



(51) International Patent Classification:

B60H 1/00 (2006.01) **B60W 40/02** (2006.01)

(21) International Application Number:

PCT/EP2017/071773

(22) International Filing Date:

30 August 2017 (30.08.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1615234.0 08 September 2016 (08.09.2016) GB

(71) Applicant: **JAGUAR LAND ROVER LIMITED**
[GB/GB]; Abbey Road Whitley, Coventry Warwickshire
CV3 4LF (GB).

(72) Inventors: **SMITH, Richard**; c/o Jaguar Land Rover,
Patents Department W/1/073 Abbey Road, Whitley, Coventry
Warwickshire CV3 4LF (GB). **ANDERSON, Craig**; c/
o Jaguar Land Rover, Patents Department W/1/073 Abbey
Road, Whitley, Coventry Warwickshire CV3 4LF (GB).

(74) Agent: **DITUM, Caroline**; Jaguar Land Rover, Patents De-
partment W/1/073 Abbey Road, Whitley, Coventry War-
wickshire CV3 4LF (GB).

(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: APPARATUS AND METHOD FOR CONTROLLING AIR-INLET FLOW BASED ON NEIGHBOURING VEHICLES

(57) Abstract: The present invention provides an air inlet controller for a vehicle, comprising: input means (440) arranged to receive a neighbouring vehicle signal indicative of a presence of a neighbouring vehicle; output means arranged to output a flow control signal to control a flow control means (fan) for controlling a flow of air through an air inlet of the vehicle; and processing means (450, 460) arranged to determine the flow control signal in dependence on the neighbouring vehicle signal thereby to compensate for an effect on pressure distal of an air inlet associated with the presence of the neighbouring vehicle.

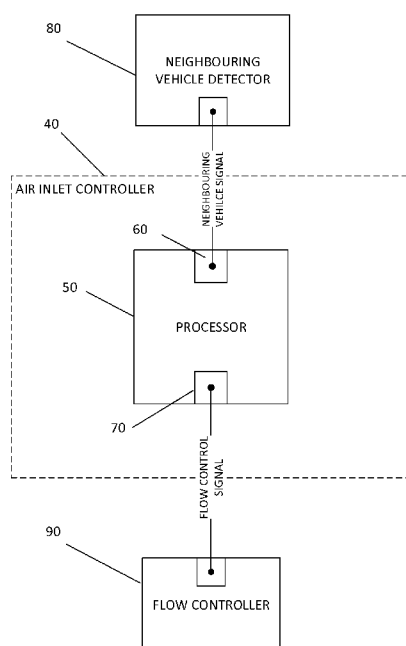


Fig. 7



APPARATUS AND METHOD FOR CONTROLLING AIR-INLET FLOW BASED ON NEIGHBOURING VEHICLES

TECHNICAL FIELD

5

The present disclosure relates to an apparatus and method for controlling air-inlet flow based on a neighbouring vehicle. Aspects of the invention relate to an air inlet controller for a vehicle, an air intake system comprising the air inlet controller, a vehicle comprising the air inlet controller or system, a method of controlling air intake in respect of a vehicle, and software, a computer readable medium, and a processor for implementing the method of controlling air intake in respect of a vehicle.

BACKGROUND

15 In order to compensate for an increase in air pressure distal of an air inlet of a vehicle, a flow control means such as a fan may be set based on vehicle speed, e.g. the speed of the fan may be reduced with increasing vehicle speed.

However, setting the flow control means based on vehicle speed alone may be inappropriate in certain circumstances, leading to overcompensation and inadequate air intake.

It is an object of embodiments of the invention to provide improved air inlet control.

SUMMARY OF THE INVENTION

25

Aspects and embodiments of the invention provide an air inlet controller for a vehicle, an air intake system comprising the air inlet controller, a vehicle comprising the air inlet controller or system, a method of controlling air intake in respect of a vehicle, and software, a computer readable medium, and a processor for implementing the method of controlling air intake in respect of a vehicle.

According to an aspect of the invention there is provided an air inlet controller for a vehicle, comprising: input means arranged to receive a neighbouring vehicle signal indicative of a presence of a neighbouring vehicle; output means arranged to output a flow control signal to control a flow control means for controlling a flow of air through an air inlet of the vehicle; and processing means arranged to determine the flow control signal in dependence on the

neighbouring vehicle signal thereby to compensate for an effect on air pressure distal of an air inlet associated with the presence of the neighbouring vehicle.

The presence of a neighbouring vehicle can affect the pressure distal of an air inlet of the vehicle. A reduction in pressure distal of the air inlet can result in a reduced air flow through the air inlet. Accordingly, by determining a flow control signal in dependence on a neighbouring vehicle signal indicative of a presence of a neighbouring vehicle, it is possible to compensate for an effect on the pressure associated with the presence of the neighbouring vehicle.

Conversely, an increase in pressure distal of the air inlet can result in an increased air flow through the air inlet. Accordingly, by determining a flow control signal in dependence on a neighbouring vehicle signal indicative of an absence of a neighbouring vehicle, it is possible to compensate for an effect on the pressure associated with the absence of a neighbouring vehicle. This advantageously may reduce the energy requirements of the flow control means by, for example, reducing a fan speed. The flow control means may operate in a "sailing mode" in dependence on the flow control signal thereby reducing the energy requirements of the flow control means.

The neighbouring vehicle signal may be indicative of a characteristic of the neighbouring vehicle; and the flow control signal may be determined in dependence on the characteristic of the neighbouring vehicle. The effect of a neighbouring vehicle on the pressure distal of an air inlet of the vehicle will be dependent on the characteristics of the neighbouring vehicle and therefore by determining the flow control signal in dependence on a characteristic it is possible to more accurately compensate for the presence of the neighbouring vehicle.

The characteristic may comprise neighbouring vehicle speed. The characteristic may comprise neighbouring vehicle size. The characteristic may comprise neighbouring vehicle proximity. The characteristic may comprise estimated wake region characteristics. Employing more than one characteristic will synergistically contribute to greater accuracy in respect of compensating for the effect of the neighbouring vehicle; with each further characteristic the effect of the neighbouring vehicle can be more accurately predicted.

The input means may be arranged to receive a vehicle speed signal indicative of the speed of the vehicle; and the processing means may be arranged to determine the flow control signal in dependence on the speed of the vehicle. The speed of the vehicle affects the pressure distal of the air inlet of the vehicle owing to a so-called 'ram air' effect. By determining the flow control signal further in dependence of the vehicle speed, it is possible to compensate for both the

influence of the neighbouring vehicle and the 'ram air effect' in determining the flow control signal.

The processing means may be arranged to initially determine the flow control signal in dependence on the speed of the vehicle and revise the flow control signal in dependence on the neighbouring vehicle signal. This offers the possibility to facilitate improved backwards compatibility with any existing system that already determines a flow control signal in dependence on vehicle speed.

The processing means may be arranged to determine a frequency of neighbouring vehicles in dependence on the neighbouring vehicle signal thereby to estimate a traffic density; and the flow control signal may be determined in dependence on the estimated traffic density. Traffic density can affect the pressure distal of the air inlet of a vehicle, and therefore by determining the flow control signal in dependence on the estimated traffic density, it is possible to compensate for the effect of the traffic density.

The processing means may be arranged to communicate with a wireless communication means to determine an estimated traffic density from a remote server; and the flow control signal may be determined in dependence on the estimated traffic density. This offers the possibility to either improve the estimation of traffic density as above or replace it with a potentially more accurate estimation given the prevalence of accurate road traffic mapping data available from remote servers.

The output means may be arranged to output an output flow control signal to control an outflow control means for controlling flow of air through an outlet of the vehicle; and the output flow control signal may be determined in dependence on the flow control signal. By determining the output flow control signal in dependence on the flow control signal it is possible to prevent positive or negative pressure build up in the vehicle.

According to another aspect of the invention there is provided an air intake system for a vehicle, comprising: an air inlet controller according to any preceding paragraph.

The air intake system may further comprise a flow control means.

The flow control means may comprise a fan. The flow control means may comprise a variable aperture. Either a fan or variable aperture can be provided or both together. The combination of a fan and variable aperture can facilitate improved backward compatibility with existing

systems already employing a fan, in the sense that the existing control of the fan speed can be retained and the variable aperture used to compensate for the effect of the neighbouring vehicle. Furthermore or alternatively the use of a variable aperture in addition with the fan may facilitate smoothing of the variation in fan speed, leading to reduced noise disturbance and an increased component longevity.

The air intake system may comprise neighbouring vehicle detection means arranged to output the neighbouring vehicle signal.

The neighbouring vehicle detection means may comprise a camera. The neighbouring vehicle detection means may comprise a proximity sensor. The use of the camera or proximity sensor enables improved backward compatibility by exploiting existing sensor systems in a vehicle. The use of the combination may facilitate yet further improved compensation by facilitating improved characterisation of the neighbouring vehicle.

The neighbouring vehicle detection means may be arranged to detect a vehicle situated in front of the vehicle. Vehicles situated in front of the vehicle will typically give rise to the greatest effect in respect of the pressure distal of the air inlet of the vehicle.

The neighbouring vehicle detection means may be arranged to detect a neighbouring vehicle situated at a side of the vehicle. The neighbouring vehicle detection means may be arranged to detect a neighbouring vehicle situated behind the vehicle. These features can facilitate prediction of overtaking of a neighbouring vehicle and determining the flow control signal in dependence of the predicted overtaking of the neighbouring vehicle. This facilitates a more rapid compensation of the effect of the neighbouring vehicle.

According to another aspect of the invention there is provided a vehicle comprising the air inlet controller or air intake system according to any preceding paragraph.

According to another aspect of the invention there is provided a method of controlling air intake in respect of a vehicle comprising: receiving a neighbouring vehicle signal indicative of a presence of a neighbouring vehicle; determining, in dependence on the neighbouring vehicle signal, a flow control signal to control a flow control means for controlling a flow of air through an air inlet of the vehicle thereby to compensate for an effect on pressure distal of an air inlet associated with the presence of the neighbouring vehicle; and outputting the flow control signal.

According to another aspect of the invention there is provided a computer program product executable on a processor so as to implement the method above.

According to another aspect of the invention there is provided a non-transitory computer readable medium carrying computer readable code which when executed causes a vehicle to carry out the method according to the method above.

According to another aspect of the invention there is provided a processor arranged to implement the method or computer product above.

According to an aspect of the invention there is provided a controller for controlling a heating, ventilation, and air conditioning HVAC system of a vehicle, comprising: input means arranged to receive a neighbouring vehicle signal indicative of a presence of a neighbouring vehicle, wherein the controller is configured to control an HVAC system in dependence on the neighbouring vehicle signal of a vehicle to compensate for the presence of a neighbouring vehicle.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the invention will now be described by way of example only, with reference to the accompanying drawings, in which:

Figure 1 shows an example of a vehicle having an air-intake system;

Figure 2 shows an example of a flow control means arranged to control the flow of air through an air inlet;

Figure 3 shows an example of a vehicle at speed experiencing a high pressure zone in the vicinity of the air inlet;

5 Figure 4 shows an example of a vehicle at speed with a neighbouring vehicle directly in front of the vehicle;

Figure 5 shows an example of a vehicle at speed with a neighbouring vehicle indirectly in front of the vehicle;

10

Figure 6 shows an example of a vehicle in dense traffic;

Figure 7 shows an example of an air inlet controller;

15 Figure 8 shows an example of an air intake system; and

Figures 9 and 10 show example methods of controlling air intake in respect of a vehicle.

DETAILED DESCRIPTION

20

Fig. 1 depicts a vehicle 1 having an air inlet 5. Vehicle air inlets are typically situated at the front of the vehicle and just below a vehicle windscreen 3, as is shown in Fig.1.

25 Fig. 2 depicts a flow control means 7 arranged to control the flow of air flowing through an air inlet 5. Air entering through the air inlet 5 flows through a conduit 9, and the through flow 8 is controlled by the flow control means 7.

30 The flow control means 7 may be controlled by a flow control signal, the flow control means 7 being caused to give a greater or lesser through flow of air depending on the flow control signal.

In Fig. 2 the flow control means 7 is a fan. In the case of a fan 7 acting as the flow control means, the flow of air through the air inlet 5 can be controlled via a flow control signal by increasing or decreasing the fan speed. The through flow 8 can be increased by increasing
35 the fan speed, or reduced by decreasing the fan speed.

The flow control means can take other forms. For example, the flow control means can comprise a variable aperture, not shown, and the extent of opening of the aperture can control the flow of air 8. An increase in flow can be effected by widening the aperture and conversely a limitation of flow can be effected by virtue of a narrowing of the aperture.

5

The flow control means need not be limited to a fan 7 or aperture; other forms of controlling of flow could equally constitute flow control means so long as the flow control means can provide a variable control over the flow of air through the air inlet 5.

10 Furthermore, the flow control means could comprise several flow control entities, e.g. the flow control means could comprise the combination of a fan 7 and variable aperture. In this case fan speed variation can be smoothed by employing the variable aperture, e.g. an extreme reduction in fan speed can be prevented by either only narrowing the aperture or slightly reducing the fan speed and narrowing the aperture. Conversely an extreme increase in fan
15 speed can be prevented by widening an aperture in isolation or in combination with a slight increase in fan speed. It will readily be appreciated that various combinations of increasing or decreasing fan speed and widening or narrowing of the aperture can be employed to give effect to an increase or decrease in the through flow.

20 The attention of the reader is now directed to Fig. 3. This figure illustrates the effect of vehicle speed in respect of the pressure in the vicinity of the air inlet 5. In particular, when a vehicle 1 is travelling at speed, there is a resultant high pressure region 11 in the vicinity of the air inlet 5. This may be described as a 'ram air' effect and can cause a number of unwanted effects such as unwanted noise, the cabin airflow exceeding a comfortable level, and the excess air
25 intake can give rise to interference with maintaining the user-selected cabin air temperature.

In order to counteract the 'ram air' effect, the flow control means can be adjusted to reduce the draw of air through the air inlet based on vehicle speed. Thus, in the case where the flow control means comprises a fan 7, the fan speed can be reduced so as to counteract the high
30 pressure region 11 in an effort to give rise to a constant through flow of air notwithstanding the increase in the pressure in the vicinity of the air inlet 5 arising from the vehicle 1 travelling at speed. This countermeasure can be effective in counteracting the 'ram air' effect.

Fig. 4 depicts a scenario in which a vehicle 1 is travelling at speed behind a neighbouring
35 vehicle 2 situated in front of vehicle 1. Whilst the neighbouring vehicle 2 is subjected to the 'ram air' effect arising from the high pressure region 11, similar to that shown in Fig. 3, the vehicle 1 is subjected to a reduced pressure 10 in the vicinity of the air inlet 5 as compared to

the case when no neighbouring vehicle 2 is present, as in Fig. 3. Assuming that both vehicles 1 and 2 implement the countermeasure described above based on vehicle speed alone, whilst the neighbouring vehicle 2 will correctly compensate for the high pressure in vicinity of its air inlet 6, the vehicle 1 will overcompensate and the situation will arise where insufficient air is drawn in through the air inlet 5 as the flow control means is controlled without there being any account of the reduction in pressure in the pressure region 10 in the vicinity of the air inlet 5 arising from the presence of the neighbouring vehicle 2.

The reason for the reduction in pressure in the region 10 in the vicinity of the air inlet 5 arises from a wake region 4 generated by the neighbouring vehicle 2. The wake region 4 is a region of disturbed flow, generally turbulent, downstream of the neighbouring vehicle 2 arising from the flow of air around the neighbouring vehicle 2 travelling through the air at speed. The characteristics of the wake region 4 is influenced by factors such as the size, speed and particularly the geometry of the neighbouring vehicle 2. Wake characteristics are a well understood area of fluid dynamics, particularly with the increased understanding of boundary layer effects and computational modelling techniques. The skilled person will readily appreciate that the techniques used to model the aerodynamic capabilities of vehicles, and characterising vehicle wake turbulence, can be applied to the techniques described herein for characterising the wake region associated with a neighbouring vehicle 2.

As the characteristics of the wake region 4 are dependent on the characteristics of the neighbouring vehicle 2, controlling a flow control means based on one or more characteristics of a detected neighbouring vehicle 2 can facilitate improved control of the flow control means by more appropriately taking into account the effect of the presence of the neighbouring vehicle 2 in respect of air flow through the air inlet 5 of a vehicle 1.

A vehicle detection means can be provided that is capable of detecting the presence of a neighbouring vehicle 2. The flow control means can then be controlled based on the neighbouring vehicle detection means. The flow control means can also be controlled based on a detected vehicle speed.

According to one specific example, the flow control means can be set based on vehicle speed and this setting revised based on the neighbouring vehicle detection means detecting a neighbouring vehicle.

It is pertinent to consider the cases in which the presence of the neighbouring vehicle 2 may give rise to reduction in the otherwise high pressure region in the vicinity of the air inlet arising

from the presence of a wake region 4. Generally this will occur when the neighbouring vehicle is at speed and situated in front of the vehicle 1. Here, in front of is not to be interpreted in the narrow sense of being directly in front of, but rather forward of the vehicle 1. Turning to Fig. 5, although the neighbouring vehicle 2 is not directly in front of the vehicle 1, the effect of the wake region 4 will serve to still reduce the pressure in the vicinity of the air inlet 5 of the vehicle 1 and in this situation the neighbouring vehicle 2 is to be considered to be situated in front of the vehicle 1.

It will be appreciated that the setting of the flow control means based on the presence of one or more neighbouring vehicles 2 would ideally be varied depending on estimated characteristics of the wake region 4 relative to the vehicle 1. For example, the flow control means may be set based on a determined distance between the wake region and the air inlet 5, which may be approximated based on a determined distance between the vehicle 1 and neighbouring vehicle.

The neighbouring vehicle detection means can take a number of different forms. For example, the neighbouring vehicle detection means can comprise a camera, ultrasonic detector and/or radar. In the case where the vehicle detection means comprises a ultrasonic detector or radar, the proximity of the neighbouring vehicle 2 relative to the vehicle 1 can be easily discerned and this proximity can be employed in characterising the wake region 4 and determining the appropriate limitation of the restriction of the flow of air owing to the presence of the neighbouring vehicle 2.

The neighbouring vehicle detection means may determine the size of the neighbouring vehicle. In the case of the neighbouring vehicle detection means comprising a camera, image processing techniques may be employed to determine the size of a detected neighbouring vehicle. In the case of the neighbouring vehicle detection means comprising radar or ultrasonic detector, a radio or sound-based return footprint may be employed to determine the size of the neighbouring vehicle.

In determining how best to control the flow of air through the air inlet 5 in the case of a vehicle 1 in the presence of one or more neighbouring vehicles 2, it may be helpful to estimate the traffic density. In the situation shown in Fig. 6, where there is an extreme traffic density, where a large number of vehicles are moving in a similar direction at speed, a situation may arise where there is a large low pressure region around the vehicle 1 (and indeed all the inside vehicles). This information can usefully be exploited in controlling the flow control means.

Fig. 7 illustrates an example of an air inlet controller 40.

The air inlet controller 40 comprises an input 60 arranged to receive a neighbouring vehicle signal from a neighbouring vehicle detector 80. The neighbouring vehicle signal could be a binary signal indicative of the presence or lack of presence of a neighbouring vehicle 2. The neighbouring vehicle signal may also characterize one or more detected neighbouring vehicles 2. The neighbouring vehicle signal may take different forms with the detection and any characterization information embedded in the signal in different ways.

The air inlet controller 40 further comprises an output 70 arranged to output a flow control signal for controlling a flow controller 90 for controlling the flow of air through an air inlet of the vehicle.

The air inlet controller 40 further comprises a processor 50 arranged to determine the flow control signal in dependence on the neighbouring vehicle signal. Thus, for example, in the presence of a neighbouring vehicle signal the flow control signal may be determined to cause the flow controller 90 to give a reduced air draw through the air inlet 5 of a vehicle 1. In this way the effect on the air intake of the presence of a neighbouring vehicle 2 can be compensated for in controlling the inlet flow controller 90.

Characterization of the neighbouring vehicle can be employed to improve the control of the flow controller 90 by improving the compensation of the presence of the neighbouring vehicle 2 based on the characteristics of the neighbouring vehicle(s) 2. So, for example, the flow control signal may be caused to give a greater reduction in air draw through the air inlet 5 of a vehicle 1 in the case where the neighbouring vehicle 2 is determined to be large; and conversely the flow control signal may be caused to give a lesser reduction in air draw through the air inlet 5 in the case where the neighbouring vehicle 2 is determined to be small.

Thus a neighbouring vehicle characteristic giving rise to a greater or lesser reduction in pressure associated with the presence of a neighbouring vehicle can be taken into account in controlling the flow control means. Fluid dynamics principles and/or modelling techniques can be employed to determine an optimal flow control signal for specific scenarios whilst putting into effect the underlying principles of this disclosure.

Fig. 8 illustrates an example of an air intake system 200 comprising an air controller 40. The air system 200 may comprise a processor 150 and memory 160. An inlet flow controller 170 is provided to control the flow of air through the air inlet.

The air intake system 200 may comprise an air inlet for providing fresh air to the vehicle cabin. The air inlet may comprise a conduit for receiving air external to the vehicle for delivery to the vehicle cabin. The inlet flow controller 170 may reside in the air inlet.

5

The processor 150 may receive a neighbouring vehicle signal from the neighbouring vehicle detector 120 and determine a flow control signal in dependence on the neighbouring vehicle signal.

10 Memory 160 may store a mapping between the neighbouring vehicle signal and flow control signal. A mapping may be provided between neighbouring vehicle characteristics (and optionally also vehicle speed) and the flow control signal. The processor may consult the mapping in determining the flow control signal in dependence on the neighbouring vehicle signal (and optionally the vehicle speed).

15

An outflow controller 180 may control the flow of air through an air outlet. It may be desirable to set the flow of air through the air based on the inlet flow controller 170. In this way a constant cabin pressure can be maintained and thus avoid a positive or negative cabin pressure which may be uncomfortable for the operator or passenger(s) of the vehicle.

20

A networking interface 190 may be arranged to interface with a remote traffic density server 195 in order to obtain traffic density data that can be employed in determining an optimal restriction of flow by the flow control means.

25 There may be provided a dedicated wake region estimator 130 for characterising the wake region in respect of a neighbouring vehicle. The wake region estimator 130 may estimate the strength and/or area of effect of the wake region associated with a neighbouring vehicle 2 based on detected characteristics of the neighbouring vehicle 2 such as a detected proximity of the neighbouring vehicle 2 relative to the vehicle 1. The flow control signal sent from the
30 processor 150 to the inlet flow controller 170 may be determined in dependence on the wake region characteristics.

A traffic density determinator 140 may determine the traffic density by various means. For example, the neighbouring vehicle detector 120 may be employed in order to determine the
35 presence of one or more vehicles on the side of the vehicle 1 and accordingly determine the traffic density. The traffic density could be assumed to be significant when there is a neighbouring vehicle 2 on one or both sides of the vehicle 1. The number of neighbouring

vehicles 2 passing the vehicle 1 may be counted and the density of the traffic may be determine based on that count. The flow control signal sent from the processor 150 to the inlet flow controller 170 may be determined in dependence on the estimated traffic density.

- 5 Fig. 9 illustrates an example method 300 of controlling air intake in respect of a vehicle. In step 310, a neighbouring vehicle signal is received. In step 320, a determination of the flow control signal is made based on the neighbouring vehicle signal.

10 Fig. 10 illustrates a specific example of a method 400 of controlling air intake in respect of a vehicle. This example method includes control based on vehicle speed, but whilst control based on vehicle speed can be revised based on the principles of the disclosure, they are not limited in this respect; indeed the presence of a neighbouring vehicle can be compensated for in isolation from control based on vehicle speed.

15 It will also be readily appreciated that modifications can be made to the specific example shown in Fig. 10 without departing from the underlying principles of the disclosure. For example, whilst a fan is employed as the flow controller, a variable aperture or other flow control means could equally be employed.

20 In block 410, vehicle speed is determined. In block 420, a determination is made based on the vehicle speed, whether or not the vehicle is moving. In the event that the vehicle is not moving, according to block 470, there is no fan speed reduction. In the event that the vehicle is moving, according to block 430, the fan speed is reduced based on vehicle speed.

25 In block 440 a neighbouring vehicle detector is employed and in block 450 a traffic proximity or slipstream factor is determined. A slipstream factor could be determined based on characteristics of the neighbouring vehicle such as size, shape, relative speed etc.

30 In block 460 the fan speed reduction is attenuated based on the determined traffic proximity or slipstream factor.

Thus in this way a flow control signal can be determined in dependence on vehicle speed and revised in dependence on a neighbouring vehicle signal indicative of the presence of, and potentially also characterizing, a neighbouring vehicle.

35

It will be appreciated that embodiments of the present invention can be realised in the form of hardware, software or a combination of hardware and software. Any such software may be

stored in the form of volatile or non-volatile storage such as, for example, a storage device like a ROM, whether erasable or rewritable or not, or in the form of memory such as, for example, RAM, memory chips, device or integrated circuits or on an optically or magnetically readable medium such as, for example, a CD, DVD, magnetic disk or magnetic tape. It will be appreciated that the storage devices and storage media are embodiments of machine-readable storage that are suitable for storing a program or programs that, when executed, implement embodiments of the present invention. Accordingly, embodiments provide a program comprising code for implementing a system or method as claimed in any preceding claim and a machine readable storage storing such a program. Still further, embodiments of the present invention may be conveyed electronically via any medium such as a communication signal carried over a wired or wireless connection and embodiments suitably encompass the same.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of any foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed. The claims should not be construed to cover merely the foregoing embodiments, but also any embodiments which fall within the scope of the claims.

CLAIMS

1. An air inlet controller for a vehicle, comprising:
input means arranged to receive a neighbouring vehicle signal indicative of a presence
5 of a neighbouring vehicle;
output means arranged to output a flow control signal to control a flow control means
for controlling a flow of air through an air inlet of the vehicle; and
processing means arranged to determine the flow control signal in dependence on the
neighbouring vehicle signal thereby to compensate for an effect on pressure distal of an air
10 inlet associated with the presence of the neighbouring vehicle.
2. The air inlet controller according to claim 1, wherein:
the neighbouring vehicle signal is indicative of a characteristic of the neighbouring
vehicle; and
15 the flow control signal is determined in dependence on the characteristic of the
neighbouring vehicle.
3. The air inlet controller according to claim 2, wherein:
the characteristic comprises neighbouring vehicle speed.
20
4. The air inlet controller according to claim 2 or 3, wherein:
the characteristic comprises neighbouring vehicle size.
5. The air inlet controller according to any one of claims 2 to 4, wherein:
25 the characteristic comprises neighbouring vehicle proximity.
6. The air inlet controller according to any one of claims 2 to 5, wherein:
the characteristic comprises estimated wake region characteristics.
- 30 7. The air inlet controller according to any preceding claim, wherein:
the input means is arranged to receive a vehicle speed signal indicative of the speed
of the vehicle; and
the processing means is arranged to determine the flow control signal in dependence
on the speed of the vehicle.

35

8. The air inlet controller according to claim 7, wherein:

the processing means is arranged to initially determine the flow control signal in dependence on the speed of the vehicle and revise the flow control signal in dependence on the neighbouring vehicle signal.

9. The air inlet controller according to any preceding claim, wherein:

the processing means is arranged to determine a frequency of neighbouring vehicles in dependence on the neighbouring vehicle signal thereby to estimate a traffic density;

the flow control signal is determined in dependence on the estimated traffic density.

10. The air inlet controller according to any preceding claim, comprising:

the processing means is arranged to communicate with a wireless communication means to determine an estimated traffic density from a remote server;

the flow control signal is determined in dependence on the estimated traffic density.

11. The air inlet controller according to any preceding claim, wherein:

the output means is arranged to output an output flow control signal to control an outflow control means for controlling flow of air through an outlet of the vehicle; and

the output flow control signal is determined in dependence on the flow control signal.

12. An air intake system for a vehicle, comprising:

an air inlet controller according to any preceding claim.

13. The air intake system according to claim 12, comprising:

a flow control means.

14. The air intake system according to claim 13, wherein:

the flow control means comprises a fan.

15. The air intake system according to claim 13 or 14, wherein:

the flow control means comprises a variable aperture.

16. The air intake system according to any one of claims 12 to 15, comprising:

neighbouring vehicle detection means arranged to output the neighbouring vehicle signal.

17. The air intake system according to claim 16, wherein:
the neighbouring vehicle detection means comprises a camera.

18. The air intake system according to claim 16 or 17, wherein
the neighbouring vehicle detection means comprises a proximity sensor.

19. The air intake system according to any one of claims 16 to 18, wherein:
the neighbouring vehicle detection means is arranged to detect a vehicle situated in
front of the vehicle.

20. The air intake system according to any one of claims 16 to 19, wherein:
the neighbouring vehicle detection means is arranged to detect a neighbouring vehicle
situated at a side of the vehicle.

21. The air intake system according to any one of claims 16 to 20, wherein:
the neighbouring vehicle detection means is arranged to detect a neighbouring vehicle
situated behind the vehicle.

22. A vehicle comprising the air inlet controller or air intake system according to any
preceding claim.

23. A method of controlling air intake in respect of a vehicle, comprising:
receiving a neighbouring vehicle signal indicative of a presence of a neighbouring
vehicle;

determining, in dependence on the neighbouring vehicle signal, a flow control signal
to control a flow control means for controlling a flow of air through an air inlet of the vehicle
thereby to compensate for an effect on air pressure distal of an air inlet associated with the
presence of the neighbouring vehicle; and

outputting the flow control signal.

24. A computer program product executable on a processor so as to implement the
method according to claim 23.

25. A non-transitory computer readable medium carrying computer readable code which
when executed causes a vehicle to carry out the method according to claim 23.

26. A processor arranged to implement the method according to claim 23, or the computer program product according to claim 24.

5 27. A controller for controlling an HVAC system of a vehicle, comprising: input means arranged to receive a neighbouring vehicle signal indicative of a presence of a neighbouring vehicle, wherein the controller is configured to control an HVAC system in dependence on the neighbouring vehicle signal of a vehicle to compensate for the presence of a neighbouring vehicle.

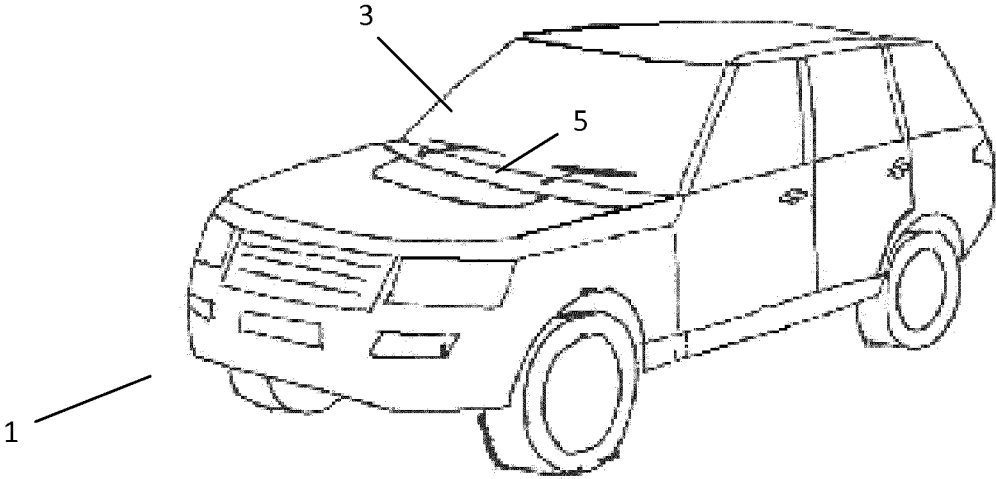


Fig. 1

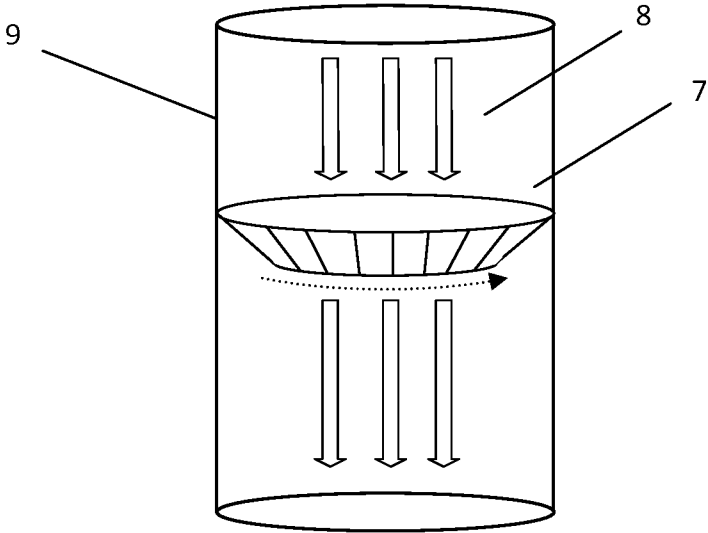


Fig. 2

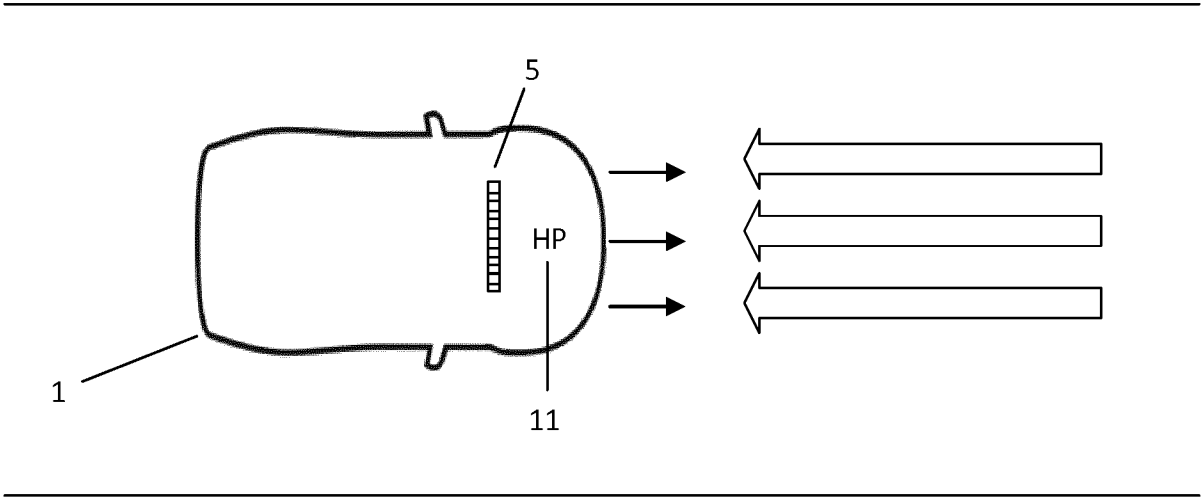


Fig. 3

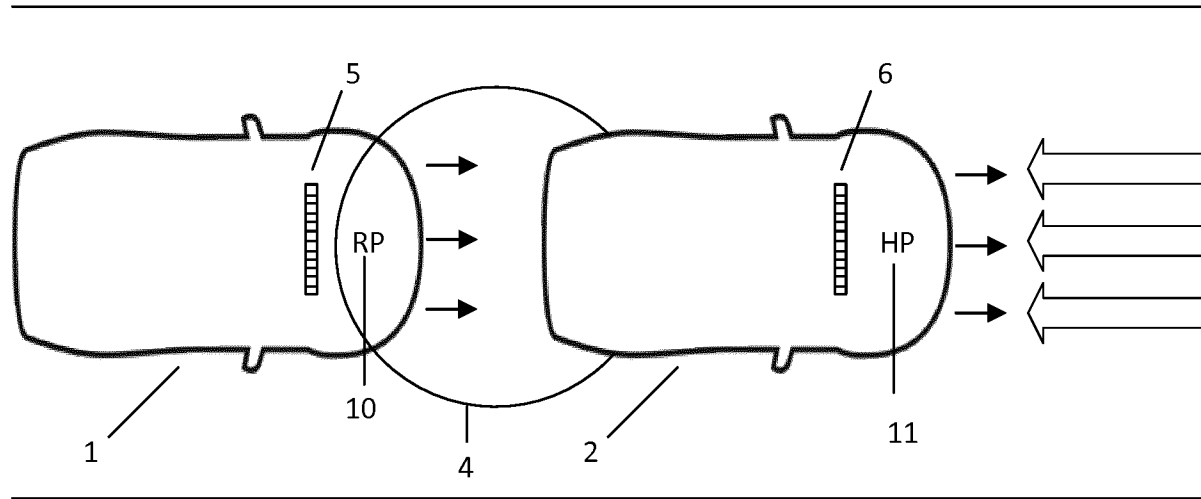


Fig. 4

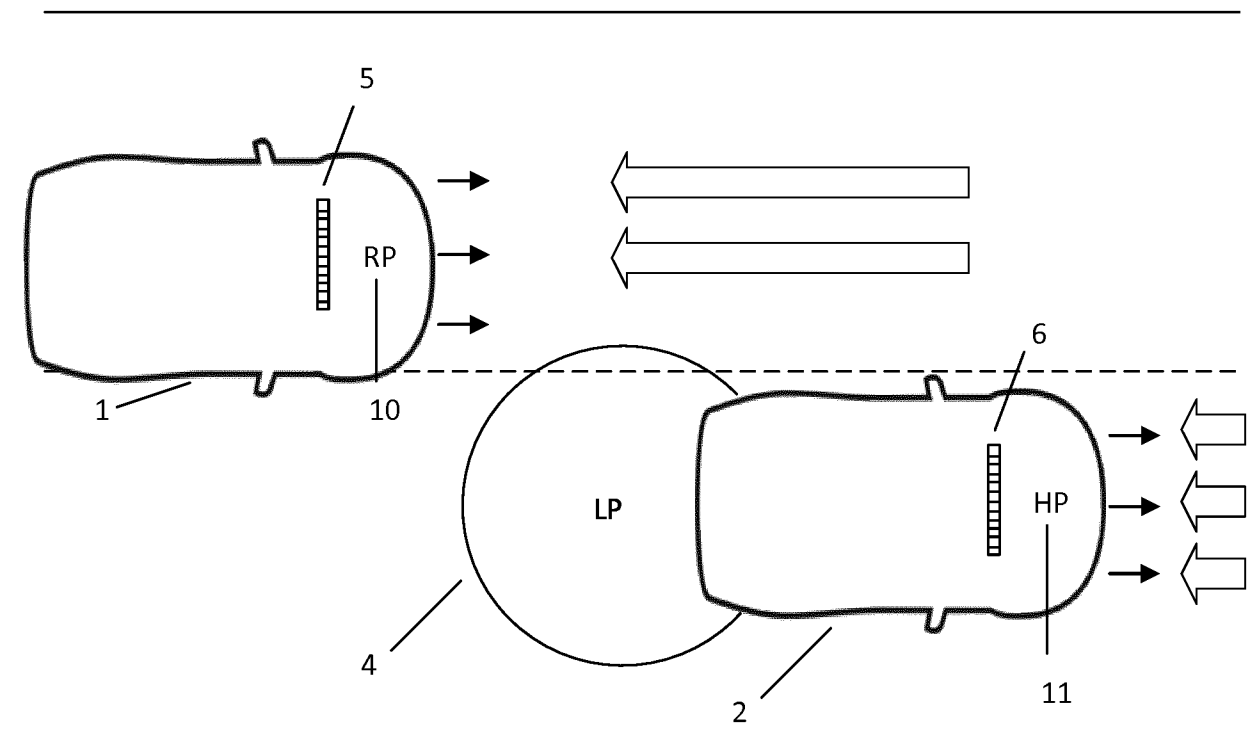


Fig. 5

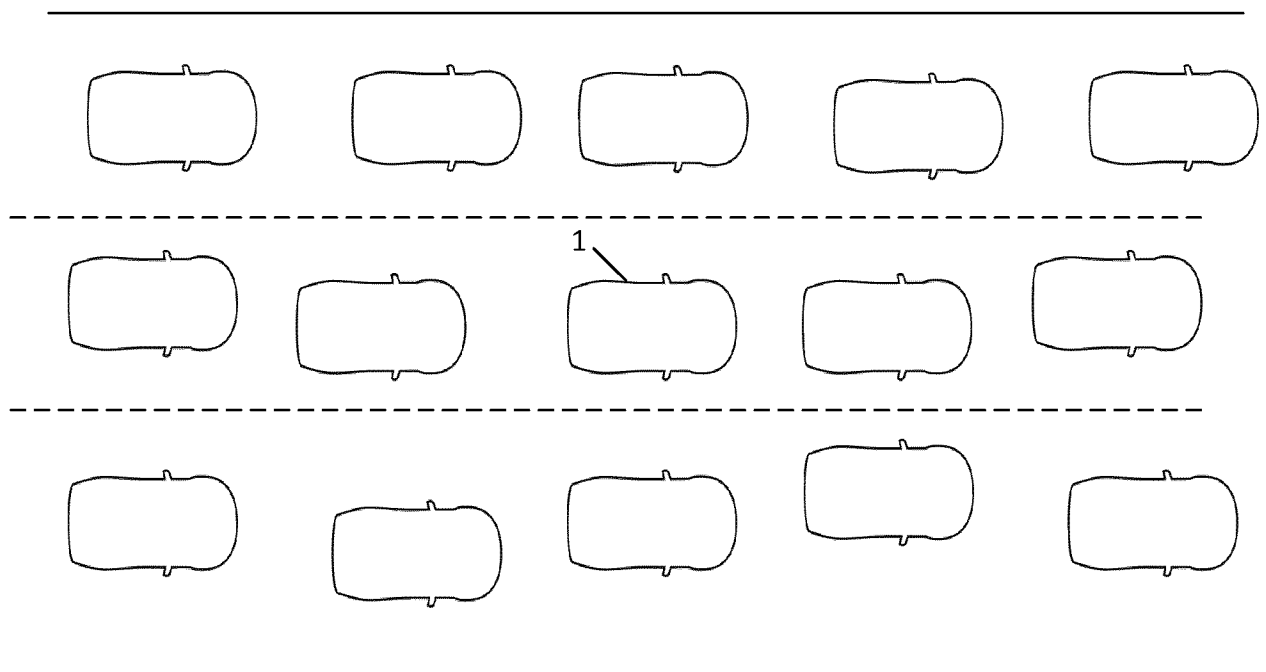


Fig. 6

4/7

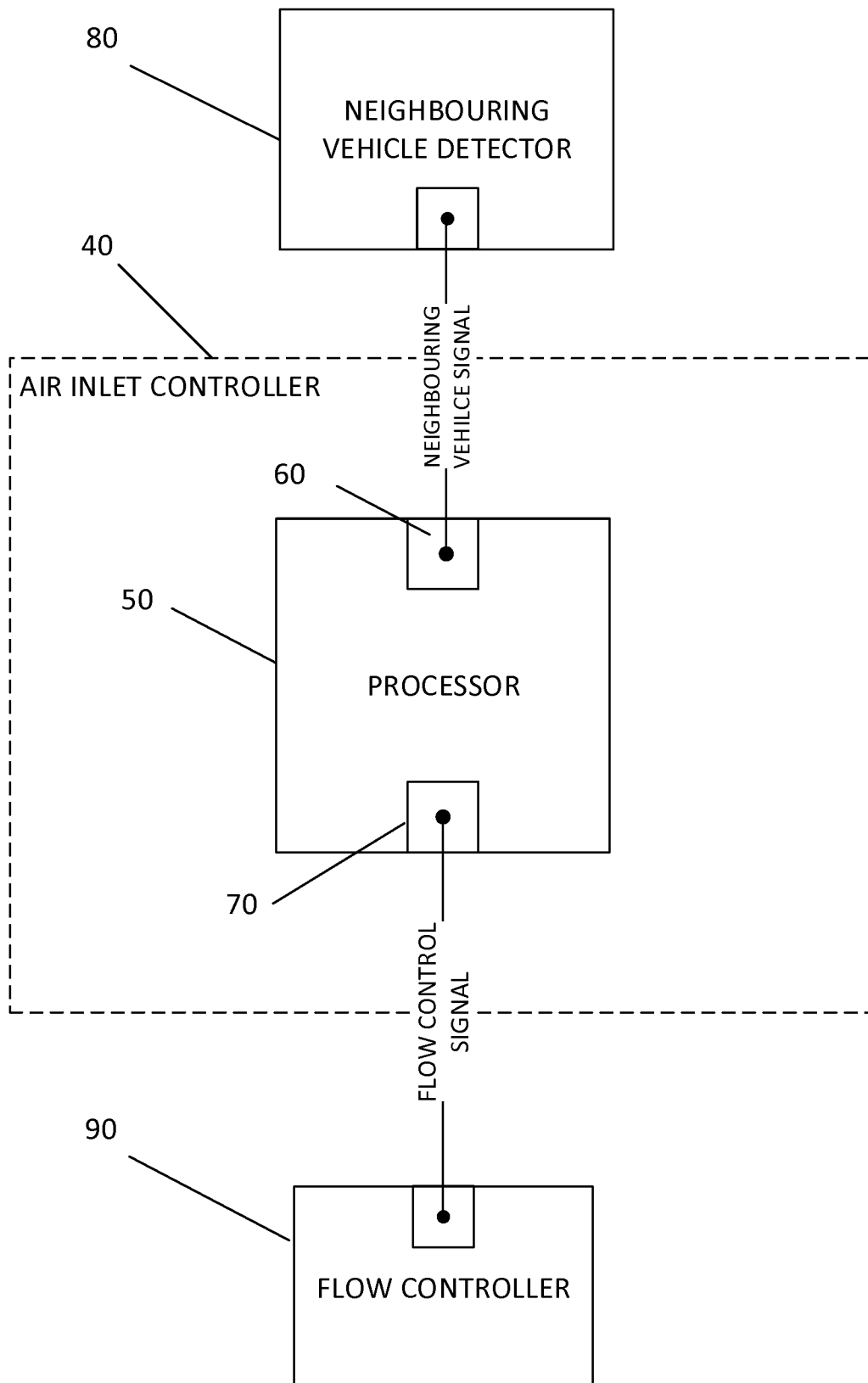


Fig. 7

5/7

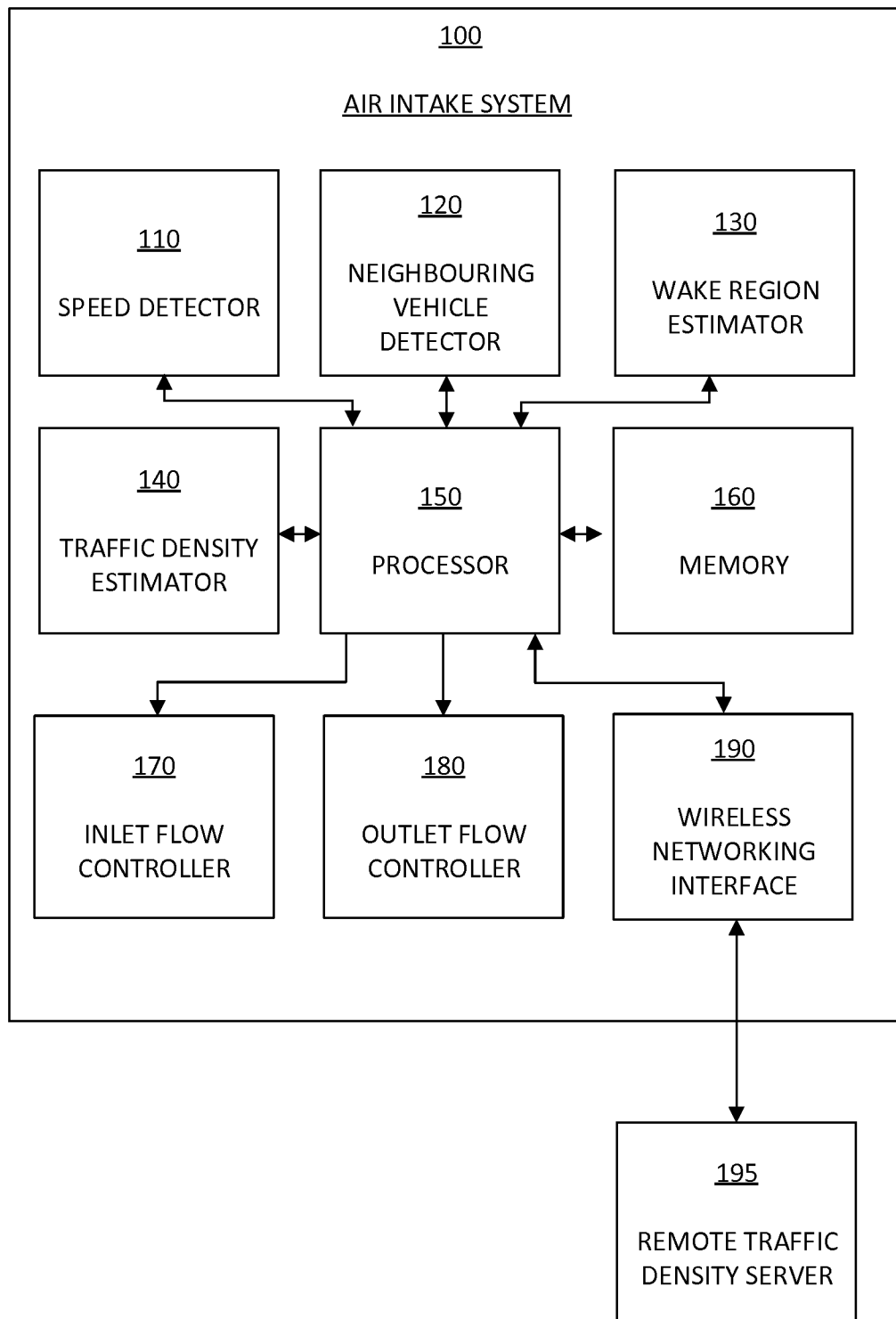


Fig. 8

6/7

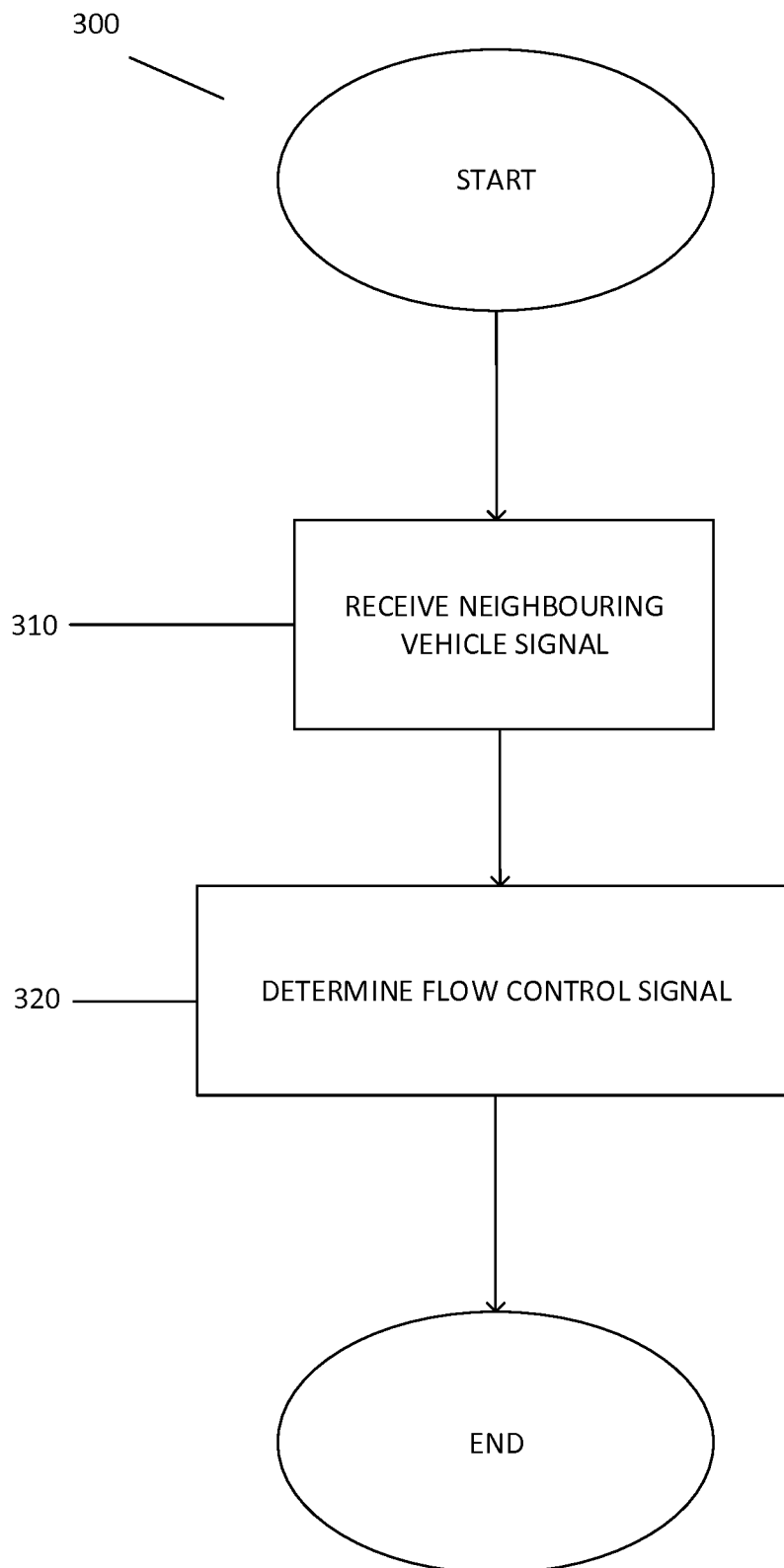


Fig. 9

7/7

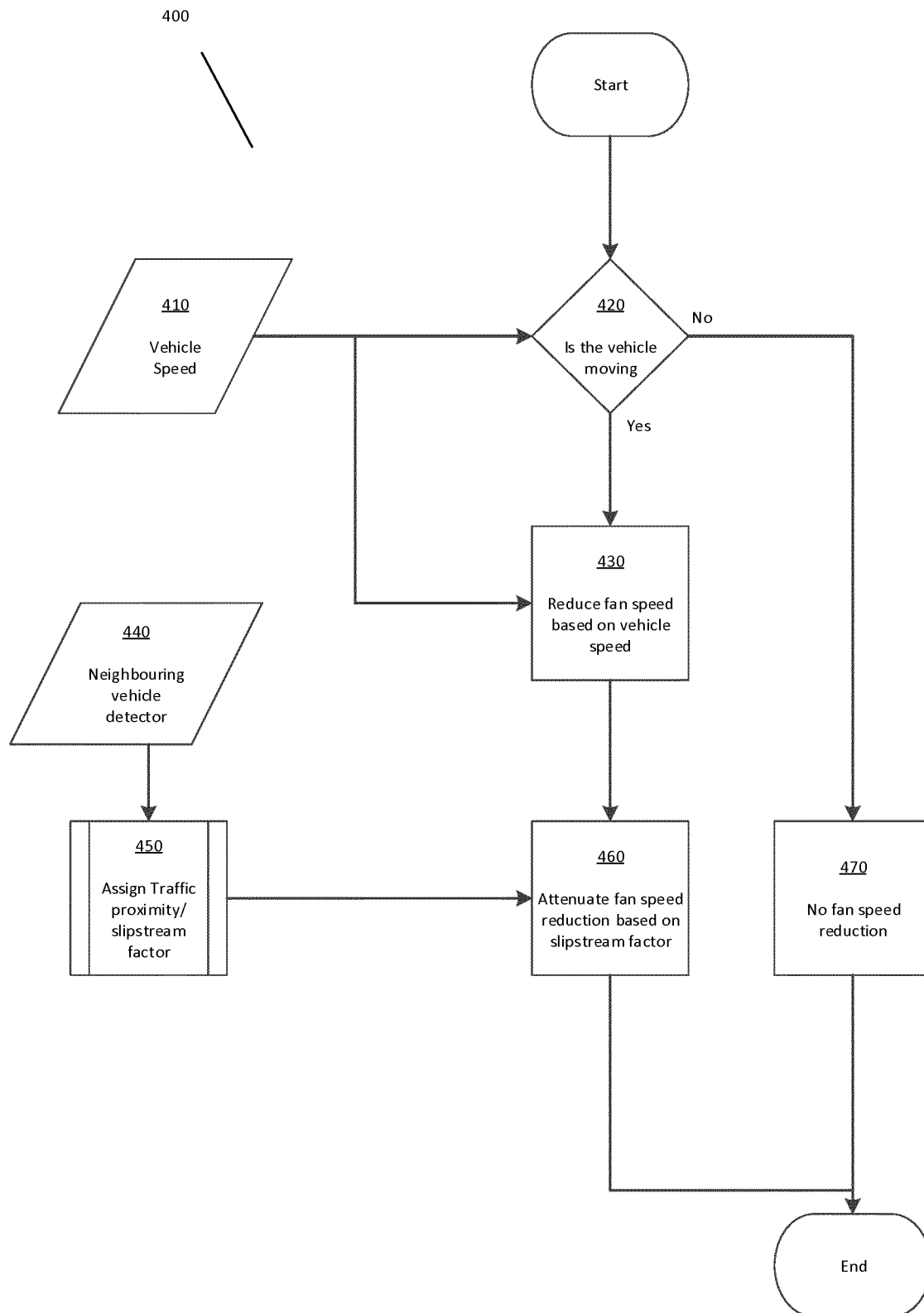


Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/071773

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60H1/00 B60W40/02
ADD.

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)

B60H B60W

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

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

EP0-Internal, 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	DE 10 2012 215623 A1 (BOSCH GMBH ROBERT [DE]) 6 March 2014 (2014-03-06) paragraphs [0008], [0009], [0023], [0056], [0058]; figure 5 -----	1-27
X	DE 10 2011 055684 A1 (CONTINENTAL TEVES AG & CO OHG [DE]) 29 May 2013 (2013-05-29) paragraphs [0014] - [0019] -----	1-27
X	JP 2004 331019 A (CALSONIC KANSEI CORP) 25 November 2004 (2004-11-25) the whole document -----	1-27
X	US 2013/141578 A1 (CHUNDRLIK JR WILLIAM J [US] ET AL) 6 June 2013 (2013-06-06) paragraphs [0025] - [0047] -----	1-5, 11-27



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 November 2017

Date of mailing of the international search report

08/12/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Gumbel, Andreas

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/071773

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102012215623 A1	06-03-2014	NONE	
DE 102011055684 A1	29-05-2013	NONE	
JP 2004331019 A	25-11-2004	NONE	
US 2013141578 A1	06-06-2013	US 2013141578 A1	06-06-2013
		US 2016165188 A1	09-06-2016
		US 2017072770 A1	16-03-2017