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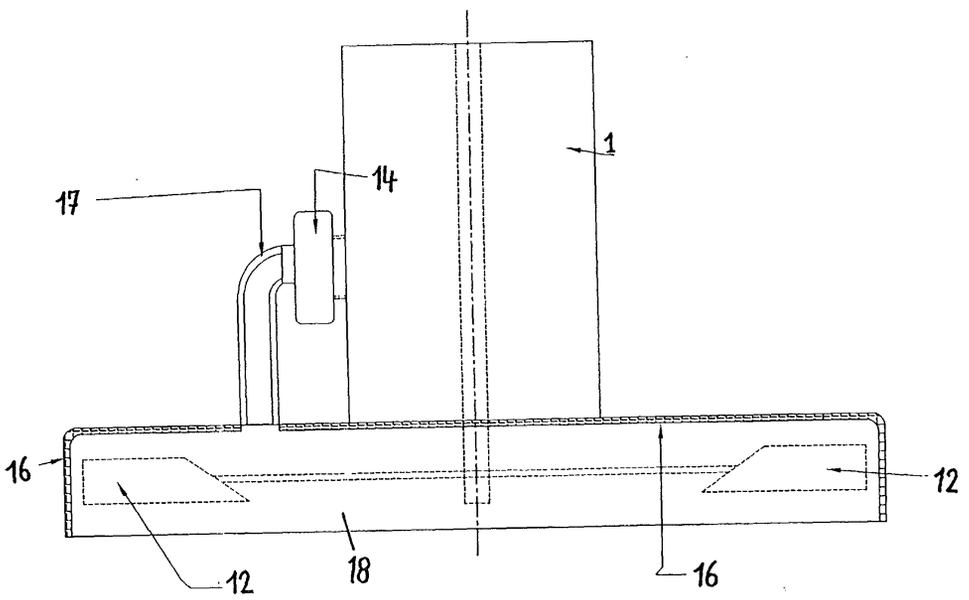
(54) Mowing machine with combustion engine

(57) This invention relates to a mowing machine comprising a mowing means (12) drivable by a combustion engine (1) and a wall (16) provided opposite the mowing means (12) and provided to let the exhaust gases originating from the combustion engine (1) escape on the side of the said wall (16) where the mowing means (12) is situated. Preferably this wall is constituted by a shielding element (16) situated above the mowing means (12), so that the exhaust gases flow into the operating space (18) of the mowing means (12) situated under this shielding element (16) and partly surrounded. The intensity of the sound produced by the combustion engine (1) is considerably reduced by repeated reverberations in this space (18) and by absorption by the ground and/or vegetation situated underneath the mowing means (12). Additionally, a sound deadening hood (9) can be provided around the exhaust and/or the engine (1). Preferably the space (2) surrounded by the hood (9) is then cooled by means of a cooling device driven by the flow of exhaust gases.

FIG. 1



EP 1 225 317 A1

Description

[0001] This invention relates to a mowing machine, such as, for instance, a grass-cutter comprising a combustion engine and a mowing means drivable by this engine. In this patent application the matter is more particularly about a mowing machine of which the sound produced by its engine is muffled.

[0002] This invention relates more particularly to a mowing machine with a combustion engine whose engine and/or exhaust are at least partly surrounded by a sound deadening wall.

[0003] In this patent application, the term mowing machine applies, among others, to grass cutters irrespective of type, operating principle, capacity or size. Not only the traditional grass cutters, but also the so-called self-propelled mowers provided with a seat for the operator are included. Besides, the term mowing machines refers likewise to other machines, devices or tools meant to remove at least part of the overgrowth or vegetation, such as among others mowing machines for woods or agricultural or farming machines.

[0004] The term mowing means is used in this context in the sense of any element intended to cause, by its movement, the said removal of (a part of) the overgrowth or vegetation. In doing so, the mowing means may operate by any principle and may have, for instance, a cutting or chopping action. In the known traditional grass cutters the mowing means is generally a rotatable knife.

[0005] Machines with a combustion engine have the great disadvantage that the combustion engine produces rather much noise when operating. Particularly as far as machines are concerned which are used in more or less the same place during a long period, such as, for instance, grass cutters or mowing machines for woods and similar machines, the constant engine noise can be very disturbing for people in the vicinity. Moreover, machines or devices for the maintenance of gardens, such as lawn mowers, are used in the open air and often also in densely populated neighbourhoods at times when most people living in the neighbourhood are at home. This noise pollution can therefore be very disturbing for a great number of people.

[0006] It is known to reduce noise pollution by using walls of a sound deadening material. Where combustion engines are the sound source an efficient sound deadening wall should surround both engine and exhaust, but then there is the problem that the temperature in the enclosed space will rise too high, whereas moreover the sound deadening wall acts as a thermal insulating wall. Applying known cooling systems in order to solve this problem would make the machine too expensive and/or complicated. Additional disadvantages of these cooling systems are their energy consumption and/or the space they require.

[0007] One purpose of the invention is to provide a mowing machine with a combustion engine causing notably less noise pollution than the known machines and which moreover can be carried out in a simple, compact and cheap manner. An additional purpose consists in taking care that the sound deadening measures will increase engine fuel consumption only to a very small extent.

[0008] These aims will be obtained with a mowing machine comprising a combustion engine, a mowing means drivable by this engine, and a wall provided opposite this mowing means, whereas the machine according to this invention is provided to let the exhaust gases escape on the side of said wall where the mowing means is situated.

[0009] In most mowing machines the mowing means is surrounded on one or several sides by a covering or shielding hood or a covering or shielding plate, most of the time for the sake of safety. For the mowing means, which can be very dangerous during its movement, is situated within a well shielded space. Most of the time, this space is confined on top and on one or several sides.

[0010] A great deal of the noise caused by the operation of a combustion engine is evacuated via the exhaust. In letting escape the exhaust gases on the side of the wall where the mowing means is situated, the sound waves arrive in a more or less surrounded space. Moreover, during normal use of the mowing machine, this space is confined at the bottom by an overgrowth or ground or soil (with a grass cutter this is the ground covered with grass). In this space, the intensity of the noise will strongly decrease, by repeated reverberations of the sound waves against the surfaces confining this space (the wall of the machine and the overgrowth or the soil) on the one hand, and because a strong absorption of the sound may occur in the ground.

[0011] In a very simple embodiment according to this invention, connecting the exhaust of the engine to the space, in which the mowing means is situated, by means of a pipe or duct will suffice. This can be a rather short piece of pipe, so that the invention can be realized in a very simple and cheap manner. Because the exhaust gases being are diverted only over a short distance, there will be hardly any additional fuel consumption of the engine.

[0012] In a preferred embodiment, said wall is constituted by a shielding element situated opposite the mowing means, and the machine is provided to let the exhaust gases escape into the operating space of the mowing means confined by this shielding element.

[0013] When the mowing machine is provided to mow the overgrowth or vegetation growing on a ground or soil, the exhaust gases are preferably conducted to escape in the direction of the soil or ground when the mowing machine is used as intended. Because of this a good sound absorption is obtained in the soil or ground and/or in the overgrowth on it.

[0014] When the machine is provided to make its exhaust gases escape in a direction more or less perpen-

dicular with said ground or soil the sound absorption wall be optimal.

[0015] Preferably, there are at least two exhaust openings for the exhaust gases, ending on the side of said wall, where the mowing means is situated. These exhaust openings end, for instance, in the operating space of the mowing means confined by a shielding plate. This may occur, if required, via a number of ducts, which are connected to a central receiving space for exhaust gases, but of course also directly by means of an engine exhaust with several outlets.

[0016] In the wall provided opposite the mowing means or the said shielding element, at least one opening is provided for the supply of exhaust gases, to which a pipe or duct connected to the engine exhaust is connected. This embodiment can be realized in a particular simple, quick and cheap manner.

[0017] In order to realize an additional sound deadening and to obtain a very noiseless mowing machine the engine and/or the exhaust can be installed in a space which is at least partly surrounded by a sound deadening wall.

[0018] In order to avoid that the temperature in the space surrounded by the sound absorbing wall becomes too high it is better to provide a cooling system, intended to take in air and to bring it into that space.

[0019] It is likewise a purpose of this invention to provide a mowing machine with a combustion engine and a cooling system, the cooling system of which is simple, compact and cheap and causing only a small increase of the engine fuel consumption.

[0020] This aim is obtained when the mowing machine comprises a combustion engine and a cooling system provided to take in air and to conduct it to one or more parts or spaces to be cooled, whereas this device comprises at least one intake body which is rotatable in order to take in the air and which is installed in such a manner that it can be rotated by the flow of exhaust gases originating from the combustion engine or by an air flow caused by this flow of exhaust gases.

[0021] By using a flow of exhaust gases, or an air flow caused by it, as driving means for the intake body, this cooling device is particularly energy saving. Moreover, it can be realized in a simple, compact and relatively cheap embodiment. An air flow caused by the flow of exhaust gases can also be itself a flow of cooling air, which is obtained with the help of an intake body which, according to this invention, is rotated by the exhaust gases. Taking in the cooling air by means of another air flow has the advantage that a construction is possible where the exhaust gases cannot pollute this cooling air.

[0022] Also a mowing machine with a combustion engine where the exhaust gases are not discharged on the side of the wall (shielding hood) where the mowing means is situated can be equipped with such a cooling system to be realized in a simple manner. A noiseless mowing machine can also be realized only by installing a sound deadening hood, preferably in combination with the cooling system described above, without having the exhaust gases discharged on the side of the wall (shielding hood) where the mowing means is situated.

[0023] Preferably this cooling system is carried out in such a manner that it comprises one or several intake ducts for taking in air and an exhaust duct to discharge the exhaust gases, whereas the intake body comprises at least one surface rotating around a shaft, which alternately is brought into the intake duct and into the exhaust duct, via a connecting opening which connects the two parts of these ducts, running one beside the other.

[0024] The air taken in may be used for cooling the exhaust gases and/or cooling the exhaust duct and/or cooling the engine.

[0025] The said intake body comprises, for instance, a surface rotatable around a shaft, which, by said rotation, is brought alternately into the intake duct and into the exhaust duct via a connecting opening connecting parts of these pipes running one beside the other.

[0026] A similar intake body can, for instance, be carried out in a very simple manner as a blade wheel rotatably installed or as a number of surfaces radially protruding rotatably together around a common shaft. In the exhaust duct, the rotatable surfaces are moved forward by the flow of exhaust gases, so that the intake body is driven. Because of this the surfaces in the intake duct are also moved as a result of which an intake effect is produced and consequently air is taken in. An additional advantage of such an intake element is that the intensity of the sound waves in the ducts is reduced, because the sound waves reverberate against the rotating surfaces.

[0027] Preferably the sound deadening wall consists of at least two layers of sound deadening material, whereas between each two successive layers of sound deadening material a respective intermediate space is provided. A similar wall provides an excellent sound deadening.

[0028] In order to deaden the sound in an efficient manner the engine device is carried out such, that the exhaust duct of the combustion engine ends in an intermediate space between two successive layers of sound deadening material.

[0029] In the most preferred embodiment of the engine device according to this invention the sound deadening wall comprises an inner layer, a middle layer and an outer layer of sound deadening material, whereas the exhaust duct of the combustion engine ends in the intermediate space between the inner layer and the middle layer, and the intake duct is provided to take in air from the intermediate space between the middle layer and the outer layer.

[0030] So, taking in air occurs in a space which is well separated from the space in which the exhaust gases end up. Furthermore, the outer layer of sound deadening material acts as a filter for the intake duct, as a result of which dirt flying about is prevented from entering the cooling duct.

[0031] After the exhaust gases have pushed on oper-

ating in conjunction with the intake body and/or in the said intermediate space between two layers of sound deadening material, they are discharged - according to this invention - on the side of the shielding plate, where the mowing means is situated.

[0032] In a particular embodiment the mowing machine is provided with a rotatable mowing means and the cooling system is provided with conducting means to conduct the exhaust gases flowing out, to the mowing means in a flowing direction corresponding with the sense of rotation of the cutting means.

[0033] As a result of which, the rotating parts of the mowing means are surrounded by a flow of a mixture of exhaust gases and air moving in the same direction. Consequently these rotating parts meet with less resistance. This may cause an additional sound deadening. By the combination of these sound deadening measures, a particularly noiseless mowing machine is obtained.

[0034] In the following detailed description of a number of examples of embodiments of this invention, the characteristics and advantages of the invention are further explained and the additional characteristics and advantages are indicated. The intention of this description is only to explain the general principles of this invention and therefore may never be interpreted as a limitation of the field of application of the invention or of the patent rights claimed in the claims.

[0035] In this description reference is made to the attached figures 1 to 9 by means of reference numbers, of which

- the figures 1 and 2 respectively represent an upper view and a side view of a part of a grass cutter with a combustion engine according to this invention, the exhaust gases of which are discharged under the shielding hood next to the rotating knife,
- figure 3 represent in a schematic manner a horizontal cross section of a part of an engine with cooling system according to this invention,
- figure 4 represents a schematic side view of a part of the cooling system of figure 3,
- the figures 5 and 6 respectively represent a vertical cross section and a horizontal cross section of an upper part of a grass cutter with sound deadening hoods according to this invention,
- the figures 7 and 8 respectively represent a vertical and a horizontal cross section of a part of the grass cutter represented in the figures 5 and 6, and
- figure 9 is a vertical cross section in the plane coinciding with the direction of the flow of exhaust gases in the intermediate space between the inner hood and the middle hood of this grass cutter.

[0036] The grass cutter represented in the figures 1 and 2 comprises a rotatable knife (12) above which a shielding hood (16) in metal or synthetic material is provided. This shielding hood (16) is made from plate-shaped material and comprises a flat rectangular part, which extends above the knife (12) and which, over its entire circumference changes into a flank extending downwards. In this manner this shielding hood (16) confines the operating space (18) of the knife (12) on top and on the sides.

[0037] Furthermore, this grass cutter comprises a combustion engine (1) with an engine exhaust or muffler (14) to which an exhaust pipe (17) is connected. These parts are provided above the said shielding hood (16).

[0038] In the horizontal part of the shielding hood (16) an opening has been provided. The extremity of the exhaust pipe (17) is attached with the exhaust opening opposite the opening in the shielding hood (16). This can be done, for instance, by means of a flange which is attached to the shielding hood (16) by means of a little fastening plate.

[0039] Via the exhaust pipe (17) and the opening in the shielding hood (16), the exhaust gases end up in the space (18) under the shielding hood (16). The direction of the outflow of these exhaust gases is perpendicular to the plane of rotation of the knife (12) and therefore also perpendicular to the ground surface covered with grass, during the time the grass cutter is used. Because of this a good sound absorption is obtained in the ground.

[0040] According to an alternative embodiment a pipe (19) is attached to the underside of the rectangular part of the shielding hood (16), which consists of four straight parts connected together forming a rectangle, so that they constitute a circuit. This pipe (19) (indicated in figure 2 by means of a dot and dash line) is connected to the exhaust pipe (17) via the said opening in the shielding hood (16). On each side of the rectangle this pipe (19) has an exhaust opening (20) for the exhaust gases. In this embodiment also, the exhaust openings are at right angles to the ground surface when using the grass cutter.

[0041] An existing grass cutter can be transformed into a grass cutter according to the invention with very little means and in a very simple and cheap manner.

[0042] Only an opening to be provided in the shielding hood (16) is needed and a pipe connected to the engine exhaust on the one hand and attached to the shielding hood (16) on the other hand in such a way that the exhaust gases are conducted to the space (18) in which the knife (12) is situated via the opening in the shielding hood (16).

[0043] The piping system conducting the exhaust gases to the operating space (18) of the knife (12) may consist of any material. By this piping system the sound leaving the engine device via the exhaust, is conducted under the shielding hood (16). Because this sound is absorbed by the lawn to be mowed and by the ground underneath and which is repeatedly reflected on the shielding hood, a deadening of this sound is obtained. Because of this it is possible that the rotating parts of the knife will experience very little resistance, but at the

same time they will further the absorption of the sound. The contact with the rotating knives (the mowing means in general) also will cause a small additional deadening of the sound.

[0044] The exhaust pipe (17) can have several branches (see figure 2), so that several exhaust openings for the exhaust gases can be obtained. The number of openings and their positions in the shielding hood (16) is determined in function of the construction of the mowing machine and of the sound deadening desired.

[0045] A mowing machine according to this invention, carried out differently, is provided with a sound deadening hood (9) surrounding the engine (1) and/or the exhaust at least partly, and comprises a cooling system to cool the space (2) inside this hood (9) sufficiently (see figures 3 to 9). This mowing machine has a combustion engine (1) with a muffler (14) to which an exhaust pipe (5) is connected. A pipe (4) to take in cooling air runs along the exhaust pipe (5). Both the exhaust pipe (5) and the pipe for the cooling air (4) have a square or rectangular section. In three different places an opening has been provided in the adjoining walls of the two ducts (4),(5) connecting both ducts with each other. In each opening there is a multiple valve (3) with a number of radially directed wings (7) rotatable around a thin shaft (6). The thin shaft (6) is situated in the plane of the opening between these two ducts (4),(5). Each valve (3) has two, three or four radial wings (7) and is, as a whole, rotatable around its shaft (6). The flow of exhaust gases (see arrow from right to left in the exhaust pipe (5) in figure 1) causes the anti-clockwise rotating movement of the valves (3). Each time a wing (7) moves in the cooling air pipe (4) it causes a suction effect in that pipe (4), because of which cooling air is taken in (from left to right in figure 3: see arrow in the cooling air pipe (4)). Because of the rotating wings (7) the sound waves in the exhaust pipe (5) are also broken and the sound waves in the cooling air pipe (4) are hit towards the exhaust pipe (5) via the opening between the two ducts (4),(5). Also note that possible sound waves in the cooling air pipe move from right to left (see figure 5) away from the engine, and therefore will move against the flow of cooling air, so that in doing so they are up against a strong resistance. Because of this an additional deadening of the sound is obtained. The cooling air is blown into the space (2) where the engine is situated and/or into the space (10) provided in which the exhaust pipe (5) ends (see further on).

[0046] A grass cutter with sound deadening hoods according to the present invention (see figures 5 and 6) comprises a shielding hood (16) with a horizontal plate on which a petrol engine (1) with a muffler (14) is installed. The shaft (15) of the engine (1) extends via a passage in this plate of the shielding hood (16) below this plate where it is connected to a horizontal body extending symmetrically with respect to the shaft (15) and carrying a respective knife (12) on both extremities.

A set of three hoods (9A), (9B), (9C) with intermediate spaces (2), (10), (11) is provided on the plate (16), so that the combustion engine (1) and the muffler (14) are situated in a central space (2) which sideways and on top is confined by the inner hood (9A). The middle hood (9B) surrounds the inner hood (9A) sideways and at the top and the outer hood (9C) surrounds the middle hood sideways and at the top. Between the successive hoods an intermediate space (10), (11) is provided each time. The horizontal plate of the shielding hood (16) confines all spaces (2), (10), (11) at the bottom. The exhaust pipe (5) runs through an opening in the inner hood (9A) into the space (10) between the inner hood (9A) and the middle hood (9B), extends in this space according to the sense of rotation of the knives (12) and ends in this space (10). In this space the exhaust gases are therefore ejected clockwise. This is also the sense of rotation of the knives (12).

[0047] Each hood (9A), (9B), (9C) is carried out separately, but two or three hoods together may form a whole. The hoods may also consist of two or several parts which are easily detachable in order the get access to the confined spaces (2), (10), (11). Known sound deadening materials are, for instance, glass wool and rock wool or other fibrous structures, but it is an understood thing that all sound shielding, sound insulating or sound absorbing materials are suitable materials for manufacturing the hoods (9A), (9B), (9C). Also materials which are not commercialized as such, such as for instance synthetic materials, may have a sound deadening effect and can be used in this invention with good results. Therefore the term "sound deadening" in the sense of this patent application aims at the effect of the material used and not, or not only, at the principal characteristic of the material used. Therefore the invention can be realized with one or several hoods made from all possible materials.

[0048] In four different places spread over the circumference of this exhaust space (10), the horizontal plate of the shielding hood (16) has rectangular openings (13) which are formed because rectangular parts (8) of this plate have been cut out on three sides, and while remaining connected to the plate with one side, are sloping upwards against the direction of the flow of the exhaust gases (see also figures 7, 8 and 9). Each opening (13) lets through a part of the exhaust gases above the sloping parts of the plate and catches a portion of the exhaust gases, so that they reach the knives (12) with an anti-clockwise direction of the flow, corresponding with the sense of rotation of the knives (12).

[0049] In the exhaust space three cooling air pipes (4) are provided, which extend beside the exhaust pipe (5) and, as described above, are provided with multiple valves (3) which can rotate in both pipes (4), (5) via openings (which connect the exhaust pipe (5) with the cooling air pipe (4). The cooling air pipes (4) have their intake opening in an opening in the middle hood (9B). Therefore the cooling air originates from the space (11) between the middle hood (9B) and the outer hood (9C).

The cooling air pipe (4) represented at the bottom of figure 6 brings cooling air into the central space (2) in which the engine (1) and the muffler (14) are installed. The two other cooling air pipes (4) bend down and end in the exhaust space (10) in order to cool this space (10) also. The cooling air circulates in this space (10) and will also cool down the exhaust pipe (5) installed in this space.

[0050] Via the opening in which a valve (3) rotates in the exhaust pipe (5) and the cooling air pipe (4), exhaust gases might enter the cooling air pipe (4) and thus be conducted to the central engine space (2), causing ignition problems. In order to avoid this, all said cooling air pipe (4) are made to end in the exhaust space (10) and an additional cooling air pipe (not represented in the figure) is provided next to the first cooling air pipe (4). In an opening connecting the first cooling air pipe (4) to the additional cooling air pipe, a multiple valve (3) is provided as described above. This valve (3) is installed before the valve (3) between the first cooling air pipe (4) and the exhaust pipe (5) seen in the direction of the flow in this first cooling air pipe (4) and can be rotated by fresh air flowing in the first cooling air pipe (4). Because of this, cooling air is also taken in via the additional cooling air pipe. This cooling air is not polluted and can be conducted to the central engine space without any risk.

[0051] Of course, it can be necessary to adapt the form of the hoods to certain parts of the grass cutter. Thus, the grass collecting bin and the passage ending in this collecting bin require a specific design. Openings might be provided through the hoods, for instance to allow the throttle lever to pass through or to give access to an oil gauge or oil tank.

[0052] Preferably, the petrol tank is installed outside the hoods.

[0053] This grass cutter is simple and particularly noiseless because of the combination of letting the exhaust gases escape under the shielding hood (16) on the one hand, and to provide for a sound deadening hood (9) with the simple and the energy economical cooling system on the other hand. However, each of these measures can be applied separately and result in a considerable limitation of the sound level.

Claims

1. Mowing machine comprising a combustion engine (1), a mowing means (12) drivable by this engine and a wall provided opposite the mowing means (12), **characterized in that** this machine is provided to let the exhaust gases originating from the engine (1) escape on the side of the said wall (16) where the mowing means (12) is situated.

2. Mowing machine according to claim 1, **characterized in that** the said wall is constituted by a shielding element (16) situated opposite the mowing means (12) and **in that** the machine is provided to let exhaust gases escape in the operating space of the mowing means (12) confined by this shielding element (16).

3. Mowing machine according to claim 1 or 2, **characterized in that** the machine is provided to cut an overgrowth or vegetation of a ground or soil, and **in that** the exhaust gases escape in the direction of the soil or ground when the mowing machine is used as intended.

4. Mowing machine according to claim 3, **characterized in that** the machine is provided to let the exhaust gases escape in a direction which is almost at right angles to the said soil or ground.

5. Mowing machine according to any one of the preceding claims, **characterized in that** at least two escape openings for the exhaust gases are provided, which end on the side of the said wall (16) where the mowing means (12) is situated.

6. Mowing machine according to any one of the preceding claims, **characterized in that** at least one opening is provided in the wall (16) provided opposite the mowing means (12), to which a duct (17) connected to the engine exhaust is connected.

7. Mowing machine according to any one of the preceding claims, **characterized in that** the engine (1) and/or the exhaust (15), (15) is installed in a space (2) which is at least partly surrounded by a sound deadening wall (9).

8. Mowing machine according to claim 7, **characterized in that** it comprises a cooling system provided to take in air and to conduct it to the space (2) which is at least partly surrounded by a sound deadening wall (9).

9. Mowing machine according to claim 8, **characterized in that** the said cooling system comprises at least one intake body (3) which is rotatable in order to take in air, and **in that** the intake body (3) is installed in such a way that it can be rotated by the flow of exhaust gases origination from the engine (1) or by an air flow caused by these flow of exhaust gases.

10. Mowing machine according to claim 9, **characterized in that** it comprises one or several intake ducts (4) to take in air and an exhaust duct (5) to evacuate the exhaust gases, and **in that** the intake body (3) comprises at least one surface (7) rotatable around a shaft (6) which is alternately brought into the intake duct (4) and into the exhaust duct (5) by the said rotation via an connecting opening (8) which connects parts of the ducts (4), (5) running one be-

side the other.

11. Mowing machine according to claim 8 to 10, **characterized in that** the air taken in is used to cool down the exhaust gases and/or to cool down the exhaust duct and/or to cool down the engine (1).

12. Mowing machine according to claim 7 to 11, **characterized in that** the sound deadening wall (9) consists of at least two layers (9A), (9B), (9C) of sound deadening material and **in that** between each two successive layers of sound deadening material a respective intermediate space (10), (11) is provided.

13. Mowing machine according to claim 12, **characterized in that** the exhaust duct (5) of the combustion engine (1) ends in an intermediate space (10) between two successive layers (9A), (9B) of sound deadening material.

14. Mowing machine according to claim 12 or 13, **characterized in that** the sound deadening wall comprises an inner layer (9A), a middle layer (9B) and an outer layer (9C) of sound deadening material, **in that** the exhaust duct (5) of the combustion engine (1) ends in the intermediate space (10) between the inner layer (9A) and the middle layer (9B) and **in that** the intake duct (4) is provided to take in air from the intermediate space (11) between the middle layer (9B) and the outer layer (9C).

FIG. 1

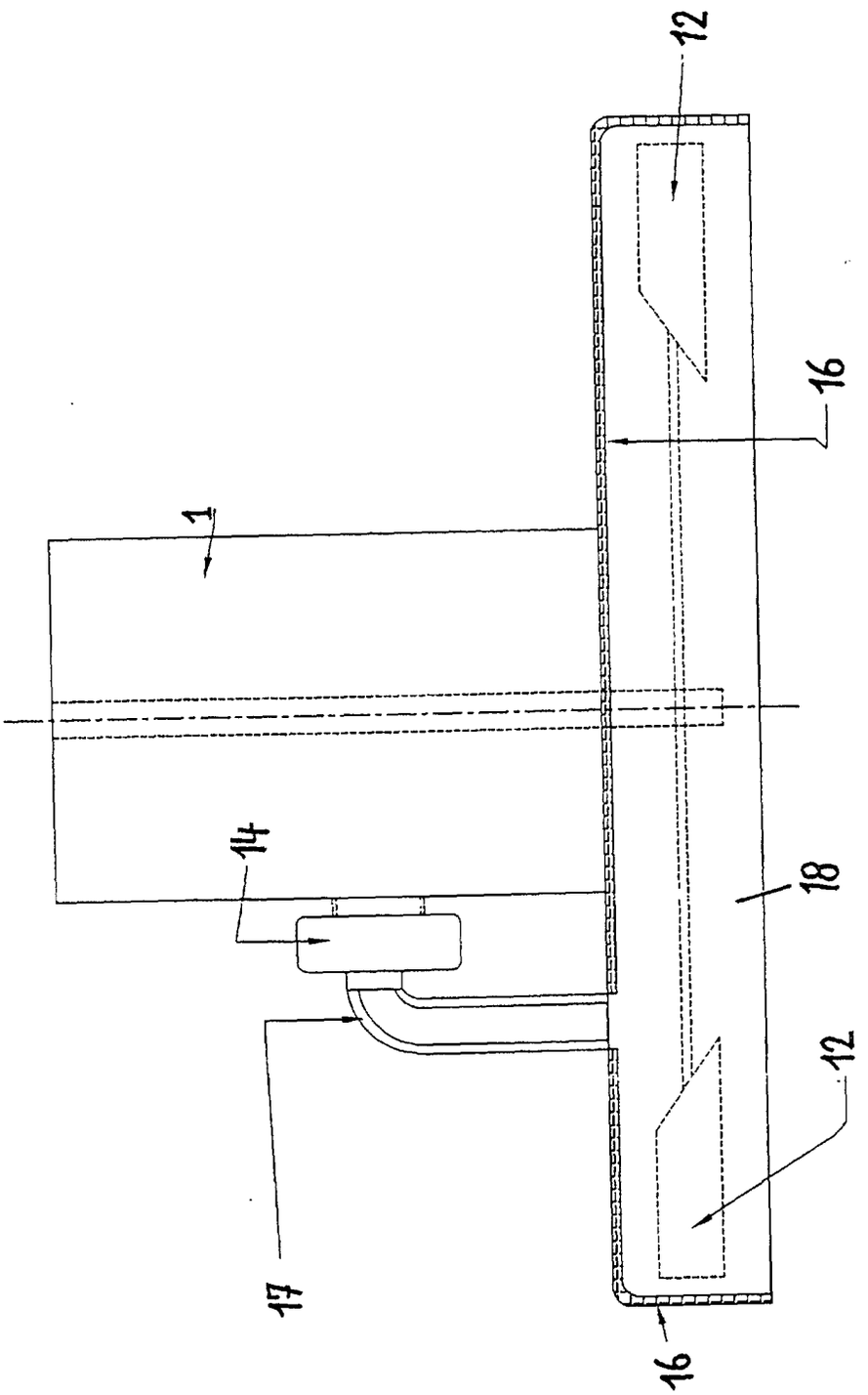
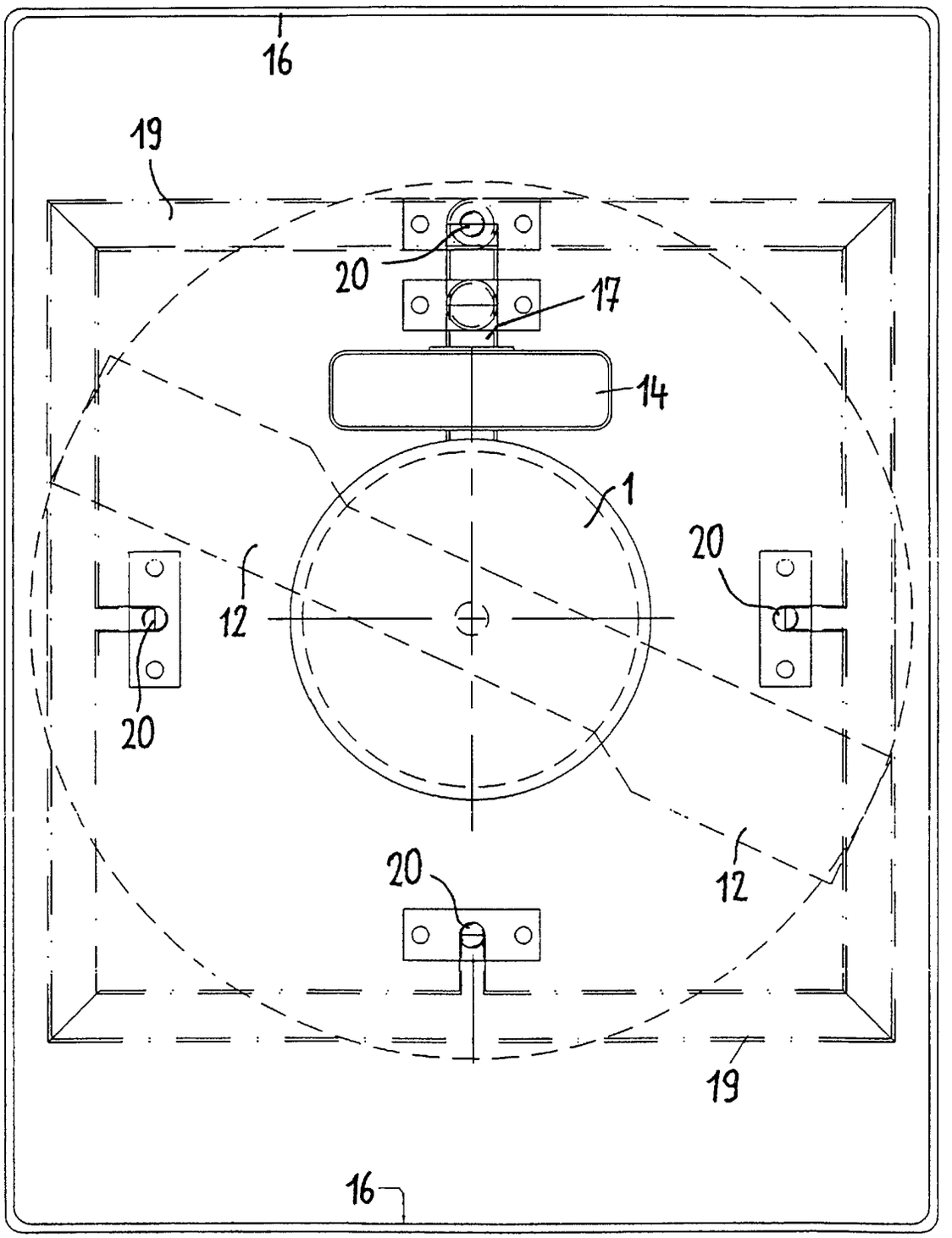


FIG. 2



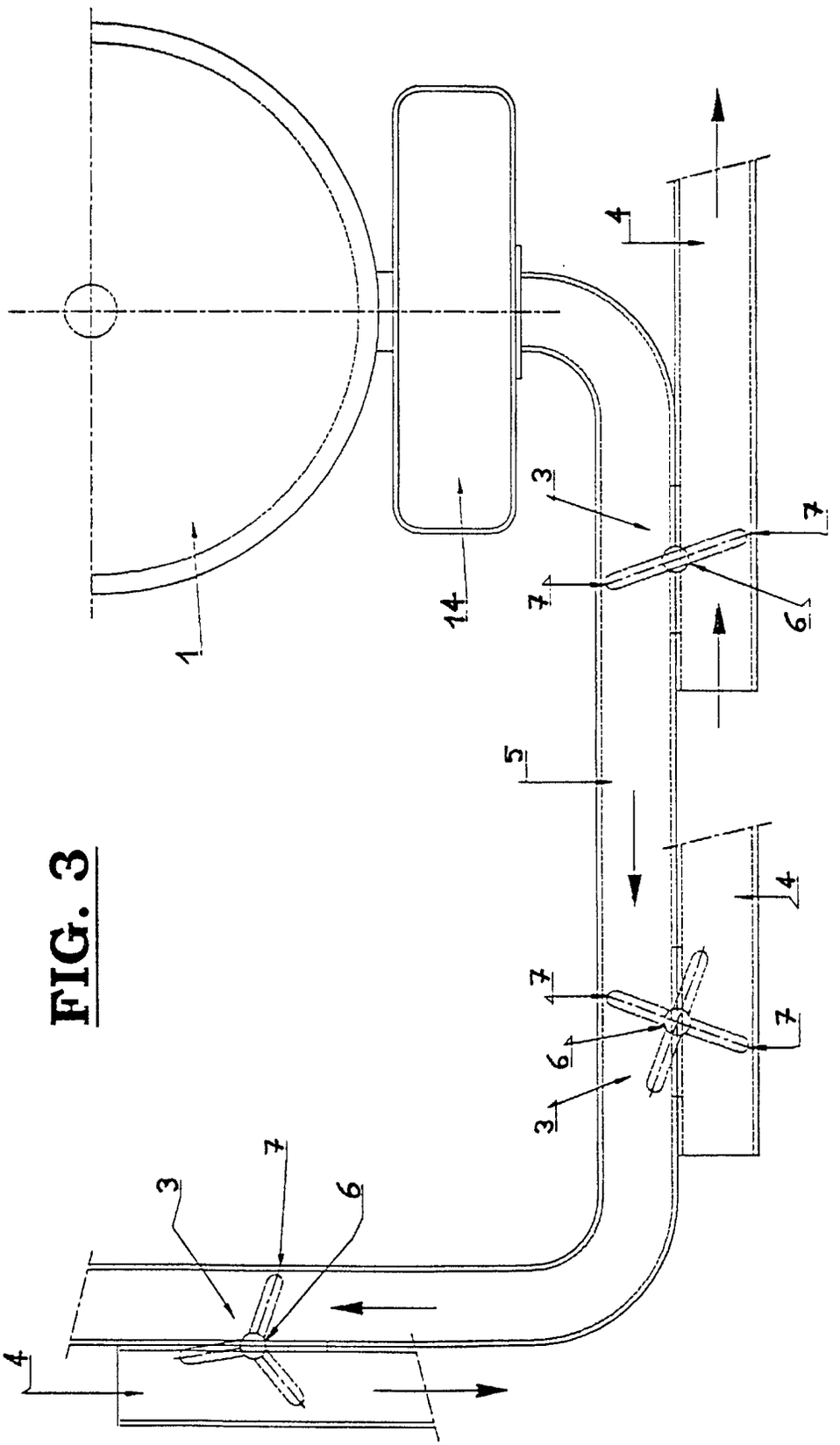


FIG. 3

FIG. 4

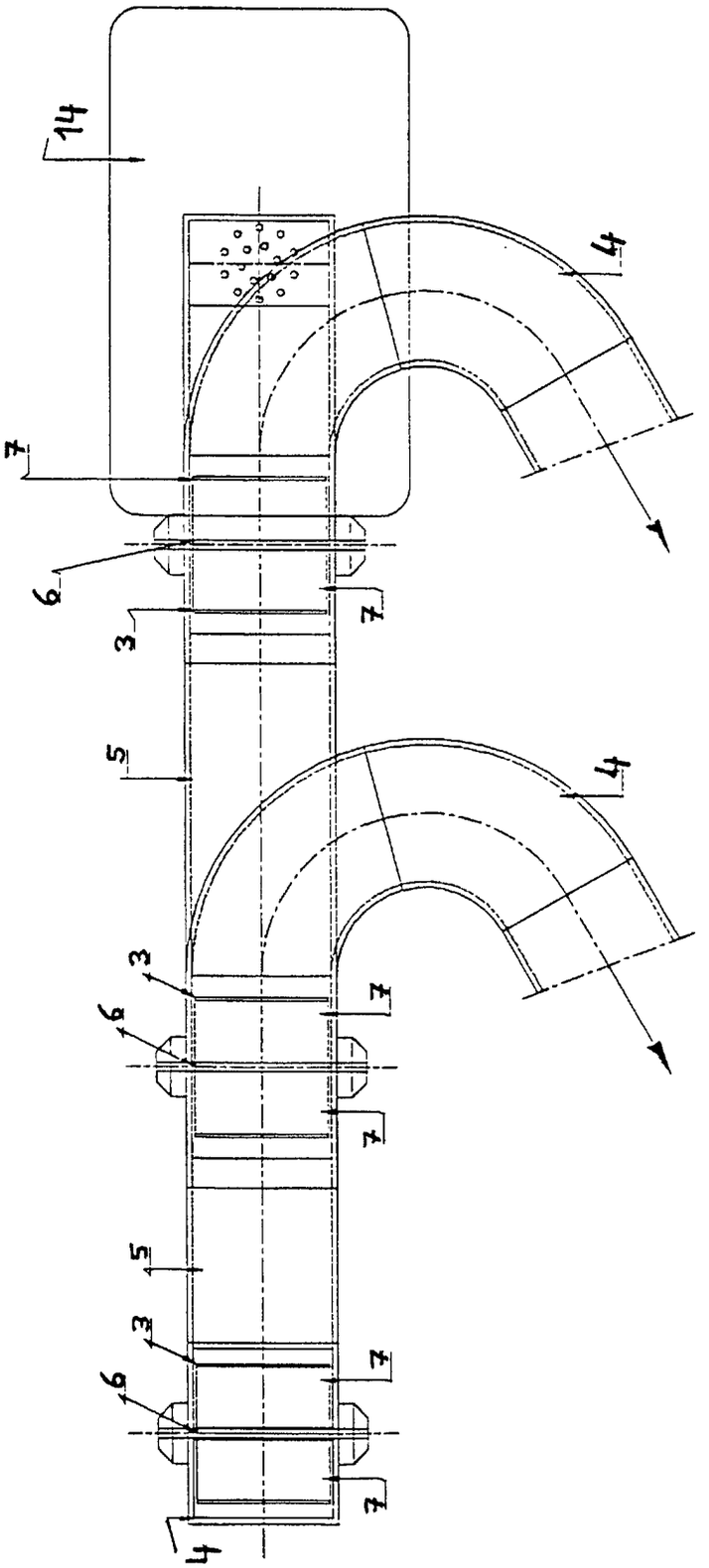
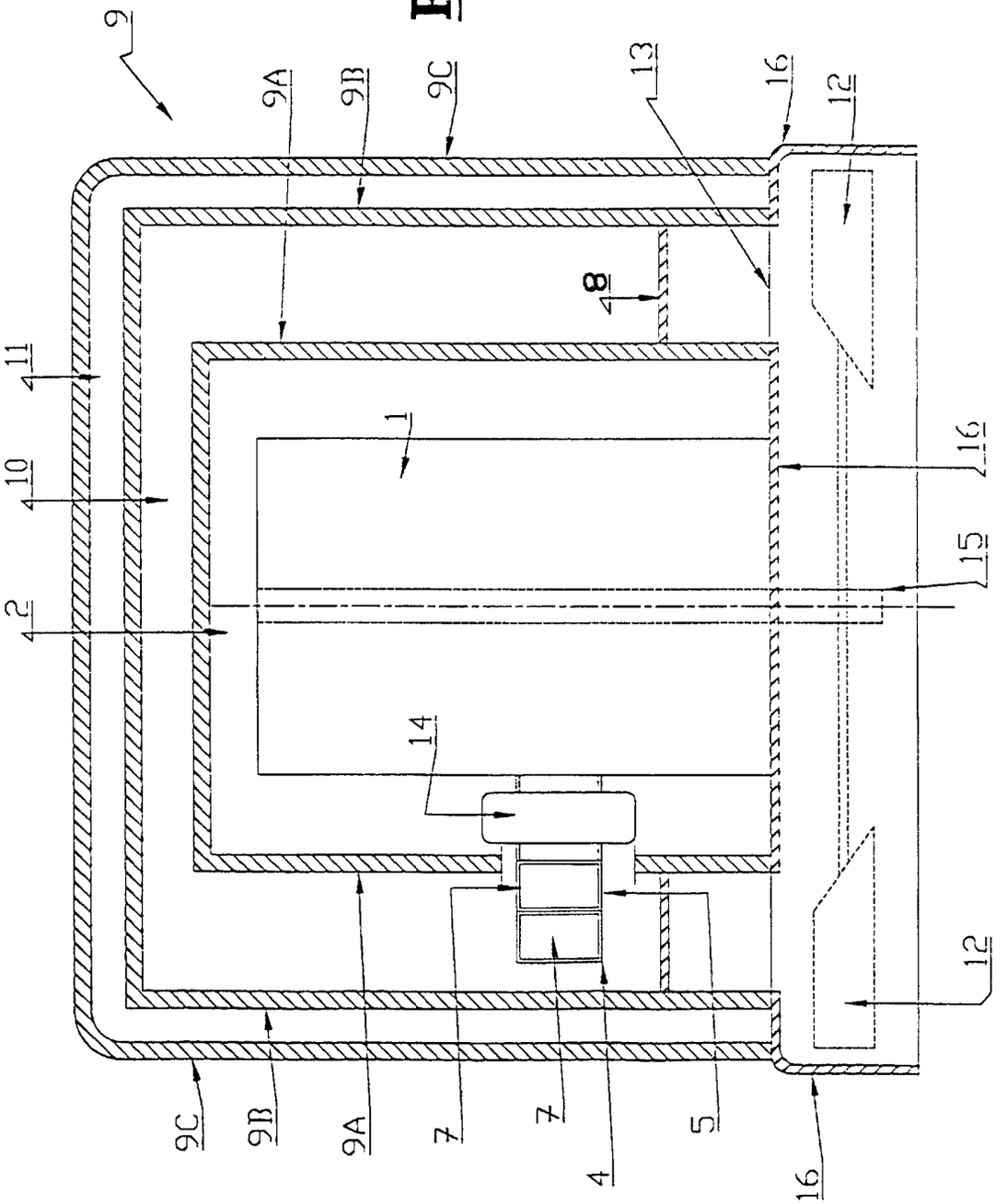


FIG. 5



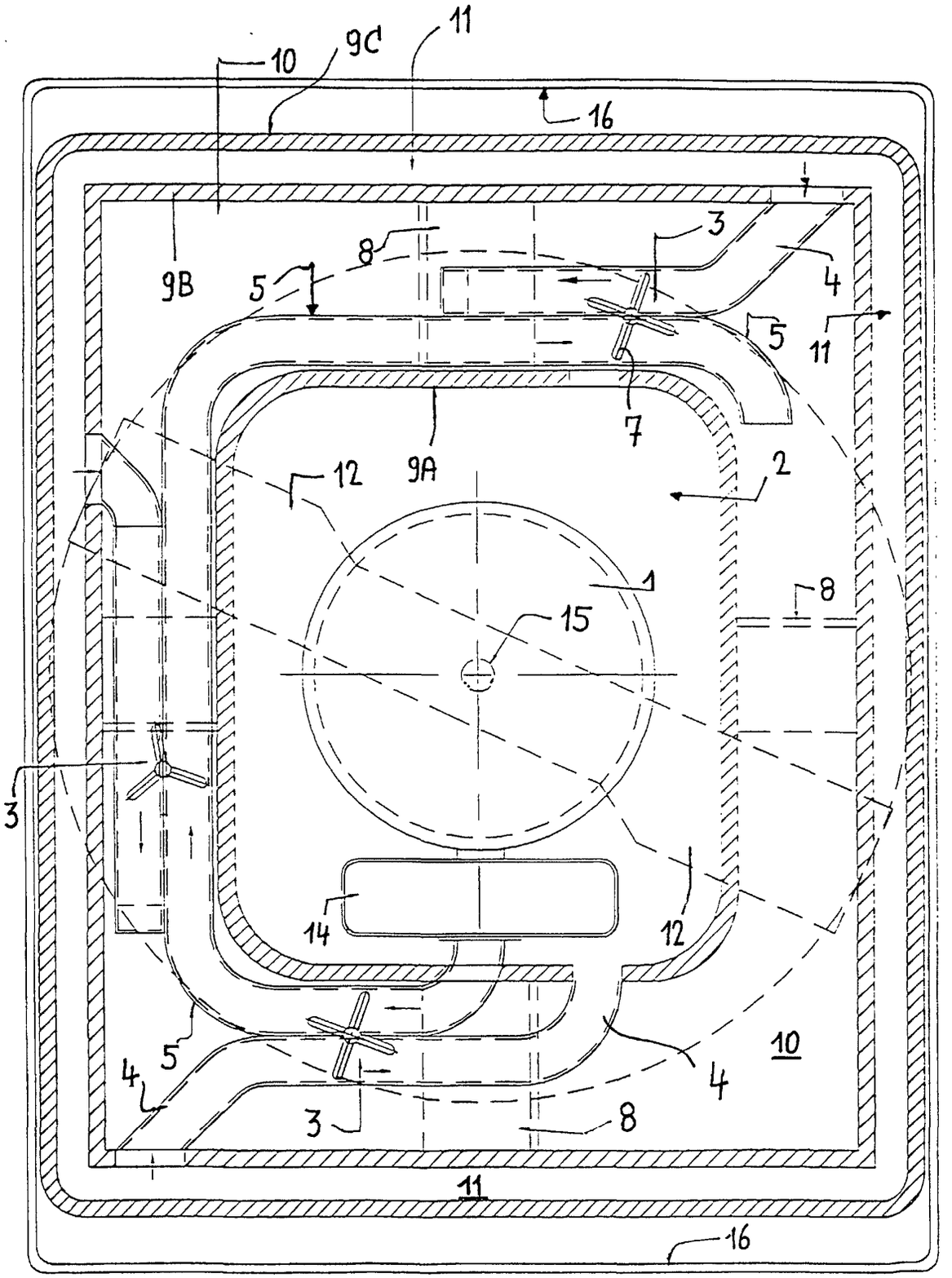


FIG. 6

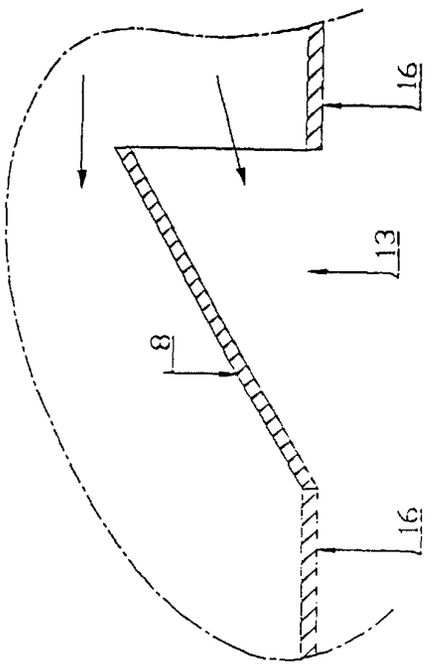


FIG. 9

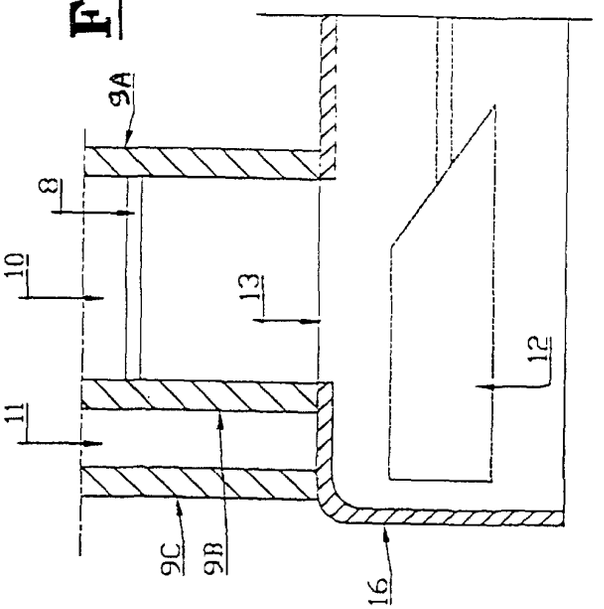


FIG. 7

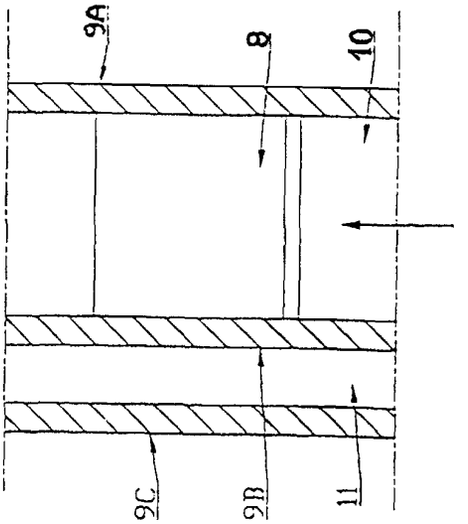


FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
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THE HAGUE	21 March 2002	Kooijman, F

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