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(54) Title: SYSTEM AND METHOD FOR IMPROVING TRACTION ON WET ROAD SURFACES

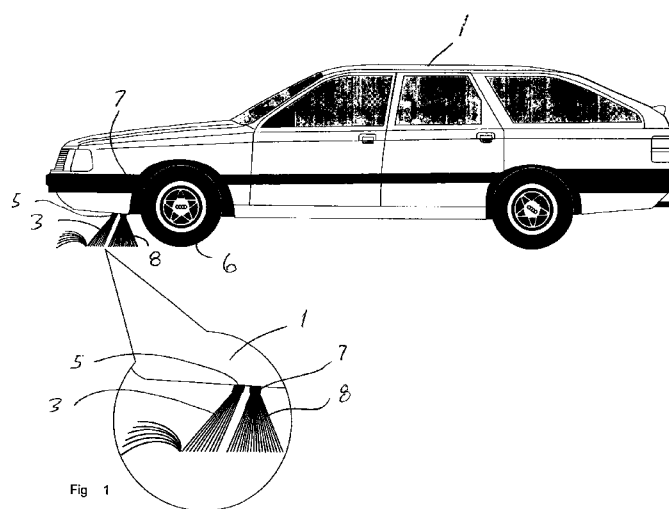


Fig. 1

(57) Abstract: The present invention concerns a system (2) for reducing the risk of hydroplaning for a vehicle (1) driven on a wet road surface including at least one first source of compressed air, at least one control system, at least one first pressure emitting nozzle (5), jet or similar. The present invention's unique feature is that it includes at least one first nozzle (5) which is arranged to emit at least one first high pressure air blast (3) which breaks the effect of wind's slipstream, and that the second nozzle (7) is arranged to emit at least one second high pressure air blast (8) which clears (blows away) completely or partially the water layer on the road surface in front of at least one of the vehicle's (1) tires (wheels) (6).

System and Method for Improving Traction on Wet Road Surfaces

Field of the Invention

The present invention relates to a system and method for improving road traction during wet driving conditions in accordance with the claims.

5 Background of the Invention

The injuries and suffering that arise in conjunction with traffic accidents are a significant problem in today's society. There are many reasons for the cause of accidents. One of the reasons is that vehicles travel at speeds that are greater than what road traction, that is to say the tire's grip on the underlying surface allows. Having sufficient road grip between the
10 vehicle's tires and the road surface is essential for enabling a vehicle to travel in a safe and reliable manner.

Another reason for the cause of accidents is that the vehicle operator is not experienced with inadequate road traction conditions. The reasons for the occurrence of inadequate road traction are many. For example, if the road surface is covered with snow, ice or the like, this
15 will diminish traction considerably. This has traditionally been solved by using different types of tires for summer or winter.

Road traction can also be quickly diminished when the surface is wet, which for instance is most commonly caused by rain. During rain or similar weather conditions, the amount of water on the road surface increases the risks of hydroplaning occurring. Especially heavy rain
20 increases significantly the risks of vehicle's hydroplaning. The risk for hydroplaning also increases when a vehicle is traveling at high speeds on wet roads. Hydroplaning is when the tire loses its grip on the road surface and the tire "skates" on the water. When a vehicle hydroplanes it temporarily becomes unable to maneuver which dramatically increases the risk that the vehicle slides from its traffic lane and either meets oncoming traffic, a guardrail or the
25 shoulder of the road. Vehicles that leave their traffic lane in this fashion usually end up in some kind of accident where material and personal damages can be substantial. In the worst cases death may even occur.

Special treads for tires have been developed which are optimized to handle both dry and wet road conditions. It is not realistic for normal driving to change tires to match the changes in

weather from dry conditions to wet. Therefore, tire treads are designed as a compromise between these two extremes for both economic and practical reasons.

Furthermore, the inside of the wheel well on most vehicles is not designed to lead off water that is thrown up from the tire's tracks. When the rear wheels have reached the point where
5 the front wheels have just passed, there is essentially just as much water present on the road surface as there was when the front wheels previously passed through. Therefore, there is a need for technology that can greatly improve tire traction on wet road surfaces.

A problem incurred by existing systems that utilize air to improve road grip is vehicle slipstream. A vehicle's slipstream works against the effects of the produced airstream's ability
10 to displace water from the road surface. There is a clear need of a system and method that can minimize or alleviate the above mentioned problems with current technology.

Prior Art

There are previously existing and known devices intended for reducing the risk for hydroplaning. For example patent US5350035 describes a system that is used to reduce the
15 risk of hydroplaning. The system has sensors that detect when a tire loses its grip in conjunction with a vehicle hydroplaning. When the sensors detect that the tire is starting to hydroplane, a jet of compressed air is used to blow away the water layer from in front of the tire. This design is vastly different from the method and system described in the present invention. For example, the design according to US5350035 does not mention the use of a
20 first nozzle and a second nozzle as described in this present invention. Furthermore, the air is not pulsed in the same fashion as in accordance with the present invention.

Patent US6270118 also describes a method and device that prevents poor road grip during wet conditions. Even this design is vastly different from the method and system described in the present invention. For example, the compressed air is not pulsed. Furthermore the design
25 lacks forward and rear nozzles in accordance with present invention.

Patent US4834320 describes a method and device that is used to reduce the breaking distance for an aircraft on a wet runway. According to the patent description, the system uses nozzles that blow away the water on the surface in front of the aircraft's tire. This design and method is vastly different from the method and system in accordance with the present patent
30 application.

Another known design that is used to reduce the risk for hydroplaning is describes in DE2239022. According to the patent description, the design lacks a first and a second nozzle in accordance with the design of the present invention.

Brief Description of the Invention Concept

- 5 The main purpose of the present invention is to create a significantly more effective method to reduce the risk of hydroplaning occurring as compared to all previously known methods. Another purpose of the present invention is to achieve a method that stops hydroplaning if hydroplaning occurs. Yet another purpose of the present invention is to achieve a system with which the method can be implemented.

10 Detailed Description of the Invention

The present invention will be described in greater detail below with reference to the accompanying schematic drawings that in an exemplifying purpose show the current preferred embodiments of the present invention.

- 15 Figures 1 and 2 show schematically a vehicle provided with a device in accordance with the present invention.

Figure 3 shows in a diagram a system in accordance with the present invention.

Figure 4 shows the pulsing flow between the first nozzle and the second nozzle.

Figure 5 shows in the figure the characteristics of the pulse.

- 20 With reference to the figures is shown a vehicle 1 equipped with a system 2 in accordance with the present invention. The system 2 is intended to be used to reduce the risk of hydroplaning when a vehicle is driven on a wet road. The vehicle 1 may be a car, a bus, a truck, a motorcycle, an aircraft or other type of wheeled vehicle.

- 25 The system 2 includes a function with which at least one high pressure blast 3 of compressed air from a compressed air source 4 through at least one first nozzle 5, jet or similar is emitted towards the surface of the road in front of at least one of the vehicle's tires (wheels) 6. The system 2 also includes at least one second nozzle 7, placed behind the first nozzle 5 in the vehicle's direction of travel but in front of the tire (wheel) 6, which emits at least one second high pressure blast 8 towards the surface of the road in front of the tire (wheel) 6. The nozzle

7 is designed to deliver the high pressure blast 8 with high intensity directed towards the water layer on the surface of the road.

In the preferred embodiment, the first nozzle 5 is designed to deliver the first high pressure air blast 3 at an askew forward angle in the vehicle's direction of travel. The angle between the road surface and the emitted high pressure air blast 3 is preferably from 91 to 120 degrees. In alternative embodiments the angle may be of another for the purpose suitable angle. The first high pressure air blast 3 is designed to substantially offset the slipstream wind effect on the second high pressure air blast 8 from the second nozzle 7. The first high pressure air blast 3 also has the task of reducing the amount of water in the water layer on the surface in front of the tire (wheel). The second nozzle 7 sends out at least one second high pressure air blast 8 towards the road surface in front of at least one of the vehicle's tires (wheels) 6 in the vehicle's direction of travel. The second high pressure air blast 8 will partially or completely remove the layer of water in front of the tire (wheel) 6.

With reference to figure 3, an example is schematically shown of a compressed air system that allows for the realization of the method in accordance with the present invention. The compressed air system includes at least one compressed air feed 9 from a pressurized air source (not shown in the figures) which via at least one check valve 10 and at least one pressure monitor 11 is transferred to at least one pressure tank 12. The pressure tank 12 in alternative embodiments may be made up of at least one interchangeable (replaceable) or portable tank. It is therefore also conceivable that a docking system for these pressurized tanks or similar exists.

The compressed air feed 9 may come from an external source or from an internal "on-board" pressurized air source in the vehicle. The on-board source may be a compressor or other device that can create compressed air. For example, it is conceivable that the vehicle's own exhaust gases may be used as a part of the compressed air device. The check valve 10 prevents the compressed air from the pressure tank 12 escaping in the reverse direction. The air that is fed from the pressure tank 12 may be regulated by at least one regulator 13. The regulator 13 may for example be used to control turning on and off the system in full and be used to optimize the pressure in the system.

The system design may also include at least one first control valve 14 that controls turning on and off the high pressure air blast 3 for the first nozzle 5. The design also incorporates at least one second control valve 15 which controls turning on and off the high pressure air blast 8 for

the second nozzle 7. Placed between the regulator 13 and the control valve 14 is preferably at least one first choke 16. Placed between the regulator 13 and the control valve 15 is preferably at least one second choke 17. The chokes are used to optimize the flow. The first control valve 14 and the second control valve 15 consist preferably of high-speed solenoid valves, in other words, control valves that can rapidly open and shut (quick on and off). This quick open and shut action of the valves increases the effectiveness of the water removal capacity of the high pressure air blasts. The force of impact on the water surface will be greatly intensified compared to using slower control valves.

Further, the system 2 includes at least one control system that controls the functions of the system. The control system controls the on and off switching of the system in its entirety. This function is for example applied when the risk for hydroplaning occurs or has already commenced. The control system gathers information from at least one sensor, and preferably from many sensors. The sensors detect tire (wheel) rotation speed, the velocity of the vehicle relative to the surface. The sensors may consist of sensors that are part of other, previously existing systems within the vehicle, such as for example, sensors in vehicle's ABS system and other appropriate systems. The control system also includes a function with which the frequency between the high pressure air blasts as well as the length of time of the high pressure air blasts can be adjusted in relation to the vehicle's speed. The switching between the front and rear nozzles is fully and freely programmable with the control system. The high pressure air blast is synchronized with the vehicle's speed.

In the preferred embodiment of the present method, the high pressure air blast 3 and the high pressure air blast 8 pulsate. First, a pulse of high pressure air blast 3 from the first nozzle 5 is emitted and thereafter a pulse of high pressure air blast 8 from the second nozzle is emitted. These pulses are illustrated in figure 4. The pulse of the first high pressure air blast 3 from the first nozzle 5 is intended to counteract the negative effect of slipstream on the second high pressure air blast 8 from the second (rear) nozzle 7. The first high pressure air blast 3 from the first nozzle 5 also has the task of reducing the amount of water in the water layer on the road surface in front of the progressing tire (wheel). The pulse of the high pressure air blast 8 from the second nozzle 7 removes partially or completely the layer of water on the road surface in front of the tire (wheel) 6. In the preferred embodiment, pulses are emitted with a pulse width (length) in the range from 5-100 milliseconds. Preferably the pulses are emitted with pulse widths amounting to 20-70 milliseconds. In alternative embodiments, it is conceivable that the pulses' pulse widths are shorter or longer than those stated above.

Figure 5 shows an example of the actual characteristics of pressure pulses taken from trials using equipment and a method in accordance with the present patent application. The figure consists of a Y-axis that shows the air volume at normal pressure. The X-axis in the figure shows the duration of the pulse length, which in the figure has a length of 50 milliseconds.

- 5 In alternative embodiments, it is conceivable that the emitted pressure pulses' duration as well as the duration between each pulse may vary widely within the scope of the present invention. It can also be proposed, that the pressure pulses overlap each other in time. By the first high pressure air blast 3 and the second high pressure air blast 8 being emitted in pulses, it is also possible to achieve a reduction in the volume of compressed air used.
- 10 With four-wheeled vehicles, or other vehicles with two wheels on the same axel, the system includes preferably at least one compressed air emitting first nozzle 5 and at least one second compressed air emitting second nozzle 7 placed in front of at least two (a first wheel 6 and a second wheel) or four of the vehicle's wheels (a first wheel 6, a second wheel, a third wheel and a forth wheel). In alternative embodiments, it is conceivable that all the vehicle's 1
- 15 wheels are equipped with one first nozzle 5 and one second nozzle 7.

In the detailed description of the present invention, design details may have been omitted which are apparent to persons skilled in the art. Such obvious design details are included to the extent necessary so that the proper and full performance of the present invention is achieved.

- 20 Even if certain preferred embodiments have been described in detail, variations and modifications within the scope of the invention can become apparent for specialists in the field and all such are regarded as falling within the scope of the following claims. For example, it is conceivable that that the system includes sensors that detect tire (wheel) rotation speed and that the system uses this data to determine if any tire is hydroplaning. It is
- 25 also conceivable that the first high pressure air blast 3 and the second high pressure air blast 8 are mounted in parallel.

Advantages of the Invention

- With the present invention several advantages are achieved The most apparent of these is that hydroplaning can essentially be eliminated for wheeled vehicles. Another benefit of the
- 30 present invention is that the system stops hydroplaning if the vehicle hydroplanes. The

pulsating high pressure air delivers high intensity blasts to the water layer on the surface of the road.

Claims

1. System (2) that reduces the risk of hydroplaning for a vehicle (1) driven on a wet road surface including at least one first source of compressed air, at least one control system, at least one first pressure emitting nozzle (5), jet or similar, and at least one second pressure emitting nozzle (7), jet or similar **characterized by** that the first nozzle (5) and the second nozzle (7) are mounted after each other in the vehicle's direction of travel and that the first nozzle (5) is arranged to emit at least one first high pressure air blast (3) which breaks the effect of wind's slipstream, and that the second nozzle (7) is arranged to emit at least one second high pressure air blast (8) which clears (blows away) completely or partially the water layer on the road surface in front of at least one of the vehicle's (1) tires (wheels) (6).
2. System (2) according to claim 1 **characterized by** that the system emits pulsating high pressure air blasts (3, 8).
3. System (2) according to claim 1 **characterized by** that the high pressure air blast (3) from the first nozzle (5) is aimed in a forward askew angle towards the surface of the road.
4. System (2) according to claim 1 **characterized by** that the high pressure air blast (3) from the first nozzle (5) is angled towards the surface of the road within the interval of 91-120 degrees.
5. Method for utilizing a system (2) in accordance with one or more of claims 1-4 **characterized by** that the first high pressure air blast (3) is emitted by at least one first nozzle (5) and at least one second high pressure air blast (8) is emitted by at least one second nozzle (7) in the direction of the road surface in front of the tire (wheel) (6) in the direction of travel whereby the first nozzle (5) emits a high pressure air blast (3) that breaks the effect of wind's slipstream on the second high pressure air blast (8) and that the second high pressure air blast (8) from the second nozzle (7) clears (blows away) completely or partially the water layer from an area in front of the tire (wheel).
6. Method in accordance with claim 5 **characterized by** that the first nozzle (5) emits a first pulsating high pressure air blast (3) and that the second nozzle (7) emits a second pulsating high pressure air blast (8).

7. Method in accordance with claim 6 **characterized by** that the first pulsating high pressure air blast (3) and the second pulsating high pressure air blast (8) are emitted alternately.
8. Method in accordance with one or more of claims 6 and 7 **characterized by** that the high pressure air blast's pulse width (duration) lasts from 5-100 milliseconds.
9. Method in accordance with claim 8 **characterized by** that the high pressure air blast's pulse width (duration) lasts from 20-70 milliseconds.
10. Method in accordance with claim 9 **characterized by** that the high pressure air blast's pulse width (duration) lasts for 50 milliseconds.

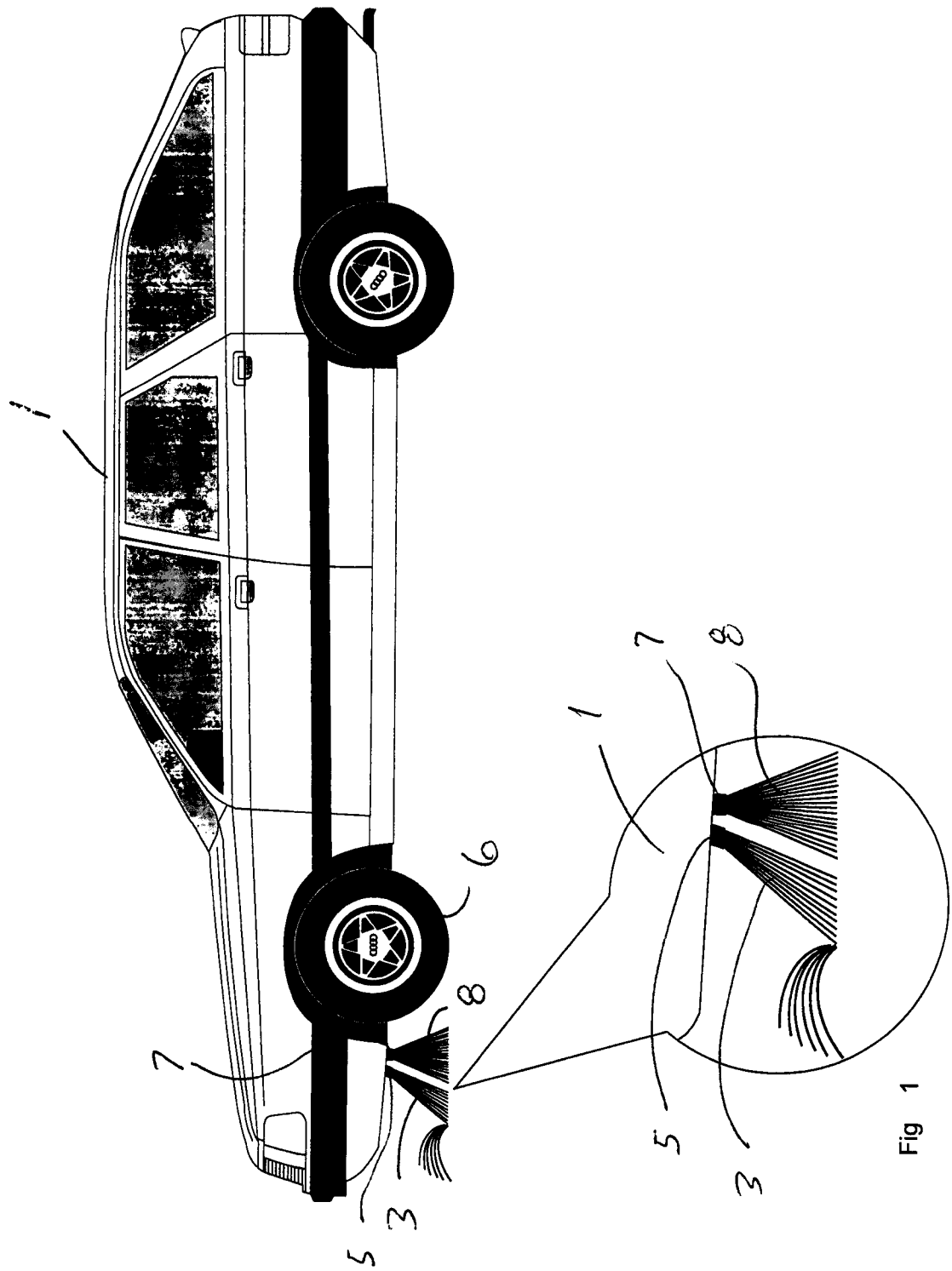
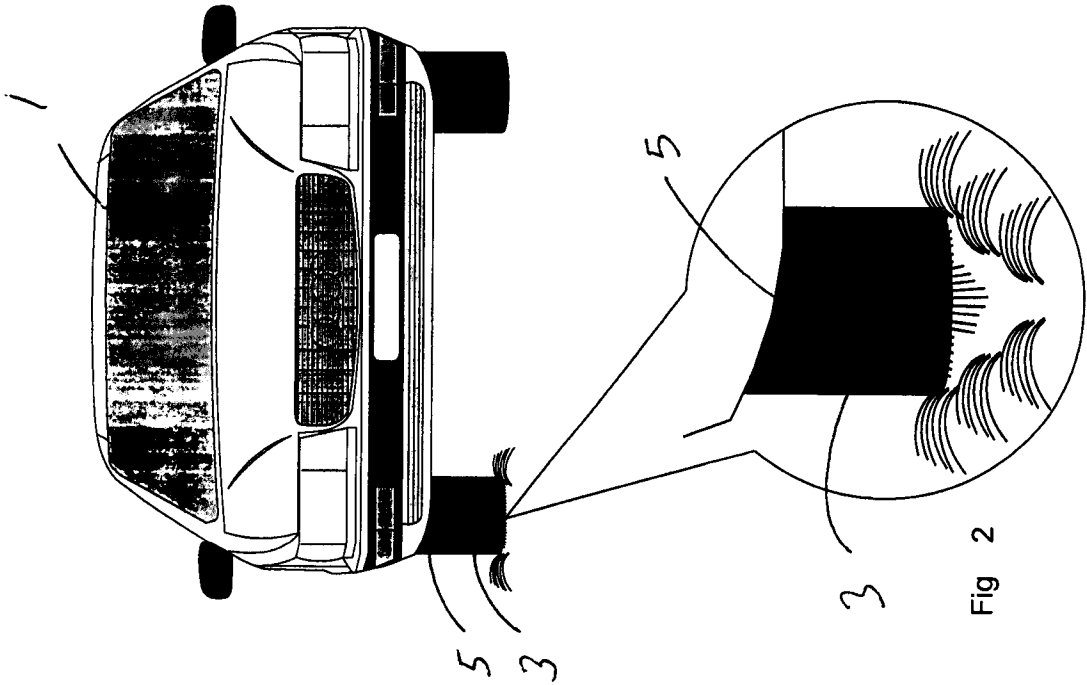


Fig 1



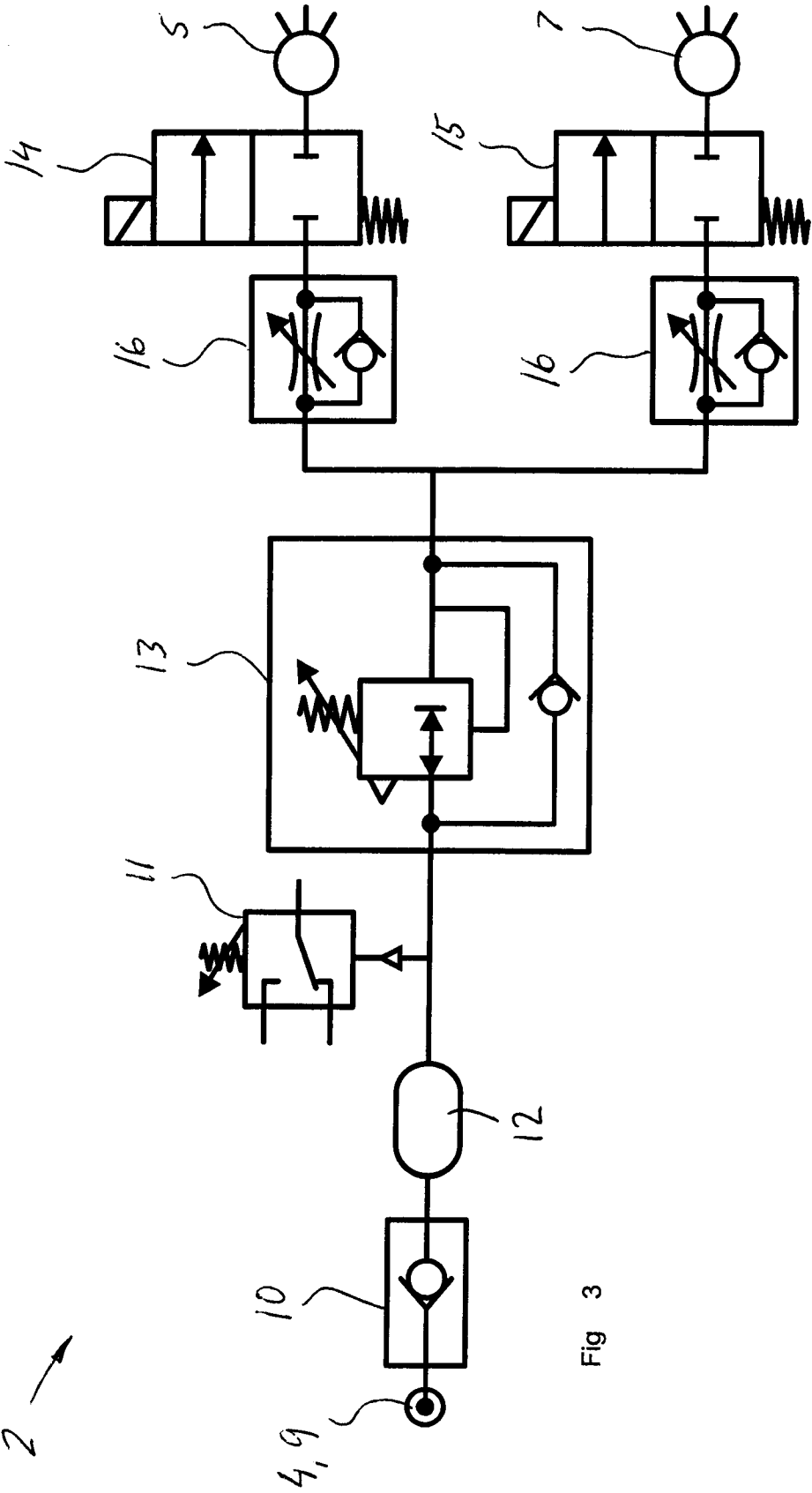


Fig 3

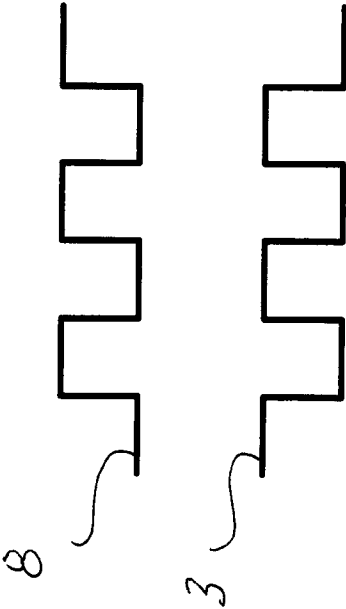


Fig 4

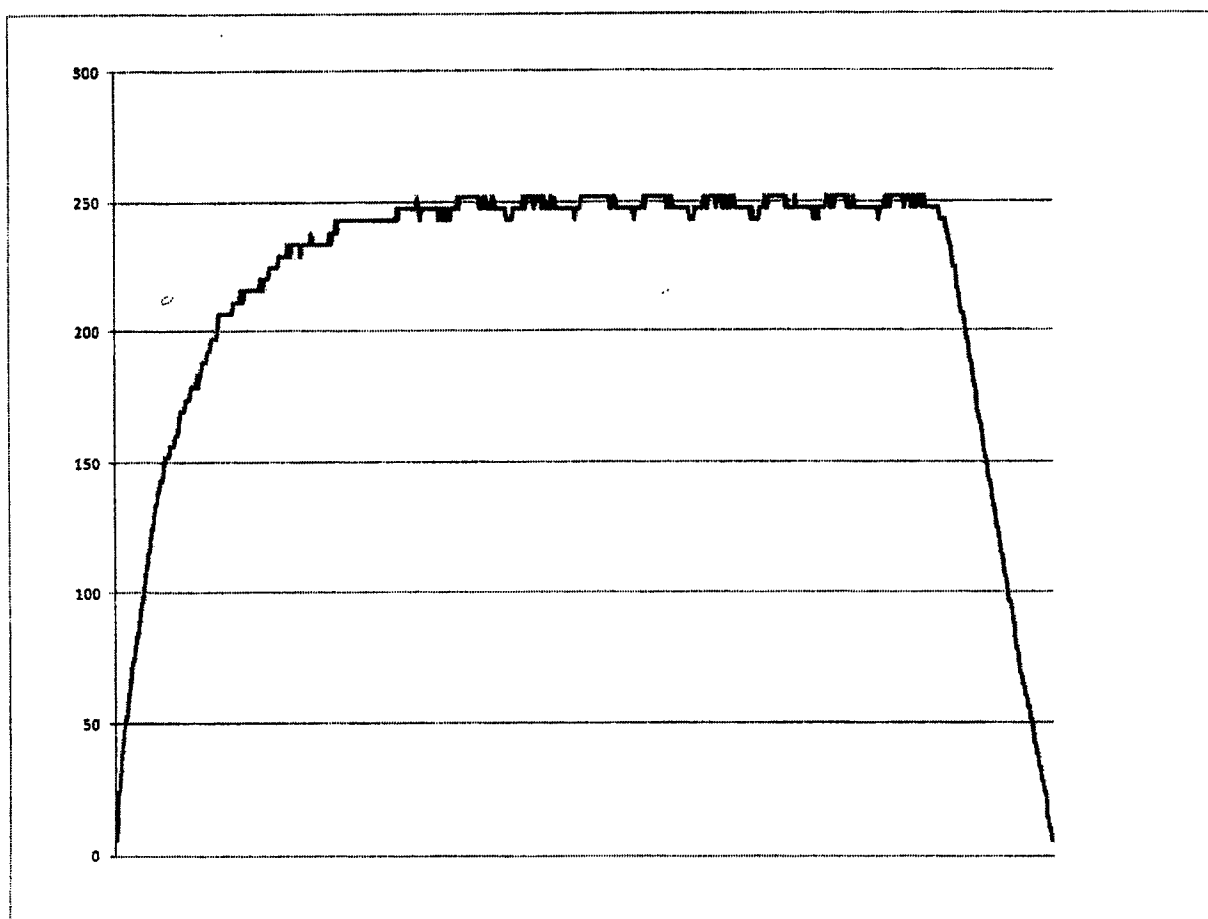


FIG 5

INTERNATIONAL SEARCH REPORT

International application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2006034515 A1 (MARAIS, JOHAN, CHRISTIAAN), 30 March 2006 (30.03.2006) --	1-10
A	DE 10258843 A1 (KETTENHOFEN, HANS-GEORG), 8 July 2004 (08.07.2004) --	1-10
A	WO 2007056834 A1 (SMILJANIC, MARIO), 24 May 2007 (24.05.2007) --	1-10
A	DE 2552075 A1 (PENZKOFER, JOSEF), 26 May 1977 (26.05.1977) -- -----	1-10

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/SE2011/000030

WO	2006034515	A1	30/03/2006	NONE
DE	10258843	A1	08/07/2004	NONE
WO	2007056834	A1	24/05/2007	NONE
DE	2552075	A1	26/05/1977	NONE