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(54) A method and arrangement for fluidizing and/or thermal curing of and/or drying a coating

(57) A arrangement comprising a device 1 for heating an anti-corrosive coating in a cavity (22) of a vehicle body (2), suitable for directing a medium, being of a temperature required for thermal curing of the coating or drying or fluidizing the coating (22, 23), in the cavity (21). Preferably, guidance elements (3) help to precisely direct the medium (A, B, C) into the cavity (21).

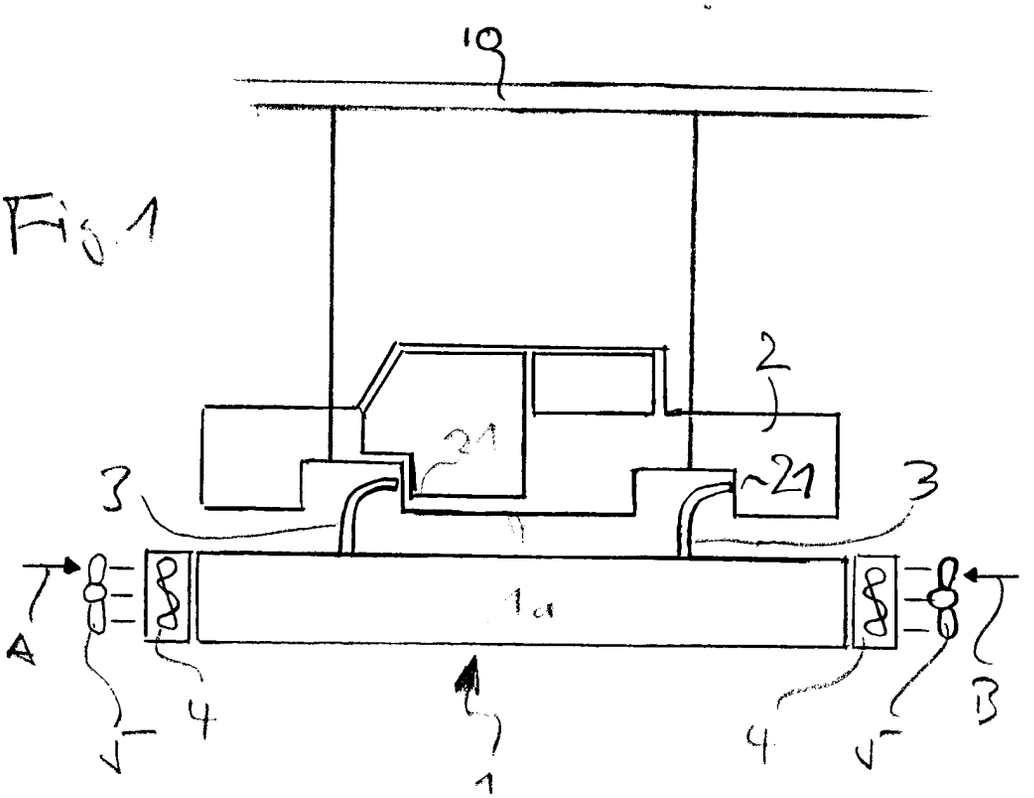

Fig. 1

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Description

[0001] The invention relates to a method and arrangement for fluidizing and/or thermal curing of and/or drying a coating in accordance with the preamble of the independent claims.

[0002] In the manufacture of transportation vehicles like passenger cars, trucks, and busses, cavities in the vehicle bodies are normally protected against corrosion by coating the cavity surface. The anti-corrosive compounds applied for the purpose of coating are waxes or wax-like substances. These ‚waxes' are selected from natural or semisynthetic compounds (e.g. plant resins), petrochemical fractionation products (e.g. bitumen) or synthetic polymers (e.g. hotmelts).

[0003] The purpose of coating requires that the waxes destined to form a solid coat on the inner surface of a cavity, are applied in a fluid state. The wax may be dissolved or dispersed in a liquid medium, particularly in a solvent (that can be evaporated later on), be fluidized by heating or be applied as polymerizable liquid mixture. All known methods require the heating of the cavity either whilst applying the coating or immediately after having applied the coating. In the first case, an abrupt solidification of a thermoplastic compound,preventing the coating from smoothly making access to crevices, is undesirable. In the second case, solidification by physical drying or thermal curing requires heat transfer to the coating material after application of the coating into the cavity.

[0004] Prior art only describes indirect methods for raising the temperature at the inner surface of the cavity by heating the vehicle body itself.

[0005] WO 96/30128 describes a method for preserving cavities in workpieces. A workpiece, i.e. a vehicle body, is delivered to a working chamber that has a predeterminable operating temperature. Immersion of the vehicle body in the working chamber pre-tempers the entire vehicle body prior to applying a coating.

[0006] The disadvantage of this method is that the conventional convection heating (an oven) is rather space consuming. Pre-tempering the entire vehicle body by heat transfer from diffusing air is time consuming, due to an inefficient heat transfer rate. Vice versa, cooling down the vehicle body afterwards, in order to prevent workers from suffering burns and facilitate further processing down the line, is time consuming, too. This circumstance renders the coating of vehicle cavities an important obstacle to overall productivity in a manufacturing line. Since the working chamber is part of a continuously operated manufacturing line, leakage and therefore energy expenditure is considerable and expensive. Other components of the partly processed vehicle body (e.g. lacquers, sealings) are subjected to undesirable thermal stress.

[0007] EP-A1-003 223 describes a process for applying a coating of a corrosion inhibiting material to cavities of a vehicle body, in which part of the vehicle body is heated by infrared radiation from the outside.

[0008] A disadvantage of this method is the still high energy consumption and the still indirect heat transfer from the outside of the vehicle body to the coating on the inner surface of the cavities. Despite the more local effect of this heating method, it suffers from dispersion of the heat to all neighbouring parts of the vehicle body. Cavities that have only a part of their walls directly exposed to the outside of the car body, and thus to infrared radiation on the outside, are inefficiently heated.

[0009] It is an object of the present invention to overcome the disadvantages of the prior art and to propose a simple arrangement for, and a simple method of, quickly, inexpensively and energy pre-servingly fluidizing or solidifying an anti-corrosive coating in a vehicle cavity. Such vehicles may be cars, trucks, busses or planes, trains etc..

[0010] This object is solved by the features of the independent claims 1, 11 and 12. In accordance with the present invention, an arrangement for fluidizing and/or thermal curing and/or drying of a coating in a cavity of a vehicle body through a process comprises a device for directing a medium through the cavity. In the context of the present invention, directing a medium through a cavity means any way of forcing the medium to flow into and/or within a cavity.

[0011] Direct heating of the coating applied to a cavity in a vehicle body has the advantage of a quick, efficient heat transfer to the coating. The preset temperature of the medium is the actual reaction temperature of the coating, i.e. the temperature required to fluidize the compound or to initiate polymerization (curing) or to efficiently evaporate a solvent, thus drying the coating. In case of solvent evaporation from a solvent-based coating, it can be sufficient to direct a non-heated medium through the cavities; ambient or room temperature will do, not to mention that removal of solvent vapor is concomittantly achieved.

[0012] Thermal stress of other, neighbouring elements of the vehicle body, e.g. sealings or laquers, is minimized. Energy expenditure is minimized due to confining the heated areas. Cooling is not any longer a prerequisite for further processing steps, except for working on the cavities themselves; therefore, process cycle times are shortened and may lead to overall enhanced productivity in a line of manufacture. Workers may access the vehicle body simultaneously or in a subsequent processing step without worrying for exposed, hot parts and thus potential hazard.

[0013] It is possible to apply cooling to the vehicle body at the end of the process by the same arrangement. It is also possible to include a control unit for automatically generating predeterminded changes in the temperature of the medium over time, e.g. to swich from a heating to a cooling mode. This helps to prevent excessive heating of the cavities and neighbouring, susceptible parts of the vehicle body, and allows for more intricate heating patterns, e.g. with several intervals of

different temperature. The automatized process is adaptable to the specific needs of the coating compounds employed therein.

[0014] In a further preferred embodiment, the device according to the present invention comprises a unit for heating the medium. Such a unit may comprise e.g. radiator elements that are heated and are placed in the way of the streaming medium. The radiator element may be heated by electric resistance, combustion or by heat exchange from a tempered transport medium. Hot, with respect to the present invention, refers to a temperature in between 50 and 150°C, preferably 70 to 120°C; functionally, this temperature allows for chemical or physical curing, solvent evaporation or fluidizing a thermoplastic compound.

[0015] In a further preferred embodiment, the device according to the present invention comprises at least one guidance element for directing the medium through a cavity. The medium emanates from the guidance element into the cavity or it is sucked up and is evacuated from the cavity by the guidance element. Such a guidance element will be constituted by tubes or pipes, either being of rigid or being of flexible material or comprising flexible joints. Thus the guidance element aims in a fixed or adaptable position at a cavity in the vehicle body. Its tip may protrude towards the cavity or may, in a movement conveyed by a worker or an auxiliary mechanism, intrude the cavity. A guidance element in accordance with the present invention may end in a broad opening or a nozzle, from which e.g. a stream of air is released.

[0016] In a further embodiment, at least one guidance element is designed to be adapted to an opening of the cavity. Adapted in the context of the present invention means any way of forming, pointing, fitting or sizing a guidance element to a cavity with respect to position, accessibility and size of the cavity. This feature contributes to optimization of process performance.

[0017] In another preferred embodiment, at least one guidance element is designed to be introduced into said cavity. The guidance element is e.g. a hollow tubing or injector introduced into a cavity. Thus, the medium is released or evacuated from within the cavity, thereby providing control of the flow behaviour or flow pattern of the medium through the cavity. It is possible that the medium is pressurized or is evacuated due to applying a reduced pressure to the guidance element. Movement of the guidance element in the cavity may be conveyed by a worker or a mechanic, auxiliary mechanism.

[0018] For instance, medium is injected in close proximity of the corners of a dead-end cavity and flows towards the opening of a cavity, thus contacting the whole surface area.

[0019] In a further preferred embodiment, the device according to the present invention comprises a means of accelerating the medium which means preferably comprises a fan or a pump. It serves to move the medium from the device into a cavity of a vehicle body by generating a flow. It is also possible that the flow of the medium, e.g. air, is generated by different means, e.g. by release of pressurized air from a container or the like.

[0020] In a further preferred embodiment, the medium according to the present invention is a gas, preferably air. This medium has the advantage of being easy to handle, has good heat transfer capacity and does not need to be disposed of. Except for solvent vapors, it can not be contaminated by the coating composition. Especially air is for free and is non-toxic to man.

[0021] In a further embodiment, the medium according to the present invention is a liquid. For certain coatings, the liquid has the advantage of an even bigger heat transfer capacity as compared to a gas. The liquid has, however, to be adapted to the chemical composition of the coating in order to avoid solvent effects.

[0022] In a further embodiment, the device according to the present invention comprises a plurality of guidance elements, preferably for directing the medium simultaneously into a plurality of cavities in the vehicle body. This further shortens process cycle times.

[0023] In a preferred embodiment of the present invention, the device according to the invention is part of a manufacturing line for vehicles, peferably for cars. It is possible that the device is mounted underneath the manufacturing line and thus allows for accessing the vehicle cavites from below, preferably by said guidance element or a plurality of said guidance elements. The vehicle body may then still be accessed from the sides, e. g. by workers or other processing machines, perferably automatically operating ones. This arrangement is time saving, easy to install and is suitable for automatization.

[0024] A further object of the present invention is a method or process, in accordance with the above said, for fluidizing and/or thermal curing and/or drying a coating in a cavity of a vehicle body, whereby a stream of a gas or fluid is directed through the cavity to which a coating has been applied. The method has a number of preferred embodiments within the scope of the above said. For the purpose of one of the preferred embodiments, 'connecting at least one guidance element with said cavity' means any way of forming, pointing, fitting or sizing a guidance element to a cavity with respect to position, accessibility and size of the cavity and process requirements.

[0025] Embodiments of the invention are shown in connection with the following drawings.

Fig. 1	shows a schematic arrangement according to the invention in connection with a car assembly line;
Fig. 2 and 3	are showing schematic cross-sections through a cavity.
Fig.4 and 5,6	are showing various modes of injecting/evacuating a heated medium into/from a cavity.

[0026] As shown in Fig. 1 a vehicle body 2 is positioned above a heating device 1 that is part of a manufacturing line 11. The car body 2 is carried and moved by means of a conventional overhead transport carrier 10.

[0027] The heating device 1 comprises fans 5 which are creating air streams A and B which are heated by two electric heating units 4. The hot air is propelled towards the center la of the heating device 1 and is finally distributed through guidance elements 3. The guidance elements 3 are directed towards cavities 21 in the vehicle body 2. The hot air is injected into the cavities 21 to heat a coating 22, 23 (fig. 2 and 3).

[0028] The cavities 21, 22 are usually best accessible from below. By injecting hot air into the cavities 21 heating of the complete car body 2 is avoided.

[0029] The coating of the cavities 21 can either be applied via conventional injectors immediately before the heating process or, optionally, in the course of the process. In a first step the hot air may be blown through the cavities 21 to heat the surface of the un-coated cavity 21, then the coating may be injected through conventional injectors (not shown) and thereafter hot air may be blown again into the cavities 21 to cure or dry the coating 22, 23 (Fig. 2+3).

[0030] Fig. 2 shows a schematic section through part of a car body 2 which has a cavity 21, in a perspectivic view.

[0031] The surface of the cavity 21 is covered with a coating 22. The coating consists of solvent-based anticorrosion wax; other coating materials, such as e.g. water-based corrosion waxes or zero-emission waxes (as described in: D. Symietz, 'Protection against Stone-Chip Damage and Corrosion', Verlag Moderne Industrie, Landsberg/Lech, 1998), may also be applied. A heating device 1, comprising an electric heating unit 4 and a fan 5 is connected to an opening 24 of the cavity 21. Hot air is blown through the cavity 21 and leaves the cavity 21 at C. The temperature of the hot air corresponds to the process temperature of the coating 22. Process temperature in that context means a temperature of about 180°-220°C which is sufficient to heat the coating 22 of a water-based coating material in a sufficiently short time which initiates curing. The temperature of the medium C can easily be adapted to the coating composition, and its specific requirements for a temperature which allows drying, curing or fluidizing and completely covering the cavity 21. The term "fluidizing" in that context means, that due to the application of hot air, the coating 22 softens, becomes liquid and penetrates small gaps and covers the surface of the cavity 21 in a substantially constant layer.

[0032] Fig. 3 shows an embodiment, in a schematic section through part of a car body, in which a heating device 1 contains a liquid-tank 1b which is connected through pipes 25, 26 to the cavity 21 of a car body 2. The tank 1b comprises an electric heating unit 4. In pipe 25 there is a pump 27 which is driven by a motor 28. When the pump 27 is activated, the liquid D flows through pipe 25, cavity 21 and back through pipe 26 to tank 1b. A connecting piece 29 serves to seal the pipe 26 from efflux of liquid D. If the coating 23 is, for example, a synthetic wax, the liquid D may be water. Alternatively, an aequeous solution may be used as heating liquid D.

[0033] In the embodiments of Fig. 2, after a time period which is sufficient to cure or dry the coating 22, heating unit 4 may be switched off and the coating 22 and the cavity 21 may be cooled by blowing cold air through the cavity 21. If the cooling process should be faster, conventional cooling units may be used to cool the air stream prior to directing it through cavity 21.

[0034] Fig.4-6 show different embodiments of the invention in a schematic crosssection through a cavity 21. They all have in common that a guidance element 3b,c, d is introduced in the cavity and is either evacuating medium E from a cavity 21 or is directing (facultatively pressurized) medium F,G into the cavity 21.

[0035] Fig. 4 shows a guidance element 3a connected to a heater 4 and a fan 5. Medium E is propelled into the cavity 21 and is subsequently removed by guidance element 3b to which a reduced pressure is applied by the pump or compressor 27c.

[0036] Fig. 5 shows a guidance element 3c from which a pressurized medium F emanates through a crosssectional opening 33 and additional lateral openings 32 into the cavity 21. Due to the pressure applied, the medium F flows towards the opening 24 of the cavity 21. The advantage of a perforated guidance element 3c is that no temperature gradient is generated by release of the heated medium F from a single point within the cavity 21.

[0037] Fig. 6 shows an embodiment where a guidance element 3d is used to release the heated medium G from within the cavity 21. In order to generate a balanced, bidirectional flow, fans 5 remove the gaseous medium G from both sides from the cavity 21 by means of guidance elements 3e.

Claims

1. An arrangement for fluidizing and/or thermal curing of and/or drying a coating (22, 23) in a cavity of a vehicle body (2) through a process, characterized by a device (1) for directing a medium (A, B, C, D, E, F, G) through the cavity (21).

2. Arrangement according to claim 1, wherein the device (1) comprises a heating unit (4) for heating the medium (A, B, C, D, E, F, G).

3. Arrangement according to one or more of the preceding claims, characterized in that the device (1) comprises at least one guidance element (3, 3a, 3b, 3c, 3d,3e) for directing the medium (A, B, C, D, E,

F, G) through the cavity (21).

4. Arrangement according to claim 3, characterized in that at least one guidance element (3) is designed to be adapted to an opening (30) of the cavity (21).

4. Arrangement according to claims 3 to 4, characterized in that at least one guidance element (3b, 3c,3d) is designed to be introduced into said cavity (21).

5. Arrangement according to one of the preceding claims, characterized in that the device (1) comprises means to accelerate the medium (A, B, C, D, E, F, G), which means preferably comprise a fan (5) or a pump (27).

7. Arrangement according to one of the proceeding claims, characterized in that the medium (A, B, C, D, E, F, G) is a gas, preferably air.

8. Arrangement according to one of the proceeding claims, characterized in that the medium is a fluid (D).

9. Arrangement according to one of the preceding claims, characterized in that the device (1) comprises a plurality of guidance elements (3), preferably for directing the medium (A, B, C, D, E, F, G) simultaneously into a plurality of cavities (21) in the vehicle body (2).

10. Arrangement according to one of the preceding claims, characterized in that the device (1) is part of a manufacturing line (11) for vehicles, preferably for cars.

11. Use of a ventilation device (5) for directing a stream of air (A, B, C,F,G) into a cavity (21) of a vehicle body (2) containing an anti-corrosion coating (22, 23).

12. A method for fluidizing and/or thermal curing and/or drying a coating (22, 23) in a cavity (21) of a vehicle body (2), characterized in that a stream of a gas (A, B, C, E, F, G) or fluid (D) is directed through the cavity (21) to which a coating (22, 23) has been applied.

13. A method according to claim 12, comprising the steps of:

(a) optionally, heating a stream of gas or fluid (A, B, C, D);
(b) optionally, heating the cavity (21) by directing a stream of hot gas or fluid (A, B, C, D) through said cavity (21);
(c) applying a coating (22, 23) in the cavity (21), and
(d) heating the coating (22, 23) by directing a stream of hot fluid or gas (A, B, C, D) through the cavity (21).

14. Method according to claim 12 or 13, comprising a further step of cooling the coating (22, 23) by directing a stream of gas or fluid (A, B, C, D) through the cavity (21).

15. Method according to one or more of the claims 12 to 14, wherein the medium (A, B, C; D) is directed into the cavity (21) and/or directed out of the cavity (21).

16. Method according to one or more of the claims 12 to 15, comprising the steps of:

(a) providing at least one device (1) to pressurize a medium and/or to evacuate or suck a medium from a cavity (21);
(b) connecting that device (la) to one or more guidance elements (3, 3a, 3b,3c) for directing the medium (A, B, C, D, E, F, G);
(c) connecting at least one guidance element (3, 3a, 3b, 3c) with said cavity (21).

17. A method according to claim 16, wherein the medium (A, B, C, D, E, F, G) is directed into the cavity (21) by pressure.

18. A method according to claim 16 or 17, wherein said medium (A, B, C, D, E, F, G) is evacuated or sucked from the cavity (21).

19. A method according to claim 18, wherein pressure and/or reduced pressure is applied within the cavity (21).

20. A method according to one or more of claims 12 to 19, comprising the further steps of:

(a) providing a guidance element (3a, 3b, 3c) which is capable of being inserted into a cavity (21);
(b) directing a stream of gas or fluid (A, B, C, D) through said guidance element (3b, 3c) into the cavity (21) and/or
(c) sucking a stream of gas or fluid (A, B, C, D) through said guidance element (3a) out of the cavity (21).

Fig 1

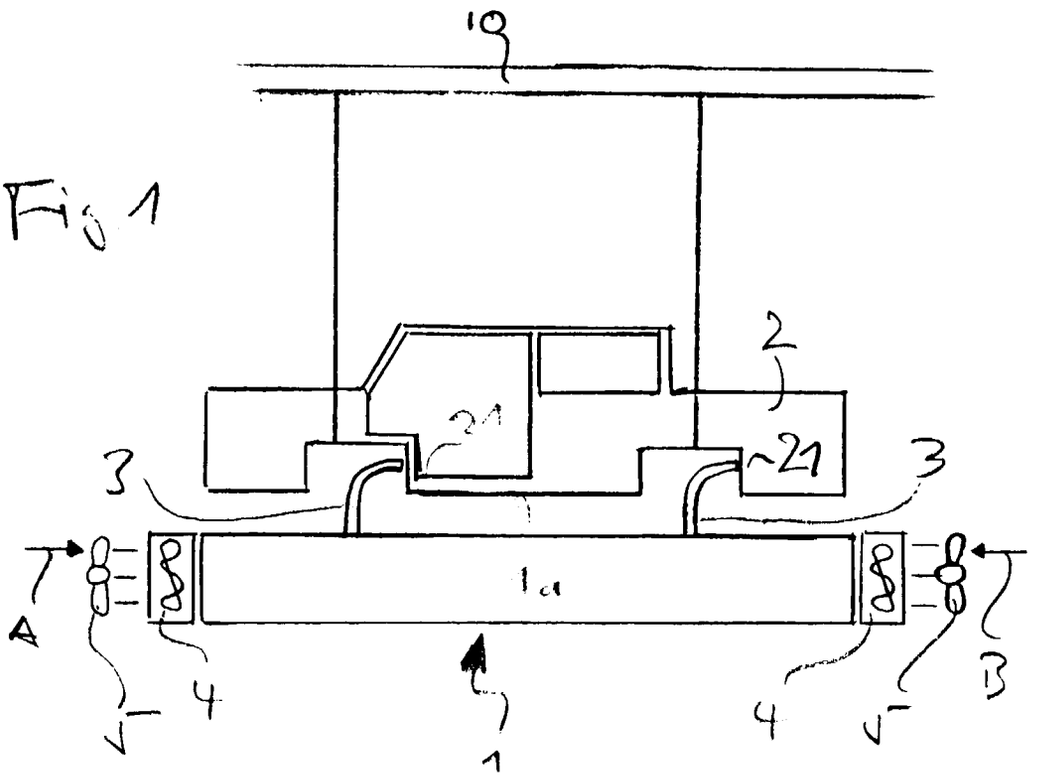


FIG.2

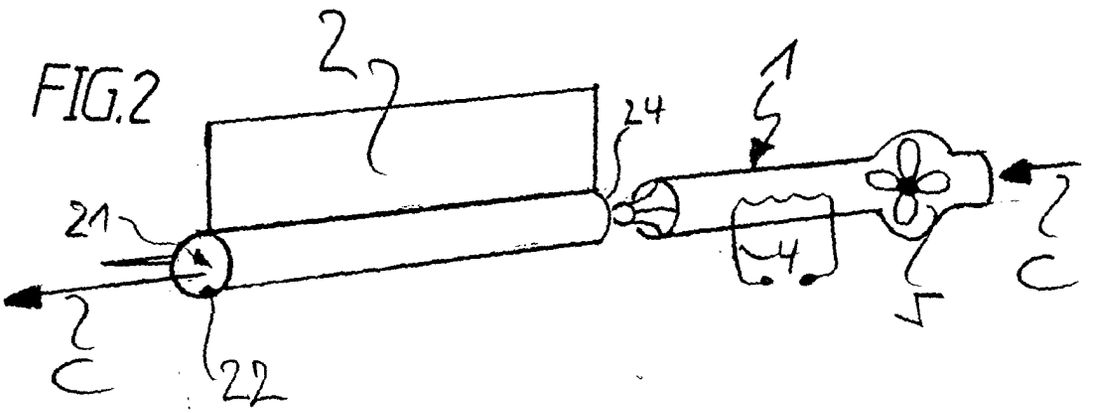


FIG.3

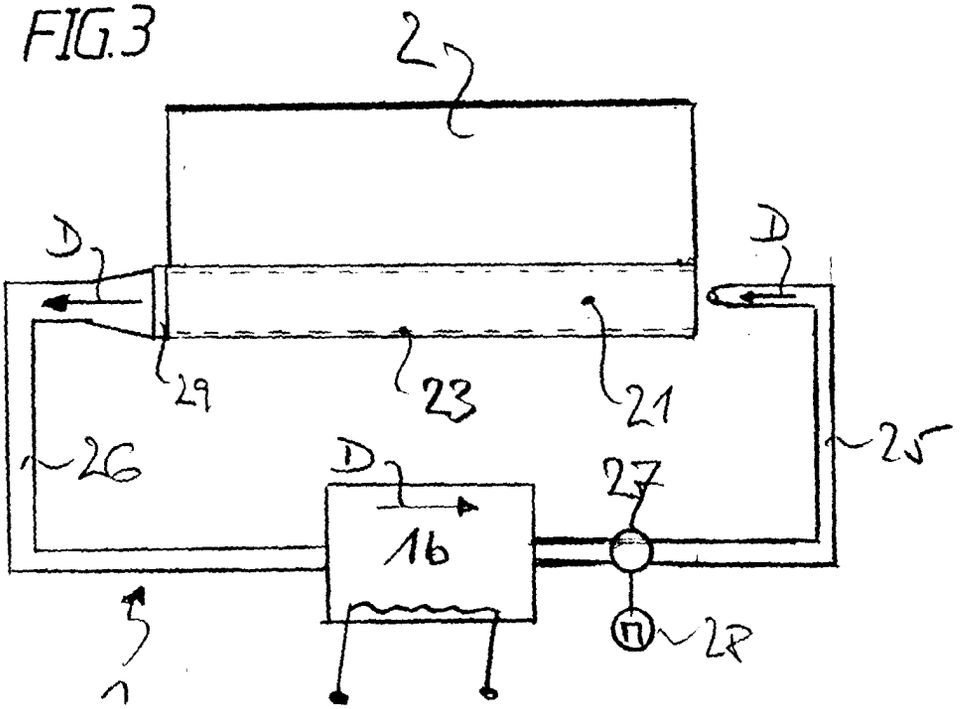


FIG.4

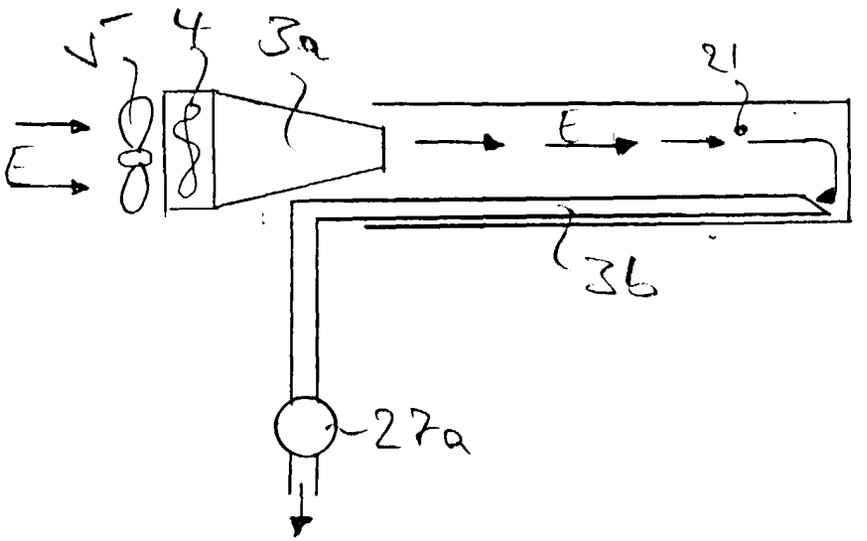


FIG.5

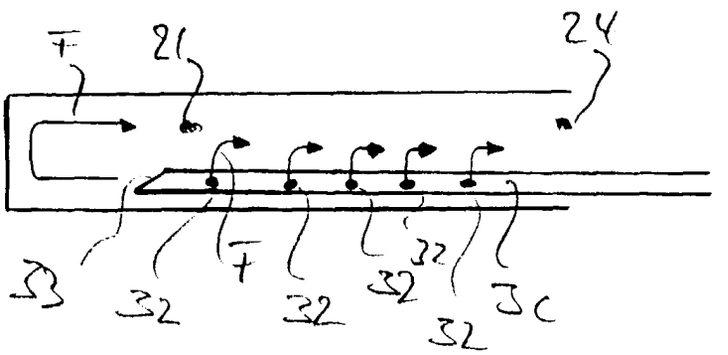
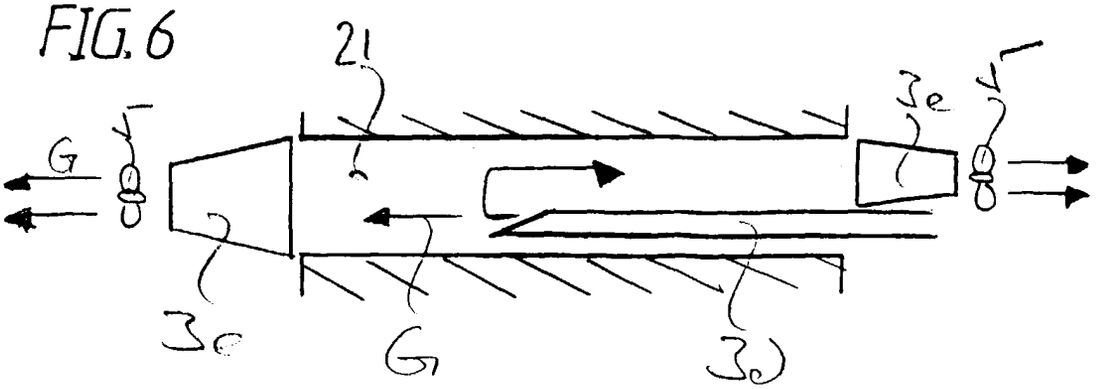


FIG.6



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EUROPEAN SEARCH REPORT

Application Number
EP 99 11 6621

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1995, no. 09, 31 October 1995 (1995-10-31) & JP 07 149544 A (SHIBUYA KOGYO CO LTD), 13 June 1995 (1995-06-13) * abstract *	1,3-5,7, 8,11,12, 14-17,19	B05C9/14 B05C11/06 B05C7/00
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 261 (C-0950), 12 June 1992 (1992-06-12) & JP 04 059959 A (KAWASAKI STEEL CORP), 26 February 1992 (1992-02-26) * abstract *	1,3-5,7, 8,11,12, 14-17	
X A	DE 24 33 310 A (BUECHNER GEORG) 22 January 1976 (1976-01-22) * page 20; claim 1; figure 9 *	1-5,7,8, 11,12, 14-17,19 9	
A	WO 96 19296 A (AKASAKA KENSAKU ;HONDA MOTOR CO LTD (JP)) 27 June 1996 (1996-06-27) * abstract; figures *	1,11,12	TECHNICAL FIELDS SEARCHED (Int.Cl.7) B05C
A,D	EP 0 003 223 A (VOLKSWAGENWERK AG) 8 August 1979 (1979-08-08) * the whole document *	1,11,12	
A	DE 40 27 634 A (TITTGEMEYER ENGINEERING GMBH) 5 March 1992 (1992-03-05) * column 3, line 37 - column 4, line 9; figures *	1,12	
A	US 4 101 623 A (WEBSTER JOHN DAVID ET AL) 18 July 1978 (1978-07-18) * column 3, line 37 - column 4, line 13; figures *	1,12	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	3 February 2000	Brévier, F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EUROPEAN SEARCH REPORT

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EP 99 11 6621

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl7)
A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 233 (C-304), 19 September 1985 (1985-09-19) & JP 60 090077 A (MAZDA KK), 21 May 1985 (1985-05-21) * abstract *		

TECHNICAL FIELDS SEARCHED (Int.Cl7)

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 11 6621

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03-02-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 07149544 A	13-06-1995	NONE	
JP 04059959 A	26-02-1992	JP 2765591 B	18-06-1998
DE 2433310 A	22-01-1976	NONE	
WO 9619296 A	27-06-1996	JP 2831288 B	02-12-1998
		JP 8173882 A	09-07-1996
		JP 8173897 A	09-07-1996
		CA 2174316 A	27-06-1996
		CN 1141601 A	29-01-1997
		GB 2303085 A,B	12-02-1997
		US 5686145 A	11-11-1997
EP 0003223 A	08-08-1979	DE 2755947 A	21-06-1979
DE 4027634 A	05-03-1992	NONE	
US 4101623 A	18-07-1978	GB 1533233 A	22-11-1978
		AU 8637375 A	12-05-1977
		BR 7507728 A	10-08-1976
		CA 1069776 A	15-01-1980
		DE 2551168 A	12-08-1976
		ES 442852 A	01-06-1977
		FR 2291801 A	18-06-1976
		JP 992763 C	15-04-1980
		JP 51071364 A	21-06-1976
		JP 54028863 B	19-09-1979
		SE 7513054 A	24-05-1976
		ZA 7506843 A	27-10-1976
		ZM 15975 A	21-04-1977
JP 60090077 A	21-05-1985	NONE	

EPO FORM P0459

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