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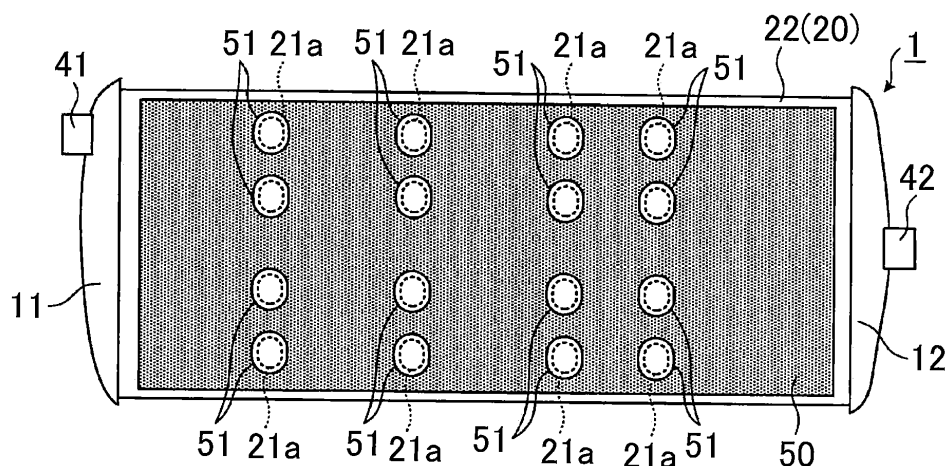
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(54) **MUFFLER DEVICE AND MANUFACTURING METHOD FOR MUFFLER DEVICE**

(57) One shell out of an outer layer shell (21) and an inner layer shell (22) has a processed part (21a) that is processed into a shape protruding towards the other shell. An intermediate sheet (50) includes a receiving part (51) in a region that faces the processed part, and the receiving part (51) is formed into a shape that allows the processed part to enter the receiving part. Since the re-

ceiving part is formed in the intermediate sheet in a region that faces the processed part, the receiving part is positioned around the processed part when the processed part enters the receiving part, thereby preventing the receiving part from shifting with respect to the processed part.

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The invention relates to a muffler device in which an intermediate sheet serving as a damping material or a sound absorbing material is arranged between double-layered shells, and to a manufacturing method for the muffler device.

2. Description of Related Art

[0002] In Japanese Patent Application Publication No. 2010-190205 (JP 2010-190205 A), and Japanese Patent Application Publication No. 2004-150310 (JP 2004-150310 A), a shell for a muffler device is structured by superimposing two metal plates on each other. In JP 2004-150310 A, a sound absorbing material is filled between the two metal plates.

[0003] In JP 2004-150310 A, in order to exert a sound absorbing function of the sound absorbing material, it is necessary to provide the sound absorbing material at a given position. As described in JP 2004-150310 A, when the sound absorbing material is filled between the two metal plates, the position of the sound absorbing material could be shifted between the two metal plates due to vibration and so on of the shell while the muffler device is used. The position of the sound absorbing material could also be shifted when manufacturing the muffler device.

SUMMARY OF THE INVENTION

[0004] The first aspect of the invention of this application is a muffler device, to which exhaust gas discharged from an internal combustion engine of a vehicle is introduced. The muffler device includes an outer layer shell, an inner layer shell, and an intermediate sheet. The outer layer shell is arranged on an outer surface of the muffler device, extends in a given direction, and is formed into a cylindrical shape. The inner layer shell is arranged on an inner side of the outer layer shell in the muffler device, extends in the given direction, and is formed into a cylindrical shape. The intermediate sheet is arranged between the outer layer shell and the inner layer shell and serves as a damping material or a sound absorbing material.

[0005] One shell out of the outer layer shell and the inner layer shell includes a processed part that is processed into a shape projecting towards the other shell. The intermediate sheet includes a receiving part in a region that faces the processed part, and the receiving part is formed into a shape that allows the processed part to enter the receiving part.

[0006] According to the first aspect of the invention of this application, since the receiving part is formed in the

intermediate sheet in the region that faces the processed part, the receiving part is positioned around the processed part when the processed part enters the receiving part, thereby preventing the receiving part from shifting with respect to the processed part. In short, it is possible to position the intermediate sheet by using the processed part and the receiving part, and it is thus possible to prevent the position of the intermediate sheet from shifting with respect to the inner layer shell and the outer layer shell when the muffler device is used. By preventing the position of the intermediate sheet from shifting, functions of the intermediate sheet as a damping material or a sound absorbing material are exerted easily.

[0007] The one shell may include a plurality of the processed parts. Further, a plurality of the receiving parts, which correspond to the plurality of processed parts, respectively, may be formed in the intermediate sheet. The plurality of receiving parts may be formed at positions that are not aligned with each other in the given direction and a circumferential direction of the outer layer shell and the inner layer shell. Thus, it is possible to prevent the position of the intermediate sheet from shifting in the given direction and the circumferential direction.

[0008] As the processed part, a bent part may be used, which is obtained by processing a part of the one shell. Thus, it is possible to structure the processed part, which projects towards the other shell, without changing the thickness of the shell. In other words, the muffler device of this invention is structured by using a shell having a uniform thickness like the related art.

[0009] The muffler device may include a separator. The separator has a flange that is formed along an inner peripheral surface of the inner layer shell, and divides a space formed on an inner side of the inner layer shell into a plurality of spaces that are lined up in the given direction. The receiving part may have a hole that allows the processed part to go through the hole and allows the processed part to come into contact with the other shell. Thus, the flange, the processed part, and the other shell can be superimposed on each other and welded to each other. Since the receiving part having the hole allows the processed part to come into contact with the other shell, it is possible to weld the flange, the processed part, and the other shell to each other easily, thereby ensuring strength of the welded part easily. The receiving part may have a recessed part other than the hole.

[0010] The second aspect of the invention of this application is a manufacturing method for the muffler device according to the first aspect of the invention. In this manufacturing method, a processed part is formed in a shell sheet that structures an outer layer shell and an inner layer shell, and an intermediate sheet is superimposed on the shell sheet by allowing the processed part to enter a receiving part. Then, by forming the shell sheet, on which the intermediate sheet is superimposed, into a cylindrical shape, the outer layer shell and the inner layer shell that sandwich the intermediate sheet are formed.

[0011] According to the second aspect of the invention

of this application, it is possible to position the intermediate sheet with respect to the shell sheet by allowing the processed part to enter the receiving part. Thus, it is possible to form the outer layer shell and the inner layer shell while positioning the intermediate sheet, thereby preventing the position of the intermediate sheet from shifting when the muffler device is manufactured. When the muffler device is manufactured, it is possible to position the intermediate sheet at a given position. Therefore, functions of the intermediate sheet as a damping material or a sound absorbing material are exerted easily.

[0012] When the outer layer shell and the inner layer shell are formed, the shell sheet may be formed into a cylindrical shape by winding the shell sheet around the separator while giving a tension to the shell sheet. By giving a tension to the shell sheet, it is possible to bring the intermediate sheet into close contact with the outer layer shell and the inner layer shell when the outer layer shell and the inner layer shell are formed. Thus, the functions of the intermediate sheet as a damping material or a sound absorbing material are exerted easily.

[0013] The third aspect of the invention of this application is a manufacturing method for the muffler device according to the first aspect of the invention of this application. In this manufacturing method, a processed part is formed in a first shell sheet that structures one of shells, the processed part is allowed to enter a receiving part, and an intermediate sheet is sandwiched between a second shell sheet that structures the other shell, and the first shell sheet. Then, the first shell sheet and the second shell sheet, which sandwich the intermediate sheet, is formed into a cylindrical shape, thereby forming an outer layer shell and an inner layer shell, respectively.

[0014] According to the third aspect of the invention of this application, it is possible to position the intermediate sheet with respect to the first shell sheet by allowing the processed part to enter the receiving part. It is thus possible to form the outer layer shell and the inner layer shell while positioning the intermediate sheet, thereby preventing the position of the intermediate sheet from shifting when the muffler device is manufactured. When the muffler device is manufactured, it is possible to position the intermediate sheet at a given position, thereby exerting functions of the intermediate sheet as a damping material or a sound absorbing material.

[0015] When the outer layer shell and the inner layer shell are formed, the first shell sheet and the second shell sheet are wound around the separator while giving a tension to the shell sheets. This makes it possible to bring the intermediate sheet into close contact with the outer layer shell and the inner layer shell. Thus, the functions of the intermediate sheet as a damping material or a sound absorbing material are exerted easily.

[0016] In the second and third aspects of the invention of this application, the intermediate sheet may include a plurality of receiving parts formed at positions that are not aligned with each other in a given direction and a circumferential direction of the outer layer shell and the

inner layer shell. Further, the one shell may include a plurality of the processed parts that correspond to the plurality of receiving parts, respectively. When the muffler device is manufactured, it is possible to position the intermediate sheet in the given direction and the circumferential direction by allowing each of the processed parts to enter each of the receiving parts.

[0017] In the second and third aspects of the invention of this application, the receiving part may have a hole that allows the processed part to go through the hole so that the processed part comes into contact with the other shell. Thus, it is possible to superimpose and weld the flange, the processed part, and the other shell to each other. Since the receiving part having the hole allows the processed part to come into contact with the other shell, it is possible to weld the processed part and the other shell to each other easily, thereby ensuring strength of the welded part easily.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] Features, advantages, and technical and industrial significance of exemplary embodiments of the invention will be described below with reference to the accompanying drawings, in which like numerals denote like elements, and wherein:

FIG. 1 is an exterior view of a muffler device according to the first example;

FIG. 2 is a sectional view of the muffler device according to the first example;

FIG. 3 is a sectional view of the muffler device according to the first example;

FIG. 4 is an exterior view of the muffler device according to the first example, in which an outer layer shell is omitted;

FIG. 5 is a sectional view showing a part of a structure of the muffler device according to the first example;

FIG. 6 is a view explaining a manufacturing method for the muffler device according to the first example;

FIG. 7 is a top view of a shell sheet on which intermediate sheets are superimposed according to the first example;

FIG. 8 is an exterior view of the muffler device according to a modified example of the first example, in which the outer layer shell is omitted;

FIG. 9 is a sectional view showing a part of a structure of a muffler device according to the second example;

FIG. 10 is a sectional view showing a part of a structure of a muffler device according to the third example;

FIG. 11 is a view showing an outline of a separator according to the third example;

FIG. 12 is a view explaining a manufacturing method for the muffler device according to the third example;

FIG. 13 is a sectional view showing a part of a structure of a muffler device according to a modified example of the third example;

FIG. 14 is a view explaining a manufacturing method for a muffler device according to the fourth example; FIG. 15 is a sectional view showing a structure of a shell according to the fourth example; and FIG. 16 is a sectional view of an intermediate sheet according to a modified example of the first to fourth examples.

DETAILED DESCRIPTION OF EMBODIMENTS

[0019] Examples of the invention is explained below.

[0020] A muffler device according to this example is explained. FIG. 1 is an exterior view of a muffler device 1. FIG. 2 is a sectional view taken along the line A1 - A1 in FIG. 1, and FIG. 3 is a sectional view taken along the line A2 - A2 in FIG. 1. FIG. 1 is an exterior view of the muffler device 1 seen from an arrow B1 shown in FIG. 2 and an arrow B2 shown in FIG. 3.

[0021] A pair of end covers 11, 12 and a shell 20 structure an outer surface of the muffler device 1. The shell 20 is formed into a cylindrical shape, and extends in a longitudinal direction of the muffler device 1 (the horizontal direction in FIG. 1, corresponding to a given direction of the invention). Opening parts are formed on both ends of the shell 20 in the longitudinal direction of the muffler device 1, and the opening parts are closed by the metallic end covers 11, 12, respectively. Each of the end covers 11, 12 is fixed to the shell 20 by welding.

[0022] As shown in FIG. 2 and FIG. 3, the shell 20 has a double-layer structure, and includes an outer layer shell 21 and an inner layer shell 22. The outer layer shell 21 and the inner layer shell 22 are both formed into a cylindrical shape, and extend in the longitudinal direction of the muffler device 1. The outer layer shell 21 is arranged on an outer surface of the muffler device 1, and the inner layer shell 22 is arranged on an inner side of the outer layer shell 21 in muffler device 1. As stated later, the outer layer shell 21 and the inner layer shell 22 are formed from one metallic shell sheet.

[0023] Inside the inner layer shell 22, four metallic separators 31 to 34 are arranged. The inner layer shell 22 is arranged along outer edges of the separators 31 to 34, and a flange is provided in the outer edge of each of the separators 31 to 34, and is in contact with an inner peripheral surface of the inner layer shell 22. Each of the separators 31 to 34 divides a space formed inside the inner layer shell 22 into five spaces S1 to S5. Each of the spaces S1 to S5 is used as an expansion chamber for exhaust gas.

[0024] The space S1 is a space surrounded by the end cover 11, the separator 31, and a part of the inner layer shell 22, and the space S2 is a space surrounded by the separators 31, 32 and a part of the inner layer shell 22. The space S3 is a space surrounded by the separators 32, 33 and a part of the inner layer shell 22, and the space S4 is a space surrounded by the separators 33, 34 and a part of the inner layer shell 22. The space S5 is a space surrounded by the separator 34, the

end cover 12, and a part of the inner layer shell 22. In this example, the four separators 31 to 34 are provided. However, the number of the separators may be set as appropriate.

[0025] A metallic first exhaust pipe 41 goes through the end cover 11 and each of the separators 31 to 34. One end part 41a of the first exhaust pipe 41 is located outside the muffler device 1, and is connected with one end part of an introduction pipe (not shown). The other end part of the introduction pipe is connected with an exhaust port of an internal combustion engine of a vehicle. Thus, gas discharged from the exhaust port (exhaust gas) is introduced to the muffler device 1.

[0026] Since the other end part 41b of the first exhaust pipe 41 is located inside the space S5, exhaust gas from the exhaust port moves inside the first exhaust pipe 41 and is discharged from the other end part 41b to the space S5. Exhaust gas discharged into the space S5 moves through the space S4, the space S3, the space S2, and the spaces S1 in this order. In each of the separators 31 to 34, opening parts are formed for allowing exhaust gas to pass through. For example, as shown in FIG. 2 and FIG. 3, the separator 32 has an opening part 32a for allowing exhaust gas to go through.

[0027] A metallic second exhaust pipe 42 passes through the end cover 12 and each of the separators 31 to 34. One end part 42a of the second exhaust pipe 42 is located outside the muffler device 1, and the other end part 42b of the second exhaust pipe 42 is located inside the spaces S1. As stated above, exhaust gas that has moved to the spaces S1 is lead from the other end part 42b into the second exhaust pipe 42, and discharged from one end part 42a.

[0028] As shown in FIG. 1 and FIG. 3, a plurality of bent parts (corresponding to processed parts of the invention) 21a are provided in the outer layer shell 21, and the bent parts 21a are formed by bending parts of the outer layer shell 21 so as to project towards the inner side of the shell 20. A thickness of the bent part 21a is equal to a thickness of the outer layer shell 21 excluding the bent parts 21a. As shown in FIG. 1, the plurality of bent parts 21a are arranged along the outer edge of each of the separators 31 to 34, and a part where the bent part 21a, the inner layer shell 22, and each of the separators 31 to 34 are superimposed each other is welded.

[0029] As shown in FIG. 2, two intermediate sheets 50 are arranged between the outer layer shell 21 and the inner layer shell 22. In short, the intermediate sheets 50 are sandwiched between the outer layer shell 21 and the inner layer shell 22. The intermediate sheets 50 are formed from a material having heat resistance because temperature of the muffler device 1 becomes high due to heat from exhaust gas.

[0030] The intermediate sheet 50 may have a function of damping vibration (damping function). As the intermediate sheet 50 having the damping function, a sheet formed from carbon (expansion graphite and so on) may be used. When exhaust gas is lead into the muffler device

1, the outer layer shell 21 and the inner layer shell 22 vibrate. By arranging the intermediate sheets 50 having the damping function between the outer layer shell 21 and the inner layer shell 22, the intermediate sheets 50 are able to damp vibration of the outer layer shell 21 and the inner layer shell 22. As vibration of the outer layer shell 21 and the inner layer shell 22 are damped, it is possible to reduce sound generated with the vibration.

[0031] Meanwhile, the intermediate sheets 50 may also have a function of absorbing sound (sound absorbing function). As the intermediate sheet 50 having the sound absorbing function, a sheet made from, for example, glass wool, may be used. As the intermediate sheets 50 absorb sound generated due to vibration of the outer layer shell 21 and the inner layer shell 22, it is possible to reduce sound transmitted outside the muffler device 1.

[0032] The intermediate sheets 50 are arranged at positions in the muffler device 1, where vibration and sound are prone to be generated. In the sectional view of the muffler device 1 shown in FIG. 2, a length of the muffler device 1 in the horizontal direction is smaller than a length of the muffler device 1 in the vertical direction in FIG. 2. Therefore, vibration and sound are prone to be generated on both side surfaces of the shell 20 in the horizontal direction in FIG. 2. Thus, in this example, as shown in FIG. 2, the intermediate sheets 50 are arranged between the outer layer shell 21 and the inner layer shell 22 on both side surfaces of the shell 20 in the horizontal direction in FIG. 2.

[0033] The positions where the intermediate sheet 50 are arranged are not limited to the positions shown in FIG. 2. Positions for arranging the intermediate sheets 50 may be set in advance in consideration of a vibrational state of the shell 20, as well as a sound generation state from the shell 20. In order to exert the damping function and the sound absorbing function, it is necessary to arrange the intermediate sheets 50 without allowing the intermediate sheets 50 from shifting from the previously-set given positions. Meanwhile, in this example, the two intermediate sheets 50 are provided. However, the number of the intermediate sheets 50 may be one, three or more.

[0034] FIG. 4 is a view showing the muffler device 1 shown in FIG. 1 in which the outer layer shell 21 is omitted. FIG. 4 shows an exterior view of one of the intermediate sheets 50 out of the two intermediate sheets 50. The two intermediate sheets 50 have the same structure.

[0035] As shown in FIG. 4, the intermediate sheet 50 has a plurality of (specifically, 16) holes (corresponding to receiving parts of the invention) 51, and each of the holes 51 passes through the intermediate sheet 50. Each of the bent parts 21a formed in the outer layer shell 21 enters an inner side of each of the holes 51. To be specific, as shown in FIG. 5, the bent part 21a of the outer layer shell 21 projects towards the inner layer shell 22 and enters the inner side of the hole 51. FIG. 5 shows a structure of a part of the muffler device 1 that is cut in the longitudinal direction of the muffler device 1.

[0036] In the intermediate sheet 50, the hole 51 is formed in a region that faces the bent part 21 a, and is also formed along an outline of the bent part 21 a. The bent part 21 a that enters the inner side of the hole 51 is in contact with the outer peripheral surface of the inner layer shell 22. The bent part 21a projects towards the inner layer shell 22 by the thickness of the intermediate sheet 50.

[0037] As shown in FIG. 5, a flange 32b is provided in an outer edge of the separator 32. The flange 32b is formed along an inner peripheral surface of the inner layer shell 22, and is also in contact with the inner peripheral surface of the inner layer shell 22. A flange similar to the flange 32b is also provided in each of the separators 31, 33, 34.

[0038] In FIG. 5, a part where the bent part 21 a, the inner layer shell 22, and the flange 32b are superimposed on each other is welded. Thus, the outer layer shell 21 and the inner layer shell 22 are fixed to the separator 32. Similarly, the flange of each of the separators 31, 33, 34 is superimposed on the inner layer shell 22 and the bent part 21a, and the superimposed part is welded. Thus, the outer layer shell 21 and the inner layer shell 22 are fixed to the separators 31, 33, 34.

[0039] Next, a manufacturing method for the muffler device 1 is explained with reference to FIG. 6 and FIG. 7.

[0040] FIG. 6 shows a state before a shell sheet 23 is wound around the end covers 11, 12 and the separators 31 to 34. The first exhaust pipe 41 and the second exhaust pipe 42 are connected with the end covers 11, 12 and the separators 31 to 34. FIG. 7 is a view of the shell sheet 23 and the intermediate sheets 50 seen from a direction of an arrow C shown in FIG. 6. In FIG. 7, the end covers 11, 12 and the separators 31 to 34 are omitted.

[0041] First of all, the shell sheet 23 is welded to the end covers 11, 12 at a position P11. Then, by rotating the end covers 11, 12 and the separators 31 to 34 in a direction of arrows R1 shown in FIG. 6, the shell sheet 23 is wound around the end covers 11, 12 and the separators 31 to 34. As the shell sheet 23 is wound around the end covers 11, 12 and the separators 31 to 34 from the position P11 up to a position P12 of the shell sheet 23, the end covers 11, 12 and the separators 31 to 34 are surrounded by the shell sheet 23, thereby forming the cylindrical-shaped inner layer shell 22.

[0042] Next, as the shell sheet 23 is wound around the end covers 11, 12 and the separators 31 to 34 from the position P12 up to a position P13 of the shell sheet 23, the cylindrical-shaped outer layer shell 21 is formed. The shell sheet 23 is welded to the end covers 11, 12 at the position P13. As stated so far, by doubly winding the shell sheet 23 with respect to the end covers 11, 12 and the separators 31 to 34, the shell 20 is formed.

[0043] Each of the two intermediate sheets 50 is superimposed in a region between the position P12 and the position P13 in the shell sheet 23. In the region between the position P12 and the position P13 in the shell

sheet 23, the plurality of bent parts 21a are formed in advance, and each of the bent parts 21a enters the inner side of each of the holes 51 of the intermediate sheets 50. Thus, it is possible to position the intermediate sheets 50 with respect to the shell sheet 23.

[0044] When the outer layer shell 21 is formed by winding the shell sheet 23, the intermediate sheets 50 are sandwiched between the inner layer shell 22 and the outer layer shell 21. At this time, the shell sheet 23 is wound around the end covers 11, 12 and the separators 31 to 34 while giving a tension to the shell sheet 23. In this way, the intermediate sheets 50 are easily brought into close contact with the outer layer shell 21 and the inner layer shell 22.

[0045] After the shell 20 is formed by winding the shell sheet 23 around the end covers 11, 12 and the separators 31 to 34, laser welding, for example, is performed on the bent parts 21a from an outer side of the shell 20. Thus, the part where the bent part 21a, the inner layer shell 22, and the flange of each of the respective separators 31 to 34 are superimposed on each other is welded. Thus, the muffler device 1 is completed. Since the bent parts 21a are formed in the outer layer shell 21, the bent parts 21a may be used as marks when laser welding is performed.

[0046] The manufacturing method for the muffler device 1 is not limited to the method stated above. Another manufacturing method for the muffler device 1 is explained below.

[0047] First of all, the cylindrical-shaped shell 20 is formed by winding only the shell sheet 23, on which the intermediate sheets 50 are superimposed. At this time, the end covers 11, 12 and the separators 31 to 34 are not assembled to the shell 20. When the cylindrical-shaped shell 20 is formed, the intermediate sheets 50 are sandwiched between the outer layer shell 21 and the inner layer shell 22.

[0048] Next, each of the separators 31 to 34 is inserted into an inner side of the cylindrical-shaped shell 20. At this time, each of the separators 31 to 34 is inserted so that the flange of each of the separators 31 to 34 is superimposed on the bent part 21a through the inner layer shell 22. Next, a pair of jigs are arranged at positions that sandwich the flange of each of the separators 31 to 34, the inner layer shell 22, and the bent part 21a, and electric current is flown between the pair of jigs, thereby welding the flange of each of the separators 31 to 34, the inner layer shell 22, and the bent part 21a to one another.

[0049] After a separator out of the separators 31 to 34 is inserted to the inner side of the shell 20 and welded, the next separator is inserted to the inner side of the shell 20 and welded. In this way, the separators 31 to 34 are inserted to the inner side of the shell 20 and welded in order. After welding of the separators 31 to 34 is finished, the end covers 11, 12 are welded to the cylindrical-shaped shell 20. Thereafter, the first exhaust pipe 41 may be assembled to the end cover 11 and the separators 31 to 34, and the second exhaust pipe 42 may be assembled

to the end cover 12 and the separators 31 to 34. Thus, the muffler device 1 is completed.

[0050] Operations and effects of this example are explained.

5 **[0051]** In the muffler device 1, the bent part 21a of the outer layer shell 21 enters the inner side of the hole 51 of the intermediate sheet 50, and is welded to the inner layer shell 22 and each of the separators 31 to 34. In the intermediate sheet 50, the hole 51 is formed in the region that faces the bent part 21a. Therefore, when the bent part 21a enters the inner side of the hole 51, the hole 51 is positioned around the bent part 21 a.

10 **[0052]** Therefore, it is unlikely that the hole 51 is shifted with respect to the welded bent part 21a. Accordingly, it is possible to prevent the intermediate sheets 50 from shifting between the outer layer shell 21 and the inner layer shell 22. By preventing the intermediate sheets 50 from shifting, it is possible to make the intermediate sheets 50 remain arranged at given positions, and it is thus possible to exert the given functions (the aforementioned damping function and sound absorbing function) using the intermediate sheet 50.

15 **[0053]** In this example, since the bent part 21 a is provided in the outer layer shell 21 in advance, it is possible to weld the bent part 21a, the inner layer shell 22, and the flange of each of the separators 31 to 34 to each other easily, and it is thus possible to ensure strength of the welded part easily. Also, it is possible to prevent deformation of the outer layer shell 21 when welding the outer layer shell 21 and the inner layer shell 22 to each other.

20 **[0054]** When the outer layer shell 21 and the inner layer shell 22 are welded to each other without forming the bent part 21a in the outer layer shell 21, it can be considered that a part of the outer layer shell 21 is deformed and inserted to the inner side of the hole 51. In this case, when the outer layer shell 21 is deformed, and intermediate sheet 50 could be crushed and a crack could occur from the hole 51. When a part of the outer layer shell 21 is deformed and welded, since the part of the outer layer shell 21 is welded in a stretched state, the welded part of the outer layer shell 21 becomes thinner, and it is likely that strength of the outer layer shell 21 is reduced.

25 **[0055]** In this example, as stated above, since the bent part 21a is used, it is not necessary to deform the outer layer shell 21. Thus, it is possible to prevent the intermediate sheet 50 from being crushed by the outer layer shell 21, and a crack is prevented from happening from the hole 51. Further, since a part of the outer layer shell 21 is not stretched when welded, it is possible to ensure strength of the outer layer shell 21.

30 **[0056]** Meanwhile, by using the bent part 21a, it is possible to project a part of the outer layer shell 21 towards the inner layer shell 22 without changing the thickness of the outer layer shell 21. In other words, similarly to the related art, it is possible to structure the muffler device 1 by using the outer layer shell 21 having a uniform thickness.

[0057] Providing at least two holes 51 makes it possible to prevent the intermediate sheet 50 from shifting in the longitudinal direction of the muffler device 1

[0058] (the horizontal direction in FIG. 4) and a circumferential direction of the shell 20. The two holes 51 only need to be formed at positions that are not aligned with one another in the longitudinal direction of the muffler device 1 and the circumferential direction of the shell 20. For example, as shown in FIG. 8, in the intermediate sheet 50, it is possible to form two holes 51A used for positioning the intermediate sheet 50, and a plurality of holes 51B that are not used for positioning of the intermediate sheet 50. FIG. 8 is a view corresponding to FIG. 4.

[0059] The holes 51A are the same as the hole 51 explained in this example. The two holes 51A are formed at positions that are not aligned with each other in the longitudinal direction of the muffler device 1 (the horizontal direction in FIG. 8), and the circumferential direction of the shell 20 (the vertical direction in FIG. 8). Therefore, by using the two holes 51A, it is possible to position the intermediate sheet 50 in the longitudinal direction of the muffler device 1 and the circumferential direction of the shell 20.

[0060] The positions where the holes 51A are provided are not limited to the positions shown in FIG. 8. As stated above, when at least two holes 51A are provided, the two holes 51A only need to be formed at positions that are not aligned with each other in the longitudinal direction of the muffler device 1 and the circumferential direction of the shell 20. Also, there may be only one hole 51A that is used for positioning of the intermediate sheet 50. In this case, it is also possible to prevent the intermediate sheet 50 from shifting because the hole 51A is fixed.

[0061] In the intermediate sheet 50, the holes 51B are formed in a region larger than the region that faces the bent part 21a, and do not have the function of positioning the intermediate sheet 50. The holes 51B are formed so as to allow the bent parts 21a to come into contact with the inner layer shell 22 and allow the bent parts 21a, the inner layer shell 22, and the flange of each of the separators 31 to 34 to be welded to each other.

[0062] Next, when the muffler device 1 is manufactured, it is possible to position the intermediate sheets 50 with respect to the shell sheet 23 by allowing the bent parts 21a to enter the holes 51. Then, in a state where the intermediate sheets 50 are positioned on the shell sheet 23, the shell sheet 23 and the intermediate sheets 50 are wound around the end covers 11, 12 and the separators 31 to 34.

[0063] This makes it possible to prevent the intermediate sheet 50 from shifting with respect to the shell sheet 23 when winding the shell sheet 23. It is thus possible to arrange the intermediate sheets 50 at the given positions between the outer layer shell 21 and the inner layer shell 22, and the given functions (the foregoing damping function and sound absorbing function) using the intermediate sheets 50 are exerted easily. As stated earlier, by

providing at least two holes 51, it is possible to prevent the intermediate sheet 50 from shifting with respect to the shell sheet 23 in the longitudinal direction of the muffler device 1 and the circumferential direction of the shell 20.

[0064] Further, by winding the shell sheet 23 around the end covers 11, 12 and the separators 31 to 34 while giving a tension to the shell sheet 23, it is possible to allow the intermediate sheet 50 to come into close contact with the outer layer shell 21 and the inner layer shell 22. Thus, it is possible to exert the given functions (the foregoing damping function and sound absorbing function) using the intermediate sheet 50 easily.

[0065] A muffler device according to the second example of the invention is explained. In this example, the same reference numerals are used for members having the same functions as the members explained in the first example, and detailed explanation is omitted. Differences from the first example are mainly explained below.

[0066] A muffler device 1 according to this example is explained with reference to FIG. 9. FIG. 9 is a view corresponding to FIG. 5. As shown in FIG. 9, an outer layer shell 21 includes a body part 21b and a projecting part (corresponding to the processed part according to the invention) 21c. The outer layer shell 21 includes a part having a thickness of the body part 21b only, and a part having a thickness of the body part 21b and the projecting part 21c.

[0067] The projecting part 21c is formed into a shape that protrudes from the body part 21b towards an inner layer shell 22. The projecting part 21c enters an inner side of a hole 51 of an intermediate sheet 50, and is in contact with the inner layer shell 22. The thickness of the projecting part 21c is equal to the thickness of the intermediate sheet 50. The hole 51 is formed in the intermediate sheet 50 in a region that faces the projecting part 21c. The body part 21b and the projecting part 21c may be formed integrally with each other, or the body part 21b and the projecting part 21c may be structured separately, and the projecting part 21c may be fixed to the body part 21b.

[0068] It is possible to manufacture the muffler device 1 according to this example in a method similar to that of the first example. It is sufficient that the projecting part 21c is formed, instead of the bent part 21a, in advance in the shell sheet 23 shown in FIG. 6 and FIG. 7.

[0069] According to this example, similarly to the first example, by using the hole 51, it is possible to prevent the intermediate sheet 50 from shifting when the muffler device 1 is used or manufactured. In addition, similarly to the first example, by allowing the projecting part 21c to enter the inner side of the hole 51 and come into contact with the inner layer shell 22, it is possible to weld the outer layer shell 21, the inner layer shell 22, and a flange of each of the separators 31 to 34 to each other easily. Therefore, it is possible to ensure strength of the welded part easily.

[0070] A muffler device according to the third example

of the invention is explained. In this example, the same reference numerals are used for members having the same functions as the members explained in the first example, and detailed explanation is omitted. Differences from the first example are mainly explained below.

[0071] In the first example, the bent part 21a is formed in the outer layer shell 21. However, in this example, a bent part 21a of an outer layer shell 21 is omitted, and a bent part 22a is formed in an inner layer shell 22 as shown in FIG. 10. FIG. 10 is a view corresponding to FIG. 5. The bent part 22a is formed by bending a part of the inner layer shell 22. The thickness of the bent part 22a is equal to the thickness of the inner layer shell 22 excluding the bent part 22a. The bent part 22a is formed in a shape that protrudes towards the outer layer shell 21, enters a hole 51 in an intermediate sheet 50, and is in contact with the outer layer shell 21.

[0072] As shown in FIG. 10, a flange 32b of a separator 32 is in contact with the bent part 22a. The flange 32b of the separator 32 is formed into a shape that goes along the inner layer shell 22. To be specific, the separator 32 is formed into a shape shown in FIG. 11. FIG. 11 is a view of the separator 32 seen from the longitudinal direction of the muffler device 1. FIG. 11 shows not only the separator 32 but also a first exhaust pipe 41 and a second exhaust pipe 42.

[0073] As shown in FIG. 11, the separator 32 has a projecting part 32c at a position corresponding to the bent part 22a. Since the bent part 22a projects towards the outer layer shell 21, the projecting part 32c is formed in the separator 32 as well. Thus, the flange 32b, which is formed in an outer edge of the separator 32, is arranged along the inner layer shell 22 including the bent part 22a.

[0074] Next, a manufacturing method for the muffler device 1 according to this example is explained by using FIG. 12. FIG. 12 is a view corresponding to FIG. 6.

[0075] First of all, the shell sheet 23 is welded to end covers 11, 12 at a position P21. Then, by rotating the end covers 11, 12 and the separators 31 to 34 in a direction of arrows R2 in FIG. 12, the shell sheet 23 is wound around the end covers 11, 12 and the separators 31 to 34. The first exhaust pipe 41 and the second exhaust pipe 42 are connected with the end covers 11, 12 and the separators 31 to 34.

[0076] By winding the shell sheet 23 around the end covers 11, 12 and the separators 31 to 34 from the position P21 up to a position P22 of the shell sheet 23, the cylindrical-shaped inner layer shell 22 is formed. The two intermediate sheets 50 are superimposed respectively in a region between the position P21 and the position P22 in the shell sheet 23.

[0077] In the region between the position P21 and the position P22 in the shell sheet 23, the plurality of bent parts 22a are formed in advance. Each of the bent parts 22a enters the inner side of the hole 51 of the intermediate sheet 50. Thus, the intermediate sheet 50 is positioned with respect to the shell sheet 23. When the inner layer shell 22 is formed, the projecting part 32c of the separator

32 shown in FIG. 11 enters an inner side of the bent part 22a (in short, a recessed part). Further, when the inner layer shell 22 is formed, the intermediate sheets 50 are arranged on an outer peripheral surface of the inner layer shell 22.

[0078] Next, by winding the shell sheet 23 around the end covers 11, 12 and the separators 31 to 34 from the position P22 up to a position P23 of the shell sheet 23, the cylindrical-shaped outer layer shell 21 is formed. The shell sheet 23 is welded to the end covers 11, 12 at the position P23. When the outer layer shell 21 is formed, the intermediate sheets 50 are sandwiched between the inner layer shell 22 and the outer layer shell 21. By winding the shell sheet 23 around the end covers 11, 12 and the separators 31 to 34 while giving a tension to the shell sheet 23, the intermediate sheets 50 are easily brought into close contact with the outer layer shell 21 and the inner layer shell 22 easily.

[0079] After the shell 20 is formed by winding the shell sheet 23 around the end covers 11, 12 and the separators 31 to 34, laser welding, for example, is performed from an outer side of the shell 20. Thus, a part where the outer layer shell 21, the bent part 22a, and the flange of each of the separators 31 to 34 are superimposed on each other is welded. Thus, the muffler device 1 is completed.

[0080] According to this example, since the hole 51 is formed in the intermediate sheet 50 in a region that faces the bent part 22a, when the bent part 22a enters the inner side of the hole 51, the hole 51 is positioned around the bent part 22a. Therefore, it is unlikely that the hole 51 is shifted with respect to the welded bent part 22a. Hence, similarly to the first example, it is possible to prevent the intermediate sheet 50 from shifting when the muffler device 1 is used or manufactured.

[0081] By allowing the bent part 22a to enter the inner side of the hole 51 and come into contact with the outer layer shell 21, the outer layer shell 21, the inner layer shell 22, and the flange of each of the separators 31 to 34 are welded to each other easily, thereby ensuring strength of the welded part easily. Moreover, by using the bent part 22a, it is possible to allow a part of the inner layer shell 22 to project towards the outer layer shell 21 without changing the thickness of the inner layer shell 22. In other words, similarly to the related art, it is possible to structure the muffler device 1 by using the inner layer shell 22 having a uniform thickness.

[0082] A modified example of this example is explained by using FIG. 13. FIG. 13 is a view corresponding to FIG. 9. As shown in FIG. 13, an inner layer shell 22 has a body part 22b and a projecting part 22c. The inner layer shell 22 includes a part having a thickness of the body part 22b only, and a part having a thickness of the body part 22b and the projecting part 22c.

[0083] The projecting part 22c is formed in a shape that protrudes towards an outer layer shell 21 from the body part 22b. The projecting part 22c enters an inner side of a hole 51 of an intermediate sheet 50 and comes into contact with the outer layer shell 21. The thickness

of the projecting part 22c is equal to the thickness of the intermediate sheet 50. The body part 22b and the projecting part 22c may be formed integrally with each other, or the body part 22b and the projecting part 22c may be structured separately and then the projecting part 22c may be fixed to the body part 22b.

[0084] A muffler device 1 according to this modified example is manufactured in a method similar to that of the first example. This means that the muffler device 1 may be manufactured by winding a shell sheet 23 around end covers 11, 12 and separators 31 to 34, or the muffler device 1 may be manufactured by assembling the separators 31 to 34 and the end covers 11, 12 to a shell 20 formed into a cylindrical shape. It is only necessary to form the projecting part 22c, instead of the bent part 22a, in advance in the shell sheet 23 shown in FIG. 12.

[0085] According to this modified example, by using the projecting part 22c and the hole 51, it is possible to prevent the intermediate sheet 50 from shifting when the muffler device 1 is used or manufactured. Further, by allowing the projecting part 22c to enter an inner side of the hole 51 and come into contact with the outer layer shell 21, the outer layer shell 21, the inner layer shell 22, and a flange of each of the separators 31 to 34 are welded to each other easily, thereby ensuring strength of the welded part easily.

[0086] A muffler device according to the fourth example of the invention is explained. In this example, the same reference numerals are used for members having the same functions as the members explained in the first to third examples, and detailed explanation is omitted. Differences from the first to third examples are mainly explained below.

[0087] In the first to third examples, the outer layer shell 21 and the inner layer shell 22 are formed by winding one shell sheet 23 around the end covers 11, 12 and the separators 31 to 34. Meanwhile, in this example, an outer layer shell 21 and an inner layer shell 22 are formed from separate shell sheets.

[0088] As shown in FIG. 14, an intermediate sheet 50 is arranged between a shell sheet 23A that structures the outer layer shell 21, and a shell sheet 23B that structures the inner layer shell 22, and the shell sheets 23A, 23B and the intermediate sheet 50 are superimposed on each other. Here, the bent part 21a explained in the first example, or the projecting part 21c explained in the second example may be formed in the shell sheet 23A. In such a case, as explained in the first example or the second example, it is possible to position the intermediate sheet 50 with respect to the shell sheet 23A by allowing the bent part 21a or the projecting part 21c to enter an inner side of a hole 51 of the intermediate sheet 50.

[0089] Meanwhile, the bent part 22a or the projecting part 22c explained in the third example may be formed in the shell sheet 23B. In such a case, as explained in the third example, it is possible to position the intermediate sheet 50 with respect to the shell sheet 23B by allowing the bent part 22a or the projecting part 22c to

enter the inner side of the hole 51.

[0090] As shown in FIG. 14, by rotating the end covers 11, 12 and the separators 31 to 34 in a direction of arrows R3, it is possible to wind the shell sheets 23A, 23B and the intermediate sheet 50 around the end covers 11, 12 and the separators 31 to 34. Therefore, as shown in FIG. 15, a cylindrical-shaped outer layer shell 21 is formed by the shell sheet 23A, and a cylindrical-shaped inner layer shell 22 is formed by the shell sheet 23B. Further, the intermediate sheet 50 is arranged between the outer layer shell 21 and the inner layer shell 22. FIG. 15 is a sectional view showing a structure of a shell 20 and the intermediate sheet 50, and corresponds to FIG. 2. In FIG. 15, the separators 31 to 34 arranged on an inner side of the shell 20 are omitted.

[0091] It is possible to wind the shell sheets 23A, 23B around the end covers 11, 12 and the separators 31 to 34 while giving a tension to the shell sheets 23A, 23B. Thus, the intermediate sheet 50 is easily brought into close contact with the outer layer shell 21 and the inner layer shell 22, thereby easily exerting the given functions (the foregoing damping function and sound absorbing function) using the intermediate sheet 50.

[0092] After this, as explained in the first to third examples, it is only necessary to weld the outer layer shell 21 and the inner layer shell 22 to each of the separators 31 to 34 and the end covers 11, 12. The shell sheets 23A, 23B are welded to the end covers 11, 12 at positions P31, P32 shown in FIG. 14.

[0093] Both ends of the shell sheet 23A at the positions P31, P32 may abut against each other and be welded, and both ends of the shell sheet 23B at the positions P31, P32 may abut against each other and be welded. Instead of abutting both ends of each of the shell sheets 23A, 23B against each other, both ends of a layered body of the shell sheets 23A, 23B at the positions P31, P32 may be superimposed on and welded to each other, when the layered body is wound.

[0094] The manufacturing method for the muffler device 1 is not limited to the methods described above. As explained in the first example, when the bent part 21a (the first example) or the projecting part 21c (the second example) is formed in the shell sheet 23A, or the projecting part 22c (the third example) is formed in the shell sheet 23B, the cylindrical-shaped shell 20 can be formed in advance by winding the layered body in which the shell sheets 23A, 23B and the intermediate sheet 50 are layered. Then, each of the separators 31 to 34 may be inserted in the inner side of the cylindrical-shaped shell 20, and each of the separators 31 to 34 may be welded to the shell 20.

[0095] When the outer layer shell 21 and the inner layer shell 22 are structured separately, it is also possible to position the intermediate sheet 50 similarly to each of the first to third examples. Therefore, the intermediate sheet 50 is prevented from shifting when the muffler device 1 is used or manufactured. Further, similarly to the first to third examples, the outer layer shell 21, the inner layer

shell 22, and the flange of each of the separators 31 to 34 is welded to each other easily, thereby ensuring strength of the welded part easily.

[0096] In the foregoing first to fourth examples, the hole 51 is formed in the intermediate sheet 50. However, the invention is not limited to this. Specifically, as shown in FIG. 16, a recessed part (the receiving part according to the invention) 52 may be formed in the intermediate sheet 50. FIG. 16 is a sectional view in a thickness direction of the intermediate sheet 50, and corresponds to FIG. 5, FIG. 9, FIG. 10, and FIG. 13. In the structure shown in FIG. 16, the recessed part 52 opens upwardly in FIG. 16.

[0097] The recessed part 52 may be formed at the same position as the hole 51 shown in FIG. 5 and FIG. 9. In this case, the recessed part 52 is open towards the outer layer shell 21. The bent part 21a shown in FIG. 5, or the projecting part 21c shown in FIG. 9 may enter an inner side of the recessed part 52. By allowing the bent part 21a or the projecting part 21c to enter the recessed part 52, the recessed part 52 is prevented from shifting with respect to the bent part 21a or the projecting part 21c, and it is thus possible to position the intermediate sheet 50 between the outer layer shell 21 and the inner layer shell 22.

[0098] The recessed part 52 may also be formed at the same position as the hole 51 shown in FIG. 10 or FIG. 13. At this time, the recessed part 52 opens towards the inner layer shell 22. The bent part 22a shown in FIG. 10 or the projecting part 22c shown in FIG. 13 may enter the inner side of the recessed part 52. By allowing the bent part 22a or the projecting part 22c to enter the recessed part 52, the recessed part 52 is prevented from shifting with respect to the bent part 22a or the projecting part 22c, and it is thus possible to position the intermediate sheet 50 between the outer layer shell 21 and the inner layer shell 22.

[0099] As shown in FIG. 16, when the recessed part 52 is formed in the intermediate sheet 50, it is not possible to weld the outer layer shell 21, the inner layer shell 22, and the flange of each of the separators 31 to 34 to each other at the position where the recessed part 52 is formed. In this case, it is possible to weld the outer layer shell 21, the inner layer shell 22, and the flange of each of the separators 31 to 34 to each other at a location where the intermediate sheet 50 is not arranged. The location where the intermediate sheet 50 is arranged is, for example, an upper part or a lower part of the muffler device 1 in FIG. 2.

[0100] It is also possible to form the hole 51 and the recessed part 52 in the intermediate sheet 50. In this case, it is possible to position the intermediate sheet 50 by using the hole 51 and the recessed part 52, and it is also possible to weld the outer layer shell 21, the inner layer shell 22, and the flange of each of the separators 31 to 34 to each other at a position where the hole 51 is formed.

[0101] Instead of the holes 51A explained in FIG. 8, the recessed parts 52 may be formed at the same posi-

tions as those of the holes 51A. The recessed parts 52 may be used as substitution for all of the holes 51A, or may be used as substitution for a part of the holes 51 A.

Claims

1. A muffler device, to which exhaust gas discharged from an internal combustion engine of a vehicle is introduced, **characterized by** comprising:

a cylindrical-shaped outer layer shell that is arranged on an outer surface of the muffler device and extends in a given direction;

a cylindrical-shaped inner layer shell that is arranged on an inner side of the outer layer shell in the muffler device and extends in the given direction; and

an intermediate sheet that is arranged between the outer layer shell and the inner layer shell and serves as a damping material or a sound absorbing material, wherein

one shell out of the outer layer shell and the inner layer shell includes a processed part that is processed into a shape protruding towards the other shell, and

the intermediate sheet includes a receiving part in a region that faces the processed part, the receiving part being formed into a shape that allows the processed part to enter the receiving part.

2. The muffler device according to claim 1, wherein the one shell includes a plurality of the processed parts, the intermediate sheet includes a plurality of the receiving parts that correspond to the plurality of processed parts, respectively, and the plurality of receiving parts are formed at positions that are not aligned with each other in the given direction and a circumferential direction of the outer layer shell and the inner layer shell.

3. The muffler device according to claim 1 or 2, wherein the processed part is a bent part formed by bending a part of the one shell.

4. The muffler device according to any one of claims 1 to 3, wherein

the muffler device includes a separator having a flange that is formed along an inner peripheral surface of the inner layer shell, the separator dividing a space formed on an inner side of the inner layer shell into a plurality of spaces that are lined up in the given direction, and

the receiving part has a hole that allows the processed part to go through the hole and so that the processed part comes into contact with the other

shell, and the flange, the processed part and the other shell are superimposed on each other and welded to each other.

5. The muffler device according to any one of claims 1 to 4, wherein
the receiving part is positioned around the processed part, and the intermediate sheet is positioned by using the processed part and the receiving part.
6. A manufacturing method for a muffler device, to which exhaust gas discharged from an internal combustion engine of a vehicle is introduced, the method being **characterized by** comprising:
 - forming a processed part in a shell sheet that structures an outer layer shell and an inner layer shell;
 - superimposing an intermediate sheet on the shell sheet by allowing the processed part to enter a receiving part; and
 - forming the outer layer shell and the inner layer shell that sandwich the intermediate sheet by forming the shell sheet, on which the intermediate sheet is superimposed, into a cylindrical shape, wherein
the muffler device includes a cylindrical-shaped outer layer shell that is arranged on an outer surface of the muffler device and extends in a given direction, a cylindrical-shaped inner layer shell that is arranged on an inner side of the outer layer shell in the muffler device and extends in the given direction, and the intermediate sheet that is arranged between the outer layer shell and the inner layer shell and serves as a damping material or a sound absorbing material, one shell out of the outer layer shell and the inner layer shell includes the processed part that is processed into a shape protruding towards the other shell, and the intermediate sheet includes the receiving part in a region that faces the processed part, the receiving part being formed into a shape that allows the processed part to enter the receiving part.
7. The manufacturing method for the muffler device according to claim 6, wherein the muffler device includes a separator having a flange that is formed along an inner peripheral surface of the inner layer shell, the separator dividing a space formed on an inner side of the inner layer shell into a plurality of spaces that are lined up in the given direction, and, when forming the outer layer shell and the inner layer shell, the shell sheet is formed into a cylindrical shape by winding the shell sheet around the separator while giving a tension to the shell sheet.
8. A manufacturing method for a muffler device, to

which exhaust gas discharged from an internal combustion engine of a vehicle is introduced, the method being **characterized by** comprising:

- forming a processed part in a first shell sheet that structures one of shells;
- allowing the processed part to enter a receiving part, and sandwiching an intermediate sheet between a second shell sheet that structures the other shell, and the first shell sheet; and
- forming the first shell sheet and the second shell sheet, which sandwich the intermediate sheet, into a cylindrical shape, thereby forming an outer layer shell and an inner layer shell, respectively, wherein
the muffler device includes a cylindrical-shaped outer layer shell that is arranged on an outer surface of the muffler device and extends in a given direction, a cylindrical-shaped inner layer shell that is arranged on an inner side of the outer layer shell
in the muffler device and extends in the given direction, and the intermediate sheet that is arranged between the outer layer shell and the inner layer shell and serves as a damping material or a sound absorbing material,
the one shell out of the outer layer shell and the inner layer shell includes the processed part that is processed into a shape protruding towards the other shell, and the intermediate sheet includes the receiving part in a region that faces the processed part, the receiving part being formed into a shape that allows the processed part to enter the receiving part.
9. The manufacturing method for the muffler device according to claim 8, wherein
the muffler device includes a separator having a flange that is formed along an inner peripheral surface of the inner layer shell, the separator dividing a space formed on an inner side of the inner layer shell into a plurality of spaces that are lined up in the given direction, and,
when forming the outer layer shell and the inner layer shell, the first shell sheet and the second shell sheet are formed into a cylindrical shape by winding the first shell sheet and the second shell sheet around the separator while giving a tension to the first shell sheet and the second shell sheet.
10. The manufacturing method for the muffler device according to any one of claims 6 to 9, wherein
the intermediate sheet includes a plurality of receiving parts formed at positions that are not aligned with each other in the given direction and a circumferential direction of the outer layer shell and the inner layer shell, and
the one shell includes a plurality of the processed

parts that correspond to the plurality of receiving parts, respectively, and the intermediate sheet is positioned in the given direction and the circumferential directions by allowing each of the processed parts to enter each of the receiving parts. 5

11. The manufacturing method for the muffler device according claim 7 or 9, wherein the receiving part has a hole that allows the processed part to go through the hole so that the processed part comes into contact with the other shell, and a part where the flange, the processed part, and the other shell are superimposed on each other is welded after the outer layer shell and the inner layer shell are formed. 10 15

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FIG. 1

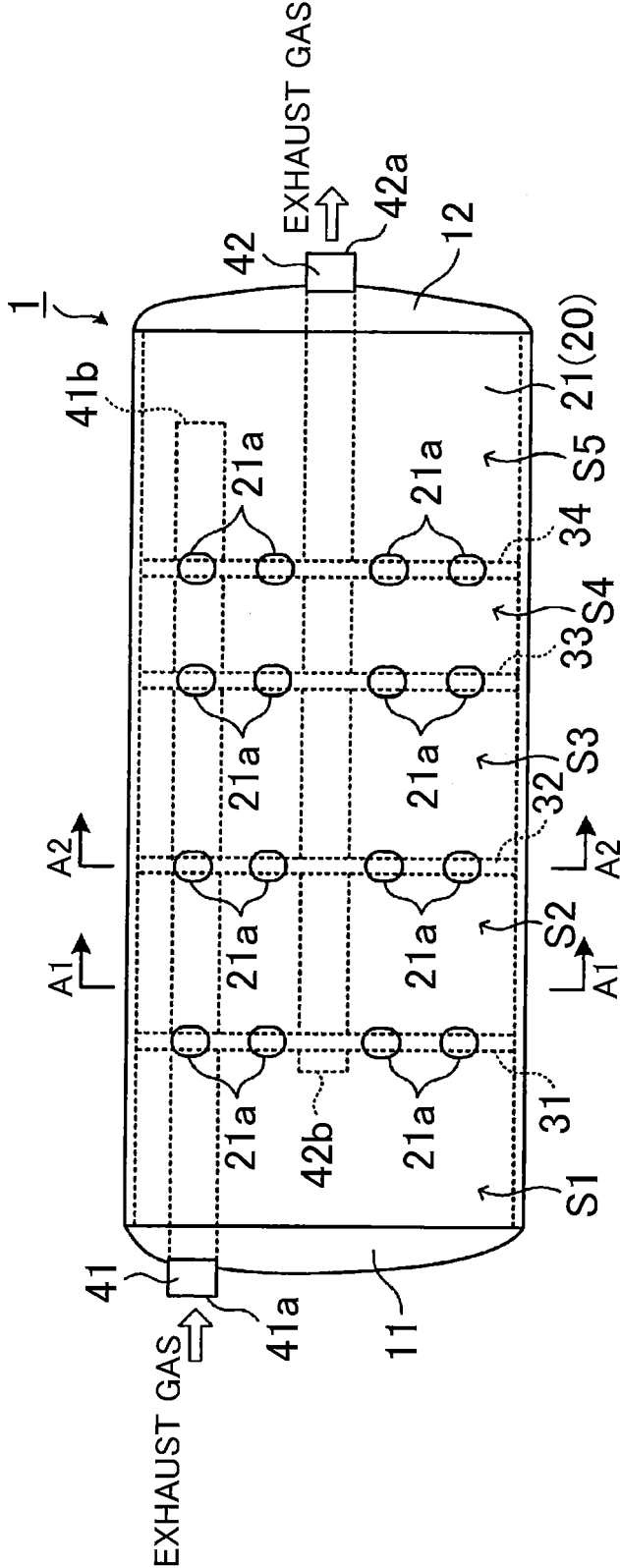


FIG. 2

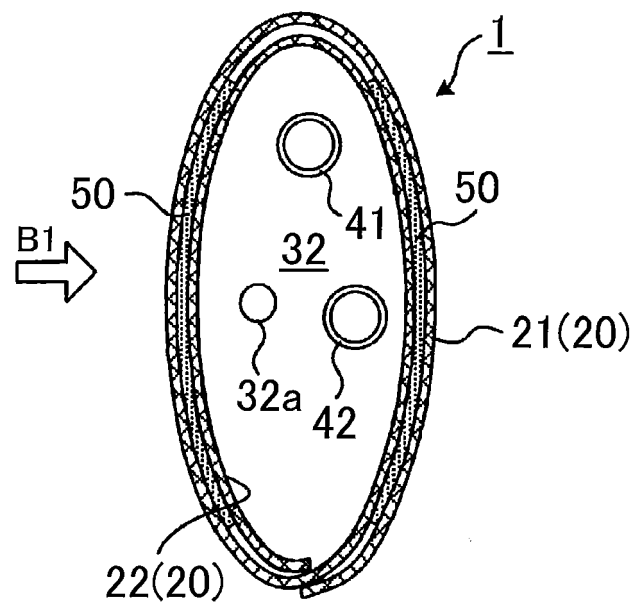


FIG. 3

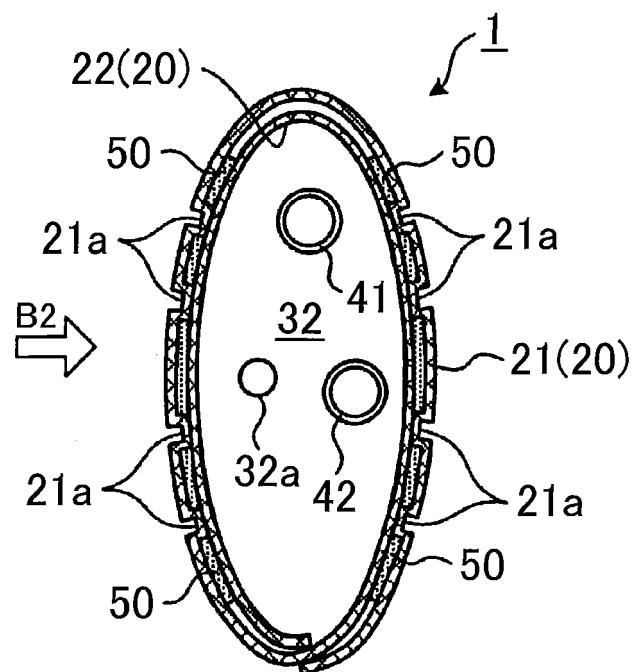


FIG. 4

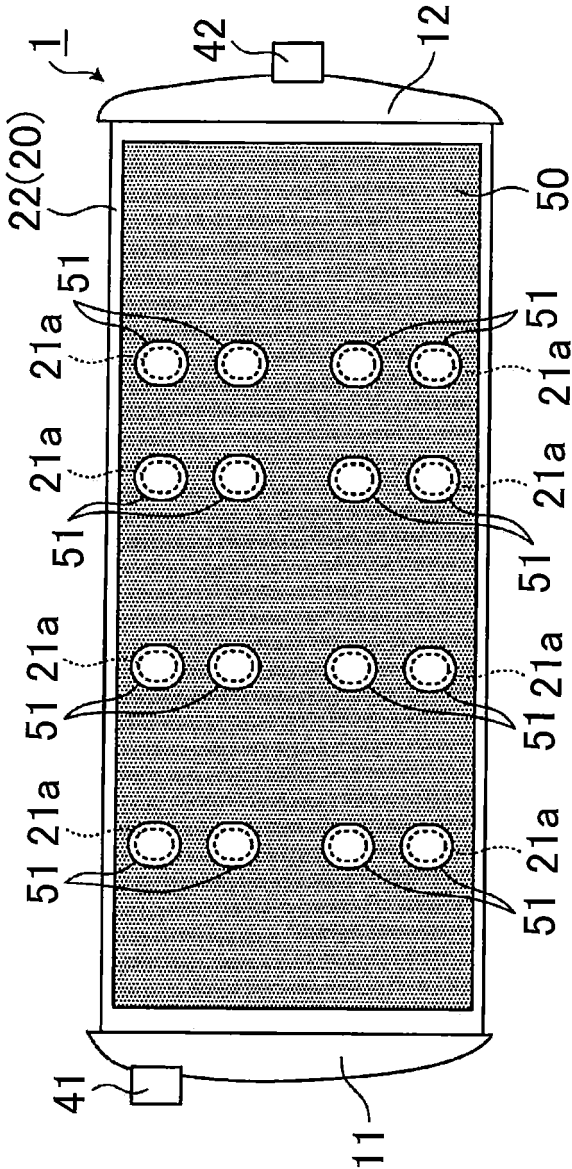


FIG. 5

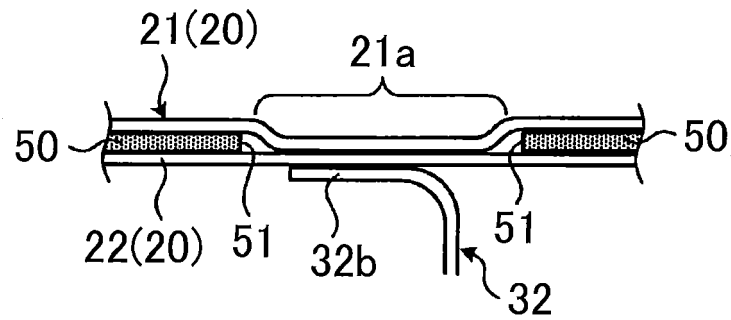


FIG. 6

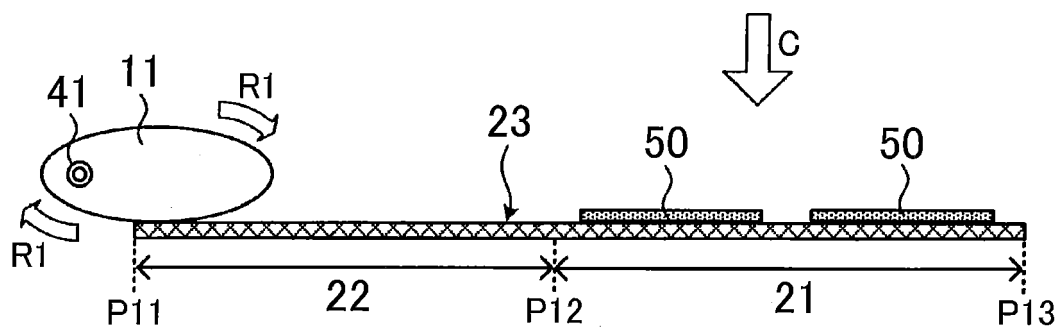


FIG. 7

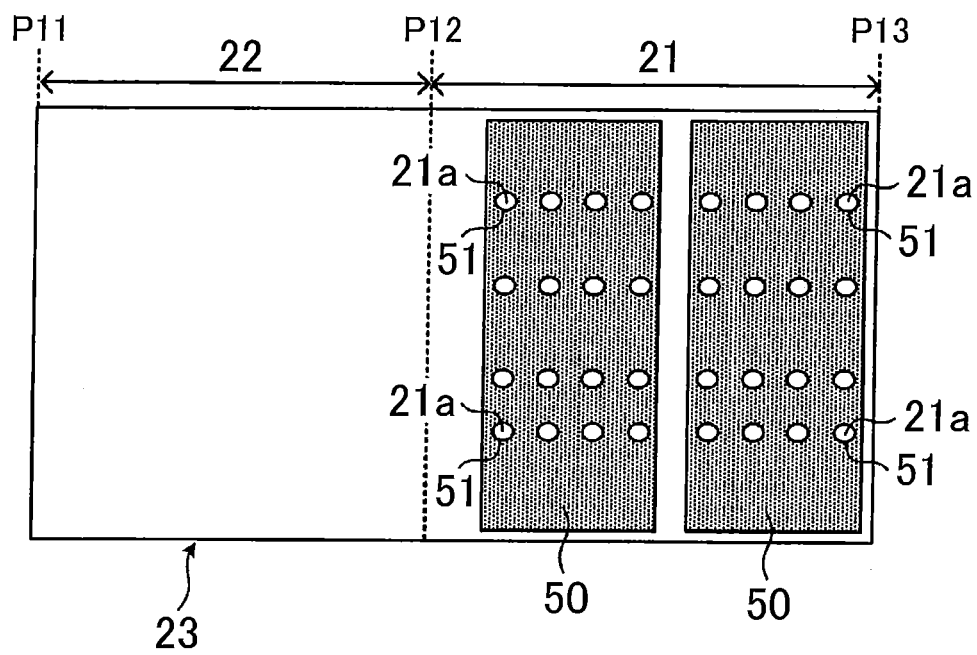


FIG. 8

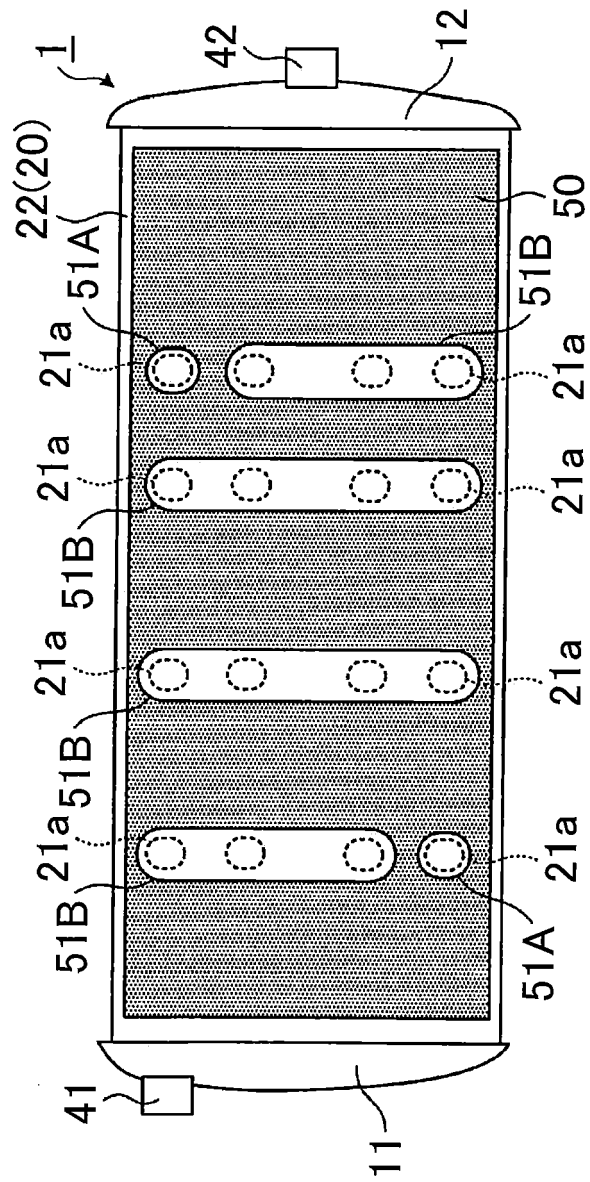


FIG. 9

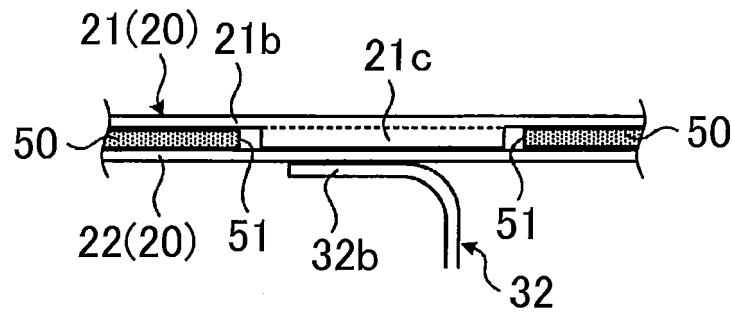


FIG. 10

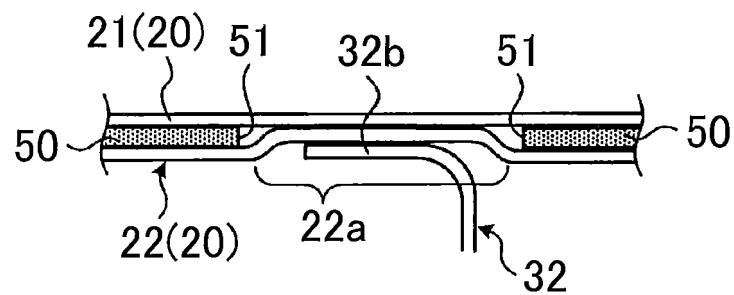


FIG. 11

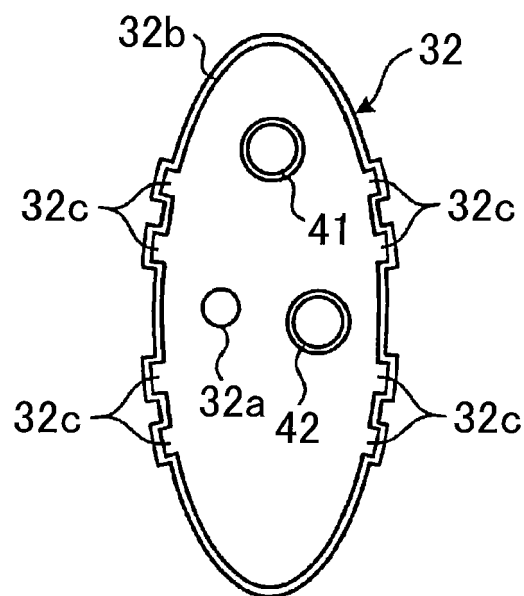


FIG. 12

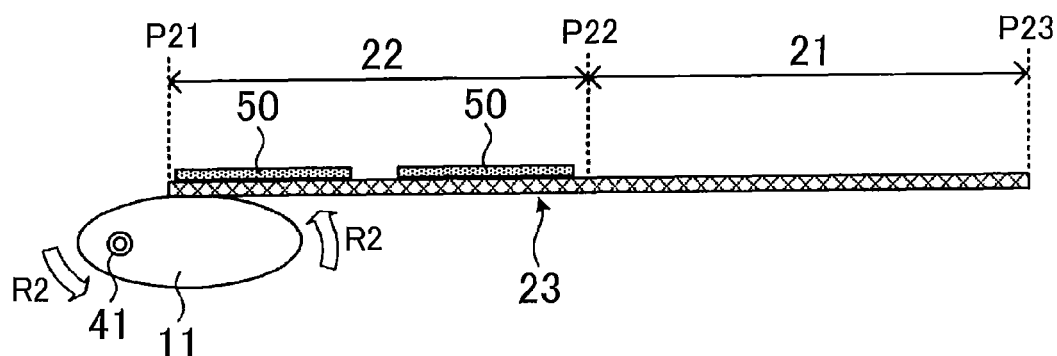


FIG. 13

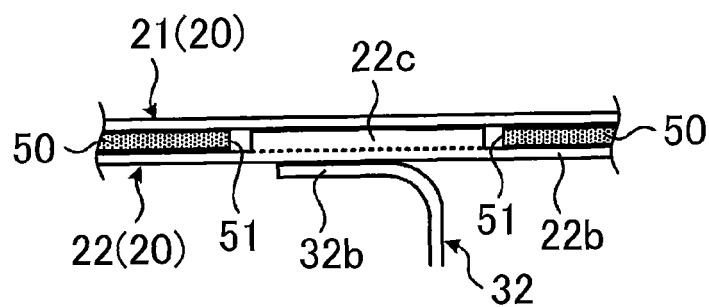


FIG. 14

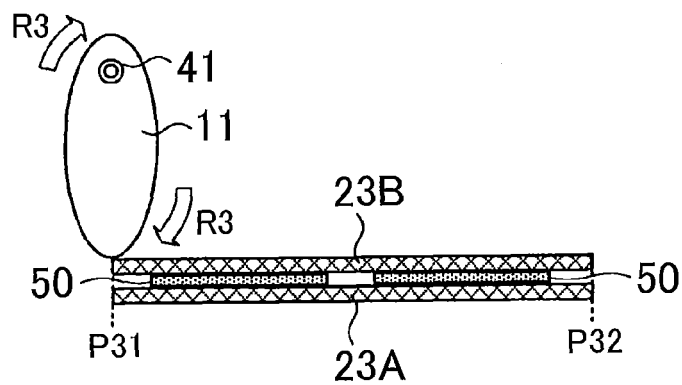


FIG. 15

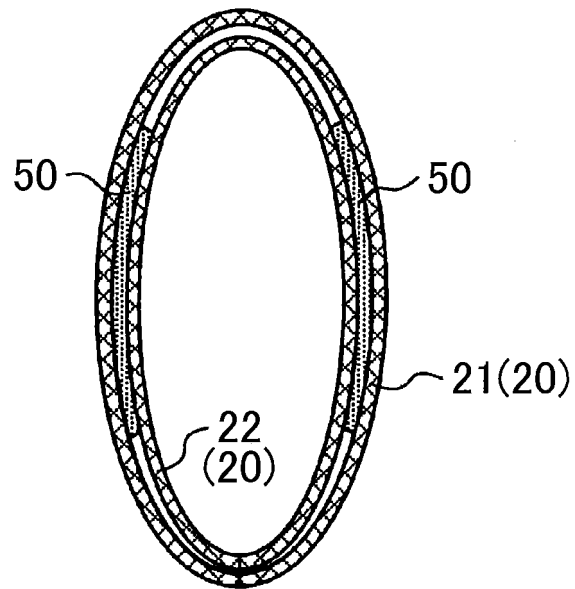
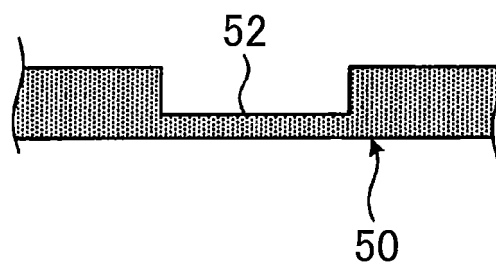


FIG. 16





EUROPEAN SEARCH REPORT

Application Number
EP 15 18 1633

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Place of search Munich		Date of completion of the search 5 January 2016	Examiner Steinberger, Yvonne
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