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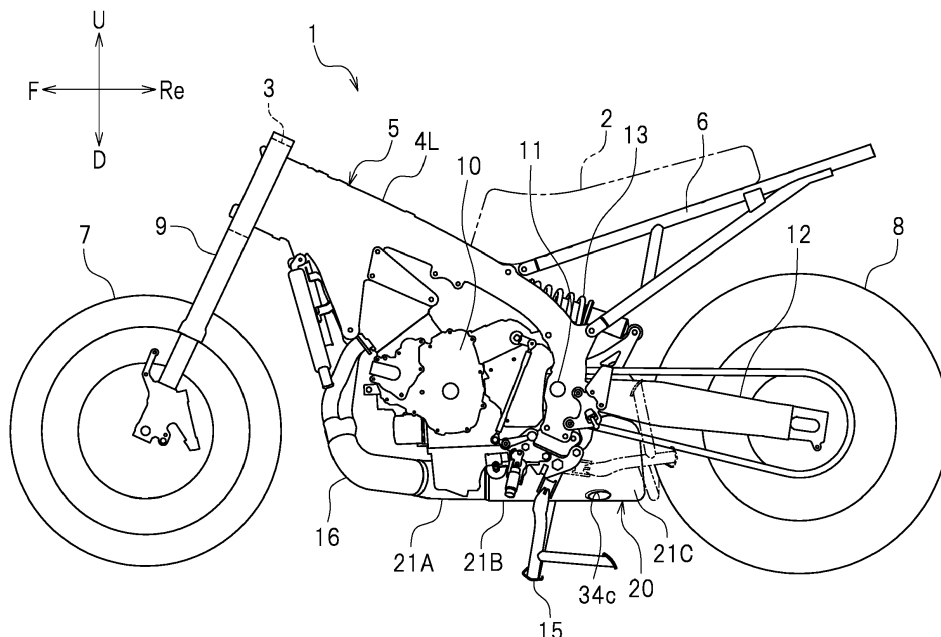
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(54) SADDLE-TYPE VEHICLE

(57) A straddled vehicle including a silencer arranged between the engine and the rear wheel, with which it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer. A silencer **20** includes: a case **21** at least a portion of which is arranged on a vehicle center line **CL** as the vehicle is seen from below; a partition wall **22** that partitions the inside of the case **21** into a first chamber **41** and a second chamber **42**; a first pipe **31**; a second pipe **32**; a fib-

er-based silencing material **23** that is arranged inside the first chamber **41** and outside the first pipe **31** and the second pipe **32**; a third pipe **33** including a third inlet **33a** that is arranged inside the second pipe **32**; and a fourth pipe **34** including a fourth inlet **34a** that is arranged inside the second pipe **32**. The first pipe **31** has a plurality of through holes **31d**. The second pipe **32** has a plurality of through holes **32d**.

FIG. 1**EP 3 514 343 A1**

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a straddled vehicle.

Description of the Related Art

[0002] Conventional straddled vehicles including a silencer for reducing the environmental noise from the exhaust are known in the art. Japanese Laid-Open Patent Publication No. 2009-248824 discloses a motorcycle including a silencer arranged between the engine and the rear wheel.

[0003] The silencer disclosed in Japanese Laid-Open Patent Publication No. 2009-248824 includes a case, the inside of which is partitioned into a first, a second and a third expansion chamber, a first pipe that connects together the first expansion chamber and the second expansion chamber, a second pipe that connects together the second expansion chamber and the third expansion chamber, and a third pipe that connects together the third expansion chamber and the outside of the case. The first expansion chamber communicates with the exhaust pipe of the engine. The first pipe and the second pipe are arranged inside the case. The third pipe extends through the side surface of the case, and a portion of the third pipe protrudes out of the case. The exhaust gas from the engine expands gradually by flowing sequentially through the first expansion chamber, the second expansion chamber and the third expansion chamber. This reduces the environmental noise from the exhaust.

SUMMARY OF THE INVENTION

[0004] With a straddled vehicle, the distance between the engine and the rear wheel tends to be relatively short, and the space between the engine and the rear wheel is small. The size of the silencer being large imposes tight constraints on designing the vehicle. However, simply reducing the size of the silencer will reduce the volumes of the expansion chambers, and it is then difficult to sufficiently reduce the environmental noise from the exhaust.

[0005] It is an object of the present invention, which has been made in order to solve such a problem, to provide a straddled vehicle including a silencer arranged between the engine and the rear wheel, with which it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer.

[0006] The present inventor focused on the fact that the environmental noise from the exhaust can be generally classified into a low-frequency component and a high-frequency component, for each of which there is an effective silencing mechanism. First, the present inventor

considered reducing the number of expansion chambers in the case, and instead providing expansion chambers of greater capacities than those of the conventional techniques. Then, it is possible to increase the degree by which the exhaust gas expands at a time even though the number of times the exhaust gas expands is reduced. Thus, it is possible to effectively reduce the low-frequency component. Next, the present inventor considered arranging a fiber-based sound-absorbing material such as a glass wool in one expansion chamber. Then, it is possible to effectively reduce the high-frequency component. The present inventor thus found that it is possible to reduce the environmental noise from the exhaust without increasing the size of the silencer by using suitable silencing mechanisms for the low-frequency component and for the high-frequency component. The present invention is based on this finding.

[0007] Above object is achieved by a straddled vehicle according to the configurations of claim 1 or 2.

[0008] A straddled vehicle disclosed herein includes: an engine; a rear wheel arranged rearward of the engine; an exhaust pipe connected to the engine; and a silencer connected to the exhaust pipe, at least a portion of which is arranged rearward of the engine and forward of the rear wheel. The silencer includes a case, a partition wall, a first pipe, a second pipe, a fiber-based silencing material, a third pipe, and a fourth pipe. At least a portion of the case is arranged on a vehicle center line as the vehicle is seen from below. The partition wall is arranged inside the case and partitions the inside of the case into a first chamber and a second chamber. The first pipe has a first inlet through which an exhaust gas from the exhaust pipe flows into the first pipe, a first peripheral wall that is arranged in the first chamber and has a plurality of through holes, and a first outlet that is opened into the second chamber. The second pipe has a second inlet that is opened into the second chamber, and a second peripheral wall that is arranged in the first chamber and has a plurality of through holes. The fiber-based silencing material is arranged inside the first chamber and outside the first pipe and the second pipe. The third pipe has a third inlet that is arranged inside the second pipe, a third peripheral wall that is arranged inside the second pipe and inside the second chamber, and a third outlet that is opened toward an outside of the case. The fourth pipe has a fourth inlet that is arranged inside the second pipe, a fourth peripheral wall that is arranged inside the second pipe and inside the second chamber, and a fourth outlet that is opened toward the outside of the case.

[0009] With the straddled vehicle described above, the inside of the case is partitioned into two chambers. As compared with conventional techniques where the inside of the case is partitioned into three chambers, it is possible to increase the volume of the second chamber without increasing the size of the case. By expanding the exhaust gas through the second chamber having a large volume, it is possible to effectively reduce the low-frequency component of the environmental noise from the

exhaust. With the straddled vehicle described above, through holes are formed in the first peripheral wall of the first pipe and the second peripheral wall of the second pipe, and the fiber-based silencing material is arranged inside the first chamber and outside the first pipe and the second pipe. Therefore, while the exhaust gas flows through the first pipe and the second pipe, it is possible to effectively reduce the high-frequency component of the environmental noise from the exhaust. It is possible, using a single fiber-based silencing material, to silence the exhaust gas flowing through the first pipe and silence the exhaust gas flowing through the second pipe. Since the fiber-based silencing material can be shared as described above, it is possible to reduce the installation space for the fiber-based silencing material. Thus, it is possible to reduce the size of the silencer. The straddled vehicle described above includes two pipes (i.e., the third pipe and the fourth pipe) for emitting the exhaust gas out of the case. Therefore, as compared with a case where the exhaust gas is emitted out of the case by using one pipe, the sound to be emitted out of the case can be dispersed. With the straddled vehicle described above, these advantageous effects are synergistically combined together, and it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer.

[0010] Another straddled vehicle disclosed herein includes: an engine; a rear wheel arranged rearward of the engine; an exhaust pipe connected to the engine; and a silencer connected to the exhaust pipe, at least a portion of which is arranged rearward of the engine and forward of the rear wheel. The silencer includes a case, a partition wall, a first pipe, a second pipe, an additional second pipe, a fiber-based silencing material, a third pipe, and a fourth pipe. At least a portion of the case is arranged on a vehicle center line as the vehicle is seen from below. The partition wall is arranged inside the case and partitions the inside of the case into a first chamber and a second chamber. The first pipe has a first inlet through which an exhaust gas from the exhaust pipe flows into the first pipe, a first peripheral wall that is arranged in the first chamber and has a plurality of through holes, and a first outlet that is opened into the second chamber. The second pipe has a second inlet that is opened into the second chamber, and a second peripheral wall that is arranged in the first chamber and has a plurality of through holes. The additional second pipe has an additional second inlet that is opened into the second chamber, and an additional second peripheral wall that is arranged in the first chamber and has a plurality of through holes. The fiber-based silencing material is arranged inside the first chamber and outside the first pipe, the second pipe and the additional second pipe. The third pipe has a third inlet that is arranged inside the second pipe, a third peripheral wall that is arranged inside the second pipe and inside the second chamber, and a third outlet that is opened toward an outside of the case. The fourth pipe has a fourth inlet that is arranged inside the addi-

tional second pipe, a fourth peripheral wall that is arranged inside the additional second pipe and inside the second chamber, and a fourth outlet that is opened toward the outside of the case.

[0011] Also with the straddled vehicle described above, the inside of the case is partitioned into two chambers, and it is therefore possible to increase the volume of the second chamber without increasing the size of the case. By expanding the exhaust gas through the second chamber having a large volume, it is possible to effectively reduce the low-frequency component of the environmental noise from the exhaust. With the straddled vehicle described above, through holes are formed in the first peripheral wall of the first pipe, the second peripheral wall of the second pipe and the additional second peripheral wall of the additional second pipe, and the fiber-based silencing material is arranged inside the first chamber and outside the first pipe, the second pipe and the additional second pipe. Therefore, while the exhaust gas flows through the first pipe, the second pipe and the additional second pipe, it is possible to effectively reduce the high-frequency component of the environmental noise from the exhaust. It is possible, using a single fiber-based silencing material, to silence the exhaust gas flowing through the first pipe, the second pipe and the additional second pipe. Since the fiber-based silencing material can be shared as described above, it is possible to reduce the installation space for the fiber-based silencing material. Thus, it is possible to reduce the size of the silencer. The straddled vehicle described above includes two pipes (i.e., the third pipe and the fourth pipe) for emitting the exhaust gas out of the case. Therefore, as compared with a case where the exhaust gas is emitted by using one pipe, the sound to be emitted out of the case can be dispersed. With the straddled vehicle described above, these advantageous effects are synergistically combined together, and it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer.

[0012] In one preferred aspect, the case has a bottom wall. The third pipe and the fourth pipe are connected to the bottom wall.

[0013] In this aspect, since the sound from the third pipe and the fourth pipe is discharged downward, it is possible to effectively reduce the environmental noise from the exhaust. Moreover, it is possible to prevent a hot exhaust gas from blowing onto the rear wheel.

[0014] In one preferred aspect, one of the third outlet and the fourth outlet is located leftward of a middle of the case in a vehicle width direction. The other one of the third outlet and the fourth outlet is located rightward of the middle of the case in the vehicle width direction.

[0015] In this aspect, the sound discharged from the third pipe and the fourth pipe is distributed left and right. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0016] In one preferred aspect, as the vehicle is seen from below, one of the third outlet and the fourth outlet

is located leftward of the vehicle center line. The other one of the third outlet and the fourth outlet is located rightward of the vehicle center line.

[0017] In this aspect, the sound discharged from the third pipe and the fourth pipe is distributed left and right. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0018] In one preferred aspect, as the vehicle is seen from below, one of a center line of the third outlet and a center line of the fourth outlet is inclined leftward with respect to the vehicle center line while extending rearward. The other one of the center line of the third outlet and the center line of the fourth outlet is inclined rightward with respect to the vehicle center line while extending rearward.

[0019] In this aspect, the sound discharged from the third pipe and the fourth pipe is distributed left and right. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0020] In one preferred aspect, a length of the third pipe and a length of the fourth pipe are different from each other.

[0021] In this aspect, it is possible to adjust the frequency of the sound that is discharged from the third pipe and the frequency of the sound that is discharged from the fourth pipe. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0022] In one preferred aspect, the third outlet and the fourth outlet are arranged inside an outline of the case, as the vehicle is seen from sideways and as the vehicle is seen from below.

[0023] In this aspect, since the third pipe and the fourth pipe are not protruding out of the case, there is little constraint on designing the vehicle.

[0024] In one preferred aspect, the third pipe and the fourth pipe are bent inside the second chamber.

[0025] The third pipe and the fourth pipe extend from the first chamber to the outside of the case via the second chamber. Since the second chamber is relatively large, it is easy to reserve a space for the third pipe and the fourth pipe to be bent midway. In this aspect, since it is possible to ensure sufficient lengths of the third pipe and the fourth pipe, it is possible to effectively reduce the environmental noise from the exhaust. Moreover, by bending the third pipe and the fourth pipe midway as appropriate, it is possible to adjust the frequency component of the environmental noise from the exhaust discharged from the third pipe and the fourth pipe.

[0026] In one preferred aspect, an inner diameter of the third pipe and an inner diameter of the fourth pipe are each less than an inner diameter of the exhaust pipe.

[0027] In this aspect, it is possible to effectively reduce the environmental noise from the exhaust.

[0028] In one preferred aspect, the third inlet and the fourth inlet are both arranged leftward or rightward of the first pipe.

[0029] In this aspect, the first pipe can be arranged lopsided to the left side or the right side of the case.

[0030] In one preferred aspect, a volume of the second chamber is greater than a volume of the first chamber.

[0031] In this aspect, by expanding the exhaust gas through the second chamber having a large volume, it is possible to effectively reduce the low-frequency component of the environmental noise from the exhaust.

[0032] In one preferred aspect, an average size of the second chamber in an up-down direction is greater than an average size of the first chamber in the up-down direction.

[0033] In this aspect, it is possible to ensure a sufficient volume of the second chamber without increasing the size of the case in the front-rear direction. It is possible to ensure a sufficient volume of the second chamber in the narrow space between the engine and the rear wheel.

[0034] In one preferred aspect of the present invention, the fiber-based silencing material is a glass wool.

[0035] A hot exhaust gas flows into the first chamber. In this aspect, it is possible to increase the heat resistance of the fiber-based silencing material.

[0036] According to the present invention, it is possible to provide a straddled vehicle including a silencer arranged between the engine and the rear wheel, with which it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037]

FIG. 1 is a left side view showing a main part of a motorcycle according to an embodiment.

FIG. 2 is a right side view showing the main part of the motorcycle.

FIG. 3 is a left side view showing a portion of the main part of the motorcycle.

FIG. 4 is a bottom view showing the silencer, the rear wheel, etc.

FIG. 5 is a front view showing the silencer, etc.

FIG. 6 is a back view showing the silencer, etc.

FIG. 7 is a right side view showing the silencer.

FIG. 8 is a horizontal cross-sectional view showing the silencer.

FIG. 9 is a right side view of the silencer showing a vertical cross-sectional view of a portion of the silencer.

FIG. 10 is a back view showing the silencer and the main stand.

FIG. 11 is a horizontal cross-sectional view showing a silencer according to another embodiment.

FIG. 12 is a horizontal cross-sectional view showing a silencer according to another embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Embodiments of the present invention will now be described. As shown in FIG. 1 and FIG. 2, a straddled

vehicle of the present embodiment is a motorcycle 1.

[0039] FIG. 1 and FIG. 2 show a left side view and a right side view, respectively, showing a main part of the motorcycle 1.

[0040] The terms front, rear, left, right, up and down, as used in the description below, refer to these directions as seen from a virtual rider seated on a seat 2 while the motorcycle 1 is standing upright on a horizontal surface with no rider and no load thereon, unless specified otherwise. The designations F, Re, L, R, U and D, as used in the figures, refer to front, rear, left, right, up and down, respectively. The term "front/forward" refers not only to the direction that extends in the front direction along the vehicle center line CL (see FIG. 4), as the vehicle is seen from above or as the vehicle is seen from below, but also to directions that are inclined left/right from that direction by an angle that is less than or equal to 45 degrees. Similarly, the term "rear/rearward" refers not only to the direction that extends rearward along the vehicle center line CL, as the vehicle is seen from above or as the vehicle is seen from below, but also to directions that are inclined left/right from that direction by an angle of 45 degrees or less. The term "left/leftward" refers not only to the direction that extends leftward vertical to the vehicle center line CL, as the vehicle is seen from above or as the vehicle is seen from below, but also to directions that are inclined frontward/rearward from that direction by an angle of 45 degrees or less. The term "right/rightward" refers not only to the direction that extends rightward vertical to the vehicle center line CL, as the vehicle is seen from above or as the vehicle is seen from below, but also to directions that are inclined frontward/rearward from that direction by an angle of 45 degrees or less. The term "up/upward" refers not only to the vertically upward direction, as the vehicle is seen from sideways, but also to directions that are inclined frontward/rearward from that direction by an angle of 45 degrees or less. The term "down/downward" refers not only to the vertically downward direction, as the vehicle is seen from sideways, but also to directions that are inclined frontward/rearward from that direction by an angle of 45 degrees or less.

[0041] As shown in FIG. 1 and FIG. 2, the motorcycle 1 includes a body frame 5, an engine 10 supported on the body frame 5, a front wheel 7 arranged forward of the engine 10, a rear wheel 8 arranged rearward of the engine 10, and a silencer 20.

[0042] The body frame 5 includes a head pipe 3, left and right main frames 4L and 4R extending rearward from the head pipe 3, and left and right seat frames 6 extending rearward from intermediate portions of the left and right main frames 4L and 4R. A steering shaft (not shown) is rotatably supported on the head pipe 3. A handle bar (not shown) is secured on the steering shaft. A front fork 9 is attached to the steering shaft. The front wheel 7 is rotatably supported on a lower end portion of the front fork 9. The engine 10 is attached to the main frames 4L and 4R. At least a portion of the seat 2 is supported on the seat frame 6.

[0043] A rear arm 12 is supported on the main frames 4L and 4R so that the rear arm 12 can pivot. A front end portion of the rear arm 12 is linked to the main frames 4L and 4R via a pivot shaft 11. The rear wheel 8 is rotatably supported on a rear end portion of the rear arm 12. A rear cushion unit 13 is provided between the main frames 4L and 4R and the rear arm 12. A main stand 15 is attached to a lower portion of the main frames 4L and 4R.

[0044] The engine 10 is an internal combustion engine. Herein, the engine 10 is a 4-cycle internal combustion engine. As shown in FIG. 3, the engine 10 includes a crank case 10A, a cylinder body 10B connected to the crank case 10A, and a cylinder head 10C connected to the cylinder body 10B. An exhaust pipe 16 is connected to the cylinder head 10C. The exhaust pipe 16 includes a first portion 16A extending downward from the cylinder head 10C, and a second portion 16B extending rearward from the first portion 16A. The first portion 16A is arranged forward of the crank case 10A. At least a portion of the second portion 16B is arranged below the crank case 10A.

[0045] Next, the silencer 20 will be described in detail. The silencer 20 is connected to the exhaust pipe 16. The silencer 20 is connected to a rear end portion of the second portion 16B of the exhaust pipe 16. At least a portion of the silencer 20 is arranged rearward of the engine 10 and forward of the rear wheel 8. A portion of the silencer 20 is arranged below the engine 10. At least a portion of the silencer 20 is arranged on the vehicle center line CL, as the vehicle is seen from below, as shown in FIG. 4. Note that the vehicle center line is a line that connects together the center of the front wheel 7 in the vehicle width direction and the center of the rear wheel 8 in the vehicle width direction, as the vehicle is seen from above or as the vehicle is seen from below, when the motorcycle 1 is unsteered (in other words, when the motorcycle 1 is running straight). There is only a relatively small space rearward of the engine 10 and forward of the rear wheel 8 of the motorcycle 1. Although the details will be described later, the silencer 20 of the present embodiment is capable of sufficiently reducing the environmental noise from the exhaust despite its small size. Therefore, it can be installed in a relatively small space.

[0046] FIG. 5 is a front view of the silencer 20, etc., and FIG. 6 is a back view of the silencer 20, etc. FIG. 7 is a right side view of the silencer 20. FIG. 8 is a horizontal cross-sectional view showing an internal configuration of the silencer 20, and FIG. 9 is a vertical cross-sectional view showing an internal configuration of the silencer. As shown in FIG. 8, the silencer 20 includes a case 21, a partition wall 22 arranged inside the case 21, a first pipe 31, a second pipe 32, a third pipe 33, a fourth pipe 34, and a fiber-based silencing material 23.

[0047] While the case 21 may be a single component, the case 21 is formed from a plurality of components in the present embodiment. The case 21 includes a pipe section 21A, to which the exhaust pipe 16 is connected,

a box section **21B**, and a box section **21C**. The box section **21B** is located rearward of the pipe section **21A**, and the box section **21C** is located rearward of the box section **21B**. As shown in FIG. 4, the case **21** overlaps the vehicle center line **CL** as the vehicle is seen from below. At least a portion of the case **21** is located on the vehicle center line **CL**. While the case **21** is located rightward of the left end of the left main frame **4L** and leftward of the right end of the right main frame **4R**, the present invention is not limited to this.

[0048] As shown in FIG. 4, the pipe section **21A** is connected to the right-side portion of the box section **21B**. The center line **CL1** of the portion of the pipe section **21A** that is connected to the box section **21B** is located rightward of the vehicle center line **CL** as the vehicle is seen from below.

[0049] As shown in FIG. 10, the main stand **15** includes a left pipe **15L**, a right pipe **15R**, and a center pipe **15C** that connects together the left pipe **15L** and the right pipe **15R**. The case **21** of the silencer **20** is accommodated in the space between the left pipe **15L** and the right pipe **15R**. The case **21** is arranged between the left pipe **15L** and the right pipe **15R** as the vehicle is seen from the back. The case **21** is arranged rightward of the right end of the left pipe **15L** and leftward of the left end of the right pipe **15R**. Therefore, the case **21** will not interfere with the main stand **15** when the main stand **15** pivots.

[0050] As shown in FIG. 7, an upper wall **21Bt** of the box section **21B** is inclined upward from the horizontal line while extending toward the rear side, as the vehicle is seen from sideways. The size of the box section **21B** in the up-down direction gradually increases toward the rear side. An upper wall **21Ct** of the box section **21C** is formed so as to extend downward, then upward and then downward while extending toward the rear side, as the vehicle is seen from sideways. The size of the box section **21C** in the up-down direction once decreases, then increases and then decreases again toward the rear side. The upper wall **21Ct** of the box section **21C** has a depression **21Cd** that is depressed downward as the vehicle is seen from sideways. As shown in FIG. 9, a first chamber **41** is formed inside the box section **21B**, and a second chamber **42** is formed inside the box section **21C**. The average size of the second chamber **42** in the up-down direction is greater than the average size of the first chamber **41** in the up-down direction. Note that the average size of a chamber in the up-down direction can be obtained by dividing the volume of the chamber by the area of the chamber as seen from below.

[0051] As shown in FIG. 3, a portion of a link mechanism **19** that is linked to the rear cushion unit **13** is arranged above the depression **21Cd** of the case **21**. With the depression **21Cd**, a portion of the link mechanism **19** can be arranged close to the case **21**. A portion of the silencer **20** can be arranged in the narrow space between the engine **10** and the rear wheel **8** without interfering with the link mechanism **19**.

[0052] As shown in FIG. 8, the partition wall **22** parti-

tions the inside of the case **21** into the first chamber **41** and the second chamber **42**. The volume of the second chamber **42** is greater than the volume of the first chamber **41**. Herein, the second chamber **42** is located rearward of the first chamber **41**. The first chamber **41** is formed forward of the partition wall **22**, and the second chamber **42** is formed rearward of the partition wall **22**. In the present embodiment, only the first chamber **41** and the second chamber **42** are provided inside the case **21**. That is, only two chambers are provided inside the case **21**. While the partition wall **22** is herein separate from the case **21**, they may be integral together.

[0053] The first pipe **31** is a cylinder with a plurality of holes **31d** formed therein. For example, the first pipe **31** may be a cylindrical punched metal. In the present embodiment, the first pipe **31** is a straight pipe. Note however that the first pipe **31** may be bent. The first pipe **31** includes a first inlet **31a**, a first peripheral wall **31b** and a first outlet **31c**. The first inlet **31a** has an opening facing forward. An exhaust gas from the exhaust pipe **16** flows into the first inlet **31a**. The first outlet **31c** has an opening facing rearward. The first outlet **31c** is opened into the second chamber **42**. The first peripheral wall **31b** is arranged in the first chamber **41**. The holes **31d** are formed in the first peripheral wall **31b**. The holes **31d** connect together the inside and the outside of the first peripheral wall **31b**. In the present embodiment, the first pipe **31** is arranged so as to bridge between the pipe section **21A** and the box section **21B**. A portion of the first pipe **31** is arranged inside the pipe section **21A**, and another portion of the first pipe **31** is arranged inside the box section **21B**. Note however that the first pipe **31** may be arranged only inside the box section **21B**. A portion of the first pipe **31** may be arranged inside the box section **21C**. A portion of the first pipe **31** may be arranged inside the second chamber **42**.

[0054] Note that the term "pipe" as used in the present specification refers to a member that has an inlet and an outlet and is capable of guiding a fluid from the inlet toward the outlet. There is no particular limitation on the shape of the "pipe". The "pipe" does not need to be formed in a tubular shape. The cross-sectional shape of the "pipe" is not limited to a circular shape, but may be an elliptical shape, a rectangular shape, or the like. The inner diameter of the "pipe" (the hydraulically equivalent diameter when the cross-sectional shape is other than a circular shape) does not need to be constant. One or both ends of the "pipe" may be closed. For example, the "pipe" may be a cylinder both ends of which are closed, with a hole to be the inlet and a hole to be the outlet.

[0055] The second pipe **32** includes a tube **32A** with a plurality of holes **32d** formed therein, and a plate **32B** with a plurality of holes **32d** formed therein. Herein, the tube **32A** is a pentagonal tube, and the plate **32B** is a pentagonal plate. However, there is no limitation on the shape of the tube **32A** and the plate **32B**. The cross-sectional shape of the tube **32A** and the plate **32B** may be for example a circular shape, an elliptical shape, a

polygonal shape other than a pentagonal shape, or any other shape. As shown in FIG. 9, the upper portion of the tube 32A has a tapered shape and is inclined upward while extending rearward. The inner diameter of the tube 32A gradually increases rearward. Note that when the tube 32A is not a cylinder, the inner diameter of the tube 32A refers to a hydraulically equivalent diameter of the tube 32A. The plate 32B closes the front end of the tube 32A. As shown in FIG. 8, the tube 32A extends straight in the present embodiment. Note however that the tube 32A may be bent. The second pipe 32 includes a second inlet 32a and a second peripheral wall 32b. The second inlet 32a has an opening facing rearward. The second inlet 32a is opened into the second chamber 42. The second peripheral wall 32b is arranged inside the first chamber 41. The holes 32d are formed in the second peripheral wall 32b. The holes 32d connect together the inside and the outside of the second peripheral wall 32b. The holes 32d of the plate 32B also connect together the inside and the outside of the second peripheral wall 32b. Note that the plate 32B may be absent. The front end of the tube 32A may have an opening facing frontward. The holes 32d of the plate 32B may be absent. The front end of the tube 32A may be tightly closed. A plate with a hole formed therein may be provided on the rear end of the tube 32A. In such a case, the hole serves as the second inlet of the second pipe 32.

[0056] The third pipe 33 is a curved cylinder. Note however that the third pipe 33 may be a straight cylinder. The third pipe 33 is bent inside the second chamber 42. Note that as opposed to the first pipe 31 and the second pipe 32, no hole is formed in the cylinder of the third pipe 33. The third pipe 33 includes a third inlet 33a arranged inside the second pipe 32, a third peripheral wall 33b arranged inside the second pipe 32 and inside the second chamber 42, and a third outlet 33c that is opened toward the outside of the case 21. The third inlet 33a has an opening facing frontward. The third pipe 33 is connected to a bottom wall 21a of the case 21. Herein, the third pipe 33 is connected to the bottom wall 21a of the box section 21C.

[0057] The fourth pipe 34 is a curved cylinder. Note however that the fourth pipe 34 may be a straight cylinder. The fourth pipe 34 is bent inside the second chamber 42. As with the third pipe 33, no hole is formed in the cylinder of the fourth pipe 34. The fourth pipe 34 includes a fourth inlet 34a arranged inside the second pipe 32, a fourth peripheral wall 34b arranged inside the second pipe 32 and inside the second chamber 42, and a fourth outlet 34c that is opened toward the outside of the case 21. The fourth inlet 34a has an opening facing frontward. The fourth pipe 34 is connected to the bottom wall 21a of the case 21. Herein, the fourth pipe 34 is connected to the bottom wall 21a of the box section 21C. Note that the cross-sectional shape of the third pipe 33 and the fourth pipe 34 does not need to be a circular shape, but may be an elliptical shape, a polygonal shape, or the like. There is no particular limitation on the shape of the third pipe 33 and the fourth pipe 34.

[0058] In the present embodiment, the second pipe 32 is arranged leftward of the first pipe 31. The third inlet 33a of the third pipe 33 and the fourth inlet 34a of the fourth pipe 34 are both arranged leftward of the first pipe 31. Note however that the silencer 20 may be formed in a left-right-inverted shape. In such a case, the second pipe 32 is arranged rightward of the first pipe 31, and the third inlet 33a of the third pipe 33 and the fourth inlet 34a of the fourth pipe 34 are arranged rightward of the first pipe 31.

[0059] In the present embodiment, the length of the third pipe 33 and the length of the fourth pipe 34 are from each other. Note that the lengths of the third pipe 33 and the fourth pipe 34 refer to their lengths along the center lines of the third pipe 33 and the fourth pipe 34. In the present embodiment, the third pipe 33 and the fourth pipe 34 are curved. Therefore, the length of the third pipe 33 is greater than the size of the third pipe 33 in the front-rear direction, and the length of the fourth pipe 34 is greater than the size of the fourth pipe 34 in the front-rear direction. Herein, the length of the fourth pipe 34 is greater than the length of the third pipe 33. Note however that the length of the third pipe 33 may be greater than the length of the fourth pipe 34. The length of the third pipe 33 may be equal to the length of the fourth pipe 34.

[0060] In the present embodiment, the length of the first pipe 31 is greater than the length of the second pipe 32. Note however that the length of the first pipe 31 may be equal to the length of the second pipe 32, or the length of the second pipe 32 may be greater than the length of the first pipe 31. The length of the third pipe 33 and the length of the fourth pipe 34 are greater than the length of the first pipe 31. Note however that the length of the third pipe 33 and/or the fourth pipe 34 may be equal to the length of the first pipe 31, or the length of the first pipe 31 may be greater than the length of the third pipe 33 and/or the fourth pipe 34. The length of the third pipe 33 and the length of the fourth pipe 34 may be greater than the length of the second pipe 32. Note however that the length of the second pipe 32 may be equal to the length of the third pipe 33 and/or the fourth pipe 34, or greater than the length of the third pipe 33 and/or the fourth pipe 34.

[0061] The inner diameter of the third pipe 33 may be equal to or different from the inner diameter of the fourth pipe 34. The inner diameter of the third pipe 33 may be greater or less than the inner diameter of the fourth pipe 34. Herein, the inner diameter of the third pipe 33 and the inner diameter of the fourth pipe 34 are equal to each other. The inner diameter of the third pipe 33 and the inner diameter of the fourth pipe 34 are each less than the inner diameter of the exhaust pipe 16. Note however that the present invention is not limited to this. The inner diameter of the shorter one (i.e., one that has a lower silencing capacity) of the third pipe 33 and the fourth pipe 34 may be less than the inner diameter of the longer one. Then, it is possible to adjust the distribution of the exhaust sound energy. Note that when the inner diameter of a

pipe is not constant, it is assumed that the inner diameter of the pipe means the average inner diameter.

[0062] In the present embodiment, the inner diameter of the second pipe **32** is greater than the inner diameter of the first pipe **31**. The inner diameter of the first pipe **31** is greater than each of the inner diameter of the third pipe **33** and the inner diameter of the fourth pipe **34**. The inner diameter of the first pipe **31** is greater than the sum of the inner diameter of the third pipe **33** and the inner diameter of the fourth pipe **34**. However, the inner diameter of the first pipe **31** may be equal to the inner diameter of the second pipe **32**, or greater than the inner diameter of the second pipe **32**. The inner diameter of the first pipe **31** may be equal to the inner diameter of the third pipe **33** and/or the fourth pipe **34**, or may be less than the inner diameter of the third pipe **33** and/or the fourth pipe **34**.

[0063] The openings of the third outlet **33c** and the fourth outlet **34c** are facing downward. The center line **CL2** of FIG. **8** is a line that passes through the center of the case **21** in the vehicle width direction. The third outlet **33c** is located rightward of the middle of the case **21** in the vehicle width direction. The fourth outlet **34c** is located leftward of the middle of the case **21** in the vehicle width direction. Note however that the third outlet **33c** may be located leftward of the middle of the case **21** in the vehicle width direction. The fourth outlet **34c** may be located rightward of the middle of the case **21** in the vehicle width direction. The third outlet **33c** and the fourth outlet **34c** may both be located leftward or rightward of the middle of the case **21** in the vehicle width direction. There is no particular limitation on the positions of the third outlet **33c** and the fourth outlet **34c**.

[0064] As shown in FIG. **4**, the third outlet **33c** is located rightward of the vehicle center line **CL** and the fourth outlet **34c** is located leftward of the vehicle center line **CL**, as the vehicle is seen from below. Note however that the third outlet **33c** may be located leftward of the vehicle center line **CL**. The fourth outlet **34c** may be located rightward of the vehicle center line **CL**. The third outlet **33c** and the fourth outlet **34c** may both be located leftward or rightward of the vehicle center line **CL**.

[0065] As shown in FIG. **4**, as the vehicle is seen from below, the center line **33k** of the third outlet **33c** is inclined rightward with respect to the vehicle center line **CL** while extending rearward. The center line **34k** of the fourth outlet **34c** is inclined leftward with respect to the vehicle center line **CL** while extending rearward. Note however that as the vehicle is seen from below, the center line **33k** of the third outlet **33c** may be inclined leftward with respect to the vehicle center line **CL** while extending rearward. As the vehicle is seen from below, the center line **34k** of the fourth outlet **34c** may be inclined rightward with respect to the vehicle center line **CL** while extending rearward. The center line **33k** of the third outlet **33c** and/or the center line **34k** of the fourth outlet **34c** may be parallel to the vehicle center line **CL**.

[0066] In the present embodiment, the third pipe **33**

and the fourth pipe **34** are not protruding out of the case **21**. As shown in FIG. **1**, FIG. **2** and FIG. **4**, the third outlet **33c** of the third pipe **33** and the fourth outlet **34c** of the fourth pipe **34** are arranged inside the outline of the case **21**, as the vehicle is seen from sideways and as the vehicle is seen from below. Note however that the third pipe **33** and the fourth pipe **34** may be formed so as to protrude out of the case **21**.

[0067] As shown in FIG. **8**, the fiber-based silencing material **23** is provided inside the first chamber **41** and outside the first pipe **31** and the second pipe **32**. In the present embodiment, the fiber-based silencing material **23** is made of a glass wool. Note however that the fiber-based silencing material **23** may be any material other than a glass wool. In the following description, the fiber-based silencing material **23** will be referred to simply as the silencing material **23**.

[0068] A portion of the silencing material **23** is arranged around the first peripheral wall **31b** of the first pipe **31**. The silencing material **23** communicates with the inside of the first pipe **31** through the holes **31d** of the first peripheral wall **31b**. Another portion of the silencing material **23** is arranged around the second peripheral wall **32b** of the second pipe **32**. Another portion of the silencing material **23** is arranged forward of the plate **32B** of the second pipe **32**. The silencing material **23** communicates with the inside of the second pipe **32** through the holes **32d** of the second pipe **32**. The silencing material **23** communicates with both the inside of the first pipe **31** and the inside of the second pipe **32** through the holes **31d** and the holes **32d**.

[0069] Next, the flow of the exhaust gas from the engine **10** will be described. The exhaust gas flows into the silencer **20** through the exhaust pipe **16** and expands. As indicated by arrow **F1** in FIG. **8**, in the first chamber **41**, the exhaust gas flows through the inside of the first pipe **31**. Since the inside of the first pipe **31** communicates with the silencing material **23** through the holes **31d**, the noise is reduced while the exhaust gas passes through the first pipe **31**. Particularly, the silencing material **23** effectively reduces the high-frequency component of the noise.

[0070] After passing through the first pipe **31**, the exhaust gas flows into the second chamber **42**. Then, the exhaust gas expands. This expansion reduces the noise. Particularly, it effectively reduces the low-frequency component of the noise. As indicated by arrow **F2**, the exhaust gas flows into the second pipe **32** from the second chamber **42**.

[0071] Since the inside of the second pipe **32** communicates with the silencing material **23** through the holes **32d**, the noise is reduced while the exhaust gas flows through the inside of the second pipe **32**. Particularly, the silencing material **23** effectively reduces the high-frequency component of the noise.

[0072] As indicated by arrow **F31**, a portion of the exhaust gas in the second pipe **32** flows into the third pipe **33**. As indicated by arrow **F32**, the exhaust gas, having

flown through the third pipe **33**, is emitted to the outside through the third outlet **33c**. As indicated by arrow **F41**, another portion of the exhaust gas in the second pipe **32** flows into the fourth pipe **34**. As indicated by arrow **F42**, the exhaust gas, having flown through the fourth pipe **34**, is emitted to the outside through the fourth outlet **34c**.

[0073] As described above, with the motorcycle **1** of the present embodiment, the inside of the case **21** of the silencer **20** is partitioned by the partition wall **22** into the first chamber **41** and the second chamber **42**. As compared with a case where the inside of the case **21** is partitioned into three chambers, it is possible to increase the volume of the second chamber **42** without increasing the size of the case **21**. By expanding the exhaust gas through the second chamber **42** having a large volume, it is possible to effectively reduce the low-frequency component of the environmental noise from the exhaust.

[0074] The fiber-based silencing material **23** is arranged inside the first chamber **41** and outside the first pipe **31** and the second pipe **32**. Therefore, while the exhaust gas flows through the first pipe **31** and the second pipe **32**, it is possible to effectively reduce the high-frequency component of the environmental noise from the exhaust.

[0075] In the present embodiment, the silencing material **23** communicates with the inside of the first pipe **31** through the holes **31d**, and communicates with the inside of the second pipe **32** through the holes **32d**. The silencing material **23** around the first pipe **31** and the silencing material **23** around the second pipe **32** are not partitioned from each other. It is possible, using a single silencing material **23**, to silence the exhaust gas flowing through the first pipe **31** and silence the exhaust gas flowing through the second pipe **32**. Since the silencing material **23** can be shared as described above, it is possible to reduce the installation space for the silencing material **23**. Thus, it is possible to reduce the size of the silencer **20**.

[0076] The motorcycle **1** includes two pipes for emitting the exhaust gas out of the case **21**, i.e., the third pipe **33** and the fourth pipe **34**. As compared with a case where the exhaust gas is emitted by using one pipe, the sound to be emitted out of the case **21** can be dispersed.

[0077] With the motorcycle **1** of the present embodiment, these advantageous effects are synergistically combined together, and it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer **20**.

[0078] According to the present embodiment, the third pipe **33** and the fourth pipe **34** are connected to the bottom wall **21a** of the case **21**. Since the sound from the third pipe **33** and the fourth pipe **34** is discharged downward, it is possible to effectively reduce the environmental noise from the exhaust. Moreover, it is possible to prevent a hot exhaust gas from blowing onto the rear wheel **8**. Since the exhaust gas is less likely to be blowing onto the rear wheel **8**, the silencer **20** can be arranged close to the rear wheel **8** (see FIG. 3). It is possible to

arrange the silencer **20** in the narrow space between the engine **10** and the rear wheel **8**.

[0079] According to the present embodiment, the third outlet **33c** of the third pipe **33** is located rightward of the middle of the case **21** in the vehicle width direction. The fourth outlet **34c** of the fourth pipe **34** is located leftward of the middle of the case **21** in the vehicle width direction. Therefore, the sound discharged from the third pipe **33** and the fourth pipe **34** is distributed left and right. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0080] According to the present embodiment, as shown in FIG. 4, the third outlet **33c** of the third pipe **33** is located rightward of the vehicle center line **CL** and the fourth outlet **34c** of the fourth pipe **34** is located leftward of the vehicle center line **CL**, as the vehicle is seen from below. Therefore, the sound discharged from the third pipe **33** and the fourth pipe **34** is distributed left and right. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0081] According to the present embodiment, as shown in FIG. 4, the center line **33k** of the third outlet **33c** is inclined rightward with respect to the vehicle center line **CL** while extending rearward, as the vehicle is seen from below. The center line **34k** of the fourth outlet **34c** is inclined leftward with respect to the vehicle center line **CL** while extending rearward, as the vehicle is seen from below. Therefore, the sound discharged from the third pipe **33** and the fourth pipe **34** is distributed left and right. Therefore, it is possible to effectively reduce the environmental noise from the exhaust.

[0082] According to the present embodiment, the length of the third pipe **33** and the length of the fourth pipe **34** are different from each other, as shown in FIG. 8. Thus, the frequency of sound that is discharged from the third pipe **33** and the frequency of sound that is discharged from the fourth pipe **34** can be different from each other. By adjusting the lengths of the third pipe **33** and the fourth pipe **34** as appropriate, it is possible to adjust the frequency component of the sound that is discharged from the third pipe **33** and the frequency component of the sound that is discharged from the fourth pipe **34**. By such an adjustment, it is possible to effectively reduce the environmental noise from the exhaust.

[0083] According to the present embodiment, as shown in FIG. 1, FIG. 2 and FIG. 4, the third outlet **33c** and the fourth outlet **34c** are arranged inside the outline of the case **21**, as the vehicle is seen from sideways and as the vehicle is seen from below. Since the third pipe **33** and the fourth pipe **34** are not protruding out of the case **21**, they are unlikely to interfere with vehicle components other than the silencer **20**. Therefore, there is little constraint on designing the vehicle. It is possible to relatively freely install vehicle components without being interfered with the third pipe **33** and the fourth pipe **34**.

[0084] According to the present embodiment, as shown in FIG. 8, the third pipe **33** and the fourth pipe **34** extend from the first chamber **41** to the outside of the

case **21** via the second chamber **42**. Since the second chamber **42** is relatively large, it is easy to reserve a space for the third pipe **33** and the fourth pipe **34** to be bent midway. In the present embodiment, the third pipe **33** and the fourth pipe **34** are bent inside the second chamber **42**. Since it is possible to ensure sufficient lengths of the third pipe **33** and the fourth pipe **34**, it is possible to effectively reduce the environmental noise from the exhaust. By bending the third pipe **33** and the fourth pipe **34** midway as appropriate, it is possible to adjust the frequency component of the environmental noise from the exhaust discharged from the third pipe **33** and the fourth pipe **34**.

[0085] According to the present embodiment, the inner diameter of the third pipe **33** and the inner diameter of the fourth pipe **34** are each smaller than the inner diameter of the exhaust pipe **16**. It is possible to effectively reduce the environmental noise from the exhaust through the third pipe **33** and the fourth pipe **34**.

[0086] According to the present embodiment, the third inlet **33a** of the third pipe **33** and the fourth inlet **34a** of the fourth pipe **34** are arranged leftward of the first pipe **31**. The first pipe **31** is arranged in the case **21** lopsided to the right side. Thus, it is possible to reduce the size of the left portion of the case **21** in the front-rear direction. As shown in FIG. **8**, it is possible to provide a space **SP** in front of the left portion of the case **21**. Other vehicle components can be arranged in this space **SP**, and the silencer **20** can be arranged in a compact manner. Note that as shown in FIG. **3**, in the present embodiment, an oil pan **10Aa**, which is a part of the crank case **10A** of the engine **10**, is arranged in the space **SP**.

[0087] The volume of the second chamber **42** does not need to be greater than the volume of the first chamber **41**, but is greater than the volume of the first chamber **41** in the present embodiment. According to the present embodiment, by expanding the exhaust gas through the second chamber **42** having a large volume, it is possible to effectively reduce the low-frequency component of the environmental noise from the exhaust.

[0088] According to the present embodiment, the average size of the second chamber **42** in the up-down direction is greater than the average size of the first chamber **41** in the up-down direction. Therefore, it is possible to ensure a sufficient volume of the second chamber **42** without increasing the size of the case **21** in the front-rear direction. It is possible to ensure a sufficient volume of the second chamber **42** in the narrow space between the engine **10** and the rear wheel **8**.

[0089] According to the present embodiment, the silencing material **23** is a glass wool. While a hot exhaust gas flows into the first chamber **41**, a glass wool is a material that has a good heat resistance. By using a glass wool as the silencing material **23**, it is possible to increase the heat resistance of the silencing material **23**.

[0090] While the motorcycle **1** has been described above as one embodiment of the straddled vehicle, other embodiments are possible. Some other embodiments

will now be described.

[0091] In the embodiment described above, the silencer **20** may be provided with a left-right-inverted structure. In such a case, the second pipe **32** is arranged rightward of the first pipe **31**. The inlet **33a** of the third pipe **33** and the inlet **34a** of the fourth pipe **34** are arranged rightward of the first pipe **31**.

[0092] Another embodiment shown in FIG. **11** is obtained by changing the shape of the case **21** of the silencer **20**, the length of the first pipe **31**, etc. Like members and sections to those of the embodiment described above will be denoted by like reference numerals and will not be described below. In this embodiment, another pipe **39** whose inner diameter gradually increases while extending frontward is connected to the front end portion of the first pipe **31**. While the case **21** may include the pipe section **21A** to which the exhaust pipe **16** is connected, the pipe section **21A** may be omitted by connecting the exhaust pipe **16** to the box section **21B**. Otherwise, the configuration is similar to the embodiment described above.

[0093] Another embodiment shown in FIG. **12** is obtained by arranging second pipes **32** on both sides, left and right, of the first pipe **31**. The third inlet **33a** of the third pipe **33** is arranged inside a second pipe **32** that is arranged rightward of the first pipe **31**. The fourth inlet **34a** of the fourth pipe **34** is arranged inside an additional second pipe **32** that is arranged leftward of the first pipe **31**. The silencing material **23** is arranged inside the first chamber **41** and outside the first pipe **31**, the second pipe **32** and the additional second pipe **32**. Otherwise, the configuration is similar to the embodiment described above, and the description is omitted. Note that in FIG. **12**, like members and sections to those of the embodiment described above are denoted by like reference numerals.

[0094] Also in this embodiment, in the first chamber **41**, the exhaust gas flows through the inside of the first pipe **31**, as indicated by arrow **F1**. Since the inside of the first pipe **31** communicates with the silencing material **23** through the holes **31d**, the noise is reduced while the exhaust gas passes through the first pipe **31**. Particularly, the silencing material **23** effectively reduces the high-frequency component of the noise.

[0095] After passing through the first pipe **31**, the exhaust gas flows into the second chamber **42**. Then, the exhaust gas expands. This expansion reduces the noise. Particularly, it effectively reduces the low-frequency component of the noise. As indicated by arrow **F2**, the exhaust gas flows into the second pipes **32** from the second chamber **42**.

[0096] Since the inside of each second pipe **32** communicates with the silencing material **23** through the holes **32d**, the noise is reduced while the exhaust gas flows through the inside of each second pipe **32**. Particularly, the silencing material **23** effectively reduces the high-frequency component of the noise.

[0097] As indicated by arrow **F31**, the exhaust gas in

the second pipe **32** flows into the third pipe **33**. As indicated by arrow **F32**, the exhaust gas, having flown through the third pipe **33**, is emitted to the outside through the third outlet **33c**. As indicated by arrow **F41**, the exhaust gas in the additional second pipe **32** flows into the fourth pipe **34**. As indicated by arrow **F42**, the exhaust gas, having flown through the fourth pipe **34**, is emitted to the outside through the fourth outlet **34c**.

[0098] Also in the present embodiment, it is possible to reduce the environmental noise from the exhaust and reduce the size of the silencer **20**, as in the embodiment described above. Also in the present embodiment, various modifications are possible, as in the embodiment described above.

[0099] A straddled vehicle refers to a vehicle that is straddled by a passenger. While a motorcycle is an example straddled vehicle, a straddled vehicle is not limited to a motorcycle. A straddled vehicle may be an auto tri-cycle, an ATV (All Terrain Vehicle), or the like.

[0100] The engine **10** is not limited to a 4-cycle internal combustion engine. The engine **10** may be a 2-cycle internal combustion engine, for example.

[0101] The third pipe **33** and the fourth pipe **34** do not need to be connected to the bottom wall **21a** of the case **21**. The third outlet **33c** and the fourth outlet **34c** do not need to be opened in the downward direction. The third pipe **33** and/or the fourth pipe **34** may be connected to the side wall of the case **21**, for example. The third outlet **33c** and/or the fourth outlet **34c** may be opened leftward or rightward, for example.

REFERENCE SIGNS LIST

[0102] 1: Motorcycle (straddled vehicle), 8: Rear wheel, 10: Engine, 16: Exhaust pipe, 20: Silencer, 21: Case, 21a: Bottom wall, 22: Partition wall, 23: Fiber-based silencing material, 31: First pipe, 31a: First inlet, 31b: First peripheral wall, 31c: First outlet, 32: Second pipe, 32a: Second inlet, 32b: Second peripheral wall, 33: Third pipe, 33a: Third inlet, 33b: Third peripheral wall, 33c: Third outlet, 33k: Center line of third outlet, 34: Fourth pipe, 34a: Fourth inlet, 34b: Fourth peripheral wall, 34c: Fourth outlet, 34k: Center line of fourth outlet, 41: First chamber, 42: Second chamber, CL: Vehicle center line

Claims

1. A straddled vehicle (1) comprising:

an engine (10);
a rear wheel (8) arranged rearward of the engine (10);
an exhaust pipe (16) connected to the engine (10); and
a silencer (20) connected to the exhaust pipe (16), at least a portion of which is arranged rear-

ward of the engine (10) and forward of the rear wheel (8),
wherein the silencer (20) includes:

a case (21) at least a portion of which is arranged on a vehicle center line (CL) as the vehicle is seen from below;
a partition wall (22) that is arranged inside the case (21) and partitions the inside of the case (21) into a first chamber (41) and a second chamber (42);
a first pipe (31) including a first inlet (31a) through which an exhaust gas from the exhaust pipe (16) flows into the first pipe (31), a first peripheral wall (31b) that is arranged in the first chamber (41) and has a plurality of through holes (31d), and a first outlet (31c) that is opened into the second chamber (42);
a second pipe (32) including a second inlet (32a) that is opened into the second chamber (42), and a second peripheral wall (32b) that is arranged in the first chamber (41) and has a plurality of through holes (32d);
a fiber-based silencing material (23) that is arranged inside the first chamber (41) and outside the first pipe (31) and the second pipe (32);
a third pipe (33) including a third inlet (33a) that is arranged inside the second pipe (32), a third peripheral wall (33b) that is arranged inside the second pipe (32) and inside the second chamber (42), and a third outlet (33c) that is opened toward an outside of the case (21); and
a fourth pipe (34) including a fourth inlet (34a) that is arranged inside the second pipe (32), a fourth peripheral wall (34b) that is arranged inside the second pipe (32) and inside the second chamber (42), and a fourth outlet (34c) that is opened toward the outside of the case (21).

2. A straddled vehicle (1) comprising:

an engine (10);
a rear wheel (8) arranged rearward of the engine (10);
an exhaust pipe (16) connected to the engine (10); and
a silencer (20) connected to the exhaust pipe (16), at least a portion of which is arranged rearward of the engine (10) and forward of the rear wheel (8),
wherein the silencer (20) includes:

a case (21) at least a portion of which is arranged on a vehicle center line (CL) as

- the vehicle is seen from below;
 a partition wall (22) that is arranged inside the case (21) and partitions the inside of the case (21) into a first chamber (41) and a second chamber (42);
 a first pipe (31) including a first inlet (31a) through which an exhaust gas from the exhaust pipe (16) flows into the first pipe (31), a first peripheral wall (31b) that is arranged in the first chamber (41) and has a plurality of through holes (31d), and a first outlet (31c) that is opened into the second chamber (42);
 a second pipe (32) including a second inlet (32a) that is opened into the second chamber (42), and a second peripheral wall (32b) that is arranged in the first chamber (41) and has a plurality of through holes (32d);
 an additional second pipe (32) including an additional second inlet (32a) that is opened into the second chamber (42), and an additional second peripheral wall (32b) that is arranged in the first chamber (41) and has a plurality of through holes (32d);
 a fiber-based silencing material (23) that is arranged inside the first chamber (41) and outside the first pipe (31), the second pipe (32) and the additional second pipe (32);
 a third pipe (33) including a third inlet (33a) that is arranged inside the second pipe (32), a third peripheral wall (33b) that is arranged inside the second pipe (32) and inside the second chamber (42), and a third outlet (33c) that is opened toward an outside of the case (21); and
 a fourth pipe (34) including a fourth inlet (34a) that is arranged inside the additional second pipe (32), a fourth peripheral wall (34b) that is arranged inside the additional second pipe (32) and inside the second chamber (42), and a fourth outlet (34c) that is opened toward the outside of the case (21).
3. The straddled vehicle (1) according to claim 1 or 2, wherein:
 the case (21) includes a bottom wall (21a); and
 the third pipe (33) and the fourth pipe (34) are connected to the bottom wall (21a).
 4. The straddled vehicle (1) according to any one of claims 1 to 3, wherein one of the third outlet (33c) and the fourth outlet (34c) is located leftward of a middle of the case (21) in a vehicle width direction, and the other one of the third outlet (33c) and the fourth outlet (34c) is located rightward of the middle of the case (21) in the vehicle width direction.
 5. The straddled vehicle (1) according to any one of claims 1 to 4, wherein as the vehicle is seen from below, one of the third outlet (33c) and the fourth outlet (34c) is located leftward of the vehicle center line (CL), and the other one of the third outlet (33c) and the fourth outlet (34c) is located rightward of the vehicle center line (CL).
 6. The straddled vehicle (1) according to any one of claims 1 to 5, wherein as the vehicle is seen from below, one of a center line (33k) of the third outlet (33c) and a center line (34k) of the fourth outlet (34c) is inclined leftward with respect to the vehicle center line (CL) while extending rearward, and the other one of the center line (33k) of the third outlet (33c) and the center line (34k) of the fourth outlet (34c) is inclined rightward with respect to the vehicle center line (CL) while extending rearward.
 7. The straddled vehicle (1) according to any one of claims 1 to 6, wherein a length of the third pipe (33) and a length of the fourth pipe (34) are different from each other.
 8. The straddled vehicle (1) according to any one of claims 1 to 7, wherein the third outlet (33c) and the fourth outlet (34c) are arranged inside an outline of the case (21), as the vehicle is seen from sideways and as the vehicle is seen from below.
 9. The straddled vehicle (1) according to any one of claims 1 to 8, wherein the third pipe (33) and the fourth pipe (34) are bent inside the second chamber (42).
 10. The straddled vehicle (1) according to any one of claims 1 to 9, wherein an inner diameter of the third pipe (33) and an inner diameter of the fourth pipe (34) are each less than an inner diameter of the exhaust pipe (16).
 11. The straddled vehicle (1) according to any one of claims 1 to 10, wherein the third inlet (33a) and the fourth inlet (34a) are both arranged leftward or rightward of the first pipe (31).
 12. The straddled vehicle (1) according to any one of claims 1 to 11, wherein a volume of the second chamber (42) is greater than a volume of the first chamber (41).
 13. The straddled vehicle (1) according to claim 12, wherein an average size of the second chamber (42) in an up-down direction is greater than an average size of the first chamber (41) in the up-down direction.
 14. The straddled vehicle (1) according to any one of

claims 1 to 13, wherein the fiber-based silencing material **(23)** is a glass wool.

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FIG.1

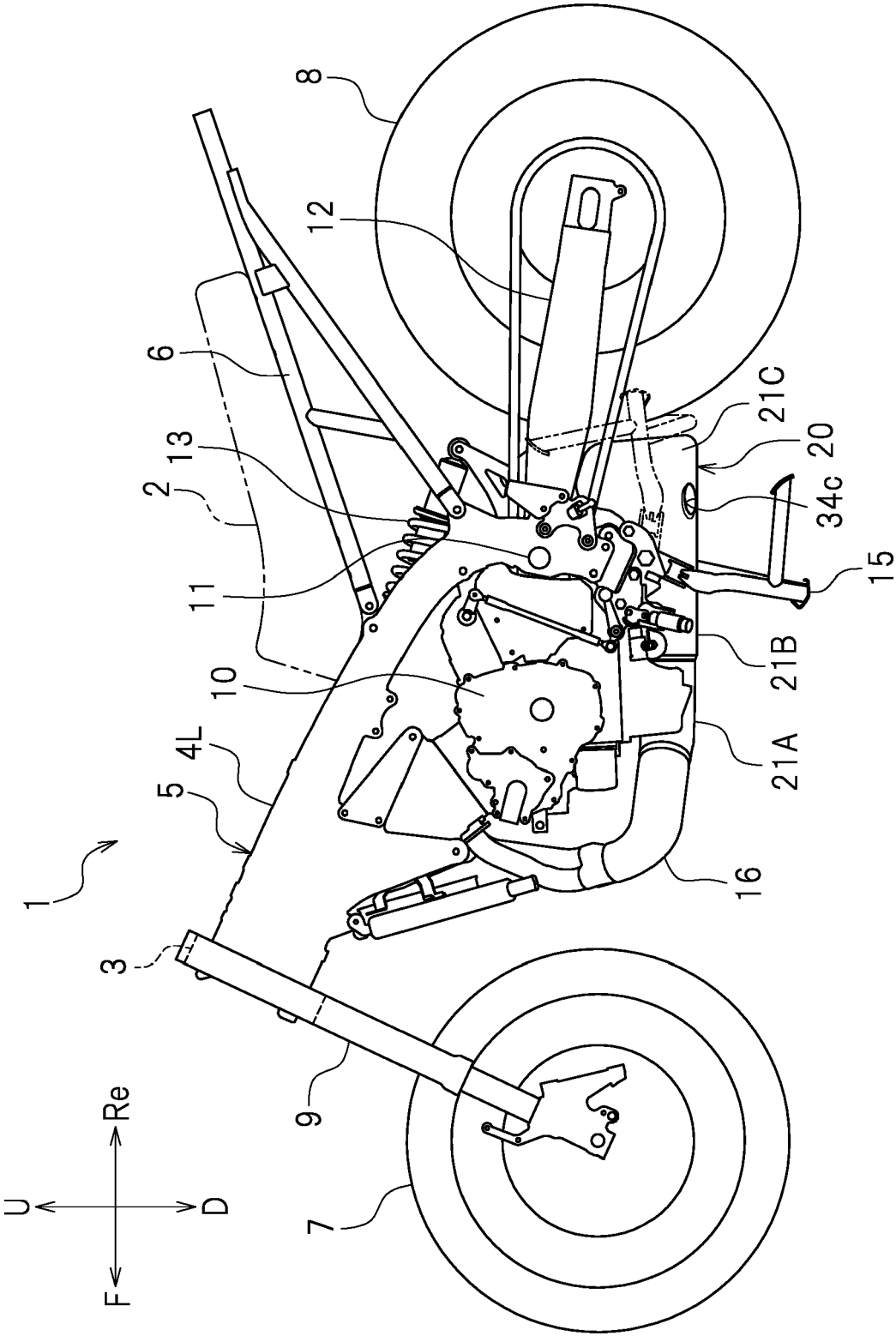


FIG.2

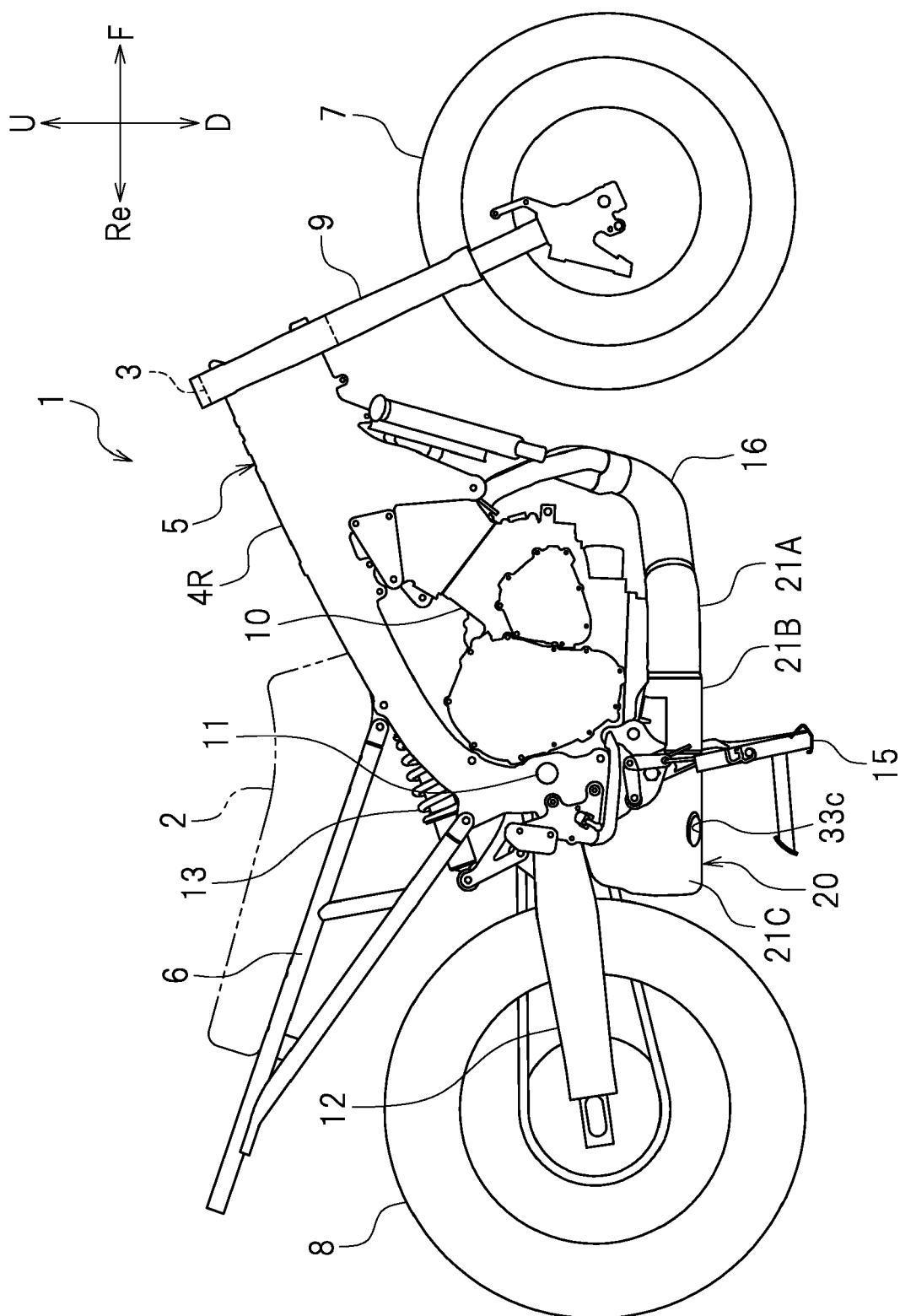


FIG.3

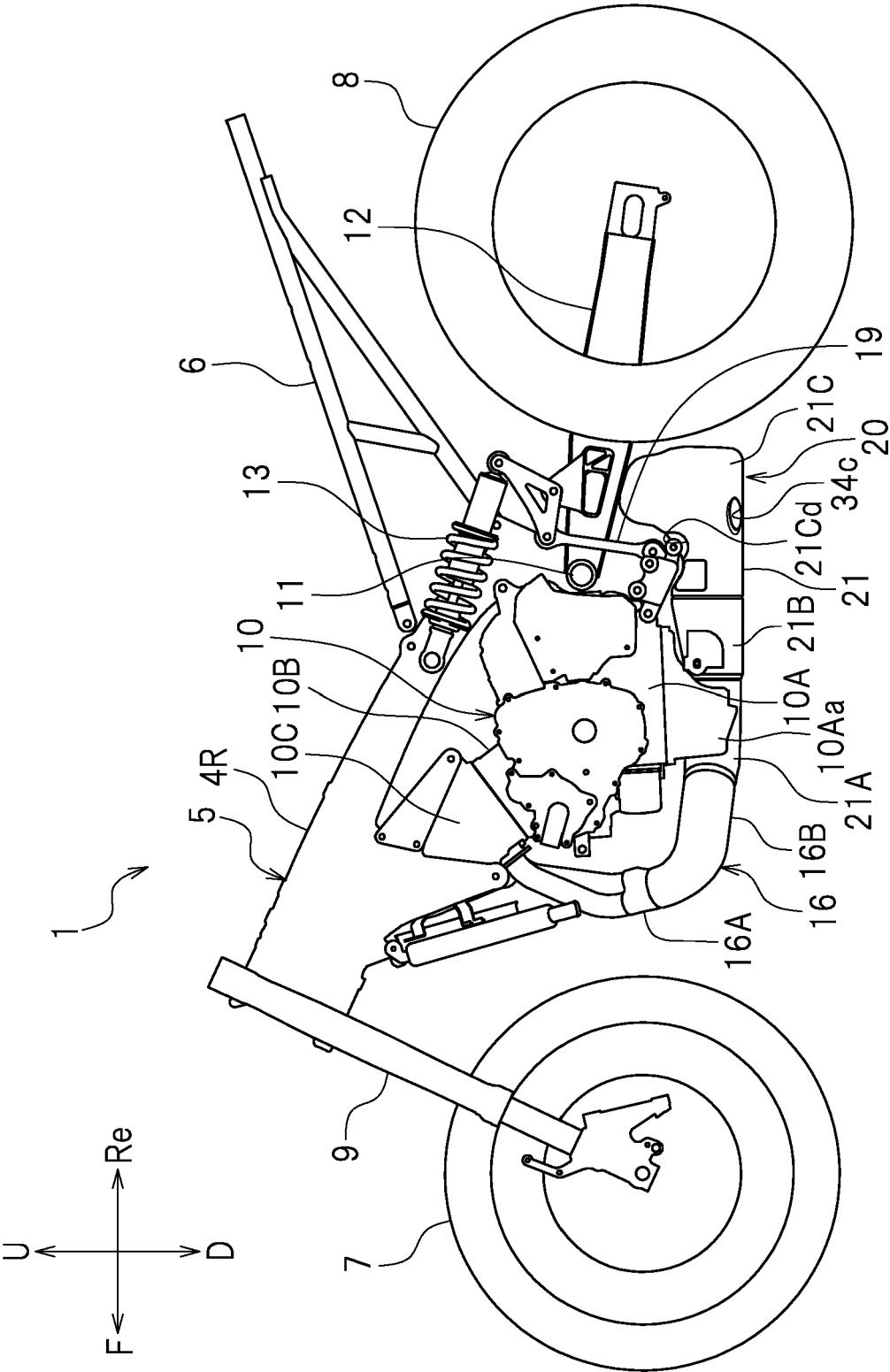


FIG. 4

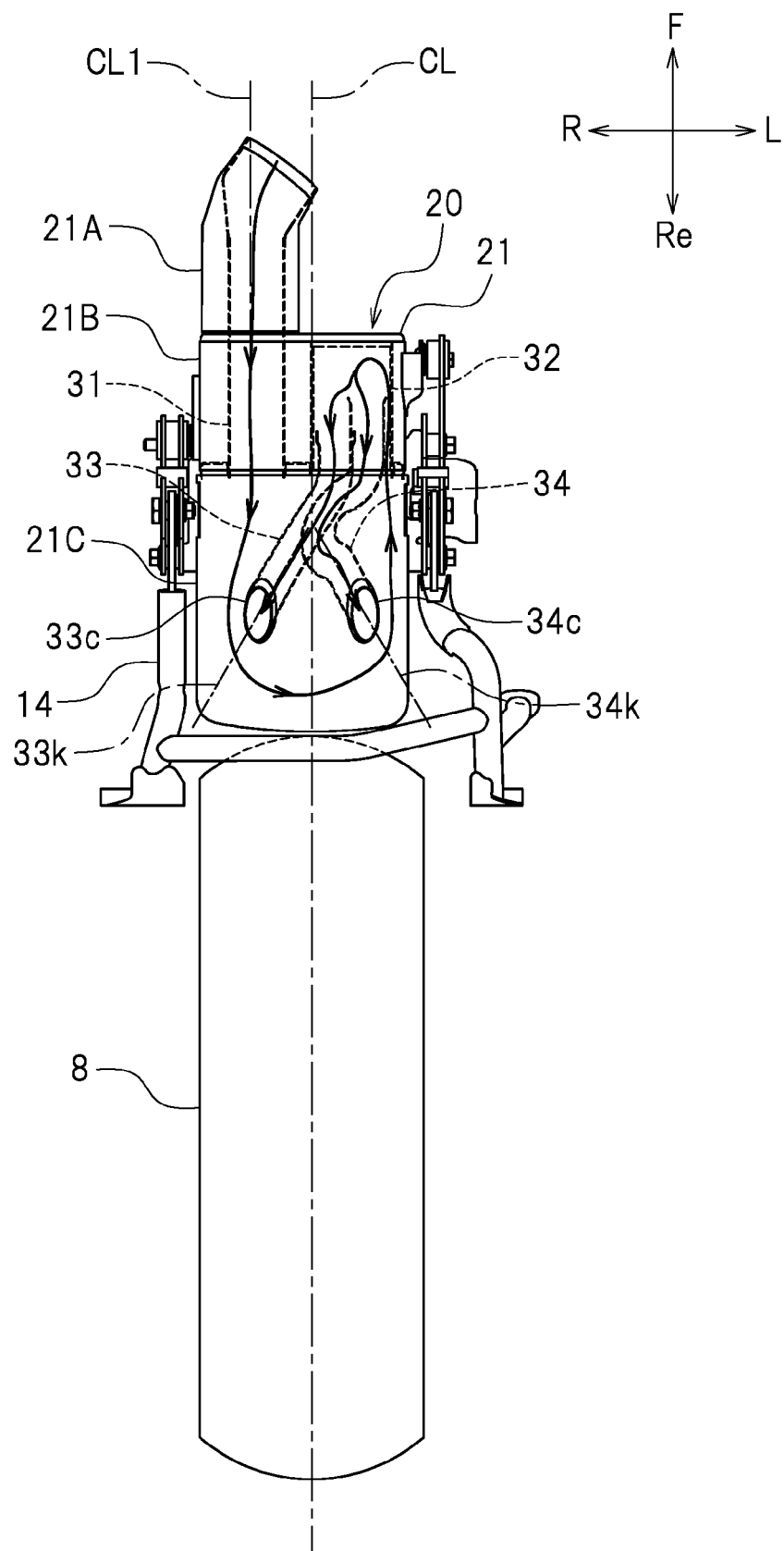


FIG. 5

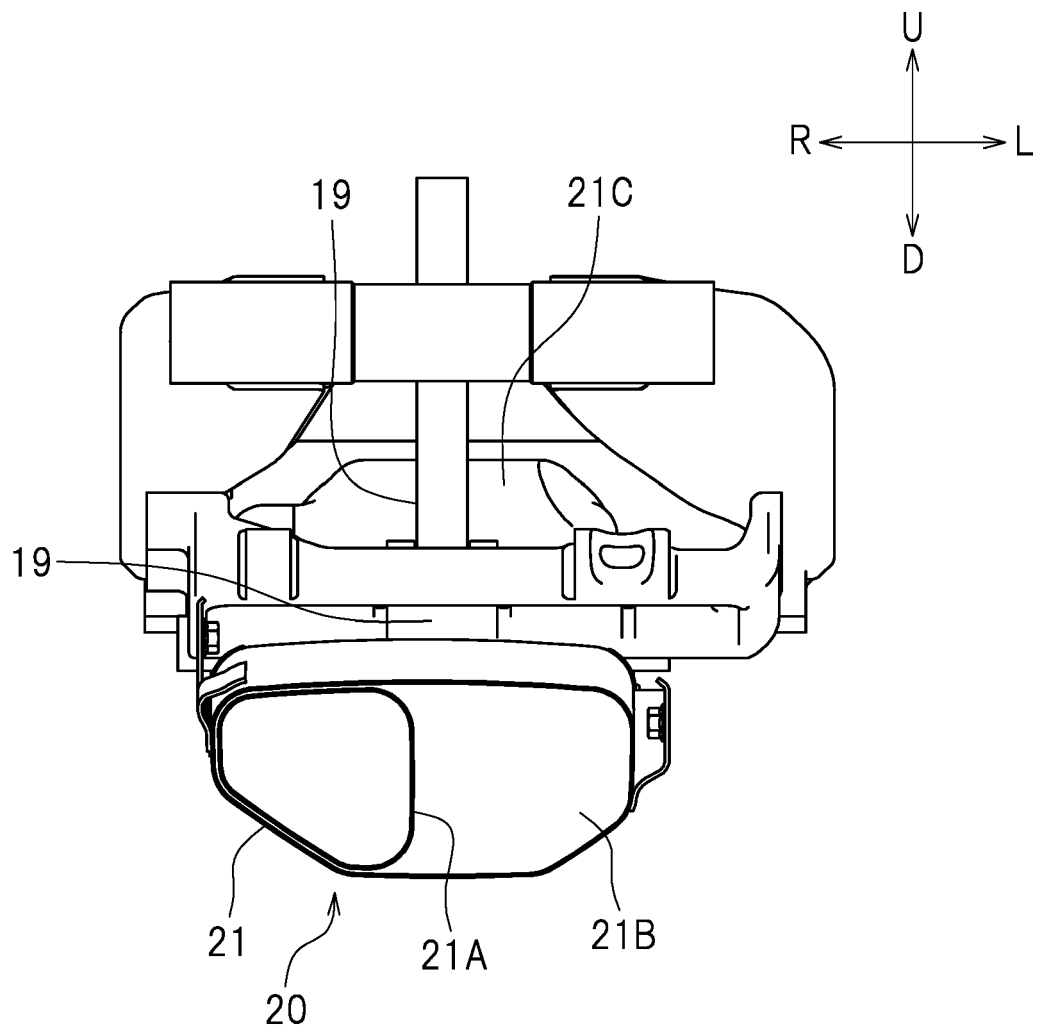


FIG.6

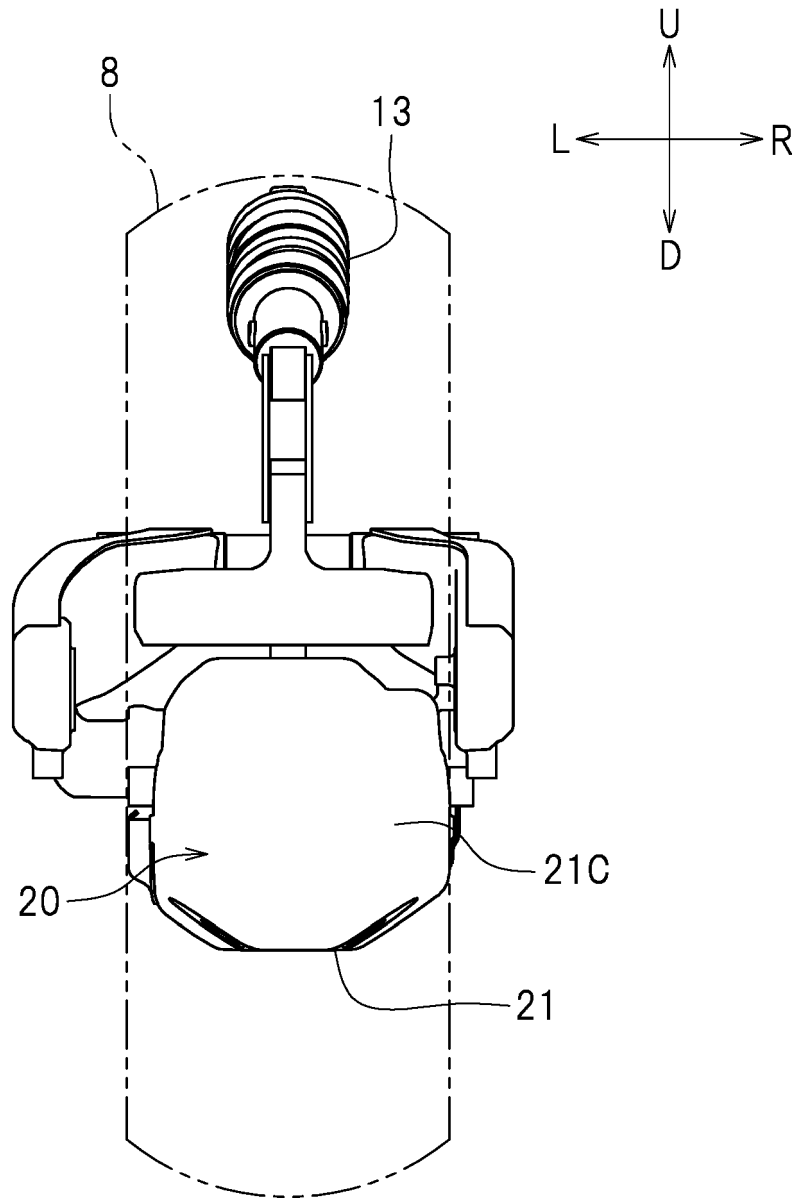


FIG. 7

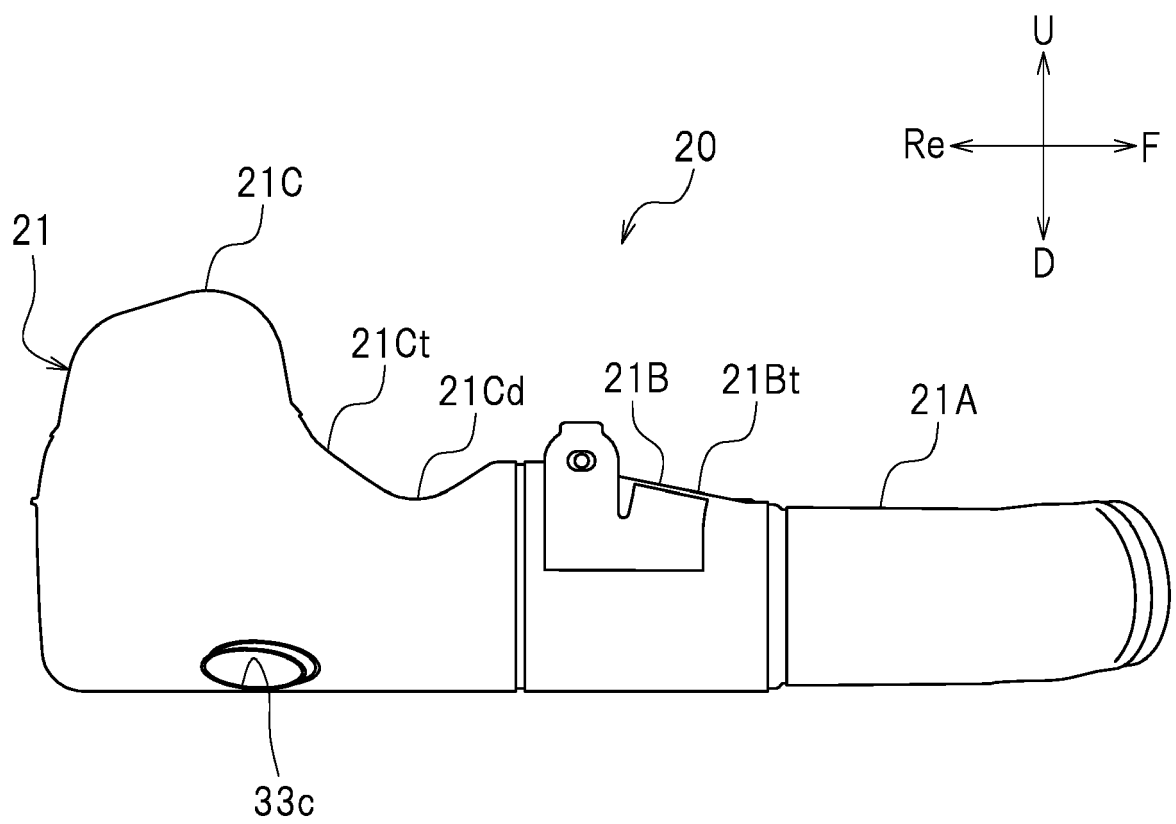


FIG. 8

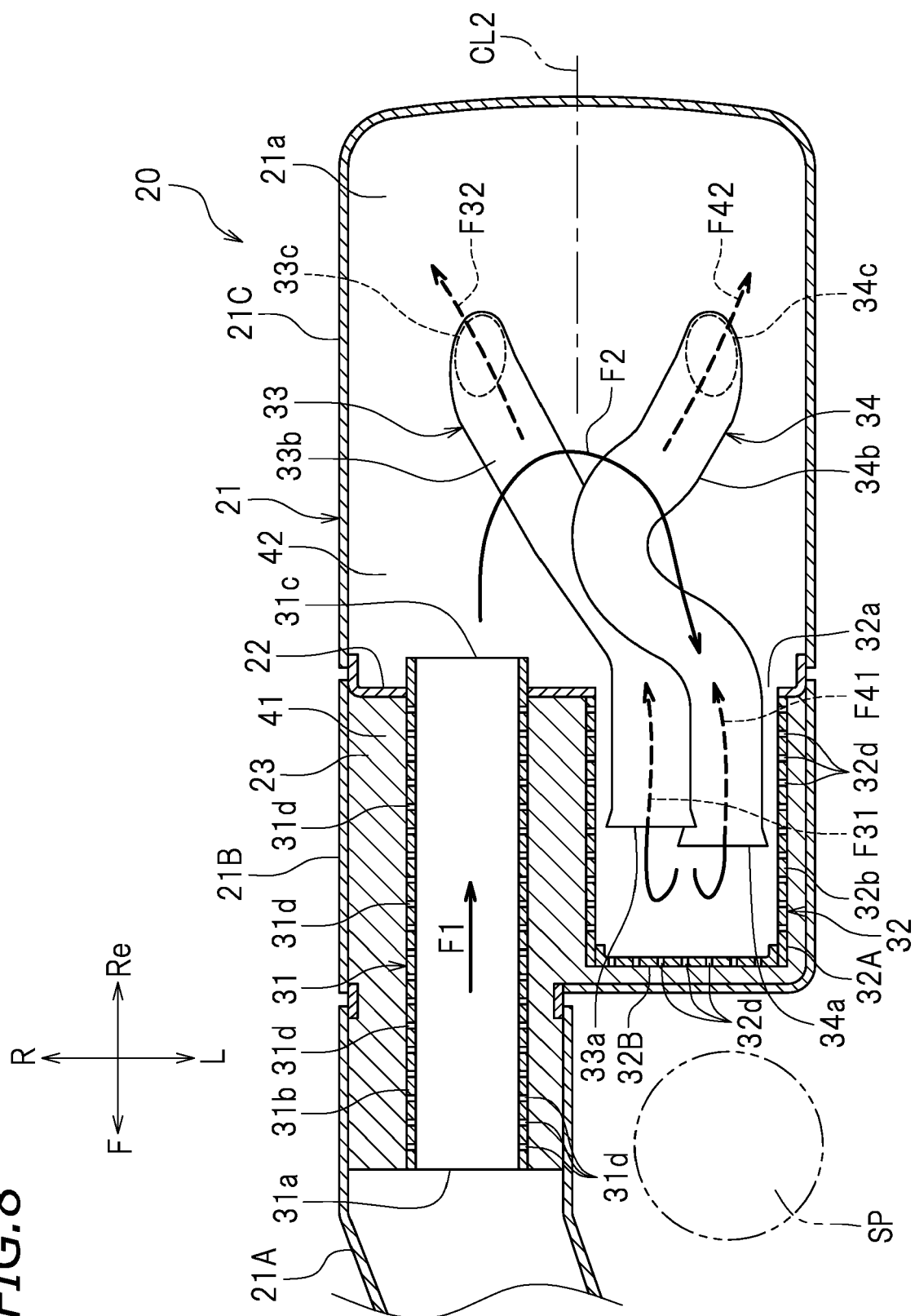


FIG. 9

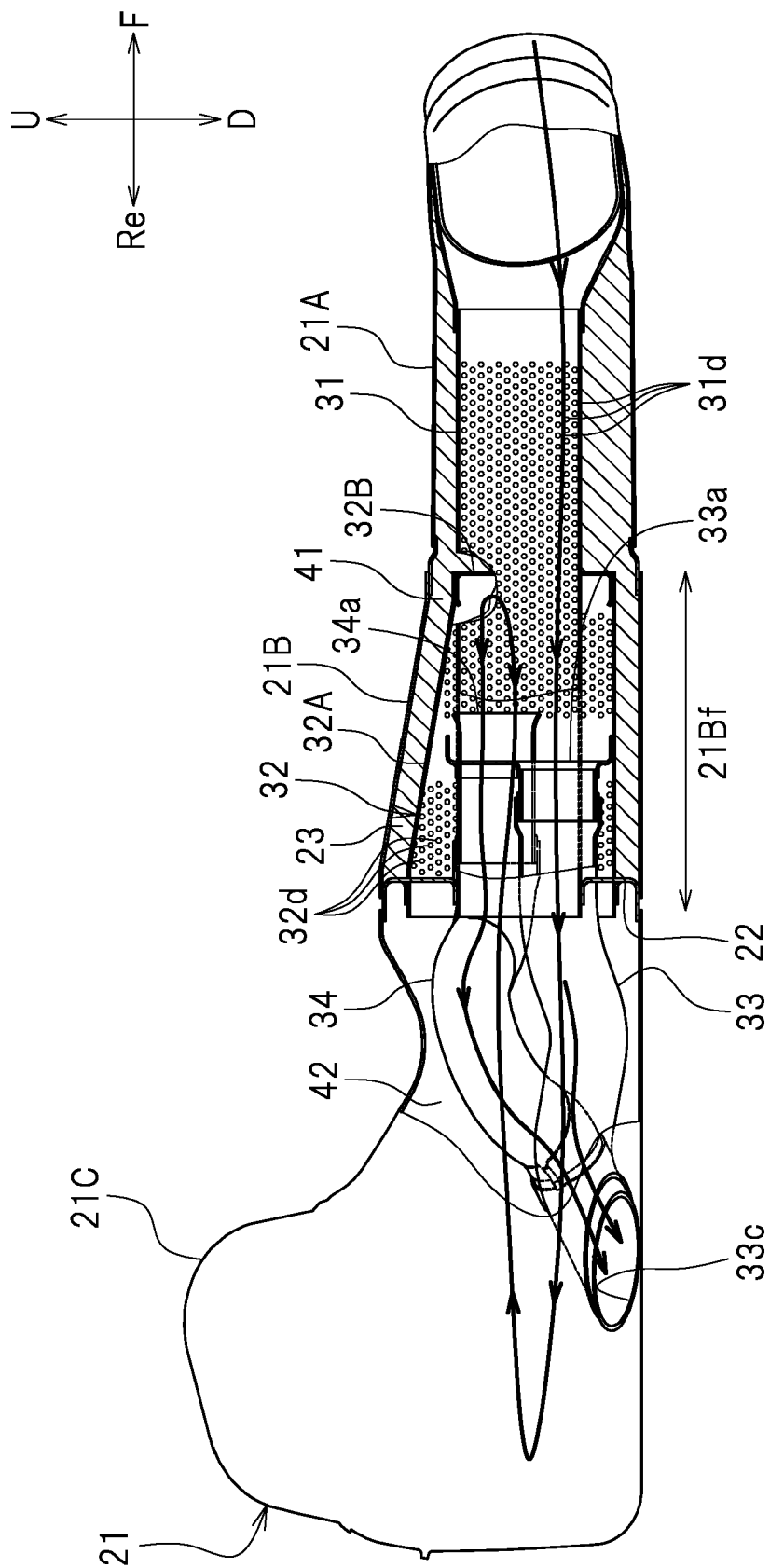


FIG. 10

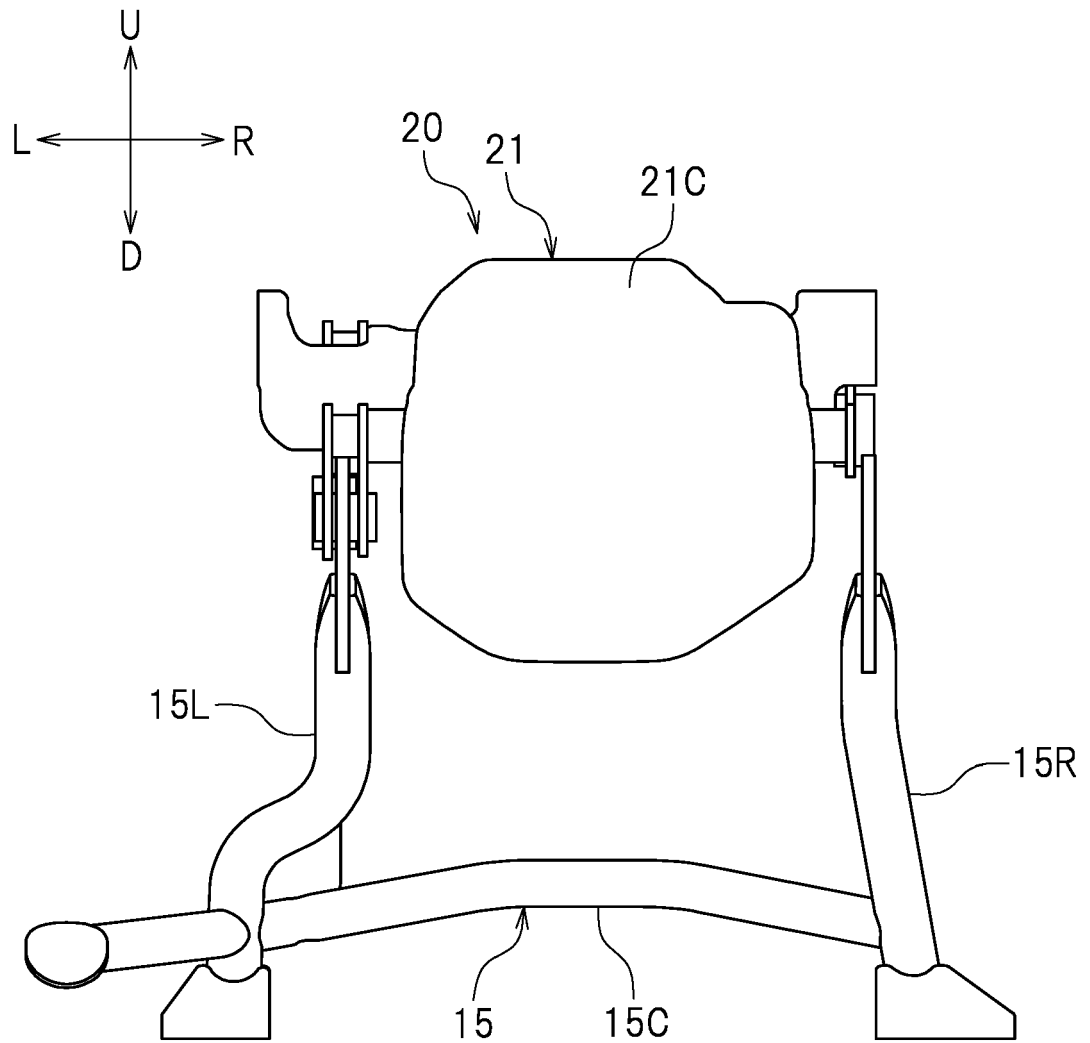


FIG.11

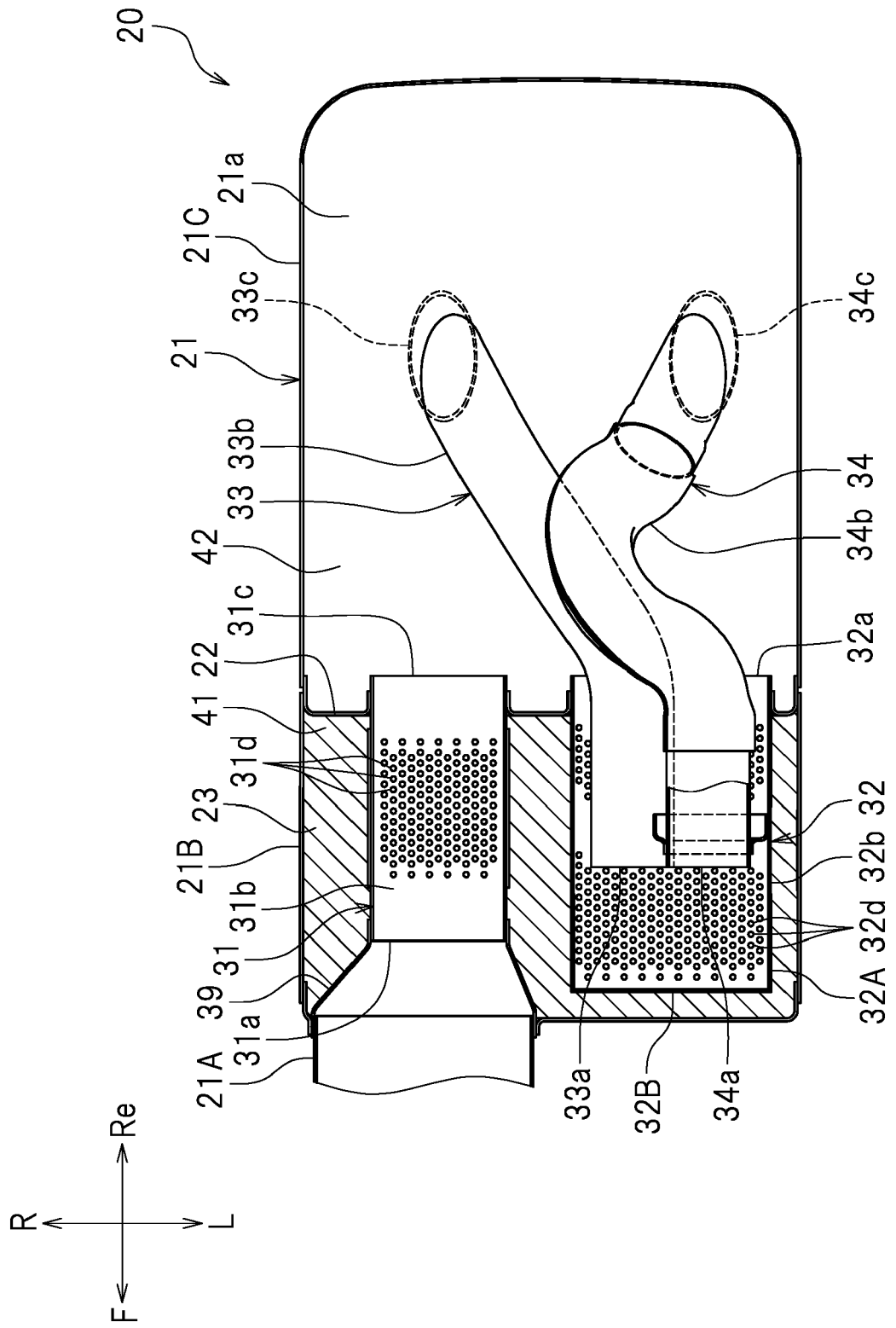
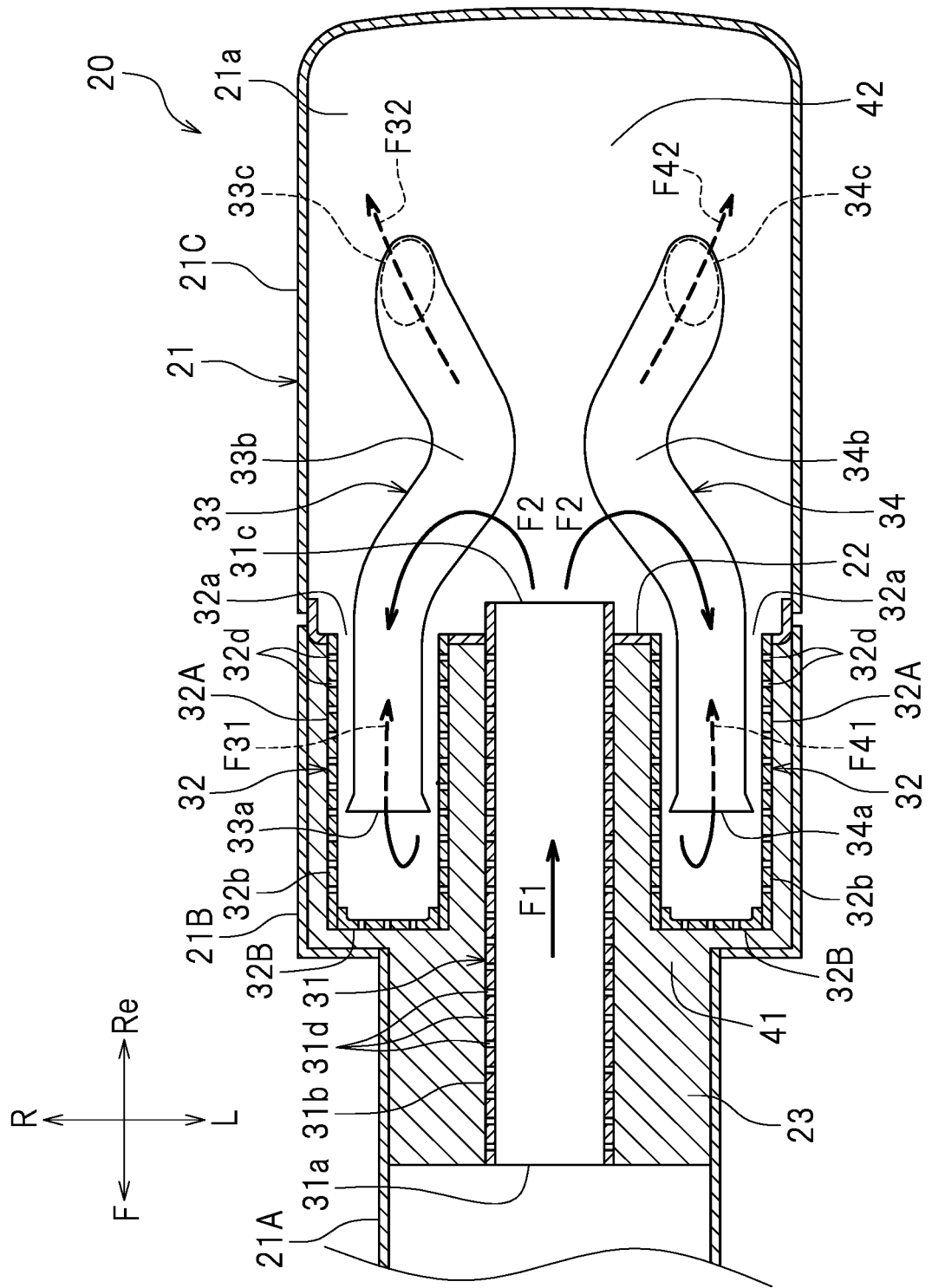


FIG.12





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			F01N
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 February 2019	Examiner Seifert, Marco
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US 2016084127 A1	24-03-2016	NONE	

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