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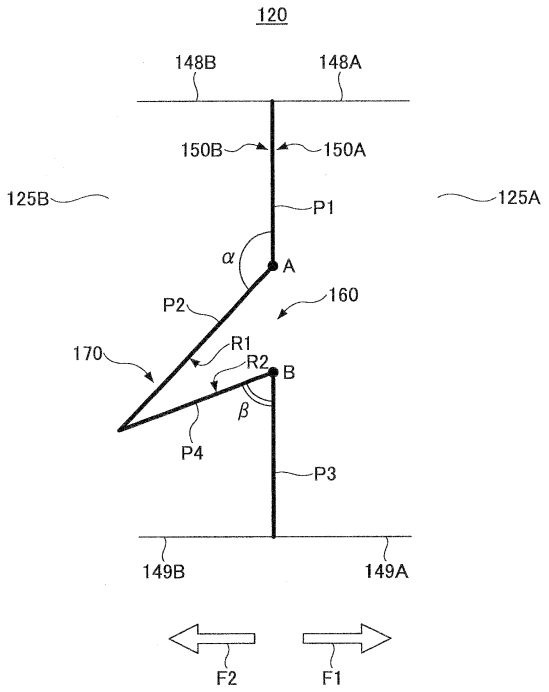
(54) Assembly and exhaust gas treatment device

(57) An assembly in which a holding and sealing member which is formed by combining plural mat members is placed on a circumferential surface of an exhaust gas treatment member. The first mat member 125A has a top end face 148A, a bottom end face 149A and a side end face 150A, and a protrusion part 160 is formed on the side end face 150A. Further, the second mat member 125B has a top end face 148B, a bottom end face 149B and a side end face 150B, and a recess part 170 is formed on the side end face 150B. By fitting the protrusion part 160 and the recess part 170 together, the first mat member 125A and the second mat member 125B are joined together at the side end faces 150A and 150B. the protrusion part 160 of the first mat member 125A has a contour part RI extending from a point A as a starting point and a contour part R2 extending from a point B as a starting point. The first point A is nearer to the top end face 148A of the first mat member 125A than the second point B. An angle α between a line segment P1 starting from the first point A and a line segment P2 passing through the first point A on the first contour part R1 is such that $\alpha > 90°$. An angle β at the second point B on the second contour part R2 is such that $\beta < 90°$.

FIG.3



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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an exhaust gas treatment device for a vehicle or the like, and in particular, to an assembly used in the exhaust gas treatment device.

2. Description of the Related Art

[0002] The number of automobiles rapidly increased in this century, and, in proportion thereto, the amount of exhaust gas discharged from internal-combustion engines of the automobiles also increased sharply. In particular, various substances included in exhaust gas of diesel engines may cause contamination, and therefore, may be seriously influencing the world environment.

[0003] In such circumstances, various types of exhaust gas treatment devices have been proposed, and have been practically used. A common exhaust gas treatment device has a structure in which a tubular or cylindrical member (casing) is provided in an exhaust pipe connected with an exhaust gas manifold of an engine, and an exhaust gas treatment member that has opening surfaces for an inlet and an outlet of exhaust gas and has many fine pores on the inside is placed inside the casing. As specific examples of the exhaust gas treatment member, there are a catalyst support and an exhaust filter such as a diesel particulate filter (DPF). For example, in a case of DPF, in the above-described structure, while exhaust gas is passed between the inlet opening surface and the outlet opening surface and discharged therefrom, fine particles are trapped by the inner walls of the pores, and thus, it is possible to remove the fine particles from the exhaust gas.

[0004] Normally, a supporting and sealing member is installed between the exhaust gas treatment member and the casing. The supporting and sealing member is used for preventing the exhaust gas treatment member from being damaged due to a contact between the exhaust gas treatment member and the casing while the vehicle is moving, and also, for preventing exhaust gas from leaking through a space between the casing and the exhaust gas treatment member. Further, the supporting and sealing member has a role of preventing the exhaust gas treatment member from being removed due to back pressure of exhaust gas. Further, the exhaust gas treatment member is to be kept at a high temperature for the purpose of maintaining the reactivity, and therefore, the supporting and sealing member needs to have also heat insulating properties. As a specific member that satisfies these requirements, there is a mat member that includes inorganic fibers such as alumina based fibers.

[0005] The mat member functions as the supporting and sealing member as a result of being wound around at least a part of the circumferential surface of the exhaust gas treatment member other than the opening surfaces, then the end faces of the mat member being joined together by an adhesive tape, and the supporting and sealing member being fixed to and unified with the exhaust gas treatment member. After that, the thus-obtained assembly is loaded inside the casing, and thus, an exhaust gas treatment device is formed.

Patent Reference

[0006]

Patent reference No. 1: Japanese Laid-Open Patent Application No. 11-173140

[0007] In the assembly having the supporting and sealing member and the exhaust gas treatment member as described above, the supporting and sealing member may include plural of the mat members. These mat members are previously made into such shapes that when they are mutually combined, the combined mat members may just fit on the circumferential shape of the exhaust gas treatment member. Thus, it is possible to form the supporting and seating member by combining these mat members.

[0008] Such a type of the supporting and sealing member that has such a segmented configuration of the mat members is advantageous in that it is possible to more positively fit the supporting and sealing members to the exhaust gas treatment members having various circumferential shapes such as a drum shape, a barrel shape and so forth. That is, a case may occur in which when the mat member having a "sheet shape" is wound around the exhaust gas treatment member having the circumferential shape other than a perfectly cylindrical shape, the mat member and the exhaust gas treatment member do not sufficiently fit together, and a gap may be created therebetween. In contrast thereto, such a problem may be avoided or reduced when the supporting and sealing member is made of the segmented configuration of mat members.

[0009] However, when the segmented configuration of mat members are thus used, the number of end faces to be joined together to assemble the supporting and sealing member increases, and therefore, the amount of the adhesive tape used for the assembling may be increased. (For example, in a case where two of the mat members are combined to form the supporting and sealing member, the number of places at which the end faces are to be joined is two. In a case where three of the mat members are combined to form the supporting and sealing member, the number of places at which the end faces are to be joined is three.)

[0010] Such an increase in an adhesive tape is not very preferable from the environmental viewpoint. That is, in a case where the mat members of such segmented configuration are used as a supporting and sealing member of an exhaust gas treatment device, the following

problem may occur. When the exhaust gas treatment device is actually used, especially when it is used initially, organic constituents included in the adhesive tape may be thermally decomposed due to heat of exhaust gas, and may be discharged outside the device. Recently, restrictions on organic constituents of exhaust gas have become more and more strict, and it is preferable to reduce a discharge of such organic constituents as much as possible.

[0011] On the other hand, in a case where the amount of an adhesive tape to be used is reduced in order to deal with this problem, the joint strength between the end faces of the mat members may be reduced, and thus, another problem of the plural mat members being easily separated may occur.

SUMMARY OF THE INVENTION

[0012] One aspect of the present invention has been devised in consideration of these problems, and an object of the aspect of the present invention is to provide an assembly that includes a supporting and sealing member obtained from combining plural mat members. In the assembly, the supporting and sealing member is configured in such a manner that end parts of the plural mat members can be fixed together with appropriate joint strength even in a case where the amount of an adhesive tape to be used for joining the end parts of the mat members together is reduced. An object of another aspect of the present invention is to provide an exhaust gas treatment device including the assembly.

[0013] According to the one aspect of the present invention, in an assembly, a holding and sealing member which is formed by combining plural mat members is placed on a circumferential surface of an exhaust gas treatment member. A first mat member of the plural mat members has a top end face and a bottom end face, and first and second side end faces connecting the top end face and the bottom end face. On the first side end face of the first mat member, a protrusion part is formed. A second mat member of the plural mat members has a top end face and a bottom end face, and first and second side end faces connecting the top end face and the bottom end face. On the first side end face of the second mat member, a recess part is formed. The first and second mat members are joined together as a result of the protrusion part and the recess part being fitted together. The protrusion part has a first contour part extending toward the second mat member from a first point "A" on the first side end face of the first mat member as a starting point; and a second contour part extending toward the second mat member from a second point "B" on the first side end face of the first mat member as a starting point. The first point "A" is nearer to the top end face of the first mat member than the second point "B". An angle α between a line segment P1 starting from the first point "A" and connecting the first side end face and the top end face on the first side end face and a line segment P2 passing through the first point "A" on the first contour part is such that $\alpha > 90°$. An angle β between a line segment P3 starting from the second point "B" and connecting the first side end face and the bottom end face on the first side end face and a line segment P4 passing through the second point "B" on the second contour part is such that $\beta < 90°$.

[0014] According to another aspect of the present invention, in the assembly, the protrusion part may substantially have a shape of a triangle, a parallelogram or a trapezium.

[0015] According to yet another aspect of the present invention, in the assembly, the protrusion part may have a contour part having a curved shape.

[0016] According to further another aspect of the present invention, in the assembly, plural of the protrusion parts may be formed on the first side end face of the first mat member.

[0017] According to further another aspect of the present invention, in the assembly, the angle α may be in a range between and including 95° and 175°, and/or the angle β may be in a range between and including 5° and 85°.

[0018] According to further another aspect of the present invention, in the assembly, the exhaust gas treatment member may be a catalyst support or an exhaust gas filter.

[0019] According to further another aspect of the present invention, in the assembly, the first mat member and/or the second mat member may include at least one selected from a group including alumina fibers, mullite fibers, silica alumina fibers and glass fibers.

[0020] According to further another aspect of the present invention, in the assembly, the first mat member and/or the second mat member may further include at least one of an inorganic binder and an organic binder.

[0021] According to further another aspect of the present invention, in the assembly, the circumferential surface of the exhaust gas treatment member may have a drum shape or a barrel shape.

[0022] According to further another aspect of the present invention, an exhaust gas treatment device may be provided. The exhaust gas treatment device includes the above-mentioned assembly in which the holding and sealing member which is formed by combining the plural mat members is placed on the circumferential surface of the exhaust gas treatment member that has two opening surfaces through which exhaust gas passes. The exhaust gas treatment device further includes a tubular or cylindrical member that houses the assembly.

[0023] According to the one aspect of the present invention, it is possible to provide an assembly that includes a supporting and sealing member obtained from combining plural mat members. In the assembly, the supporting and sealing member is configured in such a manner that end parts of the plural mat members can be fixed together with appropriate joint strength even in a case where the amount of an adhesive tape to be used for joining the

end parts of the mat members together is reduced. An object of another aspect of the present invention is to provide an exhaust gas treatment device including the assembly.

[0024] Other objects, features and advantages of the present invention will become more apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

FIG. 1 is a perspective view schematically showing one example of an assembly in the related art;
FIG. 2 schematically shows a method of assembling a holding and sealing member included in the assembly in the related art shown in FIG. 1;
FIG. 3 generally shows one example of fitting parts between a first mat member 125A and a second mat member 125B included in a holding and sealing member 120 of "segmented configuration";
FIG. 4 schematically shows a state in which the two mat members will be joined together;
FIG. 5 shows one example of shapes of a protrusion part of the first mat member 125A and a recess part of the second mat member 125B;
FIG. 6 shows one example of other shapes of a protrusion part of the first mat member 125A and a recess part of the second mat member 125B;
FIG. 7 shows one example of yet other shapes of a protrusion part of the first mat member 125A and a recess part of the second mat member 125B;
FIG. 8 schematically shows one example of the fitting parts in a case where the protrusion part of the first mat member 125A and the recess part of the second mat member 125B have contour parts having curved shapes;
FIG. 9 schematically shows another example of the fitting parts in a case where the protrusion part of the first mat member 125A and the recess part of the second mat member 125B have contour parts having curved shapes;
FIG. 10 is a perspective view schematically showing one configuration example of an assembly 100 according to one embodiment of the present invention;
FIG. 11 is a sectional view schematically showing one configuration example of an exhaust gas treatment device including the assembly 100 according to one embodiment of the present invention;
FIG. 12 is a flowchart generally showing one example of a method of manufacturing an assembly according to one embodiment of the present invention; and
FIG. 13 is a flowchart generally showing one example of a method of manufacturing a mat member to be used in a holding and sealing member of "segmented configuration" according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] Below, embodiments of the present invention will be described.

[0027] First, for the purpose of better understanding of the embodiments of the present invention, a holding and sealing member in the related art will be described first using FIGS. 1 and 2.

[0028] FIG. 1 generally shows one example of an assembly including an exhaust gas treatment member and a holding and sealing member in the related art. FIG. 2 generally shows one example of a manner of assembling the holding and sealing member.

[0029] As described above, when a holding and sealing member is installed on a circumferential surface of an exhaust gas treatment member having a circumferential shape other than a perfectly cylindrical shape, there is a case where, instead of winding a mat member of a sheet shape around the circumferential surface of the exhaust gas treatment member, it is rather preferable to form a holding and sealing member by combining plural mat members. (Hereinafter, such a holding and sealing member formed by combining plural mat members will be referred to as a holding and sealing member of "segmented configuration".)

[0030] FIG. 1 generally shows one example of an assembly 10 formed by disposing such a holding and sealing member of "segmented configuration" on a circumferential surface of an exhaust gas treatment member. As shown in FIG. 1, the assembly 10 has the exhaust gas treatment member 12 and the holding and sealing member 20 of segmented configuration disposed on the circumferential surface of the exhaust gas treatment member 12. It is noted that for the purpose of simplification, in FIG. 1, it is assumed that the circumferential shape of the exhaust gas treatment member 12 is a perfectly cylindrical shape.

[0031] As shown in FIG. 2, the holding and sealing member 20 of a segmented configuration is of a type of two segments, and includes two mat members (i.e., a first mat member 25A and a second mat member 25B) each having an approximately a semi-cylindrical shape. The first mat member 25A has a protrusion part 60 on one end part 26A, and the second mat member 25B has a recess part 70 on one end part 26B.

[0032] In the mat members 25A and 25B configured as mentioned above, by fitting the protrusion part 60 of the end part 26A of the first mat member 25A into the recess part 70 of the end part 26B of the second mat member 25B, it is possible to join the end parts 26A and 26B of the mat members 25A and 25B together. Similarly, by fitting the other respective end parts of the mat members 25A and 25B together, the mat members 25A and 25B are unified, and a holding and sealing member 20 of segmented configuration is formed.

[0033] However, in this state, the joint strength be-

tween the mat members 25A and 25B may not be sufficient. In fact, in a case where, for example, forces of arrows F1 and F2 of FIG. 2 are applied to the mat members 25A and 25B, respectively (hereinafter, these forces will be referred to as "circumferentially opposed forces"), the end parts 26A and 26B of the mat members 25A and 25B may be easily removed from one another. Thus, the mat members 25A and 25B may be separated.

[0034] Therefore, as shown in FIG. 1, after the end parts 26A and 26B of the mat members 25A and 25B are fitted together, it is necessary to further join the mat members 25A and 25B using adhesive tape 90 or the like. Also the same manner will be applied to the other end parts of the mat members 25A and 25B.

[0035] However, in a case of such a holding and sealing member of segmented configuration, the number of places at which end faces are joined together is minimally 2 or more, and therefore, the amount of adhesive tape 90 to be used for the assembling is increased in a case of a holding and sealing member of segmented configuration, in comparison to a case where a mat member of a single sheet shape is wound around.

[0036] For example, in a case where the two mat members 25A and 25B are used to form the holding and sealing member, the number of places at which the end faces are joined together is 2 (the amount of adhesive tape to be used is double). In a case where three mat members are used to form a holding and sealing member, the number of places at which the end faces are joined together is 3 (the amount of adhesive tape to be used is triple).

[0037] Such an increase in an amount of adhesive tape is not very preferable from the environmental viewpoint. That is, in a case where mat members of such segmented configuration are used as a supporting and sealing member of an exhaust gas treatment device, the following problem may occur. When the exhaust gas treatment device is actually used, especially when it is used initially, organic constituents included in the adhesive tape may be thermally decomposed due to heat of exhaust gas, and may be discharged outside the device. Recently, restrictions on organic constituents of exhaust gas have become more and more strict, and it is necessary to reduce a discharge of such organic constituents as much as possible.

[0038] In contrast thereto, according to an embodiment of the present invention, an assembly is provided. In the assembly, a holding and sealing member which is formed by combining plural mat members is placed on a circumferential surface of an exhaust gas treatment member. A first mat member of the plural mat members has a top end face and a bottom end face, and first and second side end faces connecting the top end face and the bottom end face. In the first side end face of the first mat member, a protrusion part is formed. A second mat member of the plural mat members has a top end face and a bottom end face, and first and second side end faces connecting the top end face and the bottom end face. In the first side end face of the second mat member, a recess part is formed. The first and second mat members are joined together as a result of the protrusion part and the recess part being fitted together. The protrusion part has a first contour part extending toward the second mat member from a first point A on the first side end face of the first mat member as a starting point; and a second contour part extending toward the second mat member from a second point B on the first side end face of the first mat member as a starting point. The first point A is nearer to the top end face of the first mat member than the second point B. An angle α between a line segment P1 starting from the first point A and connecting the first side end face and the top end face on the first side end face and a line segment P2 passing through the first point A on the first contour part has such a value that $\alpha > 90°$. An angle β between a line segment P3 starting from the second point B and connecting the first side end face and the bottom end face on the first side end face and a line segment P4 passing through the second point B on the second contour part has such a value that $\beta < 90°$.

[0039] Below, functions of the holding and sealing member of "segmented configuration" in the assembly according to the embodiment of the present invention having the above-mentioned feature will be described using drawings.

[0040] FIG. 3 generally shows one example of fitting parts of a first mat member 125A and a second mat member 125B included as part of a holding and sealing member 120 of segmented configuration according to the embodiment of the present invention.

[0041] As shown in FIG. 3, the first mat member 125A has a top end face 148A, a bottom end face 149A and a side end face 150A, and a protrusion part 160 is formed on the side end face 150A. Further, the second mat member 125B has a top end face 148B, a bottom end face 149B and a side end face 150B, and a recess part 170 is formed on the side end face 150B. By fitting the protrusion part 160 and the recess part 170 together, the first mat member 125A and the second mat member 125B are joined together at the side end faces 150A and 150B. It is noted that in FIG. 3, the protrusion part 160 and the recess part 170 are formed into approximately triangular shapes. However, the shapes of the protrusion part 160 and the recess part 170 are not particularly limited.

[0042] As shown in FIG. 3, the protrusion part 160 of the first mat member 125A has a contour part R1 extending from a point A as a starting point and a contour part R2 extending from a point B as a starting point. More specifically, the protrusion part 160 protrudes toward the second mat member 125B from the points A and B on the side end face 150A of the first mat member 125A as starting points. It is noted that on the side end face 150A, the point nearer to the top end face 148A is referred to as the point A and the point nearer to the bottom end face 149A is referred to as the point B.

[0043] Similarly, when attention is paid to the second

mat member 125B, as shown in FIG. 3, the recess part 170 of the second mat member 125B has a contour part R1 extending from the point A as a starting point and a contour part R2 extending from the point B as a starting point. More specifically, the recess part 170 protrudes toward the second mat member 125B from the points A and B on the side end face 150B of the second mat member 125B as starting points.

[0044] On the side end face 150A, a line segment connecting between the point A of the first mat member 125A and the top end face 148A will be referred to as P1, and a part starting from the point A, from among the contour parts R1 and R2 of the protrusion part 160, will be referred to as a line segment P2. Then, an angle α between P1 and P2 is an obtuse angle greater than 90°. On the other hand, on the side end face 150A, a line segment connecting between the point B of the first mat member 125A and the bottom end face 149A will be referred to as P3, and a part starting from the point B, from among the contour parts R1 and R2 of the protrusion part 160, will be referred to as a line segment P4. Then, an angle β between P3 and P4 is an acute angle less than 90°.

[0045] In a case where the protrusion part 160 of the first mat member 125A is formed in this shape, the two mat members 125A and 125B joined at the side end faces 150A and 150B together has significant resistance against the circumferentially opposed forces F1 and F2. This is because even when the circumferential force F1 is applied to the first mat member 125A, the contour part R2 of the protrusion part 160, in particular, the part of the line segment P4, provides resistance against the movement of the first mat member 125A in the right direction. (Expressed reversely, it can be said that, even when the circumferential force F2 is applied to the second mat member 125B, the contour part R2 of the recess part 170, in particular, the part of the line segment P4, provides resistance against the movement of the second mat member 125B in the left direction.)

[0046] Therefore, according to the embodiment of the present invention, the problems of end parts being removed from one another and thus separated in a case where the circumferentially opposed forces are applied to two mat members as in the related art is less likely to arise. Further, thereby, it is possible to significantly reduce the amount of adhesive tape to be used for assembling a holding and sealing member of segmented configuration, and it is possible to significantly reduce the amount of organic constituents discharged from an assembly.

[0047] It is noted that in the example of FIG. 3, the number of the protrusion parts 160 provided on the side end face 150A of the first mat member 125A is 1, and the number of the recess parts 170 provided on the side end face 150B of the second mat member 125A is 1. However, the number of the protrusion parts 160 and the number of the recess parts 170 are not particularly limited. The number of the protrusion parts 160 may be 2 or more and the number of the recess parts 170 may be 2 or more.

[0048] Further, according to the embodiment of the present invention, it is possible to relatively fit the first mat member 125A and the second mat member 125B together easily, as will be described below.

[0049] FIG. 4 schematically shows a manner of fitting two mat members together. It is noted that in FIG. 4, in a first mat member 125A, two protrusion parts 160 are provided on a first side end face 150A, and further two protrusion parts 160' (not shown) are provided on a second side end face 151A. Further, in a second mat member 125A, two recess parts 170 are provided on a first side end face 150B, and further two recess parts 170' (not shown) are provided on a second side end face 151B. Although it is difficult to see from FIG. 4, the protrusion parts 160 and the protrusion parts 160' have the same shapes, and the recess parts 170 and the recess parts 170' have the same shapes.

[0050] When the two mat members 125A and 125B are fitted together in the example of FIG. 4, the first mat member 125A having the protrusion parts 160 and 160' is moved in a direction of an arrow A1 from the top right direction with respect to the second mat member 125B having the recess parts 170 and 170', as shown in FIG. 4, in one example. In another example, the second mat member 125B having the recess parts 170 and 170' is moved in a direction of an arrow A2 from the bottom left direction with respect to the first mat member 125A having the protrusion parts 160 and 160', as shown in FIG. 4. Thereby, in either example, the respective protrusion parts 160 and recess parts 170 and the respective protrusion parts 160' and recess parts 170' of the mat members 125A and 125B can be fitted together easily.

[0051] It is noted that the manner in which fitting of the first mat member 125A and the second mat member 125B can be easily fitted together is not limited thereto. For example, the number or dimensions of the protrusion parts 160 formed on the first side end face 150A may be different from the number or dimensions of the protrusion parts 160' formed on the second side end face 151A in the first mat member 125A (and similarly, the number or dimensions of the recess parts 170 formed on the first side end face 150B may be different from the number or dimensions of the recess parts 170' formed on the second side end face 151B in the second mat member 125B).

[0052] Further, for example, in FIG. 4, in the first mat member 125A, the first side end face 150A may have the protrusion parts 160 and the second side end face 151A may have the recess parts 170'. Further, in the second mat member 125B, the first side end face 150B may have the recess parts 170 and the second side end face 151B may have the protrusion parts 160'. In this case, by configuring as the protrusion parts 160 of the first mat member 125A and the protrusion parts 160' of the second mat member 125B protrude in the opposite directions (i.e., for example, in FIG. 4, the protrusion parts 160 of the first mat member 125A are made to protrude obliquely downward, and the protrusion parts 160' of the second

mat member 125B are made to protrude obliquely upward, or the like), it is possible to fit the mat members 125A and 125B together easily.

[0053] That is, the protrusion parts or the recess parts are formed on the second side end face 151A of the first mat member 125A in the following manner. In one example, the protrusion direction of the protrusion parts formed on the first side end face 150A of the first mat member 125A and the protrusion direction of the protrusion parts formed on the second side end face 151A of the first mat member 125A are made to be approximately the same. In another example, the protrusion direction of the protrusion parts formed on the first side end face 150A of the first mat member 125A and the cut-out direction of the recess parts formed on the second side end face 151A of the first mat member 125A are made to be approximately the opposite. Thereby, in either example, it is possible to fit the mat members 125A and 125B together easily.

[0054] Further, as long as the direction of the protrusion parts formed on the first side end face 150A of the first mat member 125A is not made to be opposite to the direction of the protrusion parts formed on the second side end face 151B of the second mat member 125B (i.e., as long as the protrusion parts on the first and second side end faces 150A and 151B of the first and second mat members 125A and 125B respectively protrude obliquely upward or the protrusion parts on the first and second side end faces 150A and 151B of the first and second mat members 125A and 125B respectively protrude obliquely downward), the direction of winding the mat members around an exhaust gas treatment member or the direction of housing the assembly around which the mat members have been wound in a casing can be easily identified (as being indicated by the shapes of the protrusion parts, for example) and determined even without separately providing a means of identification using printing with organic pigment or the like. Thus, it is possible to further reduce organic constituents. Further, in the above-mentioned manner according to the embodiment of the present invention, also in comparison with a case where inorganic pigment is used to provide a means of identification, it is possible to omit the process of providing the means of identification, also avoiding a problematic situation of the inorganic pigment coming off from the surface of the mat members during an assembling process. Thus, according to the embodiment of the present invention, it is possible to positively identify and determine these directions without separately providing a means of identification.

[0055] It is noted that in the above description, in the examples of FIG. 3 and FIG. 4, the protrusion parts 160 and the recess parts 170 have triangular shapes. Therefore, in FIG. 3, the contour parts R1 and R2 coincide with the line segments P2 and P4, respectively. However, in the embodiment of the present invention, the shapes of the protrusion parts 160 and the recess parts 170 are not limited thereto.

[0056] FIGS. 5, 6 and 7 show other examples of the protrusion parts of the first mat member 125A (and the recess parts of the second mat member 125B accordingly).

[0057] In FIG. 5, a protrusion part 161 of a first mat member 125A and a recess part 171 of a second mat member 125B have parallelogram shapes. Further, in FIG. 6, a protrusion part 162 of a first mat member 125A and a recess part 172 of a second mat member 125B have trapezoid shapes. Further, in FIG. 7, a protrusion part 163 of a first mat member 125A and a recess part 173 of a second mat member 125B have shapes like those obtained from obliquely cutting ellipses.

[0058] In the mat members 125A having the protrusion parts 161, 162 and 163 of these shapes and the mat members 125B having the recess parts 171, 172 and 173 of these shapes, a likelihood of damaging the extending end parts at a time of fitting together is reduced, and also, the same effects described above can be obtained in comparison to the above-mentioned case of the triangular shapes, as can be clearly seen by the person skilled in the art.

[0059] Further, it is possible to provide plural of the above-mentioned protrusion parts on a single side end face, and further, use a combination of different shapes of protrusion parts on a single side end face. Further, it is also possible to use protrusion parts having combinations of different shapes between those on a first side end face 150A and those on a second side end face 151A.

[0060] Further, in a case where the protrusion parts of the first mat member 125A and the recess parts of the second mat member 125B have the contour parts of the curved shapes as shown in FIG. 7, the above-mentioned angles α and β may be determined as will be described below.

[0061] FIGS. 8 and 9 show examples of magnified views of the fitting parts in the case where the protrusion parts of the first mat member 125A and the recess parts of the second mat member 125B have the contour parts of the curved shapes.

[0062] In the example of FIG. 8, a protrusion part 160 (recess part 170) has a contour part R1 extending from a point A as a starting point to draw a shape that is concave up, and a contour part R2 extending from a point B as a starting point to draw a shape that is concave up.

[0063] In such a case, instead of the line segment P2 of FIG. 3, the straight line L1 is drawn which is tangent to the contour line R1 at the point A, and the angle between the straight line L1 and the line segment P1 may be denoted as α. Further, instead of the line segment P4 of FIG. 3, the straight line L2 is drawn which is tangent to the contour line R2 at the point B, and the angle between the straight line L2 and the line segment P3 may be denoted as β.

[0064] On the other hand, in the example of FIG. 9, a protrusion part 160 (recess part 170) has a contour part R1 extending from a point A as a starting point to draw a shape that is concave down, and a contour part R2

extending from a point B as a starting point to draw a shape that is concave down.

[0065] Also in this case, the same as the case of FIG. 8, instead of the line segment P2 of FIG. 3, the straight line L1 is drawn which is tangent to the contour line R1 at the point A, and the angle between the straight line L1 and the line segment P1 may be denoted as α. Further, instead of the line segment P4 of FIG. 3, the straight line L2 is drawn which is tangent to the contour line R2 at the point B, and the angle between the straight line L2 and the line segment P3 may be denoted as β.

[0066] It can be clearly seen that in a case where the angle α thus obtained satisfies the requirement of $\alpha > 90°$, and the angle β thus obtained satisfies the requirement of $\beta < 90°$, the effects described above for the embodiment of the present invention can be obtained. Accordingly, the embodiment of the present invention can be applied not only to a case where the contour parts of the protrusion part(s) and the recess part(s) are formed by combinations of straight lines but also a case where part or all of the contour parts of the protrusion part(s) and the recess part(s) are formed by curves, in the same or similar way.

[0067] It is noted that the angle α is preferably in a range between and including 95° and 175°, and more preferably, in a range between and including 110° and 160°. Further, the angle β is preferably in a range between and including 5° and 85°, and more preferably, in a range between and including 30° and 60°.

[0068] When the angle α becomes less than 95°, proper joint strength between the end parts (side end faces) may be lost. When the angle α becomes greater than 175°, there may be a case where the part (protrusion part 160) formed by the line segments P2 and P4 does not have sufficient strength.

[0069] When the angle β becomes less than 5°, there may be a case where the part formed by the line segments P3 and P4 does not have sufficient strength. When the angle β becomes greater than 85°, proper joint strength between the end parts (side end faces) may be lost.

[0070] The respective mat members included in the holding and sealing member of "segmented configuration" may have inorganic fibers, and also, may include an organic binder and/or an inorganic binder.

[0071] As the inorganic fibers, in an ordinary case, at least one selected from alumina fibers, silica fibers, mullite fibers, silica alumina fibers, glass fibers and so forth is used.

[0072] In an ordinary case, the organic binder and/or inorganic binder is contained in a range between and including 1 wt% and 10 wt% with respect to the overall weight of the mat member.

[0073] FIG. 10 is a perspective view schematically showing an assembly 100 according to an embodiment of the present invention.

[0074] As shown in FIG. 10, the assembly 100 according to the embodiment of the present invention includes an exhaust gas treatment member 112, and a holding and sealing member 120 that is placed on at least part of a circumferential surface of the exhaust gas treatment member 112. The holding and sealing member 120 is formed by combining at least two mat members 125A and 125B. As described above, the first mat member 125A and the second mat member 125B are joined together as a result of the protrusion parts 160 of the first mat member 125A and the recess parts 170 of the second mat member 125B being fitted together.

[0075] As described above, the fitting parts provide relatively satisfactory joint properties (joint strength) against circumferentially opposed forces, and therefore, the problem of the first and second mat members 125A and 125B being separated at the fitting parts is significantly reduced.

[0076] It is noted that in FIG. 10, no adhesive tape is installed at the fitting parts between the first and second mat members 125A and 125B. However, adhesive tape may be installed at the fitting parts between the first and second mat members 125A and 125B. However, it is necessary to note that in the assembly 100 according to the embodiment of the present invention, as described above, the amount of adhesive tape to be used is significantly reduced.

[0077] The assembly 100 is loaded in a tubular (or cylindrical) casing made by a metal or the like in a press fitting manner or the like, for example, and is used in an exhaust gas treatment device.

[0078] FIG. 11 shows one configuration example of an exhaust gas treatment device including an assembly according to an embodiment of the present invention (such as the assembly 100 described above using FIG. 10).

[0079] As shown in FIG. 11, an exhaust gas treatment device 410 includes an assembly 100, casings 212, and an inlet pipe 420 and an outlet pipe 430 for exhaust gas connected at an inlet side and an outlet side of the casings 212, respectively. The assembly 100 is formed as a result of a holding and sealing member(s) 120 having the above-described feature being installed on a circumferential surface 112-3 of an exhaust gas treatment member 112. The casings 212 house the assembly 100.

[0080] In the example of FIG. 11, the inlet pipe 420 and the outlet pipe 430 have tapering shapes in which the diameters increase at positions of being connected to the casings 212. Further, in the example of FIG. 11, the exhaust gas treatment member 112 has opening surfaces 112-1 and 112-2 for an inlet and an outlet for exhaust gas and is a catalyst support having many through holes extending in a direction parallel to a gas flow. The catalyst support is made by, for example, porous silicon carbide having a honeycomb shape, or the like. However, the exhaust gas treatment device 410 is not limited to this configuration. For example, the exhaust gas treatment member 112 may be made of a DPF in which part of the through holes are sealed.

[0081] It is noted that the holding and sealing member 120 has a first and second mat members 125A and 125B

having the above-described feature. Therefore, in the exhaust gas treatment device 410, discharge of organic constituents can be significantly reduced when it is used.

(Method of Manufacturing Assembly in Embodiment)

[0082] Next, using FIG. 12, one example of a method of manufacturing an assembly 100 according to an embodiment of the present invention (such as that described above) will be described.

[0083] FIG. 12 schematically shows a flow of a method of manufacturing an assembly 100 according to an embodiment of the present invention.

[0084] As shown in FIG. 12, a method of manufacturing an assembly 100 according to an embodiment of the present invention includes step S110 and step S120.

[0085] In step S110, an exhaust gas treatment member having first and second opening surfaces and a circumferential surface that connects the first and second opening surfaces is prepared.

[0086] In step S120, plural mat members are combined, and a holding and sealing member is formed on the circumferential surface of the exhaust gas treatment member.

[0087] The respective steps will be described below in detail.

(Step S110)

[0088] First, an exhaust gas treatment member is prepared. The exhaust gas treatment member has first and second opening surfaces (112-1 and 112-2 in FIG. 11, for example) and a circumferential surface (112-3 in FIG. 11, for example). In the first and second surfaces of the exhaust gas treatment member, plural cells through which exhaust gas flows and cell walls that separate the cells are formed. The number of the cells, the shapes thereof, the dimensions thereof, the dimensions of the cell walls and so forth are not particularly limited. Further, the material of the exhaust gas treatment member is not particularly limited. Generally speaking, as specific examples of the exhaust gas treatment member, ceramics including cordierite, alumina, silicon carbide, silicon nitride and/or the like are used.

[0089] The exhaust gas treatment member may be manufactured as a result of, for example, a molded member (or shaped member) being molded (or shaped) from slurry that includes inorganic particles, and the molded member being fired.

[0090] As described above, the exhaust gas treatment member may be a catalyst support, an exhaust gas filter such as a diesel particulate filter (DPF) or the like.

[0091] Further, the shape of the exhaust gas treatment member is not particularly limited as long as it has a column shape or a prism shape. For example, the exhaust gas treatment member has a cylindrical shape, a prism shape or a square pillar shape, a shape having an elliptic section perpendicular to the axial direction or the like. Further, the exhaust gas treatment member may have a shape in which a diameter changes along the axial direction, for example, a drum shape (having the minimum diameter at any position along the longitudinal direction) or a barrel shape (having the maximum diameter at any position along the longitudinal direction).

[0092] Especially, a holding and sealing member used in an embodiment of the present invention is formed by combining plural mat members, as mentioned above. Such a holding and sealing member of "segmented configuration" is previously shaped into a shape such that when plural mat members are combined together, the holding and sealing member has a shape just fit for a circumferential surface of an exhaust gas treatment member. Therefore, such a holding and sealing member of "segmented configuration" is advantageous in that holding and sealing members can be more positively adapted to exhaust gas treatment members having various circumferential shapes such as, for example, a drum shape, a barrel shape and so forth. That is, in a method of forming a holding and sealing member by winding a single flat "sheet-shaped" mat member around an exhaust gas treatment member, a gap may be created between the holding and sealing member and the exhaust gas treatment member as they may not be sufficiently fitted together when the holding and sealing member is wound around the exhaust gas treatment member having the circumferential shape other than a perfectly cylindrical shape. In contrast thereto, a holding and sealing member of "segmented configuration" according to an embodiment of the present invention can avoid or reduce the problem.

(Step S120)

[0093] Next, on the circumferential surface of the exhaust gas treatment member prepared in step S110, a holding and sealing member is installed, and therefore an assembly is formed.

[0094] As a specific method of forming the assembly, for example, there are two methods. In a first method, plural mat members are combined, thus an approximately tubular shape is obtained, and then, the exhaust gas treatment member is loaded inside the tubular shape. In a second method, first plural mat members are combined on the circumferential surface of the exhaust gas treatment member, and thus, at the same time of the completion of the assembling of the holding and sealing member, the assembly is formed.

[0095] Basically, either one of the first and second methods may be adopted. However, the second method may be used for a case where as described above, the exhaust gas treatment member has a circumferential shape in which the diameter is changed along the axial direction.

(Method of Manufacturing Mat Members)

[0096] Next, using FIG. 13, one example of a method of manufacturing a mat member for a holding and sealing member of "segmented configuration" (such as that described above) will be briefly described. However, the mat member may be manufactured by a method other than the following method.

[0097] As shown in FIG. 13, the mat member can be manufactured by preparing a slurry including inorganic fibers (step S210); introducing the slurry into a reticulated mold (step S220); suctioning and dewatering the mold and obtaining a wet molded member (step S230); and drying the wet molded member and taking it out from the mold (step S240).

[0098] Below, the respective steps will be described in detail.

(Step S210)

[0099] First, slurry including inorganic fibers to be used as a raw material of a mat member is prepared.

[0100] Specific examples of the inorganic fibers are not particularly limited. As specific examples of the inorganic fibers, alumina fibers, silica fibers, glass fibers and/or the like, for example, may be used.

[0101] The slurry is prepared by mixing the inorganic fibers and water. The slurry may further include an organic binder and/or an inorganic binder.

(Step S220)

[0102] Next, the slurry prepared in step S210 is introduced into an approximately tubular mold which it is possible to suction and dewater. The mold has a shape of, for example, a reticulated shape, and a shape of a molding space is formed to correspond to a circumferential shape of an exhaust gas treatment member.

[0103] Further, the mold has a mask part that projects toward the holding space so that a molded member to be obtained may include plural parts. The mask part is disposed so that the molded member is divided into desired shapes. Therefore, as a result of the molded member being separated by the mask part, it is possible to thereafter obtain plural molded members having the desired shapes.

(Step S230)

[0104] Next, a suction device is installed in the molding space of the mold, and the slurry in the molding space is suctioned and dewatered. Thereby, only slurry adhering to a surface of the mold remains, and it is possible to obtain a wet molded member having an approximately tubular shape.

(Step S240)

[0105] Next, using a drier or the like, the obtained wet molded member having the tubular shape is dried. After that, the obtained dried molded member is removed from the mold. Thereby, plural mat members can be obtained. Further, by combining the obtained mat members, it is possible to obtain a holding and sealing member corresponding to a shape of a circumferential surface of an exhaust gas treatment member.

[0106] It is noted that the above-described method is a method in which the mask part is provided in the mold, and thereby, the molded member is divided into plural parts. However, such a mask part is not necessarily needed. For example, the molded member may be formed as a tubular unified part (single part), then may be cut into desired shapes, and thus, plural mat members may be obtained.

[0107] Thus, the embodiments of the present invention have been described. It is noted that in the embodiments of the present invention, the terms "top end face" and "bottom end face" have been used for indicating relative positional relationship of parts of the members. Thus, it is noted that, for example, the "top end face" may be referred to as "bottom end face" and the "bottom end face" may be referred to as "top end face", or the like. Thus, these terms may be interpreted as being replaced with one another. Similarly, It is noted that in the embodiments of the present invention, the terms "first" and "second" have been used to indicate one and another of plural same or similar parts. Thus, it is noted that these terms may be interpreted as being replaced by one another.

[0108] The embodiments of the present invention may be used as assemblies in exhaust gas treatment devices used in vehicles and so forth.

[0109] Further, the present invention is not limited to the above-described embodiments, and variations and modifications may be made without departing from the basic concept of the present invention.

Claims

1. An assembly in which a holding and sealing member which is formed by combining plural mat members is placed on a circumferential surface of an exhaust gas treatment member, wherein
   a first mat member of the plural mat members has a top end face and a bottom end face, and first and second side end faces connecting the top end face and the bottom end face, wherein on the first side end face, a protrusion part is formed,
   a second mat member of the plural mat members has a top end face and a bottom end face, and first and second side end faces connecting the top end face and the bottom end face, wherein on the first side end face, a recess part is formed,
   the first and second mat members are joined togeth-

er as a result of the protrusion part and the recess part being fitted together,
the protrusion part has a first contour part extending toward the second mat member from a first point A on the first side end face of the first mat member as a starting point and a second contour part extending toward the second mat member from a second point B on the first side end face of the first mat member as a starting point,
the first point A is nearer to the top end face of the first mat member than the second point B,
an angle α between a line segment P1 starting from the first point A and connecting the first side end face and the top end face on the first side end face and a line segment P2 passing through the first point A on the first contour part is such that $\alpha > 90°$, and
an angle β between a line segment P3 starting from the second point B and connecting the first side end face and the bottom end face on the first side end face and a line segment P4 passing through the second point B on the second contour part is such that $\beta < 90°$.

2. The assembly as claimed in claim 1, wherein the protrusion part substantially has a shape of a triangle, a parallelogram or a trapezium.

3. The assembly as claimed in claim 1 or 2, wherein
the protrusion part has a contour part having a curved shape.

4. The assembly as claimed in any one of claims 1 through 3, wherein
plural of the protrusion parts are formed on the first side end face of the first mat member.

5. The assembly as claimed in any one of claims 1 through 4, wherein
the angle α is in a range between and including 95° and 175°, and/or
the angle β is in a range between and including 5° and 85°.

6. The assembly as claimed in any one of claims 1 through 5, wherein
the exhaust gas treatment member is a catalyst support or an exhaust gas filter.

7. The assembly as claimed in any one of claims 1 through 6, wherein
the first mat member and/or the second mat member includes at least one selected from a group including alumina fibers, mullite fibers, silica alumina fibers and glass fibers.

8. The assembly as claimed in claim 7, wherein
the first mat member and/or the second mat member further includes at least one of an inorganic binder and an organic binder.

9. The assembly as claimed in any one of claims 1 through 8, wherein
the circumferential surface of the exhaust gas treatment member has a drum shape or a barrel shape.

10. An exhaust gas treatment device comprising:

the assembly claimed in any one of claims 1 through 9 in which the holding and sealing member which is formed by combining the plural mat members is placed on the circumferential surface of the exhaust gas treatment member that has two opening surfaces through which exhaust gas passes; and
a tubular member that houses the assembly.

FIG.1

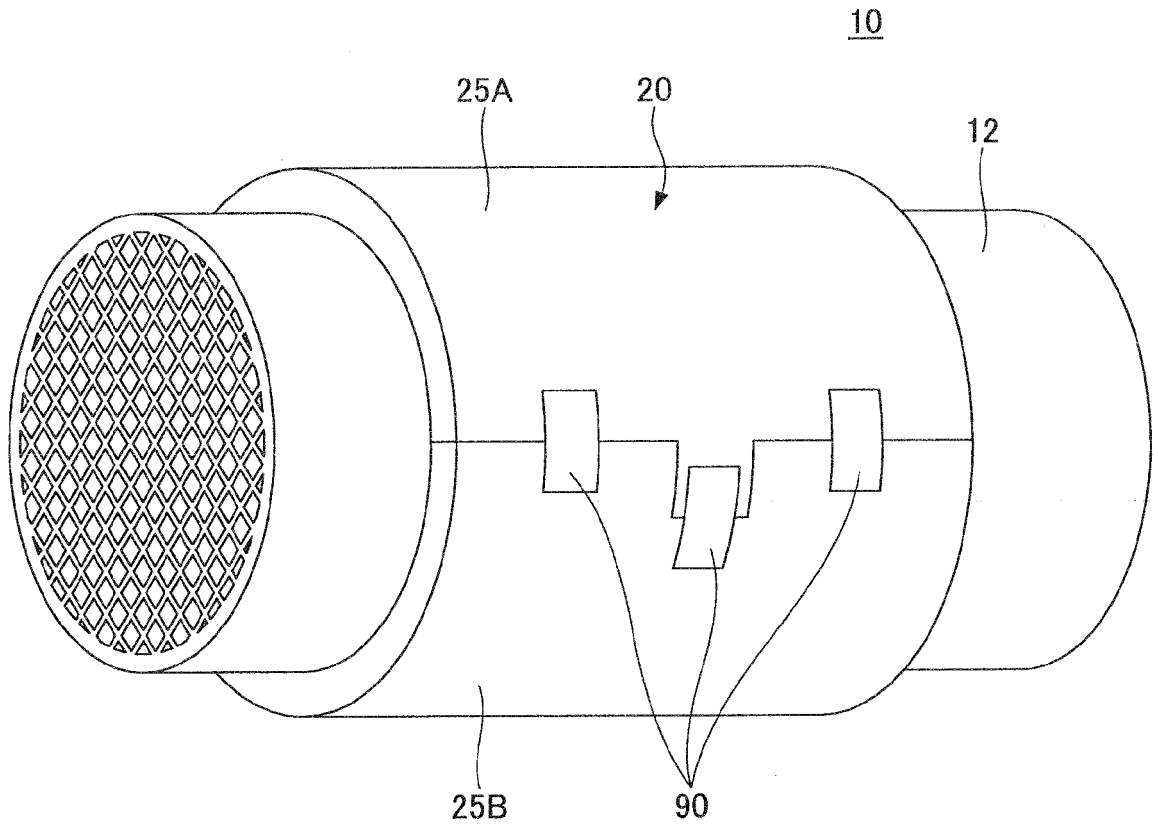


FIG.2

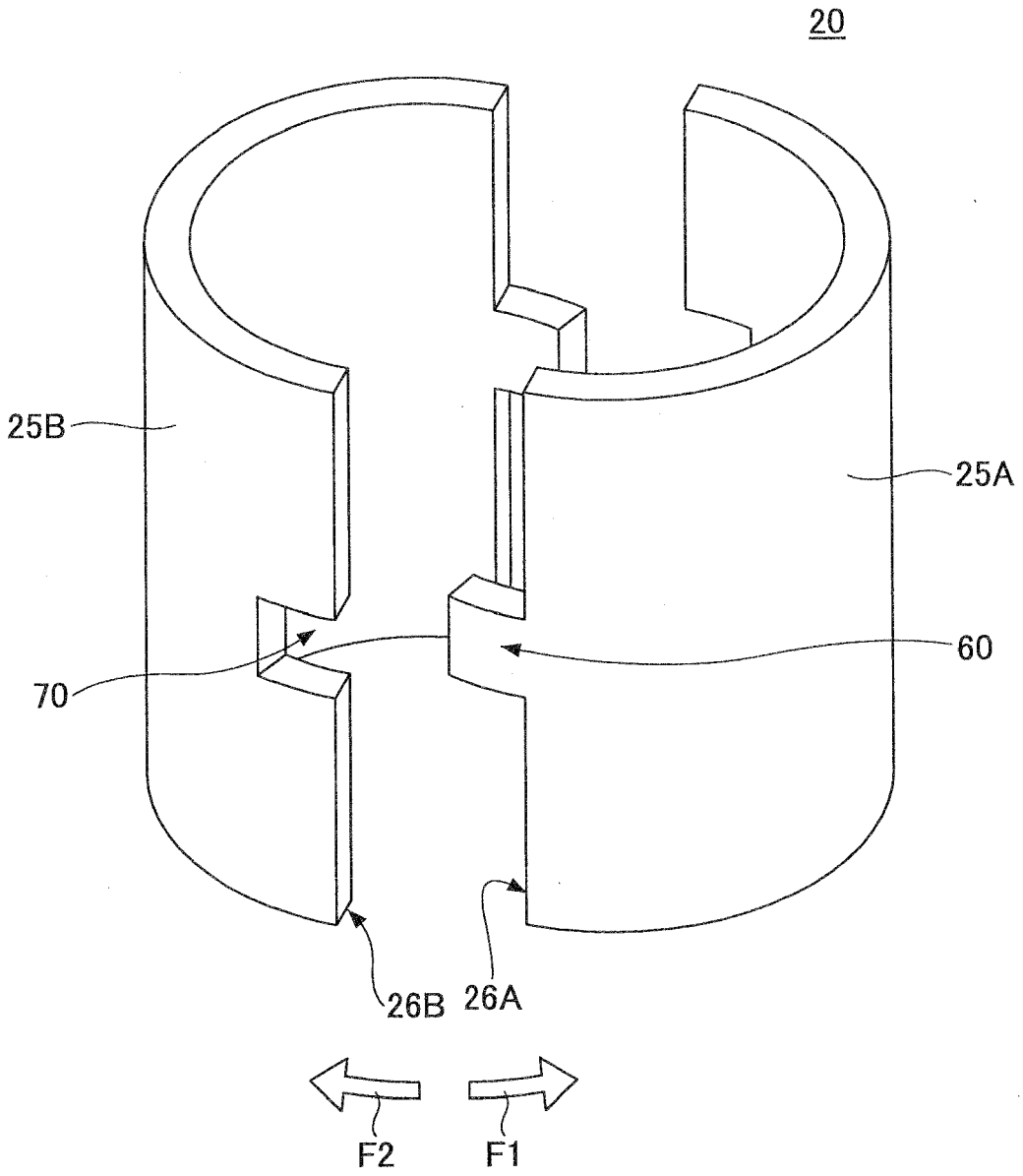


FIG.3

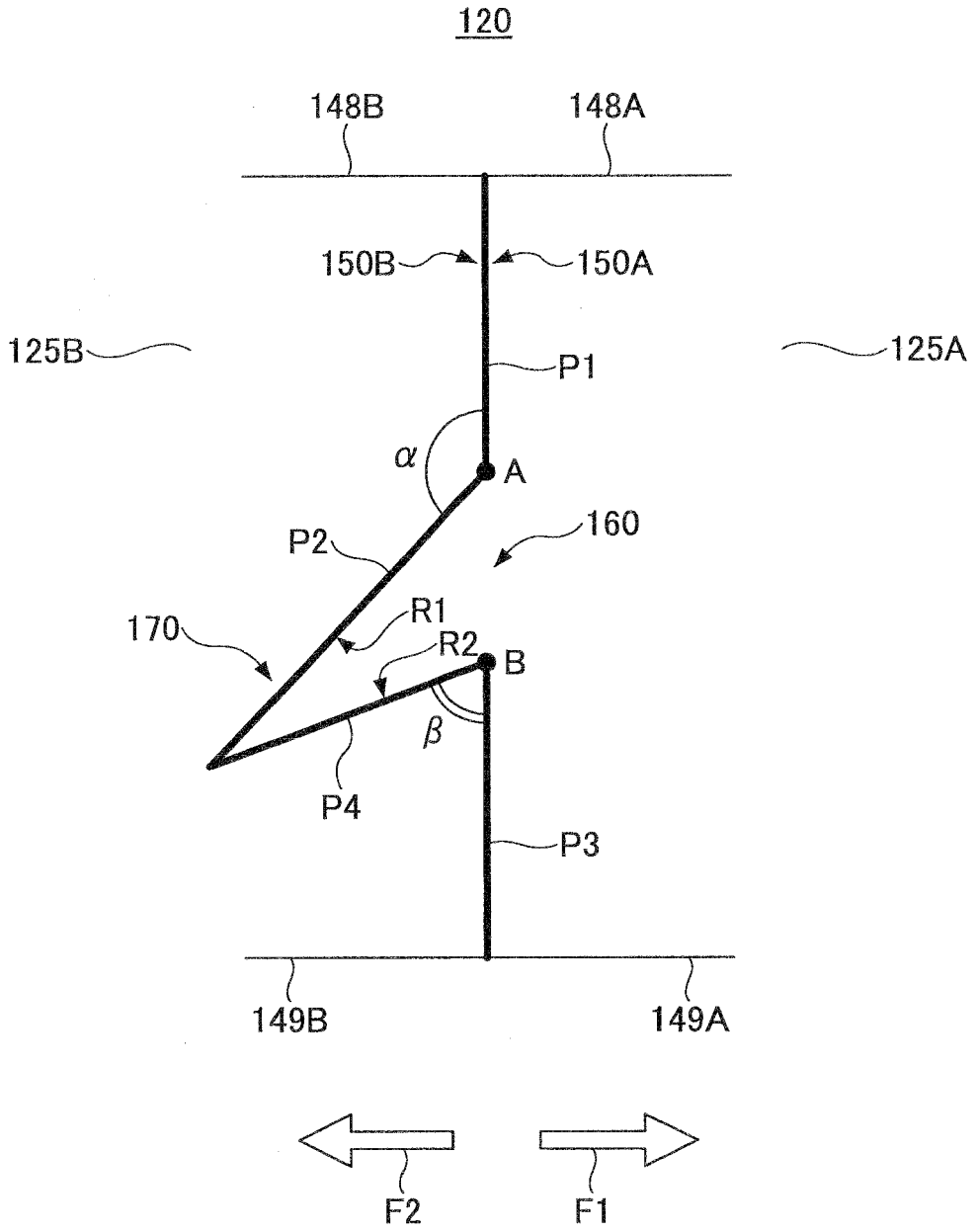

120
148B
148A
150B
150A
125B
125A
P1
α
A
P2
160
170
R1
R2
B
β
P4
P3
149B
149A
F2
F1

FIG.4

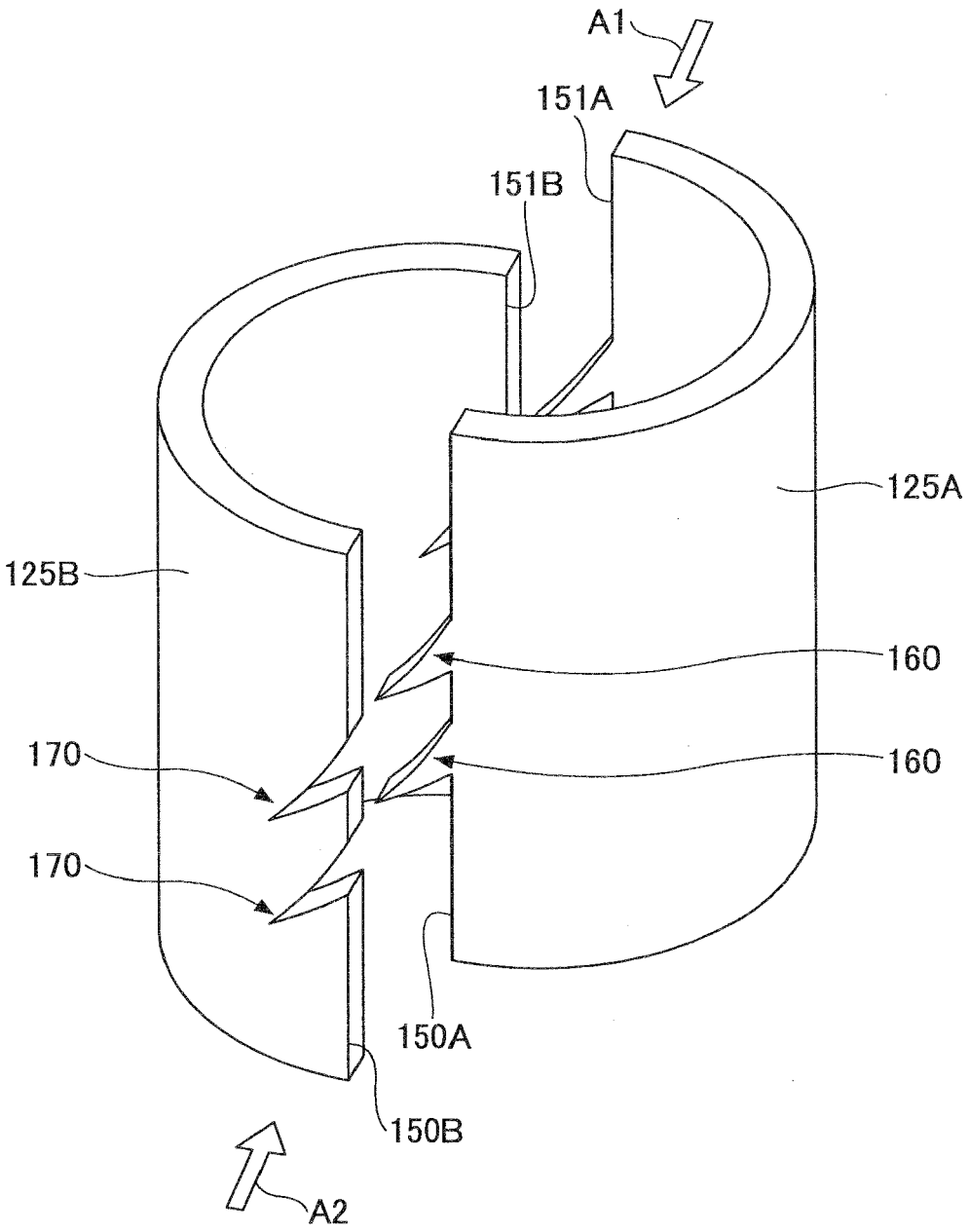


FIG.5

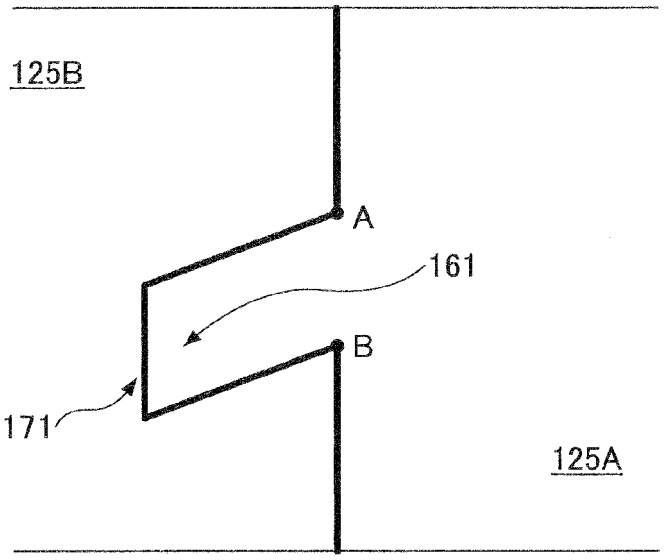


FIG.6

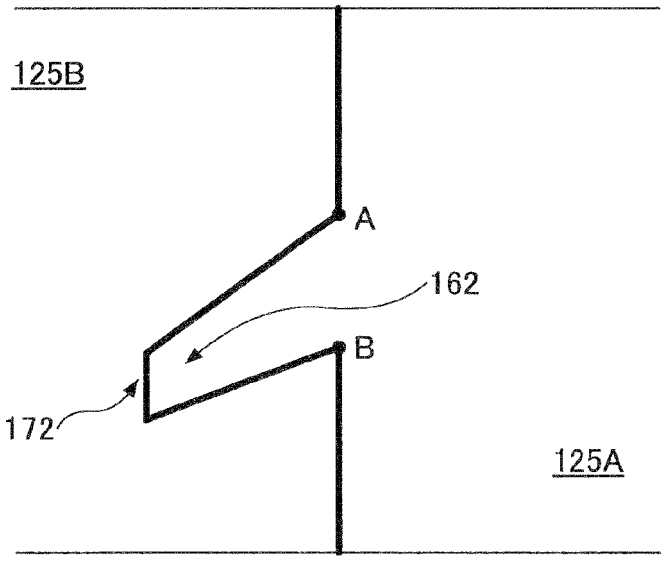


FIG.7

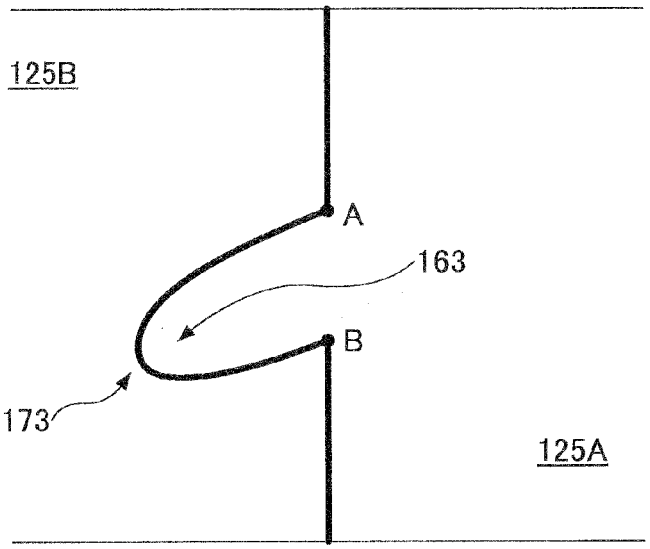


FIG.8

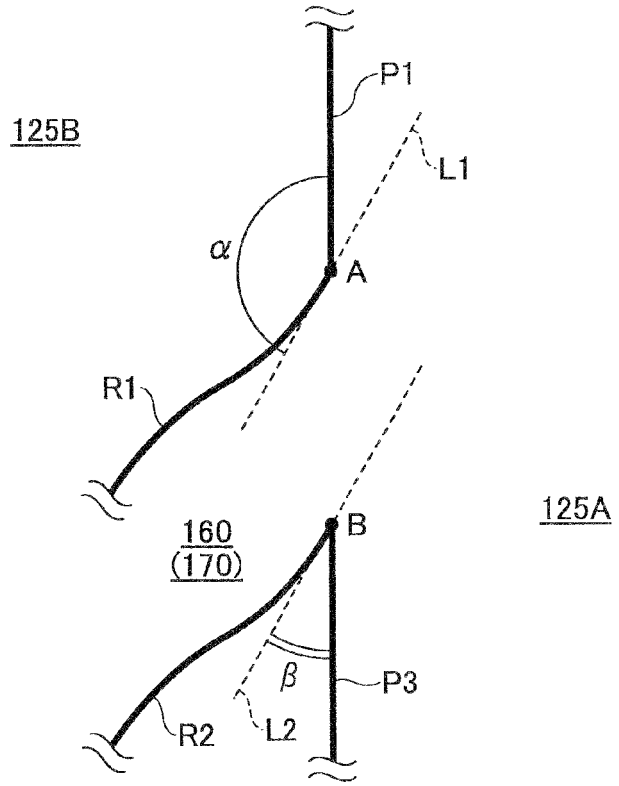


FIG.9

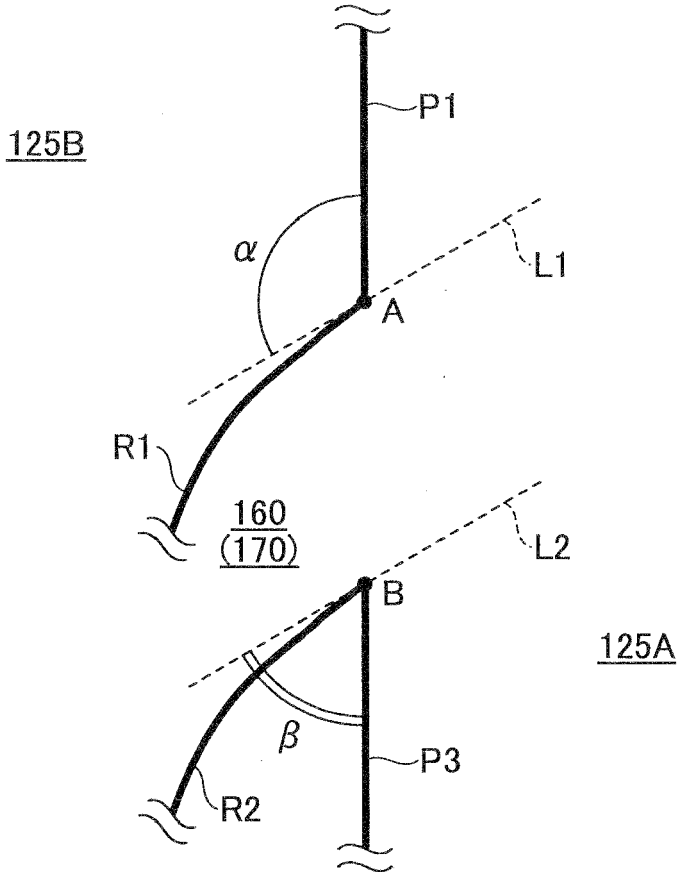


FIG.10

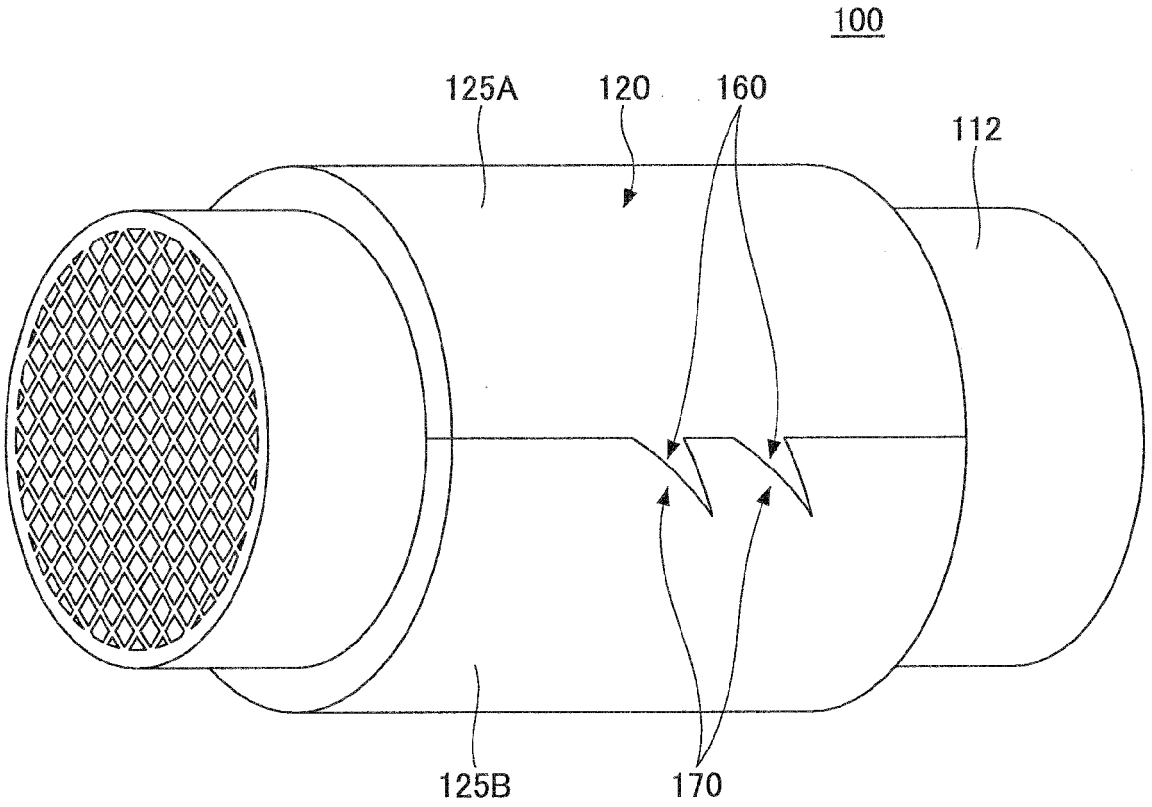


FIG.11

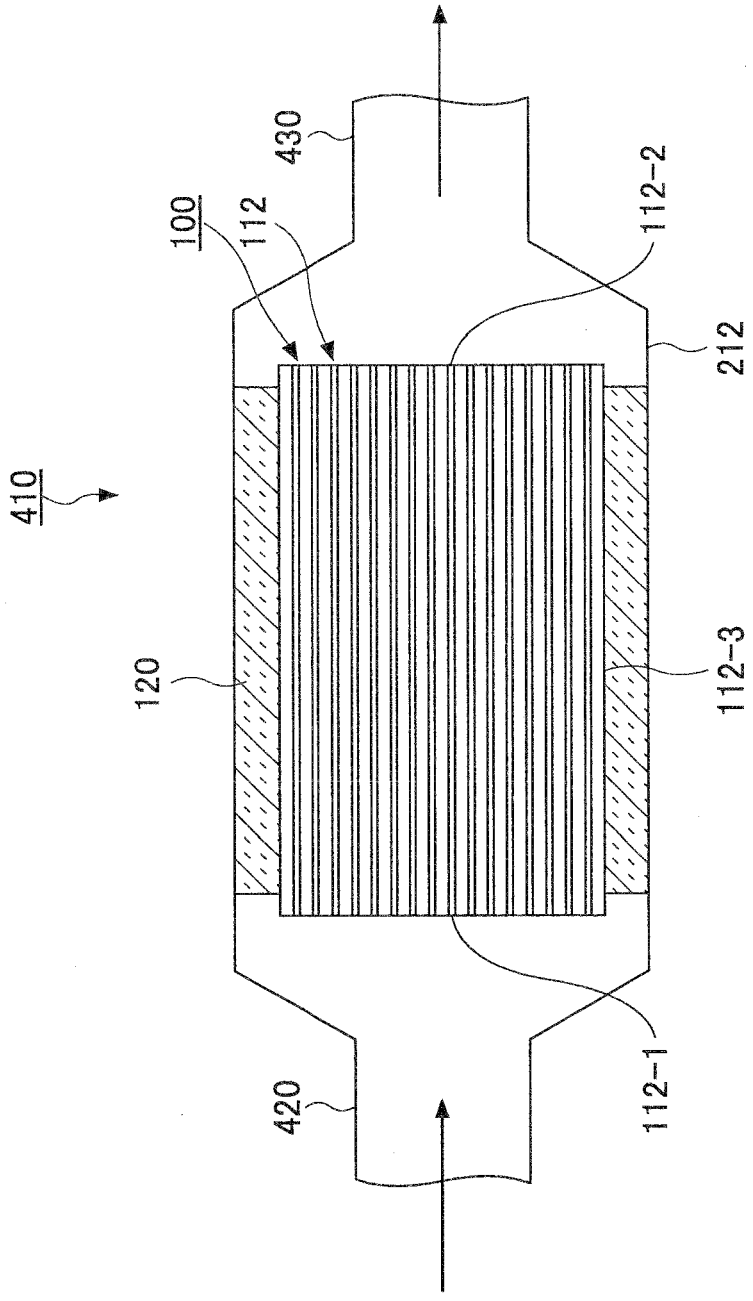


FIG.12

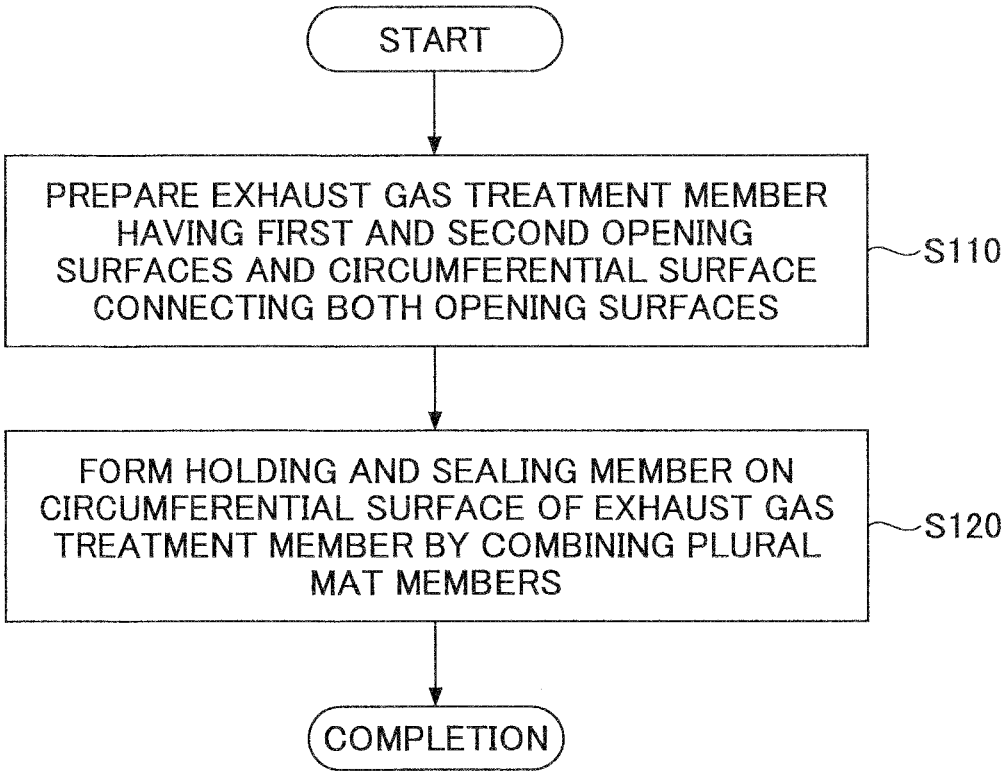
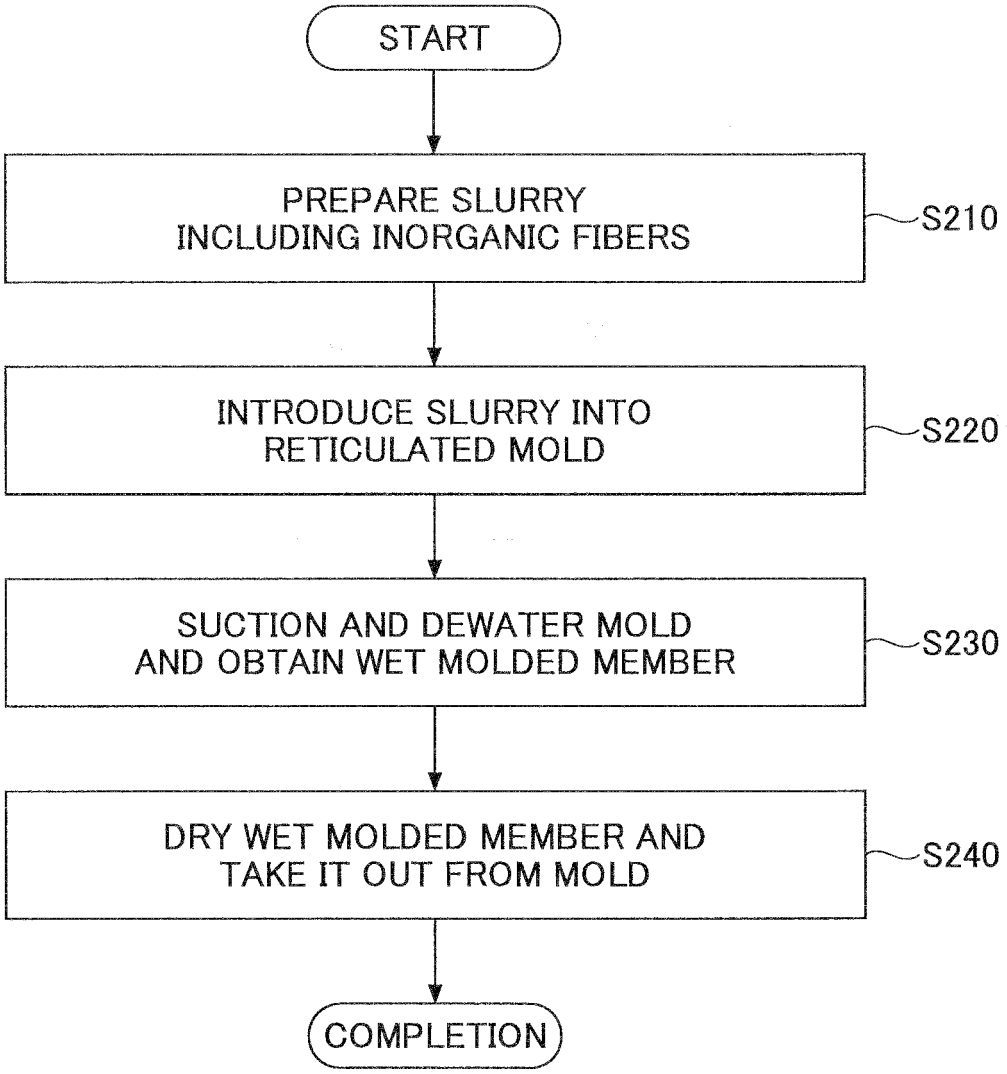

START
PREPARE EXHAUST GAS TREATMENT MEMBER HAVING FIRST AND SECOND OPENING SURFACES AND CIRCUMFERENTIAL SURFACE CONNECTING BOTH OPENING SURFACES
S110
FORM HOLDING AND SEALING MEMBER ON CIRCUMFERENTIAL SURFACE OF EXHAUST GAS TREATMENT MEMBER BY COMBINING PLURAL MAT MEMBERS
S120
COMPLETION

FIG.13


START
PREPARE SLURRY INCLUDING INORGANIC FIBERS
S210
INTRODUCE SLURRY INTO RETICULATED MOLD
S220
SUCTION AND DEWATER MOLD AND OBTAIN WET MOLDED MEMBER
S230
DRY WET MOLDED MEMBER AND TAKE IT OUT FROM MOLD
S240
COMPLETION

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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 3311

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2003/175177 A1 (TOSA SHINICHI [JP] ET AL) 18 September 2003 (2003-09-18) * paragraph [0029] - paragraph [0037]; figures 1-3 *	1-10	INV. F01N3/28
A	JP 2000 240440 A (HONDA MOTOR CO LTD) 5 September 2000 (2000-09-05) * abstract; figures 3,5 *	1-10	
A	EP 1 776 995 A1 (IBIDEN CO LTD [JP]) 25 April 2007 (2007-04-25) * paragraph [0033] - paragraph [0039]; figures 2-4 *	1-10	
A	WO 00/57041 A1 (3M INNOVATIVE PROPERTIES CO [US]) 28 September 2000 (2000-09-28) * page 7, line 6 - page 8, line 8; figures 2,3 *	1-10	
			TECHNICAL FIELDS SEARCHED (IPC)
			F01N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 September 2012	Kolland, Ulrich

CATEGORY OF CITED DOCUMENTS

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18-09-2012

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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