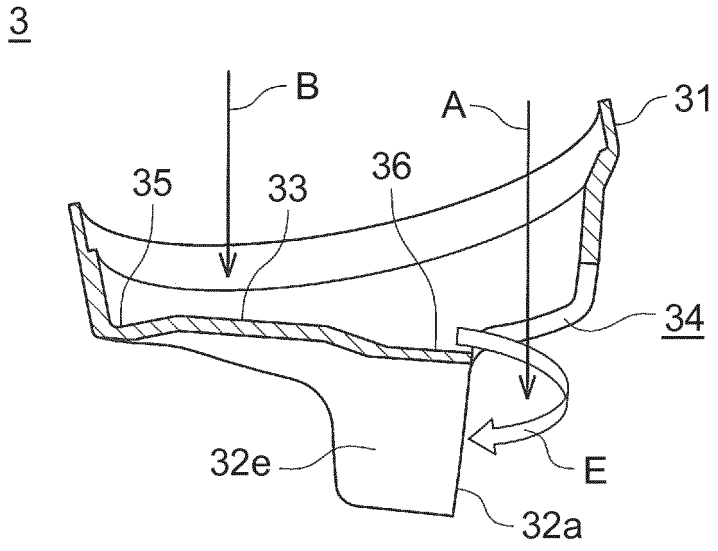
## (54) EXHAUST PIPE STRUCTURE

(57) An exhaust pipe structure includes a first exhaust pipe (21), a second exhaust pipe (44) and a coupling member (3). The coupling member (3) couples the first exhaust pipe (21) and the second exhaust pipe (44) via an opening (34) of the coupling member (3). The coupling member (3) has a groove (35) extending toward the opening (34) along an outer edge portion of a surface (facing the inside of the first exhaust pipe (21)) of a bottom plate portion (33) shaped to correspond to a region where the first and second exhaust pipes (21, 44) overlap each other.

FIG. 7

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## Description

BACKGROUND OF THE DISCLOSURE

1. Field of the Disclosure

**[0001]** The disclosure relates to an exhaust pipe structure that constitutes an exhaust system of an internal combustion engine.

2. Description of Related Art

**[0002]** A known configuration in which exhaust pipes extending in different directions are coupled together has been employed to make an exhaust system more compact.

**[0003]** FIG. 4 of Japanese Patent Application Publication No. 2013-185529 (JP 2013-185529 A) illustrates a configuration in which a first exhaust pipe (referred to as "first casing" in JP 2013-185529 A) extending along a first direction and a second exhaust pipe (referred to as "second casing" in JP 2013-185529 A) disposed downstream of the first exhaust pipe in an exhaust gas flow direction and extending along a second direction perpendicular to the first direction are coupled together via a coupling member (referred to as "communication passage" in JP 2013-185529 A). A diesel particulate filter (DPF) and a selective reduction catalyst are disposed inside these exhaust pipes.

SUMMARY

**[0004]** To make an exhaust system more compact, a configuration as schematically illustrated in FIG. 9 may be employed. In the configuration in FIG. 9, a first exhaust pipe 100 and a second exhaust pipe 200 are coupled together such that an upstream end portion of the second exhaust pipe 200 is inserted into a downstream end portion of the first exhaust pipe 100, that is, such that the first exhaust pipe 100 and the second exhaust pipe 200 overlap each other as viewed from a direction in which the first exhaust pipe 100 extends. Thus, the exhaust system can be made more compact by an amount corresponding to the insertion dimension (dimension "t" in FIG. 9). For example, when the right-left direction in FIG. 9 coincides with the vehicle-width direction, the dimension of the exhaust system in the vehicle-width direction can be decreased. In the configuration illustrated in FIG. 9, a NOx storage reduction (NSR) catalyst 101 is disposed inside the first exhaust pipe 100, and a diesel particulate filter (DPF) 201 is disposed inside the second exhaust pipe 200.

**[0005]** In this case, however, the exhaust gas flow passage area at a coupling site where the first exhaust pipe 100 and the second exhaust pipe 200 are coupled together (the exhaust gas flow passage area at a site "s" in FIG. 9) is decreased by an amount corresponding to the insertion dimension. Therefore, simply employing the configuration in which the first and second exhaust pipes 100, 200 are coupled together such that the upstream end portion of the second exhaust pipe 200 is inserted into the downstream end portion of the first exhaust pipe 100 may lower the exhaust gas discharging performance at the coupling site, thereby causing an increase in pressure inside the exhaust pipe.

**[0006]** The disclosure provides an exhaust pipe structure in which exhaust pipes extending in different directions are coupled together, the exhaust pipe structure making it possible to inhibit an increase in pressure of the exhaust gas at a coupling site where the exhaust pipes are coupled together.

**[0007]** An example of the disclosure relates to an exhaust pipe structure including a first exhaust pipe extending along a first direction, a second exhaust pipe disposed downstream of the first exhaust pipe in an exhaust gas flow direction and extending along a second direction, the second direction intersecting the first direction, and a coupling member configured to couple the first exhaust pipe and the second exhaust pipe together such that the first exhaust pipe and the second exhaust pipe overlap each other as viewed from the first direction. The coupling member has an opening, the inside of the first exhaust pipe communicates with the inside of the second exhaust pipe via the opening. The coupling member includes a bottom plate portion, the bottom plate portion shaped so as to correspond to a region where the first exhaust pipe and the second exhaust pipe overlap each other as viewed from the first direction and that is adjacent to the opening as viewed from the first direction. The coupling member has a groove defined in a surface of the bottom plate portion. The surface of the bottom plate portion faces the inside of the first exhaust pipe. The groove extends along an outer edge portion of the bottom plate portion toward the opening.

**[0008]** With this configuration, a part of the exhaust gas that has flowed from the first exhaust pipe into the coupling member flows along the groove defined in the bottom plate portion of the coupling member, and flows from the groove through the opening into the second exhaust pipe. In other words, the flow of exhaust gas is guided by the groove. Thus, even when the first exhaust pipe and the second exhaust pipe are coupled together so as to overlap each other, it is possible to secure favorable exhaust gas discharging performance at the coupling site and to suppress an increase in pressure of the exhaust gas at the coupling site.

**[0009]** In the above exhaust pipe structure, a first exhaust gas control apparatus may be disposed inside the first exhaust pipe, and a second exhaust gas control apparatus may be disposed inside the second exhaust pipe, in the region where the first exhaust pipe and the second exhaust pipe overlap each other as viewed from the first direction.

**[0010]** Thus, it is possible to effectively use the inside of the second exhaust pipe, in the region where the first exhaust pipe and the second exhaust pipe overlap each

other as viewed from the first direction, as the installation space for the second exhaust gas control apparatuses, as well as to improve the exhaust gas clean-up performance by installing the two exhaust gas control apparatuses.

**[0011]** In the above exhaust pipe structure, the coupling member may be molded by lost-wax casting of stainless steel.

**[0012]** Thus, it is possible to enhance the flexibility of the shape of the coupling member and to improve the corrosion resistance of the coupling member.

**[0013]** In the above configuration, the first exhaust pipe and the second exhaust pipe extending in different directions are coupled together via the coupling member so as to overlap each other, and the groove that guides the flow of exhaust gas is defined in the bottom plate portion of the coupling member. Thus, it is possible to make the exhaust system more compact and to inhibit an increase in pressure of the exhaust gas at the coupling site.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0014]** Features, advantages, and technical and industrial significance of disclosed embodiments will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is a view of an exhaust system including maniverters and their vicinity as viewed from the rear side of a vehicle;

FIG. 2 is a view of the exhaust system as viewed from the direction of an arrow II in FIG. 1;

FIG. 3 is a view of the exhaust system as viewed from the direction of an arrow III in FIG. 1;

FIG. 4 is a front view of a coupling member;

FIG. 5 is a plan view of the coupling member;

FIG. 6 is a view illustrating a region where a first exhaust pipe and a second exhaust pipe overlap each other;

FIG. 7 is a sectional view taken along the line VII-VII in FIG. 5;

FIG. 8 is a sectional view of a site where the exhaust pipes are coupled together via the coupling member; and

FIG. 9 is a sectional view schematically illustrating the configuration in which an upstream end portion of a second exhaust pipe is inserted into a downstream end portion of a first exhaust pipe.

## DETAILED DESCRIPTION OF EMBODIMENTS

**[0015]** Hereinafter, a disclosed embodiment will be described with reference to the accompanying drawings. In the embodiment described below, the disclosure is applied to an exhaust system of a diesel engine (internal combustion engine) mounted in a vehicle.

**[0016]** FIG. 1 is a view of an exhaust system including maniverters (closed coupled converters) and their vicinity as viewed from the rear side of a vehicle. FIG. 2 is a view of the exhaust system as viewed from the direction of an arrow II in FIG. 1 (as viewed from above). FIG. 3 is a view of the exhaust system as viewed from the direction of an arrow III in FIG. 1 (as viewed from the right side of the vehicle).

**[0017]** As illustrated in these drawings, in the exhaust system, a manifold connection pipe 1, a first maniverter 2, a coupling member 3, and a second maniverter 4 are arranged in this order from the upstream side toward the downstream side in an exhaust gas flow direction.

**[0018]** The manifold connection pipe 1 is a stainless-steel pipe that couples together an exhaust manifold (not illustrated) and the first maniverter 2. An upstream portion of the manifold connection pipe 1 in the exhaust gas flow direction extends in a substantially horizontal direction (vehicle-width direction), whereas a downstream portion of the manifold connection pipe 1 in the exhaust gas flow direction is bent so as to extend in a substantially vertical direction (more specifically, in a direction inclined with respect to the vertical direction at a prescribed inclination angle (e.g., approximately 15°)).

**[0019]** An upstream end portion of the manifold connection pipe 1 in the exhaust gas flow direction is provided with a flange 11. The flange 11 is connected to the exhaust manifold (not illustrated). In the case of an engine equipped with a turbocharger, the flange 11 is connected to a turbine housing of the turbocharger (not illustrated).

**[0020]** The first maniverter 2 includes a generally cylindrical first exhaust pipe 21 and a NOx storage reduction (NSR) catalyst 22 (see dashed lines in FIG. 1) housed inside the first exhaust pipe 21.

**[0021]** The first exhaust pipe 21 is made of stainless steel, and extends along the direction in which the downstream portion of the manifold connection pipe 1 in the exhaust gas flow direction extends. The direction in which the first exhaust pipe 21 extends (the direction along a center line O1 of the first exhaust pipe 21 (see FIG. 1)) is an example of "first direction".

**[0022]** The outer diameter of an upstream end portion of the first exhaust pipe 21 in the exhaust gas flow direction is substantially equal to the inner diameter of a downstream end portion of the manifold connection pipe 1 in the exhaust gas flow direction. The upstream end portion of the first exhaust pipe 21 in the exhaust gas flow direction is inserted into the downstream end portion of the manifold connection pipe 1 in the exhaust gas flow direction. At the insertion site, the manifold connection pipe 1 and the first exhaust pipe 21 are joined together, for example, by welding. Multiple brackets (not illustrated) for securing the first maniverter 2 to, for example, a body of the vehicle are attached respectively to multiple positions on the outer peripheral surface of the first exhaust pipe 21.

**[0023]** The NSR catalyst 22 (an example of "first exhaust gas control apparatus") stores NOx in the exhaust gas flowing into the first maniverter 2 when the oxygen

concentration in the exhaust gas is high, whereas the NSR catalyst 22reduces the stored NOx when the oxygen concentration in the exhaust gas flowing into the first maniverter 2 is decreased and there is a reducing agent. Thus, HC, CO, and NOx in the exhaust gas are removed.

**[0024]** The second maniverter 4 includes an exhaust pipe unit 41, and a NOx storage reduction (NSR) catalyst 42 and a diesel particulate filter (DPF) 43 (see dashed lines in FIG. 1) that are housed inside the exhaust pipe unit 41.

**[0025]** The exhaust pipe unit 41 includes a second exhaust pipe 44, a first side cover 45, and a second side cover 46, all of which are made of stainless steel.

**[0026]** The second exhaust pipe 44 is a cylindrical pipe that extends in a substantially horizontal direction (vehicle-width direction). The direction (substantially horizontal direction) in which the second exhaust pipe 44 extends is an example of "second direction". In other words, the second exhaust pipe 44 extends along the second direction that intersects the first direction.

**[0027]** The outer diameter of the second exhaust pipe 44 is set larger than the outer diameter of the first exhaust pipe 21 of the first maniverter 2. The NSR catalyst (an example of "second exhaust gas control apparatus") 42 housed inside the second exhaust pipe 44, is disposed upstream of the DPF 43 in the exhaust gas flow direction. The DPF 43 is also housed inside the second exhaust pipe 44.

**[0028]** The NSR catalyst 42 housed inside the second exhaust pipe 44 is larger than the NSR catalyst 22 included in the first maniverter 2. The function of the NSR catalyst 42 is the same as that of the NSR catalyst 22 included in the first maniverter 2. The DPF 43 is, for example, a porous ceramic structural body, and traps particulate matter (PM) contained in the exhaust gas when the exhaust gas passes through a porous wall.

**[0029]** The second exhaust pipe 44 has a feature that an upstream end portion of the second exhaust pipe 44 in the exhaust gas flow direction overlaps the first exhaust pipe 21. That is, as viewed from the direction in which the first exhaust pipe 21 extends (as viewed from the first direction), the first exhaust pipe 21 and the upstream end portion of the second exhaust pipe 44 in the exhaust gas flow direction overlap each other. More specifically, the first and second exhaust pipes 21, 44 overlap each other (overlap each other as viewed from the first direction) such that the center line O1 of the first exhaust pipe 21 intersects the outer peripheral surface of the second exhaust pipe 44. The NSR catalyst 42 is housed inside the second exhaust pipe 44, at the upstream end portion of the second exhaust pipe 44 in the exhaust gas flow direction. Thus, the center line O1 of the first exhaust pipe 21 intersects also the outer peripheral surface of the NSR catalyst 42. That is, a part of the NSR catalyst 42 is disposed inside the second exhaust pipe 44, in a region where the first exhaust pipe 21 and the second exhaust pipe 44 overlap each other as viewed from the first direction.

**[0030]** Multiple brackets (not illustrated) for securing the second maniverter 4 to, for example, the body of the vehicle are attached respectively to multiple positions on the outer peripheral surface the second exhaust pipe 44.

**[0031]** The first side cover 45 is disposed across the coupling member 3 (described later) and the second exhaust pipe 44, and defines an exhaust gas flow space between the coupling member 3 and the second exhaust pipe 44. The joint structure of the first side cover 45, the coupling member 3, and the second exhaust pipe 44 will be described later.

**[0032]** The second side cover 46 covers an opening at a downstream end portion of the second exhaust pipe 44 in the exhaust gas flow direction. The second side cover 46 includes an exhaust pipe connection portion 46a (see FIG. 2 and FIG. 3), and a downstream-side exhaust pipe 5 is connected to the exhaust pipe connection portion 46a. The downstream-side exhaust pipe 5 extends from the exhaust pipe connection portion 46a along the vehicle-width direction (extends rightward in FIG. 1), and is then bent toward the rear side of the vehicle.

**[0033]** The coupling member 3 is a stainless-steel member that couples together the first exhaust pipe 21 of the first maniverter 2 and the exhaust pipe unit 41 of the second maniverter 4. The coupling member 3 is molded by lost-wax casting of stainless steel.

**[0034]** An example of lost-wax casting will be described below. First, wax is poured into a die to create a wax model, a coating is applied to the model, and the model is dried sufficiently to produce a mold. The mold is heated to cause the wax inside the coating to melt and flow out, so that a cavity is created. Then, the mold is finished by being baked and solidified in a kiln. After that, molten metal is injected into the finished mold, and the mold is cooled to produce a cast product (the coupling member 3).

**[0035]** FIG. 4 is a front view of the coupling member 3 (as viewed from the rear side of the vehicle as in the case of FIG. 1). FIG. 5 is a plan view of the coupling member 3 (as viewed from the first direction). FIG. 7 is a sectional view taken along the line VII-VII in FIG. 5. FIG. 8 is a sectional view illustrating a site where the first and second exhaust pipes 21, 44 are coupled together via the coupling member 3.

**[0036]** As illustrated in these drawings, the coupling member 3 includes a first exhaust pipe joint portion 31, a vertical wall portion 32, and a bottom plate portion 33.

**[0037]** The first exhaust pipe joint portion 31 is a generally cylindrical portion that is relatively short in the height direction. The inner diameter of the first exhaust pipe joint portion 31 is substantially equal to the outer diameter of a downstream end portion of the first exhaust pipe 21 in the exhaust gas flow direction. The downstream end portion of the first exhaust pipe 21 in the exhaust gas flow direction is inserted into the first exhaust pipe joint portion 31. At the insertion site, the first exhaust pipe 21 and the coupling member 3 (the first exhaust pipe

joint portion 31) are joined together, for example, by welding.

**[0038]** The vertical wall portion 32 is contiguous with the lower side of the first exhaust pipe joint portion 31. The vertical wall portion 32 includes a front vertical wall portion 32a (see FIG. 5) and a rear vertical wall portion 32b (see FIG. 1 and FIG. 5) disposed rearward of the front vertical wall portion 32a in the vehicle front-rear direction. The inner surfaces of the front vertical wall portion 32a and rear vertical wall portion 32b (the inner surfaces that face the outer peripheral surface of the second exhaust pipe 44 when the coupling member 3 and the second exhaust pipe 44 are joined together; in FIG. 7, the inner surface of the front vertical wall portion 32a is indicated by a reference sign 32e) are shaped so as to conform to the outer peripheral surface of the second exhaust pipe 44. The inner surfaces 32e of the front vertical wall portion 32a and rear vertical wall portion 32b are overlapped with (placed on) the outer peripheral surface of the second exhaust pipe 44. At the overlapping site, the coupling member 3 (the vertical wall portions 32a, 32b of the coupling member 3) and the second exhaust pipe 44 are joined together, for example, by welding.

**[0039]** As illustrated in FIG. 4, the coupling member 3 have no vertical wall portion 32 on its right side in the vehicle-width direction. That is, a portion below a lower edge (lower edge 31a in FIG. 4) of a right side portion of the first exhaust pipe joint portion 31 in the vehicle-width direction is open toward the right side of the vehicle. Thus, the portion below the lower edge 31a is an opening 34 that is open toward the right side of the vehicle. The opening 34 is used as a space through which the exhaust gas that has flowed into the coupling member 3 flows toward the second maniverter 4. In other words, the opening 34 provides communication between the inside of the first exhaust pipe 21 and the inside of the second exhaust pipe 44.

**[0040]** The edge portions of the front vertical wall portion 32a and rear vertical wall portion 32b, the edge portions being closer to the opening 34, are used as joint portions 32c, 32d each having a generally flat outer surface to which the first side cover 45 of the second maniverter 4 is joined.

**[0041]** As illustrated in FIG. 5, the bottom plate portion 33 is disposed in the internal space of the first exhaust pipe joint portion 31, and is made of a plate material shaped so as to conform to the outer peripheral surface of the upstream end portion of the second exhaust pipe 44 (indicated by imaginary lines in FIG. 5) in the exhaust gas flow direction. Specifically, as illustrated in FIG. 5, the bottom plate portion 33 is made of a plate material shaped so as to correspond to a region that is adjacent to the opening 34 and where the first exhaust pipe 21 and the second exhaust pipe 44 overlap each other as viewed from the first direction. Thus, the bottom plate portion 33 is shaped so as to have an edge 33a facing the opening 34 and a generally arc-shaped outer edge 33b connected to the inner surface of the first exhaust pipe joint portion 31.

**[0042]** The region where the first exhaust pipe 21 and the second exhaust pipe 44 overlap each other is a region indicated by the dashed oblique lines in FIG. 6 (view illustrating the first exhaust pipe 21 and the second exhaust pipe 44 as viewed from the first direction, and indicating the coupling member 3 by imaginary lines). The bottom plate portion 33 has a shape that generally coincides with the shape of this region.

**[0043]** As illustrated in FIG. 1 and FIG. 8, and as can be seen from FIG. 4 and FIG. 5 indicating the second exhaust pipe 44 by the imaginary lines, in a state where the coupling member 3 and the second exhaust pipe 44 are joined together, the bottom plate portion 33 is overlapped with the upper surface of the second exhaust pipe 44, and, at this overlapping site as well, the coupling member 3 and the second exhaust pipe 44 are joined together.

**[0044]** As illustrated in FIG. 8, the first side cover 45 is joined to both the second exhaust pipe 44 and the coupling member 3. Specifically, the first side cover 45 covers the opening 34 of the coupling member 3 and an opening of the upstream end portion of the second exhaust pipe 44 in the exhaust gas flow direction. The first side cover 45 has an outer edge portion overlapped with the first exhaust pipe joint portion 31 and vertical wall portions 32a, 32b (joint portions 32c, 32d of the vertical wall portions 32a, 32b) of the coupling member 3 and an opening edge portion of the upstream end portion of the second exhaust pipe 44 in the exhaust gas flow direction. At the overlapping site, the first side cover 45 is joined to the coupling member 3 and the second exhaust pipe 44, for example, by welding. Thus, the internal space of the coupling member 3 and the internal space of the second exhaust pipe 44 communicate with each other through the space defined between the opening 34 of the coupling member 3 and the first side cover 45.

**[0045]** As illustrated in FIG. 5 and FIG. 7, the coupling member 3 has a feature that the bottom plate portion 33 of the coupling member 3 has a groove 35 that extends along the outer edge portion (the outer edge 33b) of the bottom plate portion 33 toward the opening 34.

**[0046]** Specifically, the outer edge portion of the bottom plate portion 33, that is, the region of the bottom plate portion 33 extending along the generally arc-shaped outer edge 33b connected to the inner surface of the first exhaust pipe joint portion 31, is depressed downward with respect to the other region of the bottom plate portion 33, and the depressed portion serves as the groove 35. That is, the sectional shape of the groove 35 at a position of the section illustrated in FIG. 7 continues to the opening 34 along the upper surface (surface facing the inside of the first exhaust pipe 21) of the bottom plate portion 33 (see FIG. 5).

**[0047]** Because the groove 35 is formed in the bottom plate portion 33 in the above-described manner, a part of the exhaust gas that has flowed from the first exhaust pipe 21 of the first maniverter 2 into the coupling member

3 flows along the groove 35 (the flow of the exhaust gas is guided through the groove 35), and flows from the open ends (the portion facing the opening 34) of the groove 35 through the opening 34 into the second maniverter 4.

**[0048]** The exhaust pipe structure according to the present embodiment is configured as described above.

**[0049]** Next, the flow of exhaust gas during an operation of the engine will be described.

**[0050]** The exhaust gas discharged from the engine flows into the first maniverter 2 through the exhaust manifold and the manifold connection pipe 1. The exhaust gas that has flowed into the first maniverter 2 is cleaned up by the NSR catalyst 22 and then flows into the coupling member 3.

**[0051]** A part of the exhaust gas that has flowed into the coupling member 3 flows inside the coupling member 3, in a relatively right side region in the vehicle-width direction. The exhaust gas flowing in the relatively right side region flows along the center line O1 of the first exhaust pipe 21 (along the first direction), and flows inside the coupling member 3 toward the opening 34. Thus, the exhaust gas flowing in the relatively right side region passes directly through the opening 34 and flows toward the second maniverter 4, as indicated by an arrow A in FIG. 7 and FIG. 8. That is, this exhaust gas passes through the opening 34 after flowing downward inside the coupling member 3, and then the flow direction thereof is changed to the horizontal direction (the direction toward the left side of the vehicle) along the shape of the inner surface of the first side cover 45, so that a flow of exhaust gas toward the NSR catalyst 42 and the DPF 43 is formed.

**[0052]** On the other hand, another part of the exhaust gas that has flowed into the coupling member 3 flows toward the bottom plate portion 33. The exhaust gas flowing toward the bottom plate portion 33 flows into the groove 35 along the bottom plate portion 33, as indicated by an arrow B in FIG. 5 and FIG. 8. As described above, the groove 35 extends along the outer edge portion of the bottom plate portion 33. That is, the groove 35 has an arc-shape extending toward the opening 34. Thus, the exhaust gas flowing along the groove 35 forms arc-shaped flows around the center line of the first exhaust pipe joint portion 31 of the coupling member 3, as indicated by an arrow C and an arrow D in FIG. 5. Then, this exhaust gas flows into the opening 34 from the open ends (the portions facing the opening 34) of the groove 35, and forms arc-shaped flows (forms arc-shaped flows as viewed from the first direction as illustrated in FIG. 5) that enter the second maniverter 4.

**[0053]** Specifically, as indicated by an arrow E in FIG. 5, FIG. 7, and FIG. 8, the exhaust gas that has flowed through a front side portion of the groove 35 in the vehicle front-rear direction (an upper side portion of the groove 35 in FIG. 5) passes through the opening 34 from the open end (the portion facing the opening 34) of the groove 35, and then flows into the second exhaust pipe 44 along a rear side portion of the inner surface (a portion of the inner surface on the rear side in the vehicle front-rear direction) of the second exhaust pipe 44 (flows into the second exhaust pipe 44 by coming around to the lower side of the bottom plate portion 33, as indicated by a dashed part of the arrow E in FIG. 5 and the arrow E in FIG. 7 and FIG. 8). On the other hand, as indicated by an arrow F in FIG. 5, the exhaust gas that has flowed through a rear side portion of the groove 35 in the vehicle front-rear direction (a lower side portion of the groove 35 in FIG. 5) passes through the opening 34 from the open end (the portion facing the opening 34) of the groove 35, and then flows into the second exhaust pipe 44 along a front side portion of the inner surface (a portion of the inner surface on the front side in the vehicle front-rear direction) of the second exhaust pipe 44 (flows into the second exhaust pipe 44 by coming around to the lower side of the bottom plate portion 33, as indicated by a dashed part of the arrow F in FIG. 5). Thus, the exhaust gas flows smoothly from the opening 34 into the second maniverter 4, and therefore favorable exhaust gas discharging performance is secured. As a result, it is possible to inhibit an increase in pressure of the exhaust gas at the coupling site where the first exhaust pipe 21 and the second exhaust pipe 44 are coupled together.

**[0054]** The exhaust gas that has flowed into the second maniverter 4 is cleaned up by the NSR catalyst 42 and the particulate matter in the exhaust gas is trapped by the DPF 43. After that, the exhaust gas is released into the atmosphere.

**[0055]** As described above, according to the present embodiment, it is possible to make the exhaust system more compact by coupling together the first and second exhaust pipes 21, 44 such that the first and second exhaust pipes 21, 44 overlap each other, and it is also possible to allow the exhaust gas to smoothly flow from the opening 34 into the second maniverter 4 by causing the exhaust gas to flow along the groove 35 defined in the bottom plate portion 33 of the coupling member 3. Thus, favorable exhaust gas discharging performance is secured, which makes it possible to inhibit an increase in pressure of the exhaust gas at the coupling site where the first exhaust pipe 21 and the second exhaust pipe 44 are coupled together. As a result, the engine performance is sufficiently delivered. As described above, the exhaust gas flowing from the coupling member 3 into the second maniverter 4 forms arc-shaped flows, so that the exhaust gas mixing performance is improved and unevenness in each of the flow velocity and temperature of the exhaust gas is reduced. This also makes it possible to secure favorable exhaust gas discharging performance.

**[0056]** In the present embodiment, the NSR catalyst 42 is disposed inside the second exhaust pipe 44, in the region where the first exhaust pipe 21 and the second exhaust pipe 44 overlap each other as viewed from the first direction. Thus, it is possible to effectively use the overlapping site as an installation space for the NSR catalyst 42, as well as to improve the exhaust gas clean-up

performance by providing the two NSR catalysts 22, 42.

**[0057]** The coupling member 3 according to the present embodiment is molded by lost-wax casting of stainless steel. This makes it possible to enhance the flexibility of the shape of the coupling member 3 and to improve the corrosion resistance of the coupling member 3.

**[0058]** In the above-described embodiment, the coupling member 3 is molded by lost-wax casting of stainless steel. However, the material and the production method of the coupling member 3 are not limited to those in the above-described embodiment, and any appropriate materials and production methods may be employed.

**[0059]** In the above-described embodiment, the disclosure is applied to the exhaust system of the diesel engine mounted in the vehicle. However, the disclosure may be applied to exhaust systems of engines mounted in machines other than vehicles. Moreover, the disclosure may be applied to exhaust systems of gasoline engines instead of exhaust systems of diesel engines.

**[0060]** The exhaust gas control apparatuses to be housed in the maniverters 2, 4 are not limited to those in the above-described embodiment. For example, a selective reduction catalyst (SCR catalyst), a three way catalyst may be used.

## Claims

1. An exhaust pipe structure **characterized by** comprising:

   a first exhaust pipe (21) extending along a first direction;
   a second exhaust pipe (44) disposed downstream of the first exhaust pipe (21) in an exhaust gas flow direction, the second exhaust pipe (44) extending along a second direction, the second direction intersecting the first direction; and
   a coupling member (3) configured to couple the first exhaust pipe (21) and the second exhaust pipe (44) together such that the first exhaust pipe (21) and the second exhaust pipe (44) overlap each other as viewed from the first direction,
   the coupling member (3) having an opening (34), an inside of the first exhaust pipe (21) communicate with an inside of the second exhaust pipe (44) via the opening (34),
   the coupling member (3) including a bottom plate portion (33), the bottom plate portion (33) shaped so as to correspond to a region where the first exhaust pipe (21) and the second exhaust pipe (44) overlap each other as viewed from the first direction, the region being adjacent to the opening (34) as viewed from the first direction, and
   the coupling member (3) having a groove (35) defined in a surface of the bottom plate portion (33), the surface of the bottom plate portion (33) facing the inside of the first exhaust pipe (21), and the groove (35) extending along an outer edge portion of the bottom plate portion (33) toward the opening (34).

2. The exhaust pipe structure according to claim 1, wherein
   a first exhaust gas control apparatus (22) is disposed inside the first exhaust pipe (21), and
   a second exhaust gas control apparatus (42) is disposed inside the second exhaust pipe (44), in the region where the first exhaust pipe (21) and the second exhaust pipe (44) overlap each other as viewed from the first direction.

3. The exhaust pipe structure according to claim 1 or 2, wherein the coupling member (3) is molded by lost-wax casting of stainless steel.

FIG. 1

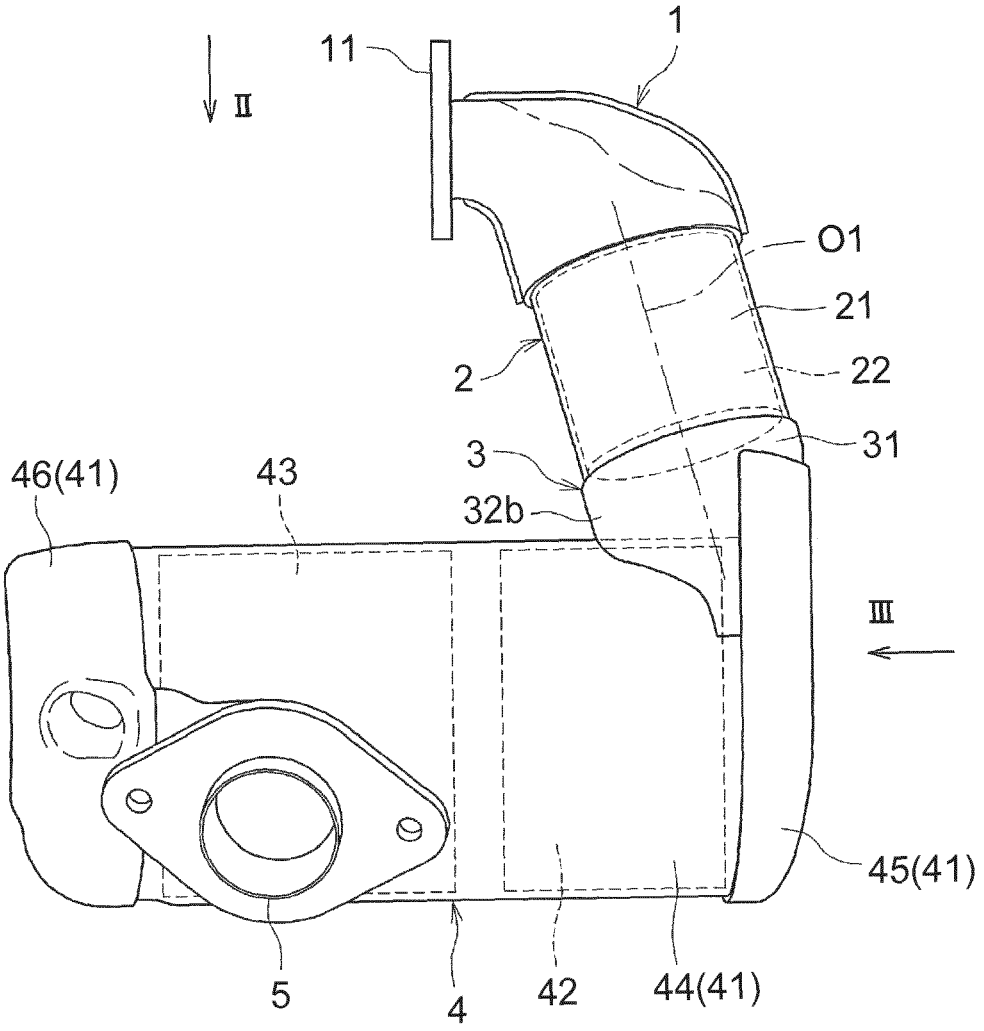


FIG. 2

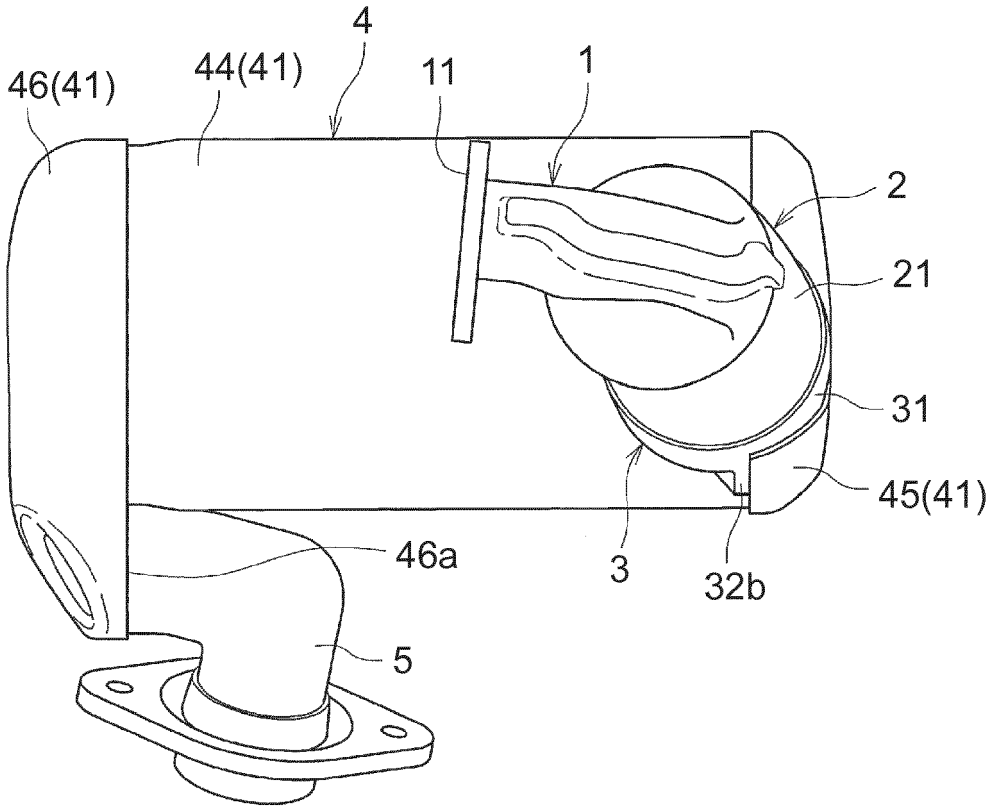


FIG. 3

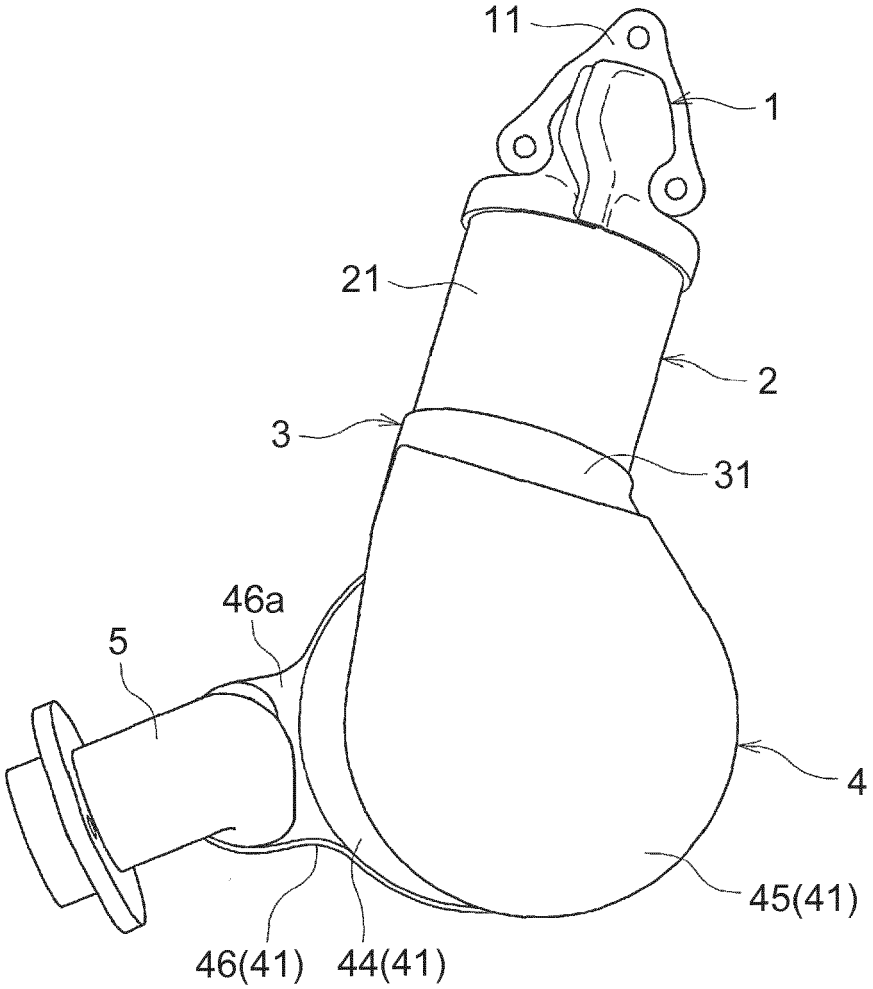


FIG. 4

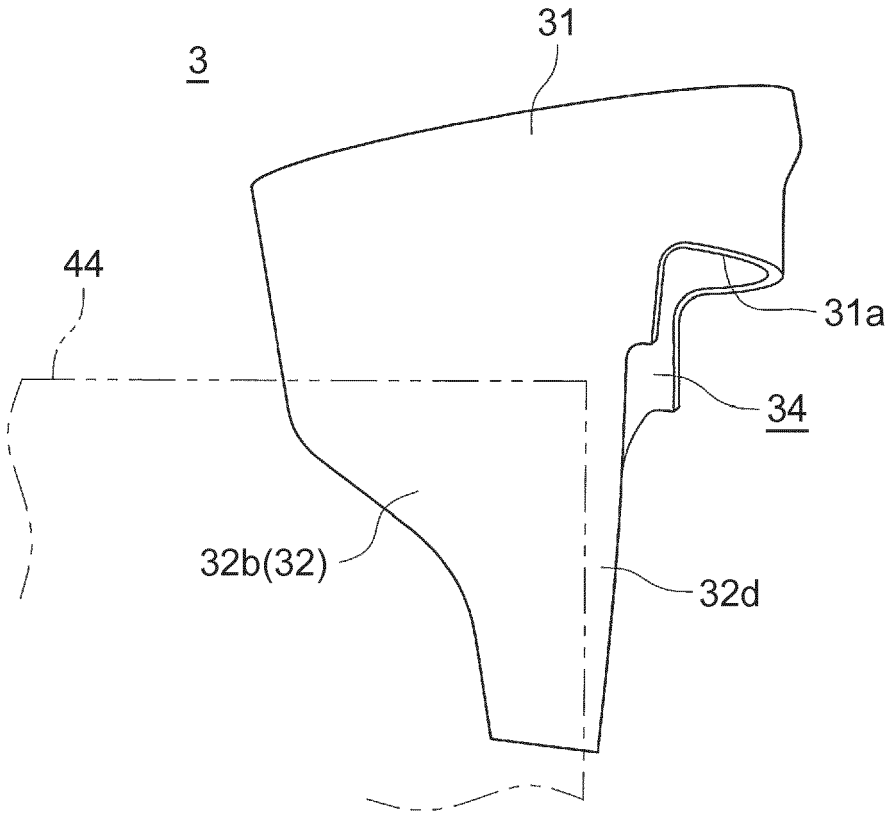


FIG. 5

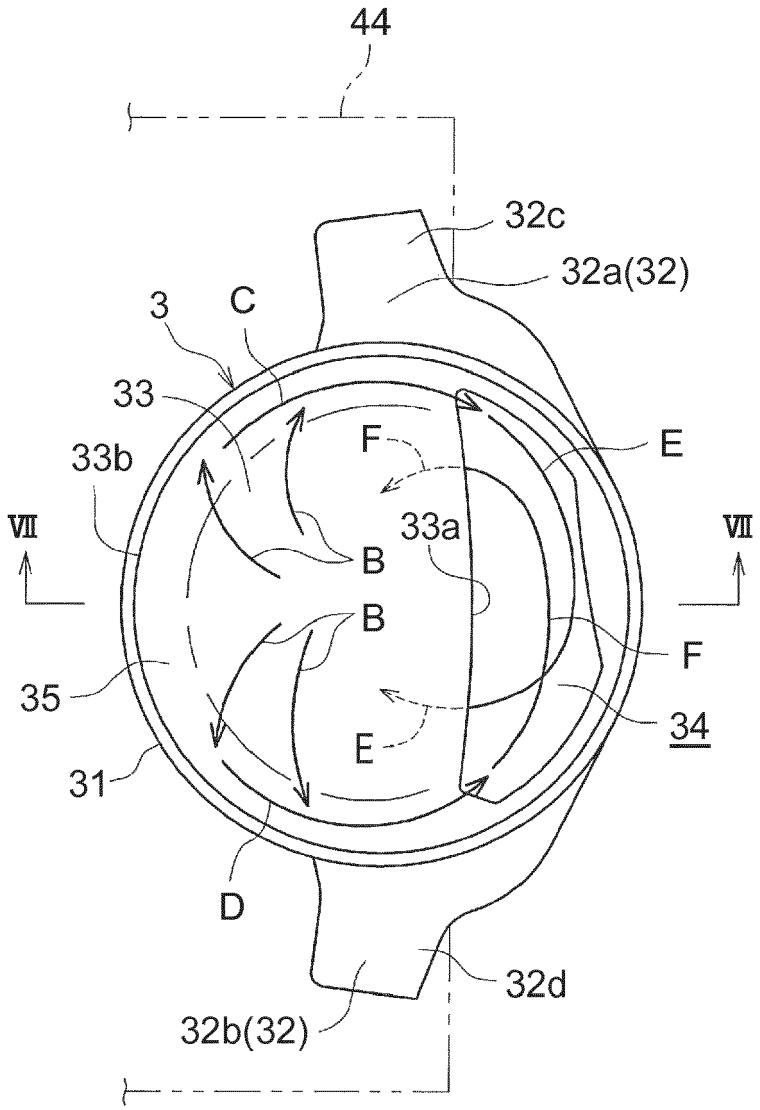


FIG. 6

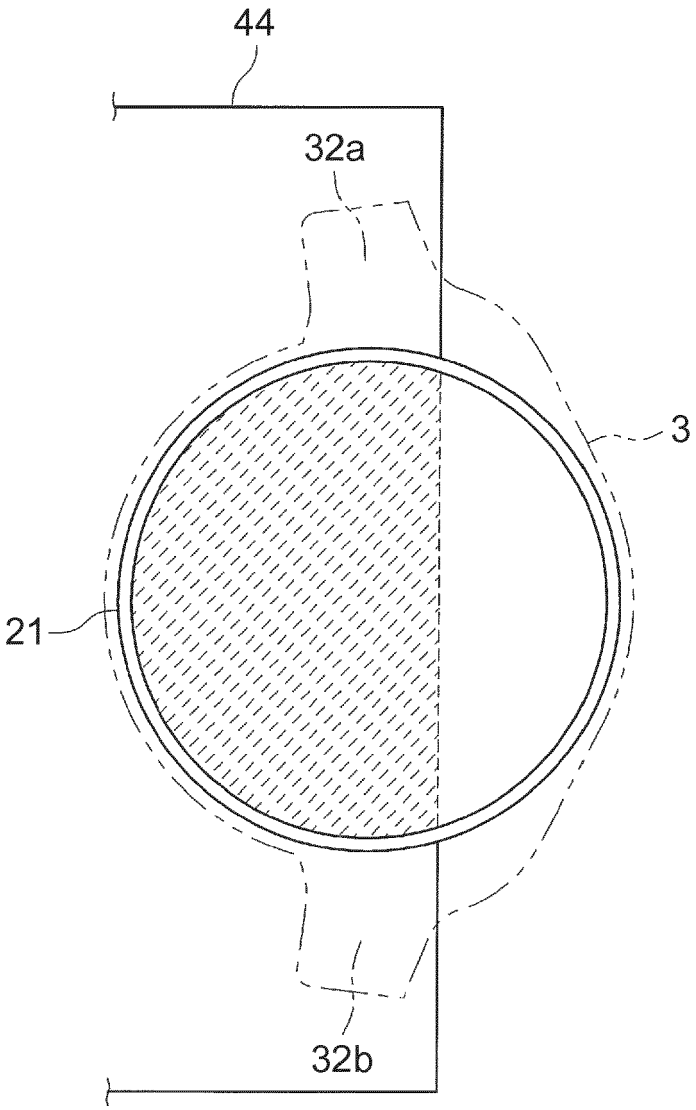


FIG. 7

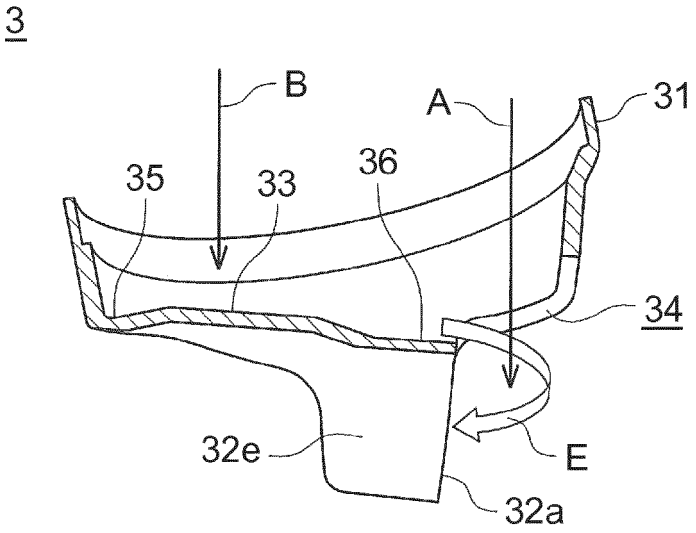



FIG. 8

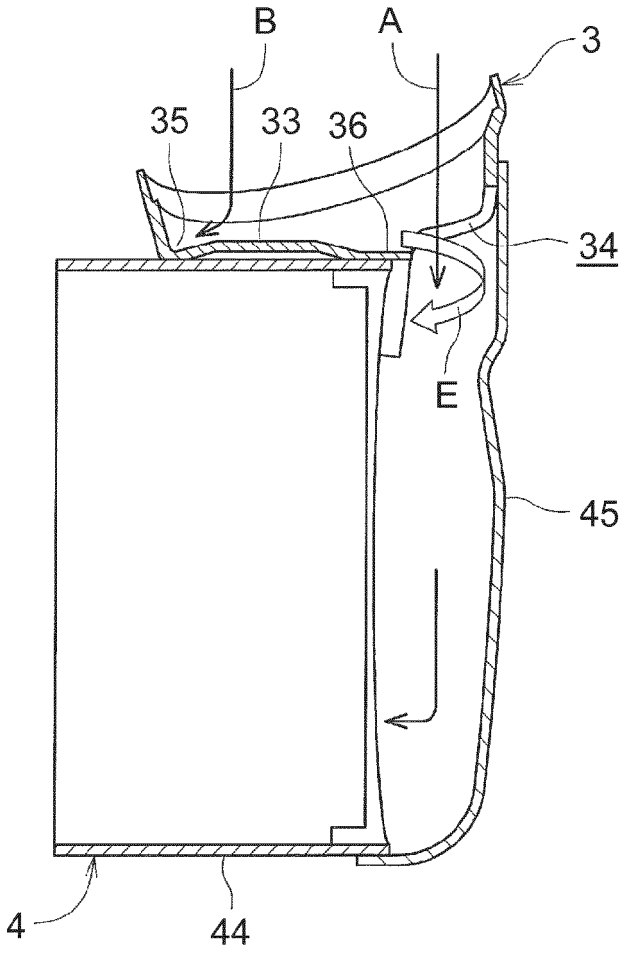
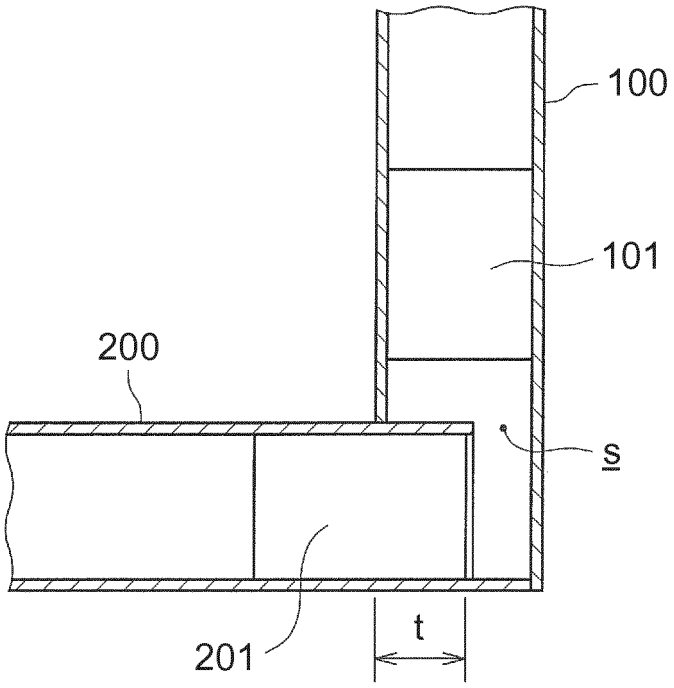


FIG. 9

RELATED ART



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Application Number
EP 16 16 2356

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| Munich | 25 August 2016 | Buecker, Christian |

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