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(54) **WORK VEHICLE**

ARBEITSFAHRZEUG

VÉHICULE DE TRAVAIL

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Description

Background

Technical Field

[0001] The present invention relates to a work vehicle, and in particular to a configuration of an engine exhaust therein.

Background Art

[0002] For example, among work vehicles such as tractors used in orchards, livestock barns, and the like, in some work vehicles provided with an engine, a muffler is provided at a lower portion of the mechanical body due to restrictions on the height of the mechanical body, or the like. In these cases, in use environments such as orchards and livestock barns, combustibles such as fallen leaves may accumulate on the ground, so there is a demand to lower the temperature of the engine exhaust discharged from the muffler.

[0003] A tractor, which is an example of a work vehicle, may be provided with a configuration as disclosed in patent literature 1 as a configuration for lowering the temperature of engine exhaust.

[0004] In patent literature 1, a first exhaust pipe from which engine exhaust is sent and a second exhaust pipe provided with an inlet having a larger outer diameter than an outlet of the first exhaust pipe are provided, wherein the outlet of the first exhaust pipe and the inlet of the second exhaust pipe are disposed in close proximity such that the outlet of the first exhaust pipe is disposed in the interior of the inlet of the second exhaust pipe.

[0005] When engine exhaust exits from the outlet of the first exhaust pipe and enters the interior of the second exhaust pipe from the inlet of the second exhaust pipe, outside air is drawn into the flow of the engine exhaust due to an ejector effect, brought into the interior of the second exhaust pipe from the inlet of the second exhaust pipe, and mixes with the engine exhaust. The temperature of the engine exhaust is thereby lowered by the outside air.

[0006] Patent literature 2 describes an apparatus for reducing the temperature of an exhaust gas for an engine of a construction machine. More particularly, patent literature 2 relates to an improved exhaust gas temperature reduction apparatus for an engine of a construction machine, in which when an exhaust gas generated in the combustion process of a smoke reduction device of an engine, preferably a diesel engine of the construction machine passes through a diffuser and a tail pipe, the exhaust gas is mixed with a cooling fan air flow and an external air so that a low-temperature exhaust gas can be discharged to the outside of an engine room.

[0007] Patent literature 3 describes an exhaust gas diffusion device introducing outside air into an outside air mixing cylinder, which has a larger inner diameter than an outer diameter of an exhaust side end part of an exhaust pipe that sends out exhaust gas of a vehicle engine and is arranged at a position where the exhaust gas from the exhaust pipe is received, and mixes introduced outside air with exhaust gas. The exhaust gas diffusion device comprises a wind direction member that promotes the mixing of the outside air and the exhaust gas by being arranged at an upstream position in a flow direction of the exhaust gas or an internal position of the exhaust pipe in the outside air mixing cylinder.

[0008] Patent literature 4 describes a device for cooling an exhaust gas stream having a discharge nozzle impinged by an exhaust gas flow. The discharge nozzle projects in an open end of an adjacent exhaust gas pipe such that a low pressure compared to the environment is generated in a suction area with passage of the exhaust gas flow. The suction area is formed between the discharge nozzle and the exhaust gas pipe. An adjusting unit is provided for changing the flow cross-section of the discharge nozzle. An independent claim is also included for a motor vehicle with an engine chamber.

[0009] Patent literature 5 describes an exhaust assembly including an exhaust pipe, a first venturi member at the inlet end of the pipe and a second venturi member at the outlet end of the pipe. A diffuser/mixer is mounted at the outlet end of the exhaust pipe. A shield pipe surrounds a portion of the exhaust pipe. A shield member is mounted to the shield pipe and covers a portion of the first venturi member. The first and second venturi members operate to combine ambient air with exhaust gases.

[0010] Patent literature 6 describes an exhaust stack for an internal combustion engine including an upstream segment having a proximal portion and a distal portion, and a downstream segment. The distal portion of the upstream segment has a non-circular cross section and at least partially defines a venturi opening. The downstream segment has a downstream proximal portion that at least partially defines the venturi opening. The distal portion defines a flow area that is less than or equal to a flow area of the proximal portion, and defines a perimeter that is greater than a perimeter of the proximal portion.

[0011] Patent literature 7 describes a tail pipe arrangement for an exhaust system of a vehicle. The tail pipe arrangement comprises an inlet, by which the surrounding air is introduced into the exhaust flow for cooling the exhaust flow. A primary pipe is provided, which introduces the exhaust gas area by area into an inlet opening of a secondary pipe in the flow direction.

Prior Art Literature

Patent Literature

[0012]

Patent Literature 1 JP 2016-153304 A
Patent Literature 2 US 2014/020638 A1
Patent Literature 3 JP 2022 102298 A

Patent Literature 4 DE 10 2009 046253 A1
Patent Literature 5 US 2013/205759 A1
Patent Literature 6 US 2012/145268 A1
Patent Literature 7 DE 10 2011 014908 A1

Summary of Invention

Problem to Be Solved by Invention

[0013] In the above configuration of patent literature 1, in order to bring in a large amount of outside air in order to lower the temperature of the engine exhaust, it is preferable to increase the flow speed of the engine exhaust at the outlet of the first exhaust pipe, and for the outlet of the first exhaust pipe, it is preferable to increase a portion (boundary surface) where the engine exhaust flow contacts the outside air.

[0014] In patent literature 1, in order to increase the flow speed of the engine exhaust at the outlet of the first exhaust pipe, the outlet of the first exhaust pipe is squeezed to a flat shape to increase the flow speed of the engine exhaust. However, if the outlet of the first exhaust pipe is squeezed too much, the disadvantage of increased engine exhaust back pressure increases.

[0015] In order to increase the portion (boundary surface) where the engine exhaust flow contacts the outside air, increasing the diameters of the outlet of the first exhaust pipe and the inlet of the second exhaust pipe, and providing many configurations wherein the outlet of the first exhaust pipe and the inlet of the second exhaust pipe are disposed in close proximity are considered, but these lead to undesired larger or more complicated structures.

[0016] An object of the present invention is to configure a work vehicle such that when the outlet of the first exhaust pipe and the inlet of the second exhaust pipe are disposed in proximity, the temperature of the engine exhaust may be lowered by a large amount of outside air being drawn into the flow of engine exhaust and mixed into the engine exhaust without squeezing the outlet of the first exhaust pipe more than necessary.

Means for Solving Problem

[0017] A work vehicle according to the present invention comprises a first exhaust pipe for engine exhaust, and a second exhaust pipe provided with an inlet having an outer diameter larger than an outer diameter of an outlet of the first exhaust pipe, wherein the outlet of the first exhaust pipe and the inlet of the second exhaust pipe are disposed in proximity such that the outlet of the first exhaust pipe is disposed inside the inlet of the second exhaust pipe. The work vehicle further comprises a partition dividing a cross-section of the outlet of the first exhaust pipe into a plurality of divided regions when viewed from the flow direction and partitions the adjacent divided regions at intervals. A cross-section of the partition has a wedge shape tapering toward an upstream of the exhaust discharged from the outlet of the first exhaust pipe.

[0018] According to the present invention, the outlet of the first exhaust pipe and the inlet of the second exhaust pipe are disposed in proximity such that the outlet of the first exhaust pipe is disposed inside the inlet of the second exhaust pipe, the cross-section of the outlet of the first exhaust pipe is divided into a plurality of divided regions by the partition and the adjacent divided regions are partitioned at intervals by the partition.

[0019] According to the present invention, when the engine exhaust is discharged from the outlet of the first exhaust pipe, the flow of the engine exhaust is divided into a plurality of flows corresponding to the divided regions while passing through the plurality of divided regions due to the partition. Immediately after the partition, the plurality of flows of engine exhaust become independent flows, and after this, the plurality of flows of the engine exhaust are mixed with outside air and then converge. At the same time, because the region of the outlet of the first exhaust pipe is narrowed by the partition, the flow speed of the plurality of flows of engine exhaust is increased.

[0020] According to the present invention, in each of the plurality of flows of engine exhaust, the peripheral part of the divided region serves as the boundary surface, and thus, the sum of boundary surfaces of the plurality of flows of engine exhaust becomes the boundary surface of the engine exhaust when the partition is provided.

[0021] In contrast, the boundary surface of the engine exhaust when the partition is not provided is the peripheral part of the outlet of the first exhaust pipe.

[0022] Therefore, the boundary surface of engine exhaust when the partition is provided is larger than the boundary surface of the engine exhaust when the partition is not provided.

[0023] As described above, according to the present invention, by providing the partition, it is possible to increase the boundary surface of the engine exhaust while increasing the flow speed of the engine exhaust appropriately, and thus, it is possible to configure so that a large amount of outside air is drawn into the flow of engine exhaust, introduced into the interior of the second exhaust pipe from the inlet of the second exhaust pipe, and mixed with the engine exhaust, so that and the temperature of the engine exhaust can be reduced.

[0024] In the present invention, a cross-section of the partition has a wedge shape when viewed from a direction orthogonal to the flow direction, the wedge shape tapering toward an upstream of a flow of the exhaust discharged from the outlet of the first exhaust pipe.

[0025] According to the present invention, when the flow of engine exhaust is divided into a plurality of divided regions by the partition, the cross-sectional shape of the partition is wedge-shaped, and therefore, the flow of engine exhaust is guided along the partition, spaces in which engine exhaust cannot flow in regions downstream of the partition are more easily generated, and these

spaces are more easily expanded further downstream. Thus, because the outside air is more easily mixed into a space wherein the engine exhaust cannot flow, it can be expected that the temperature of the engine exhaust is efficiently decreased.

[0026] According to an embodiment, the partition may be attached to the outlet of the first exhaust pipe.

[0027] According to an embodiment, at the outlet of the first exhaust pipe, the partition may be attached across one portion of the peripheral part and another portion of the peripheral part of the outlet, and therefore the outlet of the first exhaust pipe is reinforced by the partition.

[0028] According to an embodiment, the partition may be formed such that the areas of the plurality of divided regions are all the same when viewed from the flow direction.

[0029] According to this embodiment, when the flow of engine exhaust is divided into a plurality of flows by the partition as described above, the areas of the plurality of divided regions due to the partition are all the same, and the boundary surfaces of each of the plurality of flows of engine exhaust are substantially the same, and therefore, outside air can be expected to mix in each of the plurality of flows of engine exhaust substantially evenly and the temperatures of the engine exhaust of each of the plurality of flows of engine exhaust can be expected to decrease substantially evenly.

[0030] Thus, when the flows of the engine exhaust converge after being divided into a plurality of flows by the partition, it can be expected that the temperature of the engine exhaust will decrease substantially evenly.

[0031] According to an embodiment, the partition may extend radially outward from a center of the outlet of the first exhaust pipe when viewed from the flow direction.

[0032] According to this embodiment, since the partition is disposed and formed radially, it is possible to form the partition in a simple manner while giving the partition sufficient strength.

[0033] According to an embodiment, the work vehicle may further comprise a further partition, the further partition being a flat-shaped member having a plurality of openings.

[0034] According to this embodiment, since the further partition is formed in a flat shape having a plurality of openings, it is possible to form the further partition in a simple manner while giving the further partition sufficient strength.

[0035] According to an embodiment, the partition may be line symmetrical with respect to a virtual straight line passing through a center of the outlet of the first exhaust pipe when viewed from the flow direction.

[0036] According to this embodiment, it can be expected that the temperature of the engine exhaust will be reduced substantially evenly due to the outside air mixing with the engine exhaust along the line-symmetrical partition.

[0037] According to an embodiment, the work vehicle further comprises one or more notch parts extending from an end of the outlet of the first exhaust pipe to the direction opposite to the second exhaust pipe and is formed on the peripheral part of the outlet of the first exhaust pipe.

[0038] According to this embodiment, when the engine exhaust is discharged from the outlet of the first exhaust pipe, the flow of the engine exhaust is divided into a plurality of flows corresponding to the divided regions while passing through the plurality of divided regions due to the partition. Immediately after the partition, the plurality of flows of engine exhaust become independent flows, and after this, the plurality of flows of the engine exhaust are mixed with outside air and then converge. At the same time, because the region of the outlet of the first exhaust pipe is narrowed by the partition, the flow speed of the plurality of flows of engine exhaust is increased. When the engine exhaust is discharged from the outlet of the first exhaust pipe, the engine exhaust is also discharged from the notch part.

[0039] According to this embodiment, in each of the plurality of flows of engine exhaust, the peripheral part of the divided region serves as the boundary surface, and thus, the sum of boundary surfaces of the plurality of flows of engine exhaust becomes the boundary surface of the engine exhaust when the partition is provided.

[0040] When the engine exhaust is discharged from the outlet of the first exhaust pipe, the engine exhaust is also discharged from the notch part, so the peripheral part of the notch part also serves as the boundary surface. In this case, the peripheral part of the notch part is long due to the notch part extending from the end of the outlet of the first exhaust pipe to the direction opposite to the second exhaust pipe.

[0041] According to this embodiment, the boundary surface of engine exhaust when the partition is provided and the boundary surface of the engine exhaust when the notch part is provided are summed.

[0042] In contrast, the boundary surface of the engine exhaust when the partition and notch part are not provided is the peripheral part of the outlet of the first exhaust pipe.

[0043] Therefore, the boundary surface of engine exhaust when the partition and notch part are provided is larger than the boundary surface of the engine exhaust when the partition and notch part are not provided.

[0044] As described above, according to an embodiment, by providing the partition and notch part, it is possible to increase the boundary surface of the engine exhaust while increasing the flow speed of the engine exhaust appropriately, and thus, it is possible to configure so that a large amount of outside air is drawn into the flow of engine exhaust, introduced into the interior of the second exhaust pipe from the inlet of the second exhaust pipe, and mixed with the engine exhaust, so that and the temperature of the engine exhaust can be reduced.

[0045] According to an embodiment, the partition may be attached on the first exhaust pipe across a portion further separated to the direction opposite to the second exhaust pipe than the end of the notch part in the direction

opposite to the second exhaust pipe, and the end of the outlet of the first exhaust pipe, and the partition may protrude from the end of the outlet of the first exhaust pipe toward the second exhaust pipe.

[0046] According to this embodiment, the partition is formed in a long shape in the flow direction, and therefore, when the flow of engine exhaust is divided into a plurality of flows by the partition as described above, the plurality of flows of engine exhaust each easily become independent flows. This is advantageous in that the peripheral parts of the divided regions of each of the plurality of flows of engine exhaust serve as the boundary surface.

[0047] According to an embodiment, the partition and the notch part may be line symmetrical with respect to a virtual straight line passing through a center of the outlet of the first exhaust pipe when viewed from the flow section.

[0048] According to this embodiment, it can be expected that the temperature of the engine exhaust will be reduced substantially evenly due to the outside air mixing with the engine exhaust along the line-symmetrical partition and notch part.

Brief Description of Drawings

[0049]

FIG. 1 is a side view of a tractor, that is an embodiment of a work vehicle.

FIG. 2 is a side view in the vicinity of an exhaust purification device, a first exhaust pipe, and a second exhaust pipe.

FIG. 3 is a plan view of the vicinity of an outlet of a first exhaust pipe, an inlet of a second exhaust pipe, and a partition.

FIG. 4 is a side view of the vicinity of an outlet of a first exhaust pipe and a partition.

FIG. 5 is a bottom view of the vicinity of an outlet of a first exhaust pipe and a partition.

FIG. 6 is a schematic diagram illustrating divided regions.

FIG. 7 is a perspective view of the vicinity of an outlet of a first exhaust pipe and partition in a further embodiment of the present invention.

FIG. 8 is a perspective view of the vicinity of an outlet of a first exhaust pipe and partition in a further embodiment of the present invention.

FIG. 9 is a perspective view of the vicinity of an outlet of a first exhaust pipe and notch part in a further embodiment of the present invention.

Detailed Description of Embodiments of Invention

[0050] FIGS. 1 to 9 illustrate a tractor that is an example of a work vehicle, wherein F shows a forward direction, B shows a backward direction, U shows an upward direction, and D shows a downward direction.

Overall Configuration of Tractor

[0051] As illustrated in FIG. 1, a mechanical body 3 is supported by right and left front wheels 1 and right and left rear wheels 2. A diesel-type engine 4 is provided at a front portion of the mechanical body 3, a driving unit 5 is provided at back portion of the mechanical body 3, and a driver's seat 6 and a steering wheel 7 for the front wheels 1 are provided in the driving unit 5. An arch-shaped ROPS frame 8 is provided between the engine 4 and the driving unit 5.

Disposition of the First Exhaust Pipe and Second Exhaust Pipe

[0052] As illustrated in FIGS. 1 and 2, exhaust of the engine 4 is fed to an exhaust purification device (not illustrated) (DPF) to remove particulates from the exhaust of the engine 4. Next, the exhaust of the engine 4 is fed from the exhaust purification device (DPF) to an exhaust purification device 9 (SCR), and nitrogen oxide is removed from the exhaust of the engine 4.

[0053] The exhaust purification device 9 is disposed along the horizontal or left-right direction between the engine 4 and the driving unit 5 (steering wheel 7), and a round pipe shaped exhaust pipe 10 is extended downward from a right portion of the engine purification device 9. A round pipe shaped first exhaust pipe 11 is connected to the exhaust pipe 10 and extended downward, and a round pipe shaped second exhaust pipe 12 is supported along the vertical or up-down direction on the bottom of the first exhaust pipe 11.

[0054] With the above configuration, the exhaust of the engine 4 is fed from the exhaust purification device (not illustrated) (DPF) to the exhaust purification device 9 (SCR) and sent from the exhaust pipe 10 to the first exhaust pipe 11, sent from an outlet 13 of a lower portion of the first exhaust pipe 11 to an inlet 14 of an upper portion of the second exhaust pipe 12 and discharged from an outlet 15 of a lower portion of the second exhaust pipe 12 .

Configuration of the Notch Parts Formed on the Outlet of the First Exhaust Pipe

[0055] As illustrated in FIGS. 4 and 5, four triangular notch parts 18 are formed at intervals of 90 degrees on a peripheral part of the outlet 13 of the first exhaust pipe 11.

[0056] At the peripheral part of the outlet 13 of the first exhaust pipe 11, two triangular notch parts 19 smaller than the notch parts 18 are formed on each of the four portions between the adjacent notch parts 18, forming a total of eight notch parts 19. A plurality of notch parts 19 are thereby formed across the entire periphery of the peripheral port of the outlet 13 of the first exhaust pipe 11.

[0057] The notch parts 18, 19 are formed with point symmetry with respect to a center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the

flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2).

[0058] As illustrated in FIGS. 5 and 6, when imagining virtual straight lines E1, E2, E3, E4 passing through the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the notch parts 19 are formed with line symmetry with respect to virtual straight lines E1, E2, E3, E4.

[0059] Notch parts 18, 19 are formed to extend upward from end parts 13a, 13b of the outlet 13 of the first exhaust pipe 11 (opposite side of the second exhaust pipe 12). Regarding end parts 13a, 13b of the outlet 13 of the first exhaust pipe 11, the end part 13a adjacent to the notch parts 18 extends farther downward (to the second exhaust pipe 12 side) than the end part 13b between notch parts 19.

Configuration of a Partition Provided at the Outlet of the First Exhaust Pipe

[0060] As illustrated in FIGS. 3, 4, and 5, a plate material is folded into a triangular cross-section to form partitions 16, 17 and the partitions 16, 17 are combined so as to cross orthogonally and connect to each other. The partitions 16, 17 are inserted into the notch parts 18 of the outlet 13 of the first exhaust pipe 11 and attached to the outlet 13 of the first exhaust pipe 11.

[0061] Seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the orthogonally crossing portions of the partitions 16, 17 are disposed at the center of the outlet 13 of the first exhaust pipe 11. Seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11, the partitions 16, 17 are disposed and formed radially facing outward from the center of the outlet 13 of the first exhaust pipe 11.

[0062] Due to the partitions 16, 17 being formed by the plate material being bent to have a triangular cross-section, seen from the direction orthogonal to the direction A1 (see FIG. 2) of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 4), the cross-sectional shape of the partitions 16, 17 is formed in a wedge shape tapering upstream of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11.

[0063] The partitions 16, 17 are formed with point symmetry with respect to the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2).

[0064] As illustrated in FIGS. 5 and 6, when imagining virtual straight lines E1, E2, E3, E4 passing through the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the partitions 16, 17 are formed with line symmetry with respect to virtual straight lines E1, E2, E3, E4.

[0065] Even in a configuration in which the partitions 16, 17 and the notch part 19 are combined, the configuration in which the partitions 16, 17 and the notch part 19 are combined is formed with line symmetry with respect to the virtual straight lines E1, E2, E3, E4.

[0066] Outer ends 16a, 17a of the partitions 16, 17 protrude radially outward from the outer peripheral portion of the outlet 13 of the first exhaust pipe 11. The upper end parts 16b, 17b of the partitions 16, 17 are positioned above the upper end part 19a of the notch part 19 (opposite side of the second exhaust pipe 12) (see FIG. 4), and the lower end parts 16c, 17c of the partitions 16, 17 protrude downward from the end parts 13a, 13b of the outlet 13 of the first exhaust pipe 11 (to the second exhaust pipe 12 side) (see FIG. 4).

[0067] Thus, the partitions 16, 17 are attached on the first exhaust pipe across a portion further separated on the opposite side of the second exhaust pipe 12 than the end part 19a of the opposite side of the second exhaust pipe 12 of the notch part 19, and the end part 13a of the outlet 13 of the first exhaust pipe 11, and the partitions 16, 17 protrude from the end parts 13a, 13b of the outlet 13 of the first exhaust pipe 11 towards the second exhaust pipe 12 side.

Relationship Between the Partitions and Notch Parts and the Outlet of the First Exhaust Pipe

[0068] As illustrated in FIGS. 5 and 6, seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the region of the outlet 13 of the first exhaust pipe 11 is divided by the partitions 16, 17 into four divided regions B1. A region of the notch part 19 is also included in the four divided regions B1, and the adjacent divided regions B1 are partitioned by the partitions 16, 17 with intervals C1 of the width of the partitions 16, 17.

[0069] Thus, seen from the direction A1 (see FIG. 2) of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11, the areas of the four divided regions B1 are all the same.

[0070] When exhaust of the engine 4 is sent to the first exhaust pipe 11, the exhaust of the engine 4 is divided into four flows corresponding to the divided regions B1 at the outlet 13 of the first exhaust pipe 11 while passing through the divided regions B1 due to the partitions 16, 17. Immediately after the partitions 16, 17, the four flows of exhaust of the engine 4 become independent flows, and after this, the four flows of exhaust of the engine 4 are mixed with outside air and then converge.

[0071] At the same time, the cross-sectional shape of the partitions 16, 17 is formed in a wedge shape that tapers upstream of the flow of the exhaust discharged from the outlet 13 of the first exhaust pipe 11, and thus, the region of the outlet 13 of the first exhaust pipe 11 is narrowed by the partitions 16, 17 and flow of the exhaust of the engine 4 is obstructed by the partition 16, 17, causing the flow speed of the four flows of exhaust of the engine 4 to increase. A negative pressure space in

which exhaust of the engine 4 cannot flow is more easily generated in the region downstream of the partitions 16, 17, and this negative pressure space is more easily expanded downstream.

[0072] In the flow corresponding to the divided regions B1 of the exhaust of the engine 4, the boundary surface, which is the portions at which the flow of exhaust of the engine 4 contacts outside air, is the sum of a portion L1 corresponding to the lower end part 16c of the partition 16, a portion L2 corresponding to the lower end part 17c of the partition 17, two portions L3 corresponding to the peripheral parts of the two notch parts 19, and three portions L4 corresponding to end parts 13a, 13b of the outlet 13 of the first exhaust pipe 11.

[0073] Thus, the boundary surface when the partitions 16, 17 and the notch parts 19 are provided is the sum of the boundary surfaces of the four flows corresponding to the divided regions B1 of the exhaust of the engine 4.

Relationship Between the First Exhaust Pipe and the Second Exhaust Pipe

[0074] As illustrated in FIG. 3, the second exhaust pipe 12 is formed to have a larger diameter than the first exhaust pipe 11, and the inlet 14 of the second exhaust pipe 12 is formed to have a larger outer diameter than the outlet 13 of the first exhaust pipe 11. The outlet 15 of the second exhaust pipe 12 is formed so as to face laterally outward to the right from the mechanical body 3.

[0075] As illustrated in FIG. 2, in a side view (direction orthogonal to the direction A1 of the flow exhaust discharged from the outlet 13 of the first exhaust pipe 11), the outlet 13 of the first exhaust pipe 11 and the inlet 14 of the second exhaust pipe 12 are disposed in proximity such that the outlet of the first exhaust pipe 11 (end parts 16c, 17c of the partitions 16, 17) and the outlet 14 of the second exhaust pipe 12 are disposed at small intervals C2.

[0076] As illustrated in FIG. 3, seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the outlet 13 of the first exhaust pipe 11 and the partitions 16, 17 are disposed in the interior of the inlet 14 of the second exhaust pipe 12.

[0077] The peripheral part of the outlet 13 of the first exhaust pipe 11 and the peripheral part of the inlet 14 of the second exhaust pipe 12 are disposed at intervals C3. The outer end parts 16a, 17a of the partitions 16, 17 and the peripheral part of the inlet 14 of the second exhaust pipe 12 are disposed at intervals C4 narrower than the intervals C3.

[0078] With the above configuration, the exhaust of the engine 4 is discharged from the outlet 13 of the first exhaust pipe 11, is sent to the inlet 14 of the second exhaust pipe 12, enters the interior of the second exhaust pipe 12, and is exhausted from the outlet 15 of the lower portion of the second exhaust pipe 12.

[0079] As described above (relationship between the partitions and notch parts and the outlet of the first exhaust pipe), by providing the partitions 16, 17 and notch parts 19, the flow speed of exhaust of the engine 4 can be appropriately increased.

[0080] A negative pressure space in which exhaust of the engine 4 cannot flow is more easily generated in the region downstream of the partitions 16, 17, and outside air more easily mixes in this negative pressure space.

[0081] The boundary surface when the partitions 16, 17 and the notch parts 19 are provided is the sum of the boundary surfaces of the four flows corresponding to the divided regions B1 of the exhaust of the engine 4.

[0082] Thus, a large amount of outside air is drawn into the flow of exhaust of the engine 4, brought into the interior of the second exhaust pipe 12 from between the peripheral part of the outlet 13 of the first exhaust pipe 11 and the inlet 14 of the second exhaust pipe 12, mixed into the exhaust of the engine 4, and the temperature of the exhaust of the engine 4 is lowered.

First Alternative Mode of Carrying Out Invention

[0083] In the configuration illustrated in FIGS. 2 to 5, the notch part 19 may be removed.

[0084] In a side view, in order to overlap the outlet 13 of the first exhaust pipe 11 and the inlet 14 of the second exhaust pipe 12, the outlet 13 of the first exhaust pipe 11 may be disposed along the direction A1 (see FIG. 2) of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 so as to slightly enter the interior of the inlet 14 of the second exhaust pipe 12.

[0085] Partitions 16, 17 may be provided in the inlet 14 of the second exhaust pipe 12 and the outlet 13 of the first exhaust pipe 11 may be disposed in proximity to the partitions 16, 17.

[0086] The invention may also configure the work vehicle so that the partitions 16, 17 are configured to combine and connect to each other at angles other than 90 degrees so that the areas of the four divided regions B1 are not all the same while forming the partitions 16, 17 with point symmetry with respect to the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 (see FIG. 2) of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11.

Second Alternative Mode of Carrying Out Invention

[0087] The cross-sectional shape of the partitions 16, 17 may be formed in a wedge shape that is 1/2 of an elongated ellipse instead of a triangular wedge shape.

[0088] According to this configuration, the outer surfaces of the partitions 16, 17 are not linear but arcuate in cross section, and therefore it can be expected that the flow of exhaust of the engine 4 along the outer surfaces of the partitions 16, 17 will be smooth.

Third Alternative Mode of Carrying Out Invention

[0089] As illustrated in FIG. 7, a partition 20 may be configured by a flat-shaped member or a flat plate and the partition 20 formed so that a plurality of arm portions 20a extend radially outward from the center of the outlet 13 of the first exhaust pipe 11 form the center of the partition 20.

[0090] In the configuration illustrated in FIG. 7, the arm portions 20a of the partition 20 are disposed with point symmetry with respect to the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2).

[0091] When imagining virtual straight lines E1, E2 passing through the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the partition 20 is formed with line symmetry with respect to virtual straight lines E1, E2. The virtual straight line E1 may be imagined so that it passes through a different arm portion 20a than the arm portion 20a illustrated in FIG. 7 of the partition 20. The virtual straight line E2 may be imagined so that it passes through a different gap of arm portions 20a than the gap of arm portions 20a illustrated in FIG. 7 of the partition 20.

[0092] One divided region B1 is formed by two adjacent arm portions 20a of the partition 20 and the peripheral part of the outlet 13 of the first exhaust pipe 11. By setting the angles between adjacent arm portions 20a of the partition 20 to be all the same, the areas of the plurality of divided regions B1 are made all the same.

[0093] In this case, the number of arm portions 20a of the partition 20 is assumed to be 3, 4, 5, and various other numbers. The angles between adjacent arm portions 20a of the partition 20 may be set to be different from each other, to configure so that the areas of the plurality of divided regions B1 are not all the same. In addition to the partition 20, a notch part 19 illustrated in FIGS. 4 and 5 may be formed on the outlet 13 of the first exhaust pipe 11.

Fourth Alternative Mode of Carrying Out Invention

[0094] As illustrated in FIG. 8, the partition 20 may be configured by a flat-shaped member or a flat plate, and a plurality of circular openings 20b of the same inner diameter opened to form the partition 20.

[0095] One divided region B1 is formed by one opening 20b of the partition 20. Because the openings 20b of the partition 20 have the same inner diameter, the areas of the plurality of divided regions B1 are all the same.

[0096] In the configuration illustrated in FIG. 8, the openings 20b of the partition 20 are disposed with point symmetry with respect to the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2).

[0097] When imagining virtual straight lines E1, E2 passing through the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the partition 20 is formed with line symmetry with respect to virtual straight lines E1, E2. The virtual straight line E1 may be imagined so that it passes through a different inside opening 20b than the inside opening 20b illustrated in FIG. 8 of the partition 20. The virtual straight line E2 may be imagined so that it passes through a different outside opening 20b than the outside opening 20b illustrated in FIG. 8 of the partition 20.

[0098] In this case, the inner diameters of the plurality of opening 20b of the partition 20 may be set to be different from each other to configure so that the areas of the plurality of divided regions B1 are not all the same.

Fifth Alternative Mode of Carrying Out Invention

[0099] As illustrated in FIG. 9, the partitions 16, 17, 20 may be removed to form a plurality of notch parts 19 across the entire periphery of the peripheral portion of the outlet 13 of the first exhaust pipe 11.

[0100] In the plurality of notch parts 19, instead of forming all the notch parts 19 at the same size, the notch parts 19 may be configured so that a mixture of different sizes are present, such as large notch parts 19 and small notch parts 19.

[0101] In the configuration illustrated in FIG. 9, the notch parts 19 are formed with point symmetry with respect to the center D1 (see FIGS. 7 and 8) of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2).

[0102] When imagining virtual straight lines E1, E2 passing through the center D1 of the outlet 13 of the first exhaust pipe 11 seen from the direction A1 of the flow of exhaust discharged from the outlet 13 of the first exhaust pipe 11 (see FIG. 2), the notch parts 19 are formed with line symmetry with respect to virtual straight lines E1, E2.

[0103] The virtual straight line E1 may be imagined to that it passes through an end part of the second exhaust pipe 12 side of a different notch part 19 than the notch part 19 illustrated in FIG. 9. The virtual straight line E2 may be imagined to that it passes through the center part of a different notch part 19 than the notch part 19 illustrated in FIG. 9.

[0104] Instead of triangular notch parts 19, notch parts 19 of various shapes such as U-shaped, rectangular, and semicircular may be formed, and a mixture of notch parts 19 with different shapes may be configured.

Industrial Applicability

[0105] The present invention may be applied not only to tractors but also to agricultural work vehicles such as combine harvesters and ridden rice planters, construction work vehicles such as backhoes and wheel loaders, and work vehicles for transporting materials and the like.

Claims

1. A work vehicle comprising:

   a first exhaust pipe (11) for engine exhaust; and a second exhaust pipe (12) provided with an inlet (14) having an outer diameter larger than an outlet diameter of an outlet (13) of the first exhaust pipe (11), wherein
   the outlet (13) of the first exhaust pipe (11) and the inlet (14) of the second exhaust pipe (12) are disposed in proximity such that the outlet (13) of the first exhaust pipe (11) is disposed inside the inlet (14) of the second exhaust pipe (12), and
   the work vehicle further comprises a partition (16, 17) dividing a cross-section of the outlet (13) of the first exhaust pipe (11) into a plurality of divided regions when viewed from an exhaust flow direction and partitioning the adjacent divided regions at intervals, wherein a cross-section of the partition (16, 17) has a wedge shape tapering toward an upstream of the exhaust discharged from the outlet (13) of the first exhaust pipe (11).

2. The work vehicle according to claim 1, wherein the partition (16, 17) is attached to the outlet (13) of the first exhaust pipe (11).

3. The work vehicle according to claim 1 or claim 2, wherein areas of the plurality of divided regions are all the same when viewed from the exhaust flow direction.

4. The work vehicle according to any one of claims 1 to 3, wherein the partition (16, 17)extends radially outward from a center of the outlet (13) of the first exhaust pipe (11) when viewed from the exhaust flow direction.

5. The work vehicle according to any one of claims 1 to 3, further comprising a further partition (20), the further partition (20) being a flat-shaped member having a plurality of openings (20b).

6. The work vehicle according to any one of claims 1 to 5, wherein the partition (16, 17) is line symmetrical with respect to a virtual straight line passing through a center of the outlet (13) of the first exhaust pipe (11) when viewed from the exhaust flow direction.

7. The work vehicle according to claim 1wherein
   the work vehicle further comprises one or more notch parts (19) extending from an end (13a, 13b) of the outlet (13) of the first exhaust pipe (11) to a direction opposite to the second exhaust pipe (12) and formed on a peripheral part of the outlet (13) of the first exhaust pipe (11).

8. The work vehicle according to claim 7, wherein

   the partition (16, 17) is attached on the first exhaust pipe (11) across a portion of the first exhaust pipe (11) further separated to a direction opposite to the second exhaust pipe (12) than the end of the one or more notch parts (19) in the opposite direction, and the end of the outlet (13) of the first exhaust pipe (11), and
   the partition (16, 17) protrudes from the end of the outlet (13) of the first exhaust pipe (11) toward the second exhaust pipe (12).

9. The work vehicle according to claim 7 or claim 8, wherein the partition (16, 17) and the one or more notch parts (19) are line symmetrical with respect to a virtual straight line passing through a center of the outlet (13) of the first exhaust pipe (11) when viewed from the exhaust flow direction.

Patentansprüche

1. Ein Nutzfahrzeug, aufweisend:

   ein erstes Abgasrohr (11) für Motorabgase; und ein zweites Abgasrohr (12), das mit einem Einlass (14) bereitgestellt ist, der einen Außendurchmesser aufweist, der größer ist als ein Auslassdurchmesser eines Auslasses (13) des ersten Abgasrohrs (11), wobei
   der Auslass (13) des ersten Abgasrohrs (11) und der Einlass (14) des zweiten Abgasrohrs (12) in der Nähe so angeordnet sind, dass der Auslass (13) des ersten Abgasrohrs (11) innerhalb des Einlasses (14) des zweiten Abgasrohrs (12) angeordnet ist, und
   das Nutzfahrzeug ferner eine Trennwand (16, 17) aufweist, die einen Querschnitt des Auslasses (13) des ersten Abgasrohrs (11) in eine Vielzahl von unterteilten Bereichen unterteilt, wenn von einer Strömungsrichtung des Abgases aus betrachtet, und die die angrenzenden unterteilten Bereiche in Intervallen unterteilt, wobei ein Querschnitt der Trennwand (16, 17) eine Keilform aufweist, die sich in Richtung eines stromaufwärts des Abgases, das aus dem Auslass (13) des ersten Abgasrohrs (11) abgegeben wird, verjüngt.

2. Das Nutzfahrzeug nach Anspruch 1, wobei die Trennwand (16, 17) an dem Auslass (13) des ersten Abgasrohrs (11) angeordnet ist.

3. Das Nutzfahrzeug nach Anspruch 1 oder 2, wobei die Bereiche der Vielzahl der unterteilten Bereiche alle gleich sind, wenn sie aus der Strömungsrichtung des Abgases betrachtet werden.

4. Das Nutzfahrzeug nach einem der Ansprüche 1 bis 3, wobei sich die Trennwand (16, 17) aus der Strömungsrichtung des Abgases betrachtet von einer Mitte des Auslasses (13) des ersten Abgasrohrs (11) radial nach außen erstreckt.

5. Das Nutzfahrzeug gemäß einem der Ansprüche 1 bis 3, das ferner eine weitere Trennwand (20) aufweist, wobei die weitere Trennwand (20) ein flaches Element mit einer Vielzahl von Öffnungen (20b) ist.

6. Das Nutzfahrzeug gemäß einem der Ansprüche 1 bis 5, wobei die Trennwand (16, 17) in Bezug auf eine virtuelle gerade Linie, die durch eine Mitte des Auslasses (13) des ersten Abgasrohrs (11) verläuft, bei Betrachtung aus der Strömungsrichtung des Abgases, liniensymmetrisch ist.

7. Das Nutzfahrzeug gemäß Anspruch 1, wobei
das Nutzfahrzeug ferner ein oder mehrere Kerbelemente (19) aufweist, die sich von einem Ende (13a, 13b) des Auslasses (13) des ersten Abgasrohrs (11) in eine Richtung entgegengesetzt zum zweiten Abgasrohr (12) erstrecken und an einem Umfangsteil des Auslasses (13) des ersten Abgasrohrs (11) ausgebildet sind.

8. Das Nutzfahrzeug gemäß Anspruch 7, wobei

die Trennwand (16, 17) an dem ersten Abgasrohr (11) über einen Teil des ersten Abgasrohrs (11) angeordnet ist, das ferner in einer Richtung entgegengesetzt zu dem zweiten Abgasrohr (12) getrennt ist als das Ende des einen oder der mehreren Kerbelemente (19) in der entgegengesetzten Richtung, und das Ende des Auslasses (13) des ersten Abgasrohrs (11), und
die Trennwand (16, 17) vom Ende des Auslasses (13) des ersten Abgasrohrs (11) in Richtung des zweiten Abgasrohrs (12) vorsteht.

9. Ein Nutzfahrzeug nach Anspruch 7 oder 8, wobei die Trennwand (16, 17) und das eine oder die mehreren Kerbelemente (19) in Bezug auf eine virtuelle gerade Linie, die durch eine Mitte des Auslasses (13) des ersten Abgasrohrs (11) verläuft, bei Betrachtung aus der Strömungsrichtung des Abgases, liniensymmetrisch sind.

Revendications

1. Véhicule de travail comprenant :

un premier tuyau d'échappement (11) pour les gaz d'échappement du moteur ; et
un second tuyau d'échappement (12) pourvu d'une entrée (14) présentant un diamètre extérieur supérieur à un diamètre de sortie d'une sortie (13) du premier tuyau d'échappement (11), dans lequel
la sortie (13) du premier tuyau d'échappement (11) et l'entrée (14) du second tuyau d'échappement (12) sont disposées à proximité de sorte que la sortie (13) du premier tuyau d'échappement (11) est disposée à l'intérieur de l'entrée (14) du second tuyau d'échappement (12), et
le véhicule de travail comprend en outre une cloison (16, 17) divisant une section transversale de la sortie (13) du premier tuyau d'échappement (11) en une pluralité de régions divisées lorsqu'elles sont vues depuis une direction du flux des gaz d'échappement et séparant les régions divisées adjacentes à intervalles, dans lequel une section transversale de la cloison (16, 17) présente une forme de coin s'amincissant vers l'amont de l'échappement évacué par la sortie (13) du premier tuyau d'échappement (11).

2. Véhicule de travail selon la revendication 1, dans lequel la cloison (16, 17) est fixée à la sortie (13) du premier tuyau d'échappement (11).

3. Véhicule de travail selon la revendication 1 ou la revendication 2, dans lequel des zones de la pluralité de régions divisées sont toutes identiques lorsqu'elles sont vues depuis la direction du flux des gaz d'échappement.

4. Véhicule de travail selon l'une quelconque des revendications 1 à 3, dans lequel la cloison (16, 17) s'étend radialement vers l'extérieur à partir d'un centre de la sortie (13) du premier tuyau d'échappement (11) lorsque l'on regarde dans la direction du flux des gaz d'échappement.

5. Véhicule de travail selon l'une quelconque des revendications 1 à 3, comprenant en outre une autre cloison (20), l'autre cloison (20) étant un élément de forme plate comportant une pluralité d'ouvertures (20b).

6. Véhicule de travail selon l'une quelconque des revendications 1 à 5, dans lequel la cloison (16, 17) est symétrique par rapport à une ligne droite virtuelle passant par un centre de la sortie (13) du premier tuyau d'échappement (11) lorsqu'elle est vue dans la direction du flux des gaz d'échappement.

7. Véhicule de travail selon la revendication 1, dans lequel :
le véhicule de travail comprend en outre une ou plusieurs parties à encoches (19) s'étendant depuis une extrémité (13a, 13b) de la sortie (13) du premier tuyau d'échappement (11) dans une direction oppo-

sée au second tuyau d'échappement (12) et formées sur une partie périphérique de la sortie (13) du premier tuyau d'échappement (11).

8. Véhicule de travail (1) selon la revendication 7, dans lequel :

la cloison (16, 17) est fixée sur le premier tuyau d'échappement (11) à travers une partie du premier tuyau d'échappement (11) davantage séparée dans une direction opposée au second tuyau d'échappement (12) que l'extrémité de ladite une ou plusieurs parties à encoches (19) dans la direction opposée, et l'extrémité de la sortie (13) du premier tuyau d'échappement (11), et
la cloison (16, 17) fait saillie de l'extrémité de la sortie (13) du premier tuyau d'échappement (11) vers le second tuyau d'échappement (12).

9. Véhicule de travail selon la revendication 7 ou la revendication 8, dans lequel la cloison (16, 17) et ladite une ou plusieurs parties à encoches (19) sont symétriques par rapport à une ligne droite virtuelle passant par un centre de la sortie (13) du premier tuyau d'échappement (11) lorsqu'on les regarde dans la direction du flux des gaz d'échappement.

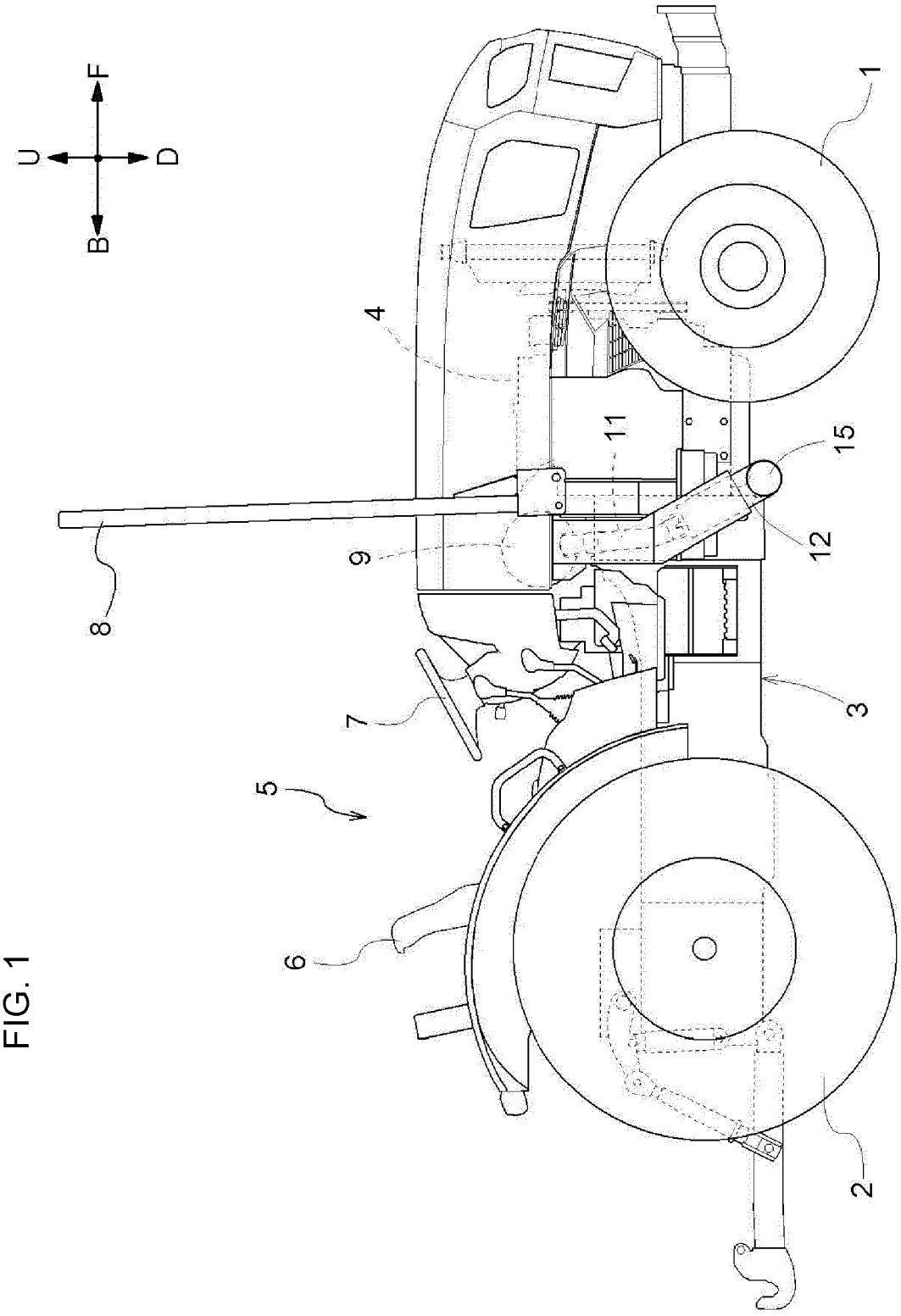


FIG. 1

FIG. 2

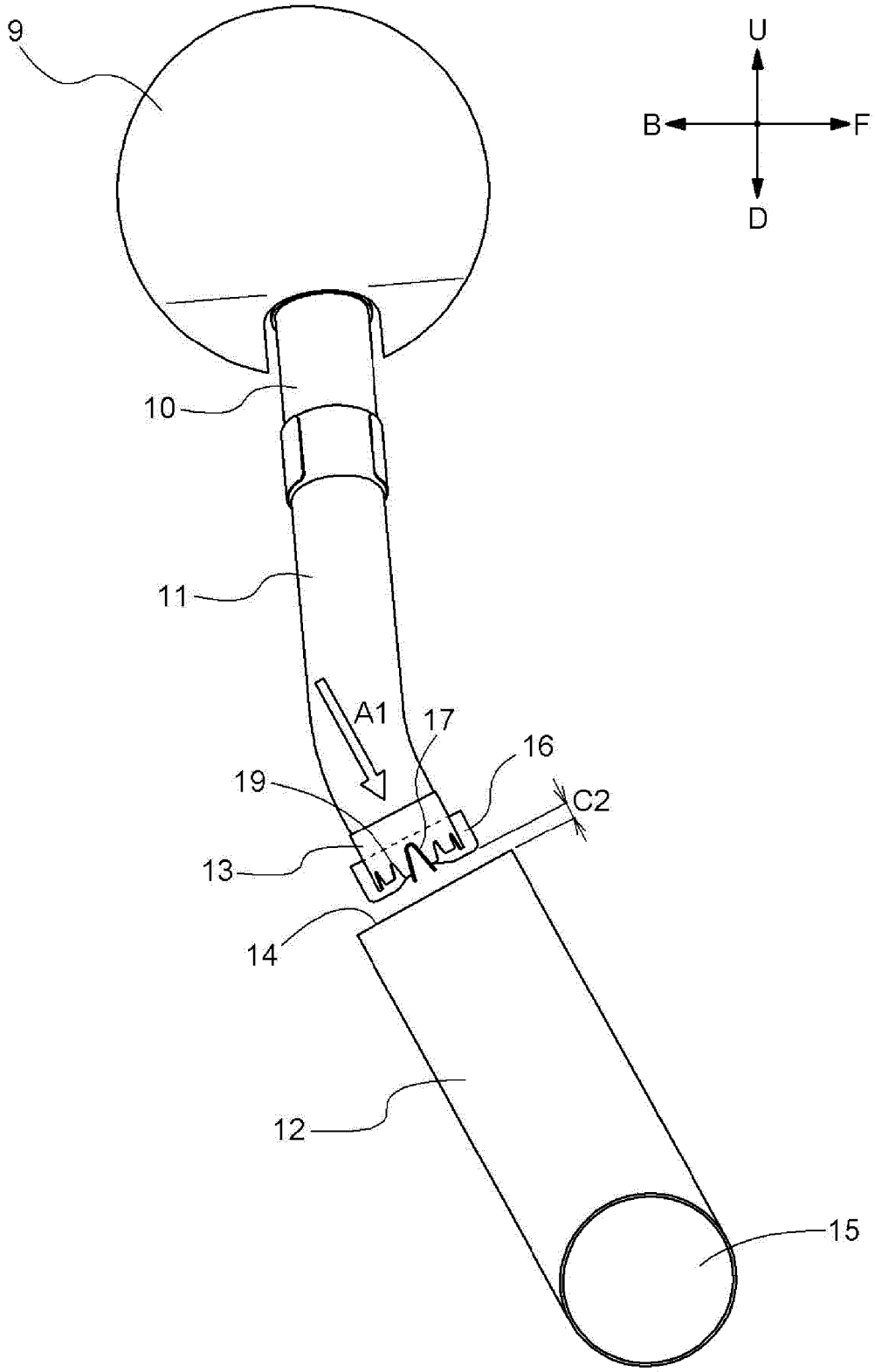


FIG. 3

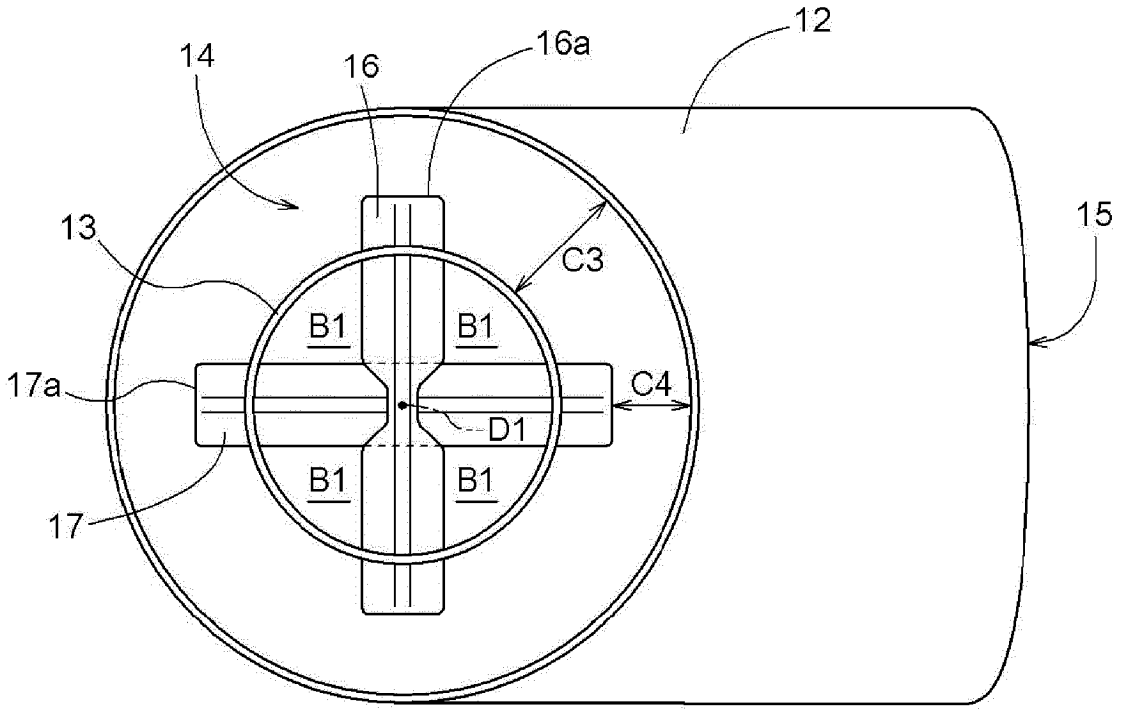

12
14
16
16a
15
13
C3
B1
B1
17a
C4
D1
B1
B1
17

FIG. 4

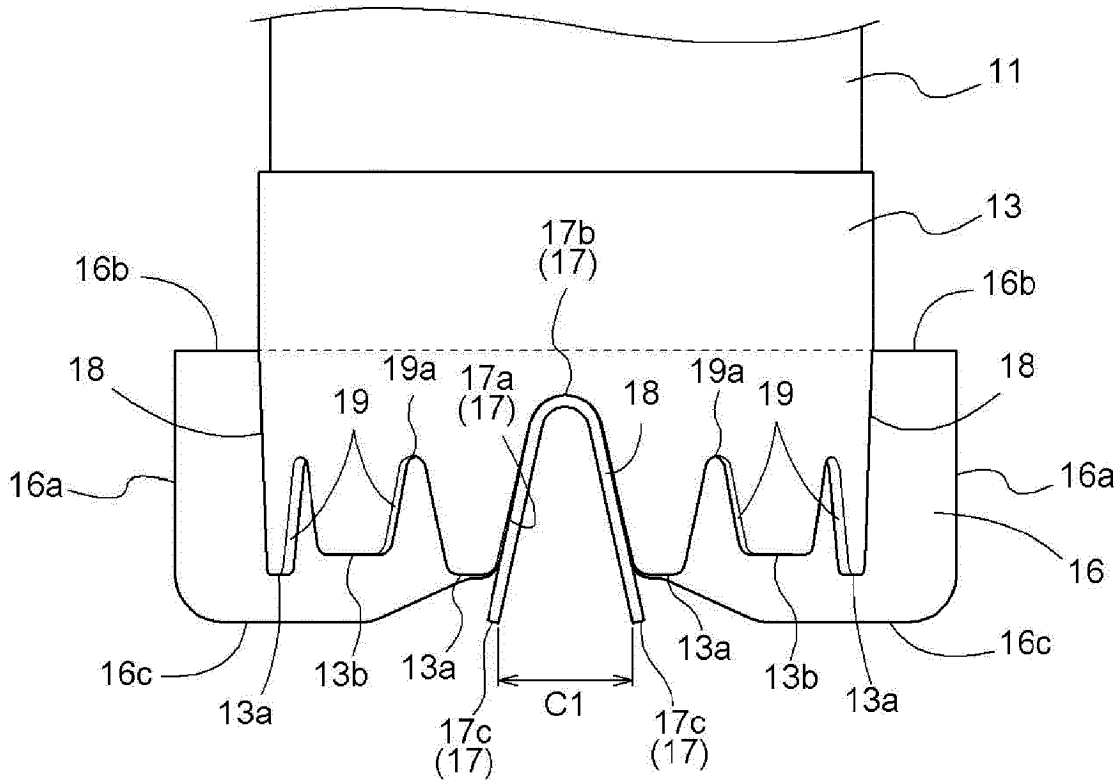

11
13
17b
(17)
16b
16b
18
19a
17a
(17)
19a
18
19
19
18
16a
16a
16
16c
16c
13b
13a
13a
13b
13a
C1
17c
(17)
17c
(17)

FIG. 5

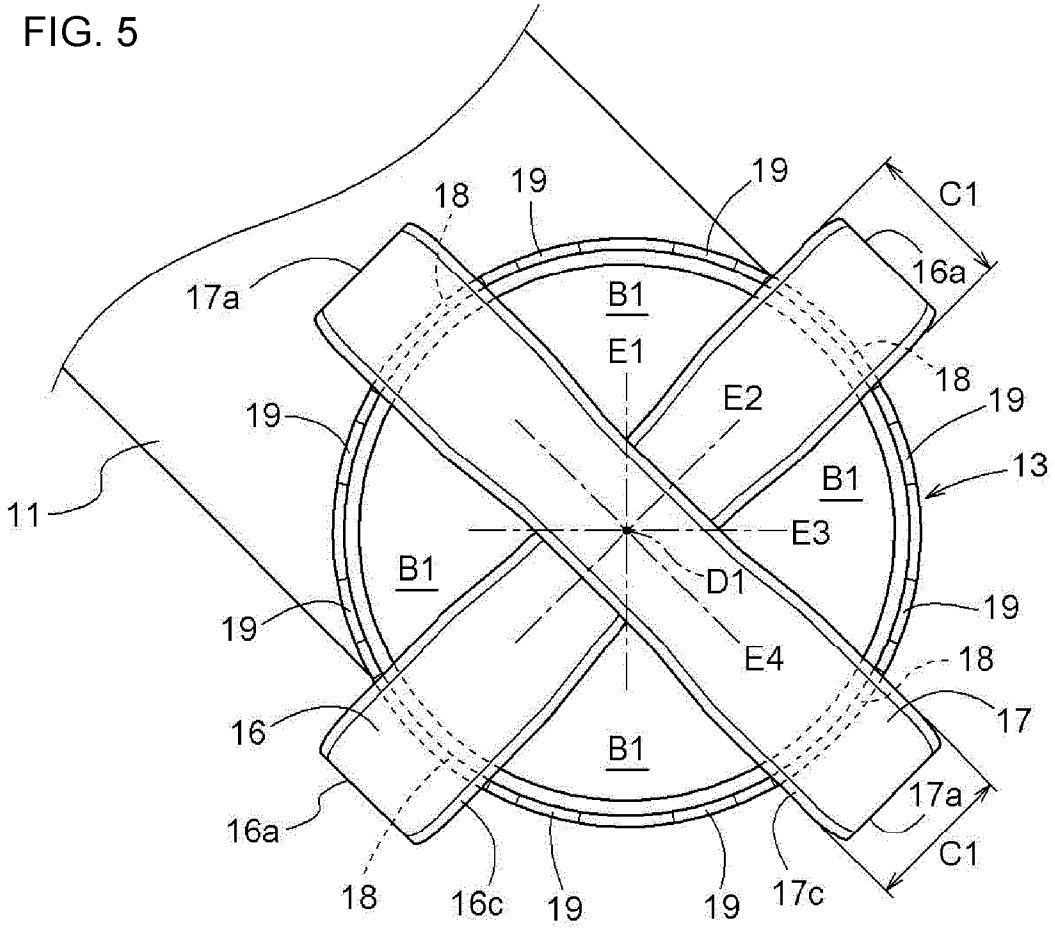

18
19
19
C1
17a
16a
B1
E1
18
19
E2
19
13
11
B1
E3
B1
D1
19
19
E4
18
16
17
B1
16a
17a
C1
18
16c
19
19
17c

FIG. 6

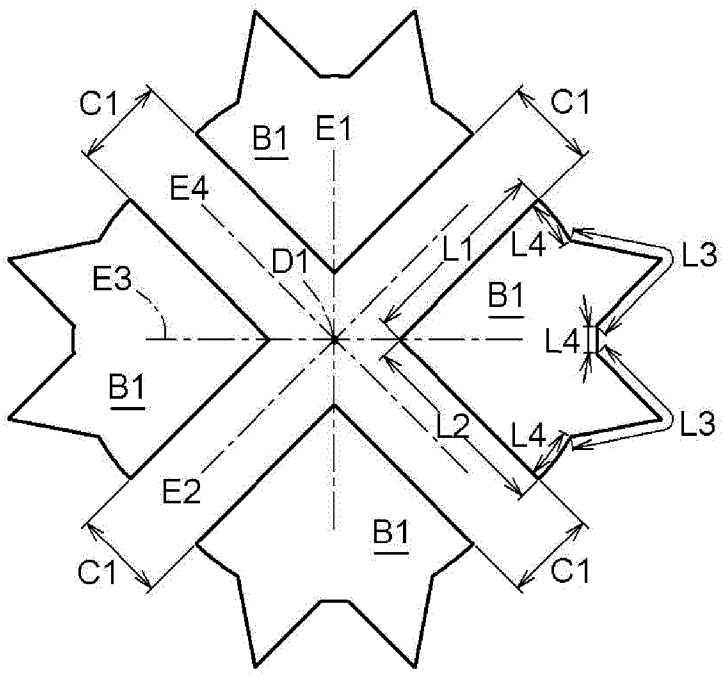

C1
C1
B1
E1
E4
L1
L4
L3
D1
E3
B1
L4
B1
L2
L4
L3
E2
B1
C1
C1

FIG. 7

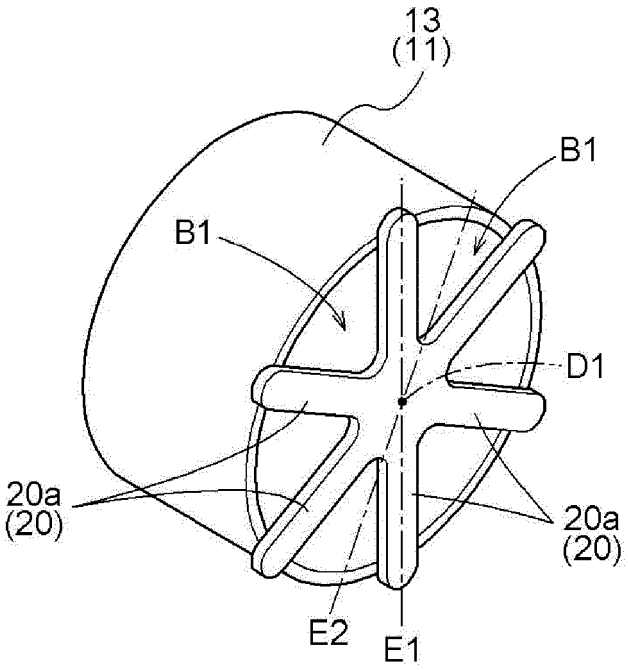


FIG. 8

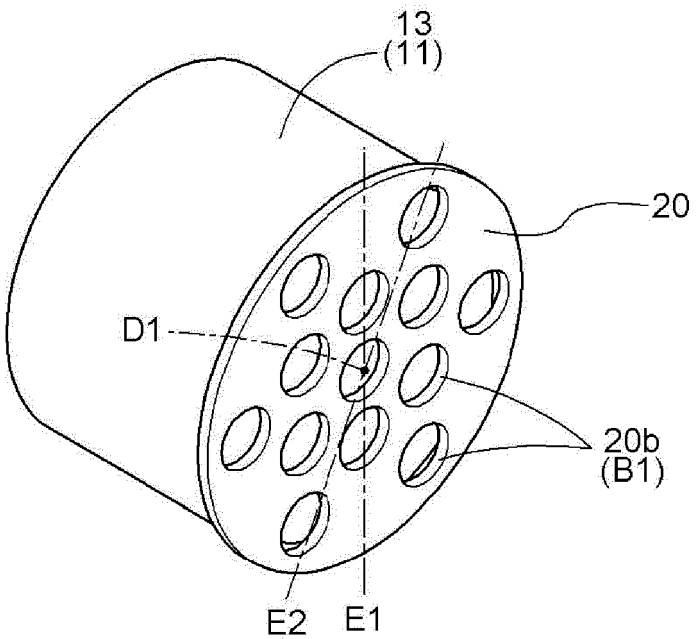
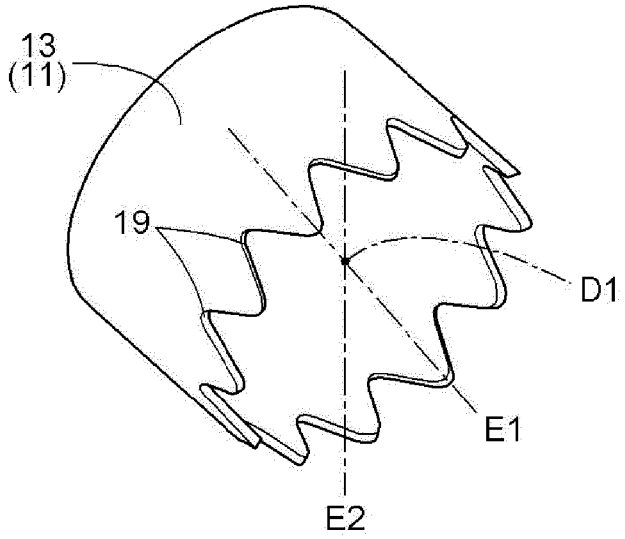


FIG. 9



REFERENCES CITED IN THE DESCRIPTION

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