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(54) Title: EXHAUST PIPE ARRANGEMENT FOR DISCHARGING EXHAUST FROM A COMBUSTION ENGINE

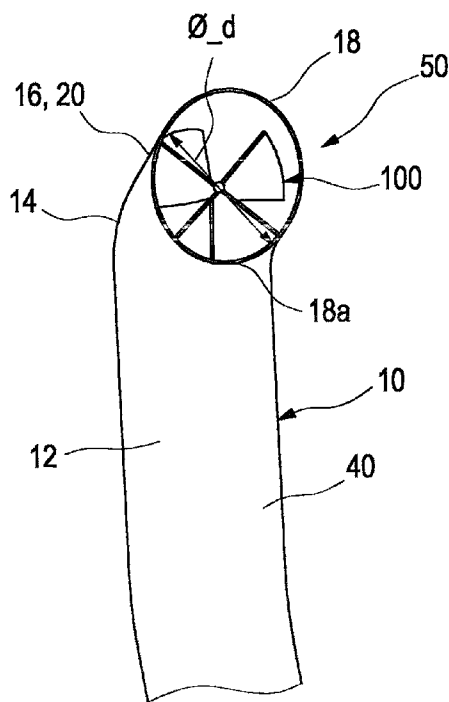


Fig. 1 a

(57) Abstract: The invention relates to an exhaust pipe arrangement (50) for discharging exhaust from a combustion engine (202) through an exhaust pipe (10), particularly for a combustion engine (202) with an exhaust gas aftertreatment system (204) requiring high temperatures in one or more operational modes, comprising an end section (16) terminated by an exhaust gas outlet (18). A diffuser section (20) is provided in the exhaust pipe (10), the diffuser section (20) having a first end (102) in a distance from the outlet (18) and a second end (104) closer to the outlet (18) is arranged in vicinity of the outlet (18), wherein at least one vane (110) with an airfoil profile (112) extends in an axial direction (130) from the first end (102) to the second end (104) of the diffuser section (20).



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## DESCRIPTION

Exhaust pipe arrangement for discharging exhaust from a combustion engine

## 5 TECHNICAL FIELD

The invention relates to an exhaust pipe arrangement for discharging exhaust from a combustion engine provided with an exhaust pipe and a vehicle comprising an exhaust pipe arrangement.

10

## BACKGROUND OF THE INVENTION

Emission regulations for vehicles equipped with a diesel engine require a limitation  
15 of soot emissions from the vehicles. The soot is a by-product of the diesel combustion and emitted with the exhaust. In modern diesel vehicles, particular trucks, soot is collected in diesel particle filters in the vehicle's exhaust aftertreatment system. These filters have to be regenerated periodically to avoid clogging. During regeneration the soot is burnt, generating very high exhaust  
20 temperatures at the exhaust pipe outlet.

US 2008/0072582 A1 discloses an exhaust gas cooler which is connected to the rearward edge of the exhaust pipe. The exhaust gas cooler includes a cylindrically shaped housing and has an open forward edge, an open rearward edge and an  
25 internal diameter that is larger than the external diameter of the exhaust pipe. A cooler support is attached to and supporting the cooler housing such that the rearward edge of the exhaust pipe is located within the cooler housing between the forward and rearward edges of the cooler housing. Ambient air entering through the rearward edge of the cooler housing is mixed with hot exhaust gases  
30 to cool the exhaust gases. For better mixing of air and exhaust gases, the cooler housing includes a vane assembly placed in front of the rearward edge of the exhaust pipe.

## SUMMARY OF THE INVENTION

It is an object of the invention to provide an exhaust pipe arrangement for discharging exhaust from a combustion engine which reduces the exhaust gas  
5 temperatures in vicinity of the exhaust pipe and has a simple design.

Another object is to provide a vehicle comprising such an exhaust pipe arrangement.

10 The objects are achieved by the features of the independent claims. The other claims, the drawings and the description disclose advantageous embodiments of the invention.

An exhaust pipe arrangement is proposed for discharging exhaust from a  
15 combustion engine through an exhaust pipe, particularly for a combustion engine with an exhaust gas aftertreatment system requiring high temperatures in one or more operational modes, comprising an end section terminated by an exhaust gas outlet. A diffuser section is provided in the exhaust pipe, the diffuser section having a first end at a distance from the outlet and a second end closer to the  
20 outlet is arranged in vicinity of the outlet, wherein at least one vane with an airfoil profile extends in an axial direction from the first end to the second end of the diffuser section.

It is of advantage that a length of a plume of hot exhaust gases is reduced so that  
25 the risk of damage to objects located in the plume of hot exhaust gases but still with a significant distance to the exhaust gas outlet is reduced.

Favourably, the diffuser section is arranged inside the cross section of the exhaust pipe so that the external contour or diameter of the exhaust pipe is not increased.  
30 The diffuser section is exposed to direct flow of exhaust gases in the exhaust pipe. Particularly, the external exhaust pipe contour or diameter of a pipe section upstream of and adjacent to the diffuser section is substantially the same as along the diffuser section. Preferably, the exhaust pipe can be a cylindrical tube with constant diameter. An advantage is that the general external design of the exhaust

pipe remains unchanged with or without diffuser section. As a result, an evacuation-hose interface formed by the shell of the exhaust pipe remains unaltered. Usually, an evacuation hose is attached to the evacuation-hose interface of the exhaust pipe when the vehicle is produced or is in a workshop.

- 5 Evacuation hoses typically have a standard diameter so that an adaptation of the diameter for an exhaust pipe with or without diffuser section can be avoided.

Further, an extension of a plume of hot exhaust gases is shorter than for conventional exhaust pipes. It is not necessary to mix ambient air to the hot exhaust gas, thus avoiding noise problems caused by suction of air into the exhaust pipe upstream of the diffuser section. The arrangement has a low weight and is cost efficient. The diffuser section does not require an additional length of the exhaust pipe and can be fitted in existing exhaust pipe layouts. The exhaust pipe arrangement is applicable even for vehicles with a short wheelbase where there is no room for a tailpipe muffler. The at least one vane can be an insert mounted inside the exhaust pipe as a separate diffuser element, or one or more vanes can be mounted separately to the inside wall of the exhaust pipe, and/or formed by the wall of the exhaust pipe.

20 According to a favourable embodiment of the invention, in a front view on a cross section of the exhaust pipe at a location of the first end and/or second end of the diffuser section the at least one vane may cover at least 25%, preferably at least 30% of the cross sectional area of the diffuser section. This results in an efficient deflection of the exhaust gas flow. The number of vanes may be adapted to the cross sectional area actually covered by the one or more vanes. Expediently, the at least one vane may have an airfoil design which smoothly deflects the exhaust gas flow thus avoiding additional noise generation. In one embodiment it is of advantage to have many but rather short vanes.

30 According to a favourable embodiment of the invention, a free space may be provided in a central region of the diffuser section provided for a passage of exhaust gas. Preferably the free space has a diameter of not more than 60%, preferably of not more than 50%, more preferably of not more than 30 %, more

preferably of not more than 20% of a diameter of the diffuser section. An increase of exhaust gas backpressure can be avoided or kept well below critical limits.

According to a favourable embodiment of the invention, the at least one vane, seen from top, may be arranged in a ring section with an outer diameter of at least 40%, preferably at least 50%, more preferably at least 60%, of a diameter of the diffuser section of the exhaust pipe. A sufficient disturbance can be introduced into the exhaust gas flow to reduce the extension of very hot exhaust gases in the exhaust gas plume.

According to a favourable embodiment of the invention, an orientation of an outer edge of the at least one vane may deviate by at least 5° from the first end to the second end of the diffuser section, preferably by at least 10°. A smooth deflection of the exhaust gas flow can be provoked in the exhaust gas flow.

According to a favourable embodiment of the invention, an orientation of the outer edge of the at least one vane may deviate by not more than 90°, preferably by not more than 80° from the first end to the second end of the diffuser section. A smooth deflection of the exhaust gas flow can be provoked in the exhaust gas flow without causing additional noise in the exhaust gas flow.

According to a favourable embodiment of the invention, a section of an outer edge of the at least one vane may extend parallel to an axial direction at the first end. An airfoil profile can be provided which reduces noise generation in the deflected exhaust gas flow.

According to a favourable embodiment of the invention, a distance from the first end to the second end of the diffuser section may be at least 40%, preferably at least 50% of the diameter of the diffuser section. Preferably, a distance between the first end and the second end of the diffuser section may be larger than the diameter of the diffuser section.

According to a favourable embodiment of the invention, at least three vanes are provided, wherein the at least three vanes may preferably be arranged

symmetrically around a central axis of the diffuser section. The design is simple and can be manufactured cost efficiently.

According to a favourable embodiment of the invention, a diffuser element may be  
5 arranged in the diffuser section which diffuser element may comprise the at least one vane and that the diffuser element is surrounded by a wall of the exhaust pipe. Advantageously, the diffuser element can be made of one or more bent metal blades forming the vanes, the vanes being arranged in rotational symmetry around a centre axis, particularly around a centre piece made of a tube. The blades are  
10 shaped in a way to smoothly redirect or deflect the exhaust gas flow from its straight path, thus minimizing noise which may be caused by a sudden flow redirection or deflection. Expediently, the contour of the vanes avoids sudden redirection or deflection of the exhaust gas flow. For instance, the tube may have a cylindrical shape. Alternatively, the tube may have a conical shape with a smaller  
15 diameter at the first end at a distance the outlet and a larger diameter at the second end of the diffuser section close to the outlet.

The diffuser element can be mounted in the exhaust pipe just before the outlet where it disturbs the exhaust gas flow by deflecting or redirecting the exhaust gas  
20 flow, and as a result reduces a distance that the hot exhaust gases travel through the air outside the exhaust pipe. Outside the exhaust pipe the disturbed exhaust gas flow can also mix efficiently with the ambient air. The outlet of the exhaust pipe may have recesses at its free end where material of the pipe rim is removed. This arrangement can help to direct the exhaust plume so that it is inclined  
25 somewhat with respect to the straight extension of the exhaust pipe at the outlet. This can favourably be combined with a conically shaped free space in the central region of the vanes of the diffuser section, particularly with a conically shaped tube with a smaller diameter at the first end at a distance the outlet and a larger diameter at the second end of the diffuser section close to the outlet.

30

According to a favourable embodiment of the invention, the at least one vane may be formed by a wall portion of the exhaust pipe. Advantageously, the at least one vane can be formed by many techniques such as deep drawing, blow forming and the like.

According to a favourable embodiment of the invention, the diffuser section may abut at least one section of the outlet contour. The effect of the diffuser section on the exhaust gas flow is stronger close to the exhaust pipe outlet.

5

According to another aspect of the invention, a vehicle is proposed comprising an exhaust pipe arrangement comprising anyone of the features described above.

Favourably, the vehicle has improved safety as the hot exhaust gases emitted during particle filter regeneration can be concentrated closer to the exhaust pipe outlet than in conventional systems.

10

#### BRIEF DESCRIPTION OF THE DRAWINGS

15 The present invention together with the above-mentioned and other objects and advantages may best be understood from the following detailed description of the embodiment(s), but not restricted to the embodiments, wherein is shown schematically:

20 Fig. 1a-1b a perspective view on an example embodiment of an exhaust pipe arrangement according to the invention (Fig. 1a), and in a side view the effect of the exhaust pipe arrangement on a temperature distribution of exhaust gases emitted from the exhaust pipe by way of an isothermal surface (Fig. 1b);

25 Fig. 2a-2b a perspective view on an example embodiment of a conventional exhaust pipe arrangement (Fig. 2a), and in a side view a temperature distribution of exhaust gases emitted from the exhaust pipe by way of an ISO surface (Fig. 2b);

Fig. 3a, 3b in a side view position of an example embodiment of a diffuser element arranged in an exhaust pipe (Fig. 3a) and the effect of the diffuser element on an exhaust gas flow in the exhaust pipe (Fig. 3b);

30

Fig. 4 details of the geometry of the diffuser element shown in Fig. 3a, 3b;

Fig. 5a-5c various geometries of diffuser elements; and

Fig. 6 an example embodiment of a vehicle comprising an exhaust pipe arrangement according to the invention.

## 5 DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

In the drawings, equal or similar elements are referred to by equal reference numerals. The drawings are merely schematic representations, not intended to  
10 portray specific parameters of the invention. Moreover, the drawings are intended to depict only typical embodiments of the invention and therefore should not be considered as limiting the scope of the invention.

Fig. 1a depicts schematically an example embodiment of an exhaust pipe  
15 arrangement 50 in an exhaust pipe 10 shown in a region close to its end section 16. The exhaust pipe 10 is provided for discharging exhaust from a combustion engine (not shown), particularly for a combustion engine with an exhaust gas aftertreatment system requiring high temperatures in one or more operational modes. Such operational modes may be regeneration of a component in the  
20 exhaust gas aftertreatment system, by way of example a particle filter of a diesel engine.

The exhaust pipe 10 has an outer wall 40 and a main section 12 which extends towards the exhaust gas aftertreatment system. The end section 16 of the exhaust  
25 pipe 10 is terminated by an exhaust gas outlet 18, wherein a diffuser section 20 is arranged in the exhaust pipe 10 in the vicinity of the exhaust gas outlet 18. Between the end section 16 and the main section 12 the exhaust pipe 10 may exhibit a bend 14, typically in cases where the exhaust pipe 10 is vertically arranged and the exhaust gas outlet 18 is an overhead outlet. The exhaust gas  
30 outlet 18 is inclined with respect to a longitudinal extension of the exhaust pipe 10 having a section 18a with the shortest longitudinal extension.

The end section 16 comprises a diffuser section 20 with an outer diameter  $\varnothing_d$ . the diffuser section 20 in this embodiment is a diffuser element 100 arranged in

the exhaust pipe 10 as an insert. The diffuser section 20 abuts the section 18a with its upper end.

5 The diffuser section 20 deflects the exhaust gas flow in a way that hot exhaust gas is concentrated predominantly close to the exhaust outlet 18. This is shown in Fig. 1b which depicts an isothermal surface of an exhaust temperature  $T_{ex}$  of e.g. 250°C. The isothermal surface is of irregular shape and encloses a volume 30 which has a longitudinal extension  $L_{30}$ . Inside the volume 30 the temperature is higher than  $T_{ex}$ , outside the volume 30, the temperature is lower than  $T_{ex}$ .

10

Fig. 2a and 2b show a conventional exhaust pipe 10 without diffuser section 20. As can be seen in Fig. 2b, the volume 30 enclosed by the isothermal surface 30 has a cylindrical shape. The longitudinal extension  $L_{30}$  of the volume 30 is more than double the longitudinal extension  $L_{30}$  shown in Fig. 1b for an exhaust pipe 10 comprising a diffuser section 20 according to the invention.

15

Figs. 3a and 3b show an example embodiment of a diffuser element 100 which may be inserted in the exhaust pipe 10 to provide a diffuser section 20 of the exhaust pipe 10. Fig. 4 shows the diffuser element 100 in detail.

20

Fig. 3a, 3b illustrate in a side view position the diffuser element 100 located in the exhaust pipe 10 (Fig. 3a) and the effect of the diffuser element 100 on an exhaust gas flow  $F$  in the exhaust pipe 10 (Fig. 3b). The exhaust pipe 10 is illustrated only as contour line.

25

A first end 102 of the diffuser element 100 is arranged in a distance from the exhaust gas outlet 18 and a second end 104 closer to the exhaust gas outlet 18 in vicinity of the exhaust gas outlet 18, abutting section 18a.

30 A distance  $L_{100}$  from the first end 102 to the second end 104 of the diffuser section 20 (or diffuser element 100 in this embodiment) is at least 40%, preferably at least 50% of the diameter  $\varnothing_d$  of the diffuser section 20. Preferably the distance  $L_{100}$  between the first end 102 and the second end 104 is larger than the diameter  $\varnothing_d$  of the diffuser section 20.

The diffuser element 100 comprises several vanes 110 with an airfoil profile 112 extend in an axial direction 130 from the first end 102 to the second end 104 of the diffuser section 20. The airfoil profile 112 avoids sudden redirections of the exhaust gas flow and thus reduces the risk of disturbing noise creation. As can be seen in Fig. 3b, the exhaust gas flow F is disturbed by the diffuser element 100 and smoothly deflected by the vanes 110.

Each vane 110 has an edge 106 which at its lower section 114 at the first end 102 of the vane 110 starts parallel to the longitudinal extension 130 of the diffuser section 20. The upper section 116 is angled with an angle  $\alpha$  with respect to the lower section 114 of the edge 106, wherein the vane 110 follows the airfoil profile 112. The angle  $\alpha$  is at least  $5^\circ$ , preferably at least  $10^\circ$  and not larger than  $90^\circ$ , preferably by not larger than  $80^\circ$ .

The diffuser element 100 can be made of one or more bent metal blades forming the vanes 110 and in a central region 120 a centre piece made of a tube forming a free space 122 provided for a passage of exhaust gas. The blades are shaped in a way so that they smoothly redirect the exhaust gas flow F, thus minimizing noise.

Although the diffuser element 100 is shown to be mounted in a fixed manner to the exhaust pipe 10 it is not excluded that the diffuser element 100 can be mounted rotatably in the exhaust pipe 10 (not shown).

Example embodiments shown in Fig. 5a to Fig. 5c illustrate expedient variants of the geometry of a diffuser element 100. In order to avoid unnecessary repetitions, a focus is only on the differences between the various embodiments.

Fig. 5a shows an embodiment where five vanes 110 of the diffuser element 100 are attached to an inside of a wall 40 of an exhaust pipe 10, forming a diffuser section 20 of the exhaust pipe 10. The vanes 110 surround a free space 122 in the centre of the exhaust pipe cross section. Seen from the top the vanes 110 are arranged in a ring section.

Fig. 5b shows an embodiment of a diffuser element 100 where a free space 122 surrounded by five vanes 110 is defined by a tube in the central region 120 of a diffuser section 20 of an exhaust pipe 10. Seen from top, the vanes 110 are arranged in a ring section. Compared to Fig. 5a, the outer diameter  $\varnothing_2$  of the ring section arrangement of the vanes 110 in Fig. 5b is smaller than in Fig. 5a.

Expediently, the outer diameter  $\varnothing_2$  of the ring section is at least 40%, preferably at least 50%, more preferably at least 60%, of a diameter  $\varnothing_d$  of the diffuser section 20. In this case the outer diameter  $\varnothing_2$  of the ring section equals an inner diameter  $\varnothing_d$  of the exhaust pipe 10 and the diffuser section 20, respectively.

The free space 122 surrounded by the vanes 110 has a diameter  $\varnothing_2$  of not more than 30%, preferably of not more than 25 %, more preferably of not more than 20% of the diameter of the diffuser section 20.

Fig. 5c depicts an embodiment of a diffuser element 100 with three vanes 110 arranged in an exhaust pipe 10. In a front view on a cross section 22 of the exhaust pipe 10 a projection of the vanes 110 on the cross section of the diffuser section 20 covers at least 25%, preferably at least 30% of the cross sectional area of the diffuser section 20.

Expediently, at least three vanes 110 are provided, wherein the at least three vanes 110 are preferably arranged symmetrically around a central axis 124 of the diffuser section 20.

Whereas the diffuser section 20 is formed by a diffuser element 100 inserted in the exhaust pipe 10 and the respective section of the exhaust pipe 10, it is to be understood, that at least one vane 110 may also be formed by a wall portion of the wall 40 the exhaust pipe 10 (not shown).

Fig. 6 illustrates a vehicle 200 comprising an exhaust pipe arrangement 50 as described in the preceding figures. Exhaust gas from an engine 202 is treated in an exhaust gas aftertreatment system 204 and discharged through an exhaust pipe with an overhead exhaust gas outlet 18. The hot exhaust gases generated

during regeneration of components of the exhaust gas aftertreatment system 204, particularly during regeneration of a diesel particle filter, are concentrated near the exhaust gas outlet 18 so that objects 210 in the vicinity of the exhaust gas outlet 18 is exposed to cooler exhaust gases only which reduces the danger of damage to the objects 210.

5

## C L A I M S

1. An exhaust pipe arrangement (50) for discharging exhaust from a  
5 combustion engine (202) through an exhaust pipe (10), particularly for a  
combustion engine (202) with an exhaust gas aftertreatment system (204)  
requiring high temperatures in one or more operational modes, comprising  
an end section (16) terminated by an exhaust gas outlet (18),  
**characterized** by a diffuser section (20) provided in the exhaust pipe (10),  
10 the diffuser section (20) having a first end (102) in a distance from the outlet  
(18) and a second end (104) closer to the outlet (18) is arranged in vicinity  
of the outlet (18), wherein at least one vane (110) with an airfoil profile (112)  
extends in an axial direction (130) from the first end (102) to the second end  
(104) of the diffuser section (20).  
15
2. The exhaust pipe arrangement according to claim 1, characterized in that in  
a front view on a cross section (22) of the exhaust pipe (10) at a location of  
the first end (102) and/or second end (104) of the diffuser section (20) the  
at least one vane (110) covers at least 25%, preferably at least 30% of the  
20 cross sectional area of the diffuser section (20).
3. The exhaust pipe arrangement according to claim 1 or 2, characterized in  
that a free space (122) is provided in a central region (120) of the diffuser  
section (20) provided for a passage of exhaust gas.  
25
4. The exhaust pipe arrangement according to claim 3, characterized in that  
the free space (122) has a diameter ( $\varnothing_1$ ) of not more than 60%, preferably  
of not more than 50%, more preferably of not more than 30 %, more  
preferably of not more than 20% of a diameter ( $\varnothing_d$ ) of the diffuser section  
30 (20).
5. The exhaust pipe arrangement according to claim 3 or 4, characterized in  
that the free space (122) is defined by a tube.

6. The exhaust pipe arrangement according to claim 5, characterized in that the tube defining the free space (122) has a conical shape with a smaller diameter at the first end (102) at a distance to the outlet (18) and a larger diameter at the second end (104) of the diffuser section (20) close to the outlet (18).  
5
7. The exhaust pipe arrangement according to any preceding claim, characterized in that the outlet (18) has recesses at its free end where material of the exhaust pipe rim is removed:  
10
8. The exhaust pipe arrangement according to any preceding claim, characterized in that the at least one vane (110), seen from the top, is arranged in a ring section with an outer diameter ( $\varnothing_2$ ) of at least 40%, preferably at least 50%, more preferably at least 60%, of a diameter ( $\varnothing_d$ ) of the diffuser section (20).  
15
9. The exhaust pipe arrangement according to any preceding claim, characterized in that an orientation of an outer edge (106) of the at least one vane (110) deviates by at least 5° from the first end (102) to the second end (104) of the diffuser section (20), preferably by at least 10°.   
20
10. The exhaust pipe arrangement according to any preceding claim, characterized in that an orientation of the outer edge (106) of the at least one vane (110) deviates by not more than 90°, preferably by not more than 80° from the first end (102) to the second end (104) of the diffuser section (20).  
25
11. The exhaust pipe arrangement according to any preceding claim, characterized in that a section (114) of an outer edge (106) of the at least one vane (110) extends parallel to an axial direction (130) at the first end (102).  
30
12. The exhaust pipe arrangement according to any preceding claim, characterized in that a distance (L100) from the first end (102) to the

second end (104) of the diffuser section (20) is at least 40%, preferably at least 50% of the diameter ( $\emptyset_d$ ) of the diffuser section (20).

- 5 13. The exhaust pipe arrangement according to claim 12, characterized in that a distance (L100) between the first end (102) and the second end (104) is larger than the diameter ( $\emptyset_d$ ) of the diffuser section (20).
- 10 14. The exhaust pipe arrangement according to any preceding claim, characterized in that at least three vanes (110) are provided, wherein the at least three vanes (110) are preferably arranged symmetrically around a central axis (124) of the diffuser section (20).
- 15 15. The exhaust pipe arrangement according to any preceding claim, characterized in that an diffuser element (100) is arranged in the diffuser section (20) which diffuser element (100) comprises the at least one vane (110) and that the diffuser element (100) is surrounded by a wall (40) of the exhaust pipe (10).
- 20 16. The exhaust pipe arrangement according to any preceding claim, characterized in that the at least one vane (110) is formed by a wall portion (40) of the exhaust pipe (10).
- 25 17. The exhaust pipe arrangement according to any preceding claim, characterized in that the diffuser section (20) abuts at least one section (18a) of the outlet (18).
18. A vehicle (200) comprising an exhaust pipe arrangement (50) according to any preceding claim.

19. An exhaust pipe arrangement for discharging exhaust from a combustion engine through an exhaust pipe, particularly for a combustion engine with an exhaust gas aftertreatment system requiring high temperatures in one or more operational modes, comprising an end section terminated by an exhaust gas outlet, **characterized** by a diffuser section provided in the exhaust pipe, the diffuser section having a first end in a distance from the outlet and a second end closer to the outlet is arranged in vicinity of the outlet, wherein at least one vane with an airfoil profile extends in an axial direction from the first end to the second end of the diffuser section.
20. The exhaust pipe arrangement according to claim 19, characterized in that in a front view on a cross section of the exhaust pipe at a location of the first end and/or second end of the diffuser section the at least one vane covers at least 25%, preferably at least 30% of the cross sectional area of the diffuser section.
21. The exhaust pipe arrangement according to claim 19 or 20, characterized in that a free space is provided in a central region of the diffuser section provided for a passage of exhaust gas.
22. The exhaust pipe arrangement according to claim 21, characterized in that the free space has a diameter of not more than 60%, preferably of not more than 50%, more preferably of not more than 30 %, more preferably of not more than 20% of a diameter of the diffuser section.
23. The exhaust pipe arrangement according to claim 21, characterized in that the free space is defined by a tube.
24. The exhaust pipe arrangement according to claim 23, characterized in that the tube defining the free space 2 has a conical shape with a smaller diameter at the first end at a distance to the outlet and a larger diameter at the second end of the diffuser section close to the outlet.

25. The exhaust pipe arrangement according to claim 19, characterized in that the outlet has recesses at its free end where material of the exhaust pipe rim is removed:
- 5 26. The exhaust pipe arrangement according to claim 19, characterized in that the at least one vane, seen from the top, is arranged in a ring section with an outer diameter of at least 40%, preferably at least 50%, more preferably at least 60%, of a diameter of the diffuser section.
- 10 27. The exhaust pipe arrangement according to claim 19, characterized in that an orientation of an outer edge of the at least one vane deviates by at least 5° from the first end to the second end of the diffuser section, preferably by at least 10°.
- 15 28. The exhaust pipe arrangement according to claim 19, characterized in that an orientation of the outer edge of the at least one vane deviates by not more than 90°, preferably by not more than 80° from the first end to the second end of the diffuser section.
- 20 29. The exhaust pipe arrangement according to claim 19, characterized in that a section of an outer edge of the at least one vane extends parallel to an axial direction at the first end.
- 25 30. The exhaust pipe arrangement according to claim 19, characterized in that a distance from the first end to the second end of the diffuser section is at least 40%, preferably at least 50% of the diameter of the diffuser section.
- 30 31. The exhaust pipe arrangement according to claim 29, characterized in that a distance between the first end and the second end is larger than the diameter of the diffuser section.
32. The exhaust pipe arrangement according to claim 19, characterized in that at least three vanes are provided, wherein the at least three vanes are

preferably arranged symmetrically around a central axis of the diffuser section.

- 5      33.    The exhaust pipe arrangement according to claim 19, characterized in that an diffuser element is arranged in the diffuser section which diffuser element comprises the at least one vane and that the diffuser element is surrounded by a wall of the exhaust pipe.
- 10      34.    The exhaust pipe arrangement according to claim 19, characterized in that the at least one vane is formed by a wall portion of the exhaust pipe.
35.    The exhaust pipe arrangement according to claim 19, characterized in that the diffuser section abuts at least one section of the outlet.
- 15      36.    A vehicle comprising an exhaust pipe arrangement according to claim 19.

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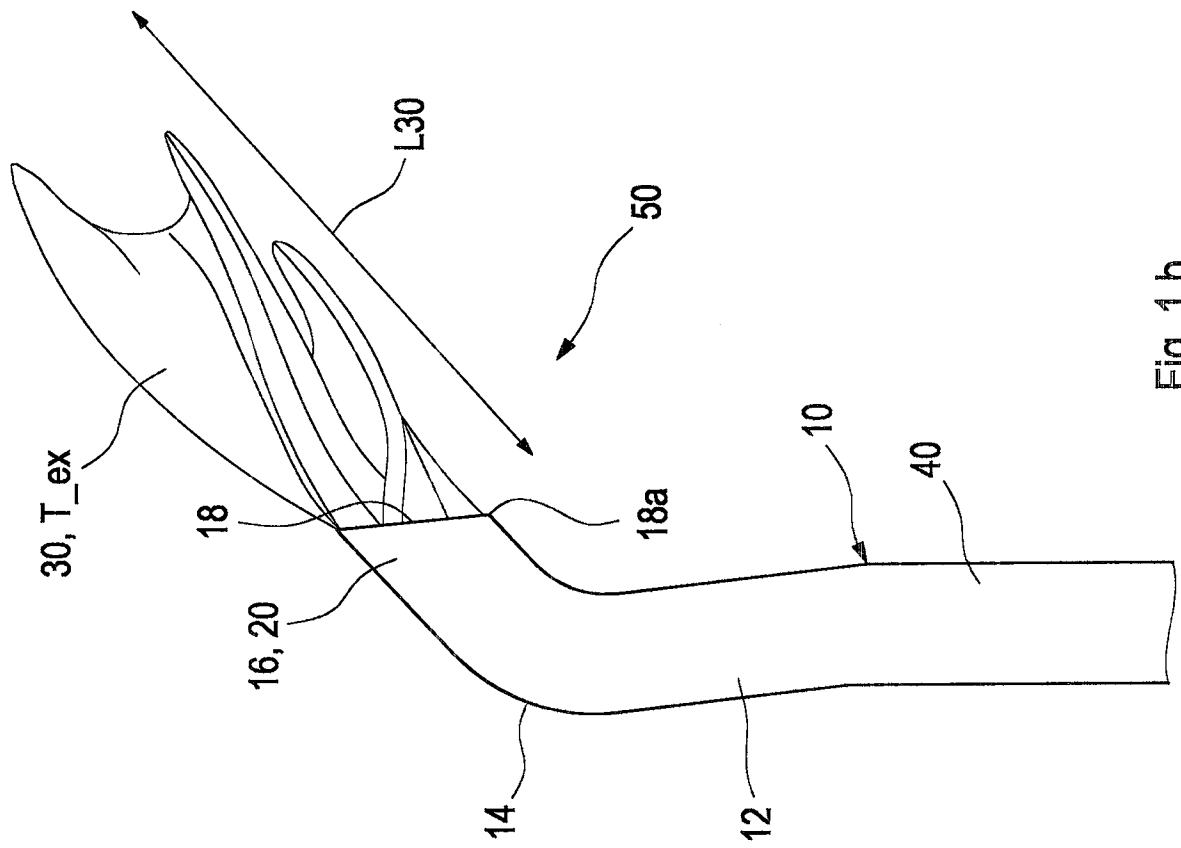


Fig. 1 b

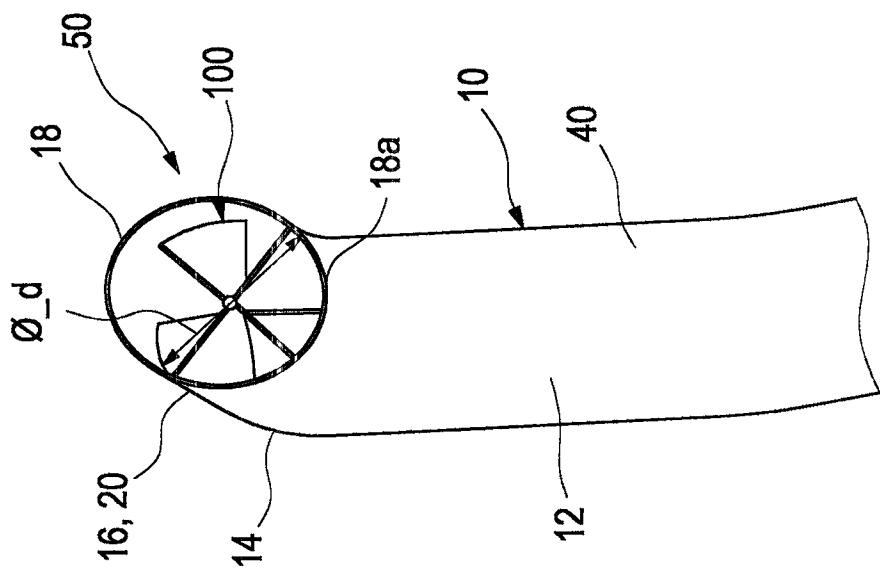


Fig. 1 a

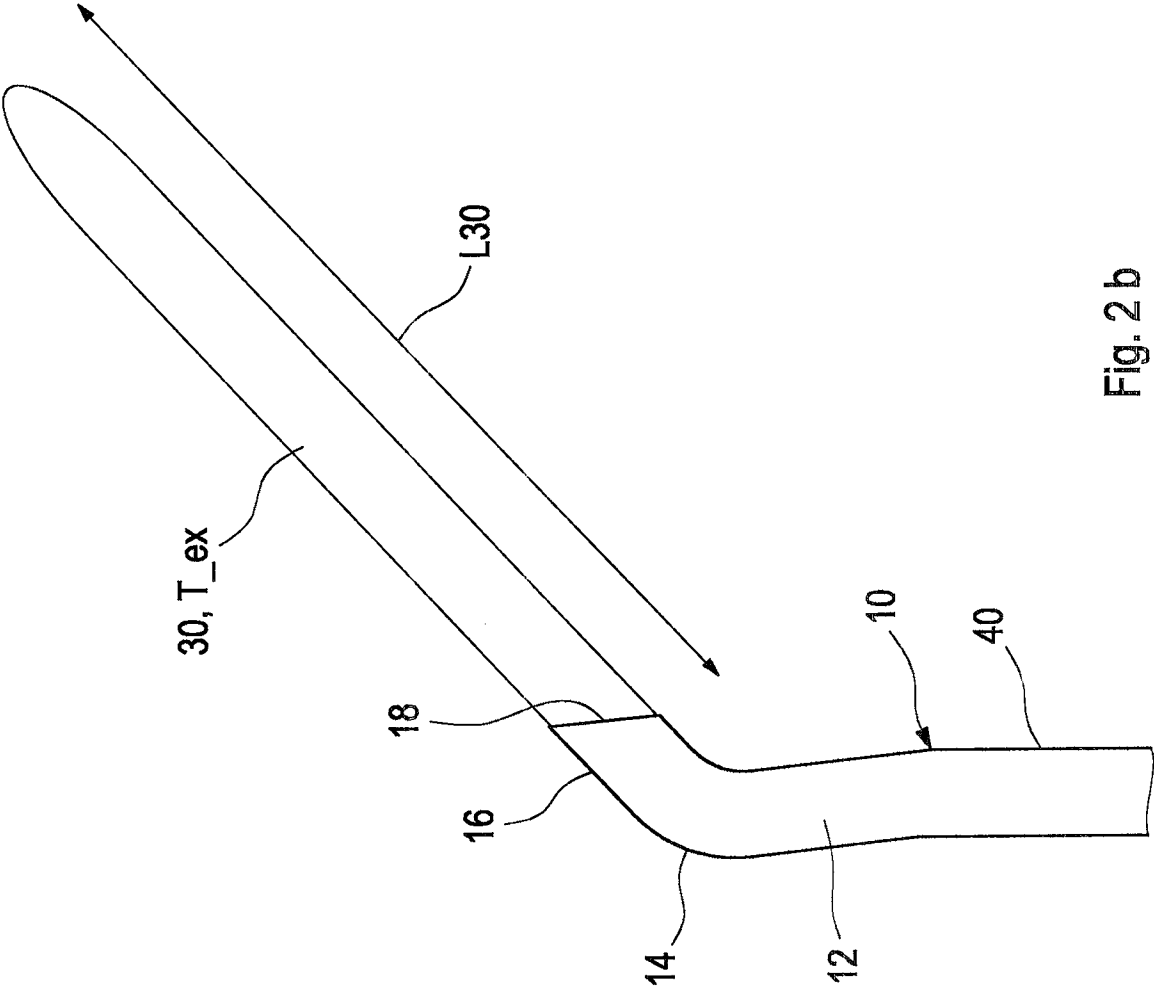


Fig. 2 b

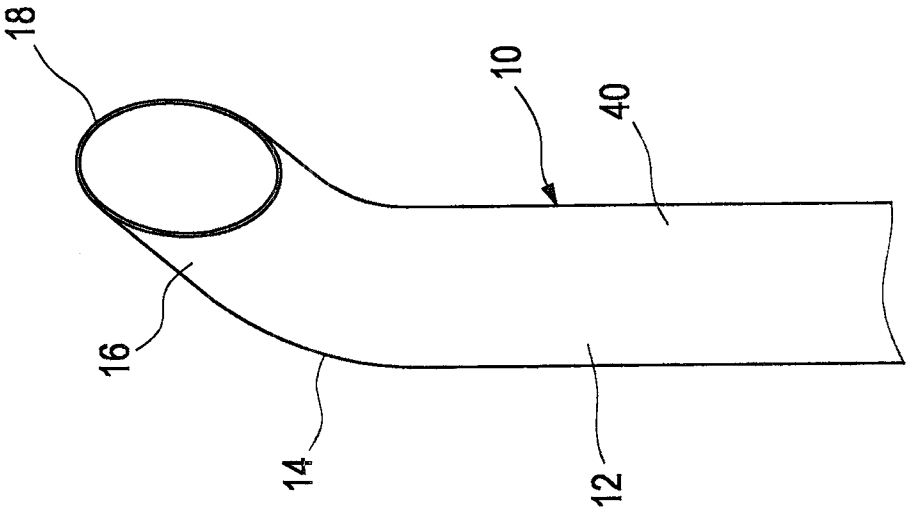


Fig. 2 a

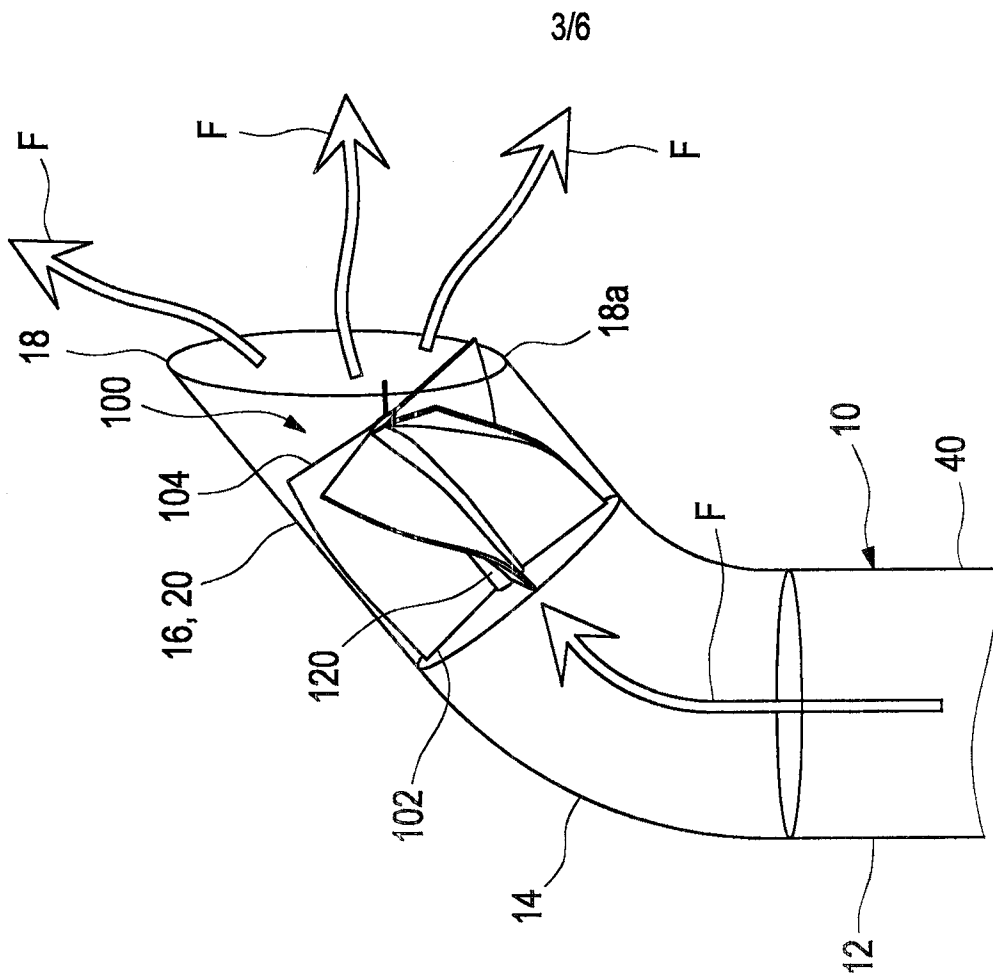
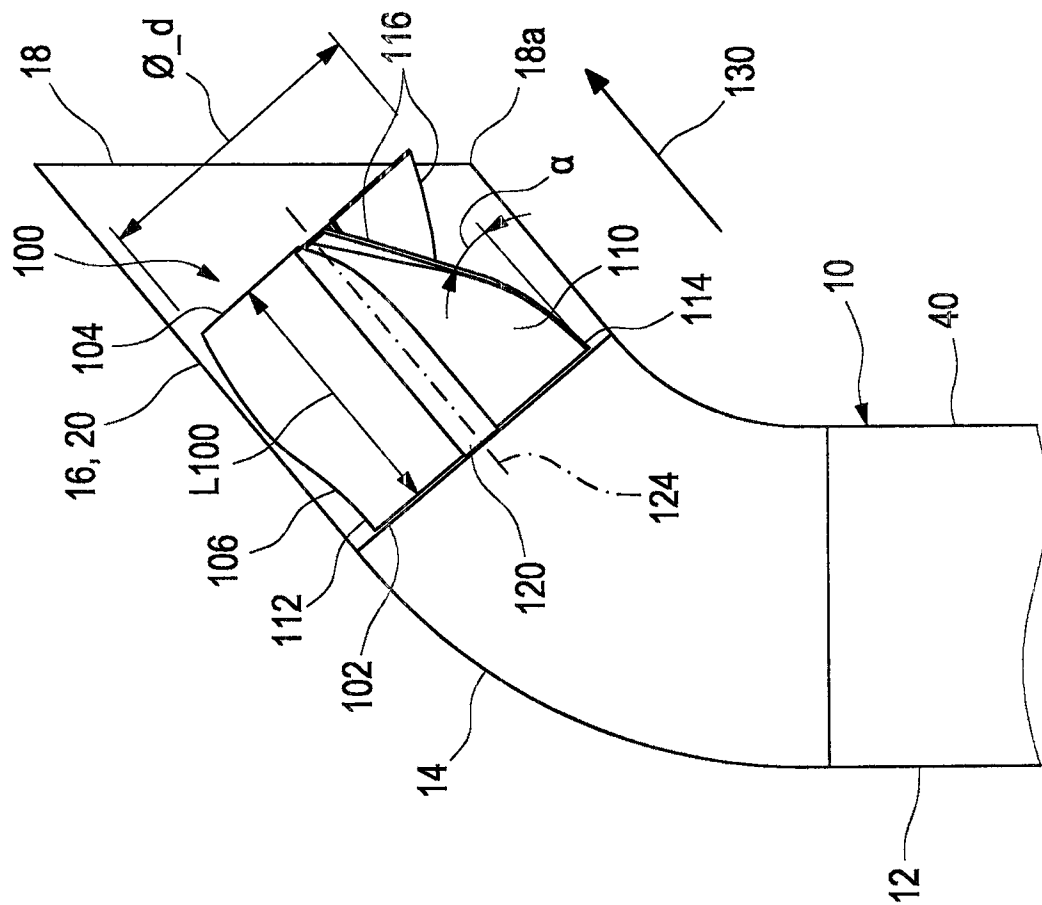


Fig. 3



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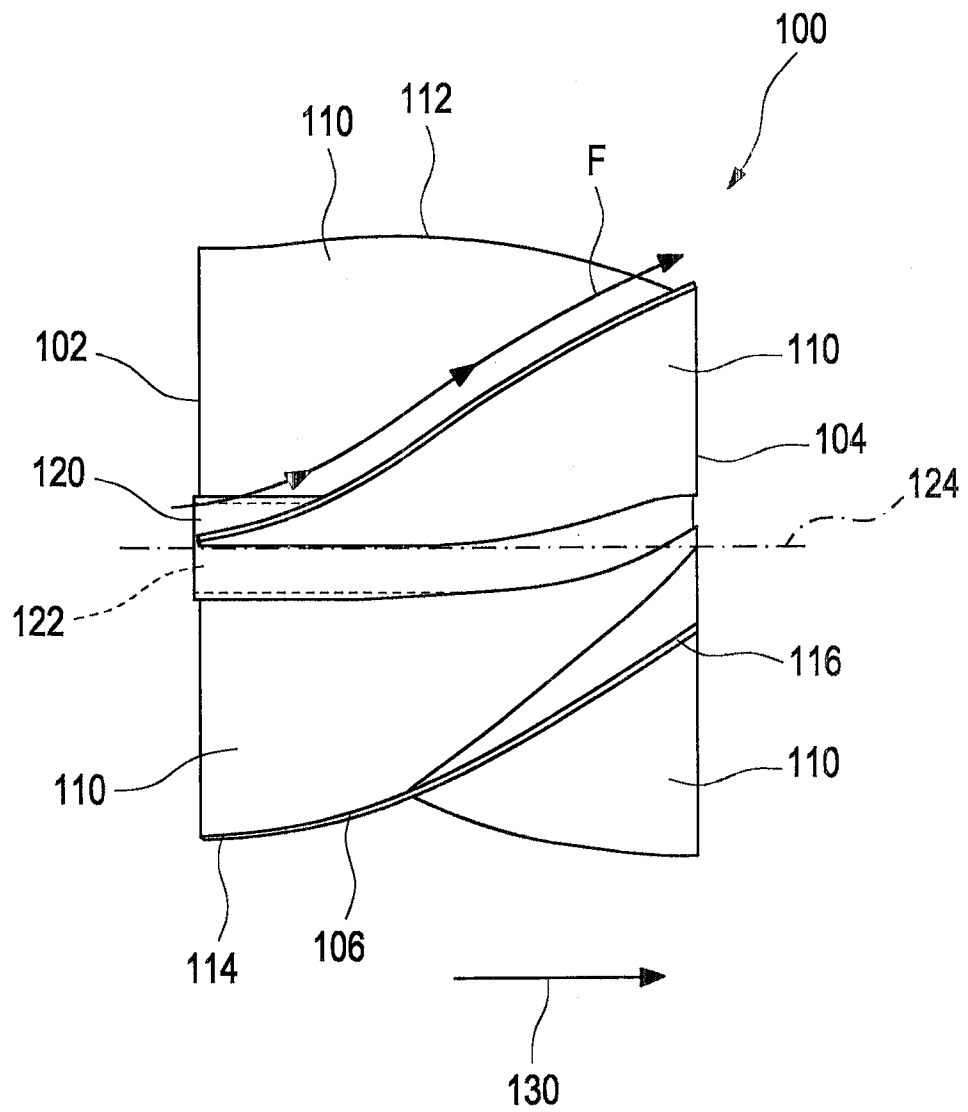
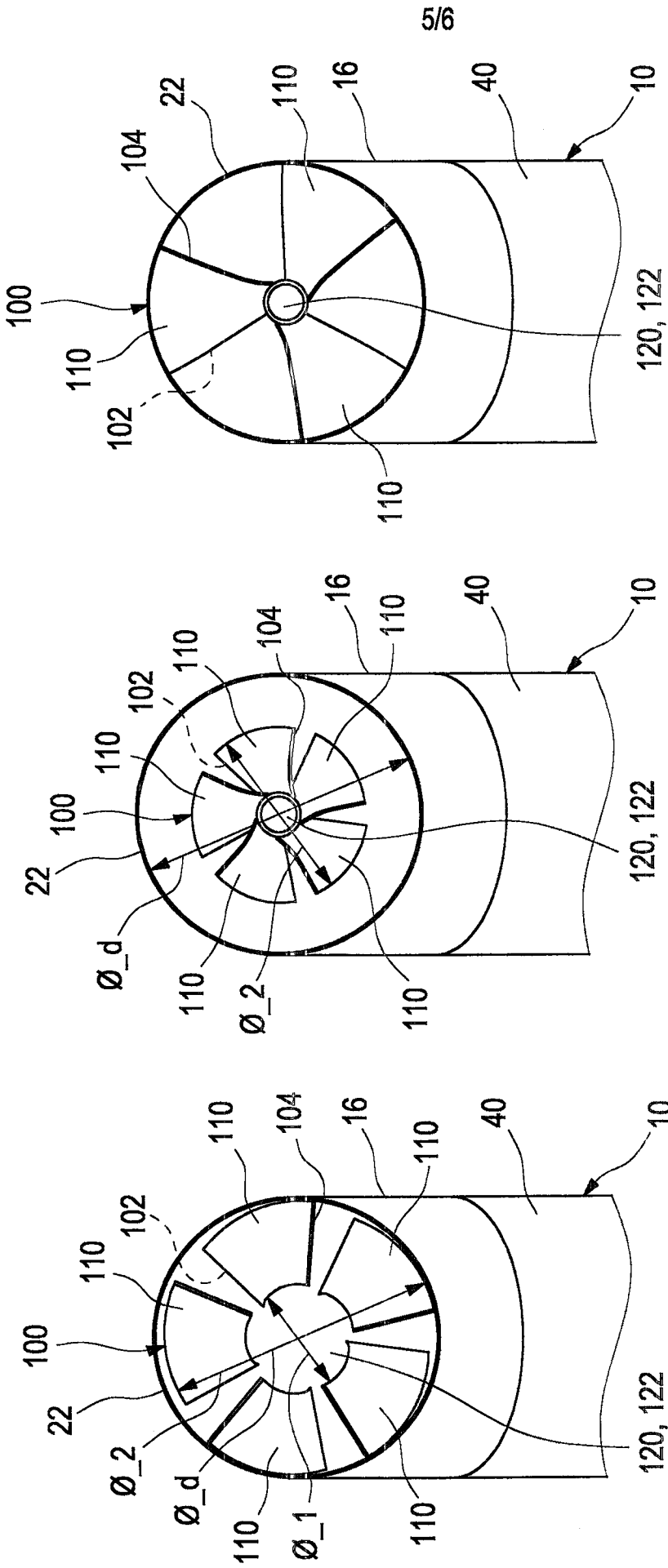


Fig. 4



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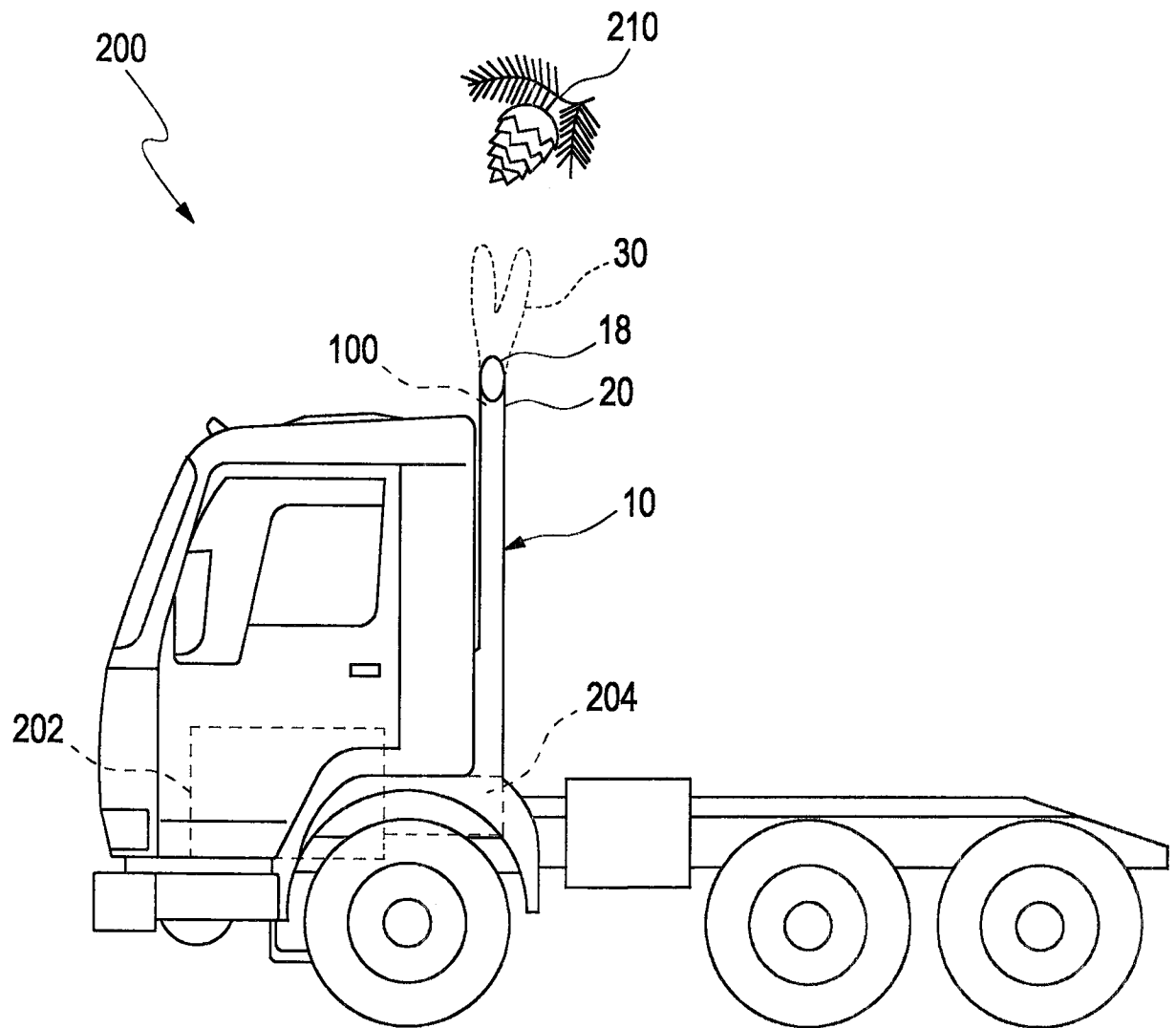


Fig. 6

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE2010/000248

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B60K, F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                          | Relevant to claim No. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X         | JP 8014041 A (YUTANI JUKO KK), 16 January 1996 (1996-01-16); (abstract) Retrieved from: PAJ database; Original document: figure 4<br>--                     | 1-36                  |
| X         | JP 2005226485 A (CALSONIC KANSEI CORP), 25 August 2005 (2005-08-25); (abstract) Retrieved from: PAJ database; Original document: figures<br>--              | 1-36                  |
| A         | JP 2000008832 A (KAWASAKI HEAVY IND LTD), 11 January 2000 (2000-01-11); (abstract) Retrieved from: PAJ database; Original document: figure 5<br>--<br>----- | 1-36                  |



Further documents are listed in the continuation of Box C.



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Date of the actual completion of the international search

13-06-2011

Date of mailing of the international search report

20-06-2011

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**Continuation of:** second sheet

**International Patent Classification (IPC)**

**F01N 13/08** (2010.01)

**F01N 3/05** (2006.01)

**F01N 3/023** (2006.01)

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Cited literature, if any, will be enclosed in paper form.

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Information on patent family members

International application No.

PCT/SE2010/000248

|    |              |            |      |            |            |
|----|--------------|------------|------|------------|------------|
| JP | 8014041 A    | 16/01/1996 | NONE |            |            |
| JP | 2005226485 A | 25/08/2005 | NONE |            |            |
| JP | 2000008832 A | 11/01/2000 | JP   | 3136130 B2 | 19/02/2001 |