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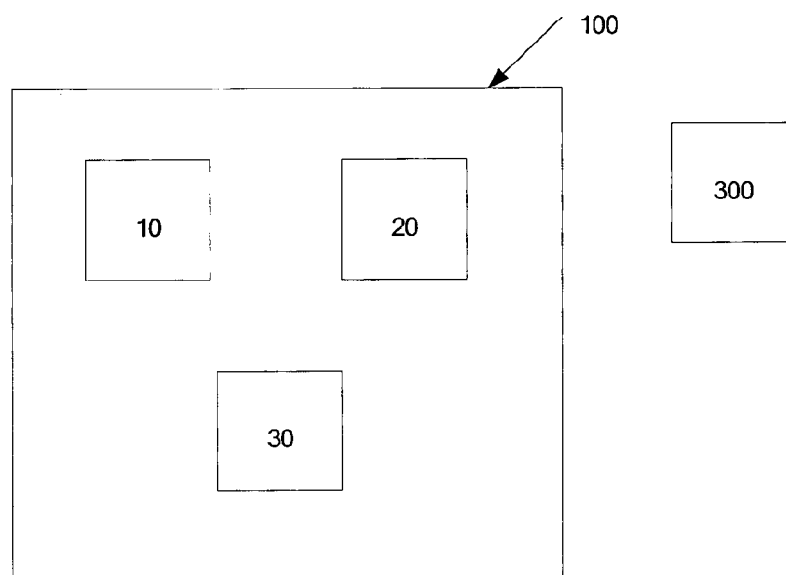


Fig. 1

(57) Abstract: It is disclosed a braking assisting system for a vehicle, comprising: a detection unit adapted to detect the weight of passenger(s) and/or luggage in the vehicle, a braking assisting signal generation unit adapted to generate a braking assisting signal based on the weight detected by the detection unit, a signal transmission unit adapted to receive the braking assisting signal from the braking assisting signal generation unit and transmitting the braking assisting signal to a braking system of the vehicle. By keeping the weight of passenger(s) and/or luggage in the vehicle in consideration and providing such braking assisting signal to the braking system of the vehicle, the braking of the vehicle can be implemented in a more accurate way.



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Braking Assisting System and Method thereof

Field of the Invention

This invention relates generally to a braking assisting system for a vehicle, more particularly, to a braking assisting system for a vehicle which will detect the weight and/or weight distribution of passengers and/or luggage in the vehicle, and to a braking assisting method thereof.

Technical Background

Most modern vehicles include driving assisting systems to assist drivers of the vehicles in driving, among them are braking assisting systems. As is known, current braking assisting systems can brake the vehicle by detecting some factors such as the distance from others vehicles and/or objects, the vehicle speed, the weather condition, the road condition, etc. In particular, when the distance between the two vehicles is relatively long, then the braking distance determined by the braking assisting system will also be longer; when the vehicle speed is very fast, then the braking distance will be set shorter; when it is a raining or snowing day, the braking distance will be much longer than the situation in a sunny day; and when the vehicle is running on an icy road, then the braking distance is also much longer than on a dry road.

However, in addition to the above-mentioned factors, there are still other aspects which may also have an influence on the braking distance. Due to inertia force, the braking distance will also be different when the weight of the vehicle is different, wherein the weight of the vehicle includes the weight of the passengers and the weight of the luggage in the vehicle. Specifically, when only the driver sits in the vehicle and thus the whole weight, i.e., the sum weight of the vehicle itself and the passengers in the vehicle is relatively light, the braking distance is normally short; and when the vehicle is occupied by several passengers and thus the above-mentioned whole weight becomes heavier, the braking distance will become longer. The same applies to the situation when there are less and more luggage in the vehicle. That is, the braking distance will also vary according to the weight of luggage in the vehicle.

For the above reasons, there is a need for a braking assisting system for a vehicle, which brakes the vehicle also based on the weight of and/or weight distribution of passengers and/or luggage in the vehicle.

Summary of the Invention

The aim of the present invention is to provide a braking assisting system for a vehicle which can brake the vehicle in a more accurate way by also considering the weight of passengers and/or luggage in the vehicle. In particular, it is disclosed a braking assisting system which will detect the weight and/or weight distribution of passengers and/or luggage in the vehicle, and to a braking assisting method thereof.

In a first aspect of the invention, it is disclosed a braking assisting system for a vehicle, comprising: a detection unit adapted to detect the weight of passenger(s) and/or luggage in the vehicle, a braking assisting signal generation unit adapted to generate a braking assisting signal based on the weight detected by the detection unit, a signal transmission unit adapted to receive the braking assisting signal from the braking assisting signal generation unit and transmitting the braking assisting signal to a braking system of the vehicle. By keeping the weight of passenger(s) and/or luggage in the vehicle in consideration and providing such braking assisting signal to the braking system of the vehicle, the braking of the vehicle can be implemented in a more accurate way.

In a second aspect of the invention, the detection unit is further adapted to detect the weight distribution of passenger(s) and/or luggage in the vehicle, and the braking assisting signal generation unit is further adapted to generate the braking assisting signal based on said weight distribution. In addition to the weight detection, such detection of weight distribution can help to provide an even more accurate braking control on the braking of the vehicle, for example, by providing different braking force to the four tyres of the vehicle.

In a third aspect of the invention, the detection unit is further adapted to detect one or any combination of the following factors: the distance between the vehicle and other surrounding objects, the speed of the vehicle, the weather condition, and/or the road condition, and the braking assisting signal generation unit is further adapted to generate the braking assisting signal based on one or a combination of said factors. In addition to the internal factors such as weight and/or weight distributions of passenger(s) and/or luggage in the vehicle, external factors mentioned here are also very important to help the driver of the vehicle to do more accurate and safer control of the vehicle.

In a fourth aspect of the invention, the detection unit is weight or mass sensors which detect the weight of passenger(s) and/or luggage in the vehicle directly. With such weight or mass sensors which could achieve the detection directly, the structure of the whole system is simple.

In a fifth aspect of the invention, the detection unit comprises tyre pressure sensors adapted to sense the tyre pressure of four tyres of the vehicle and a calculation unit adapted to calculate the weight distribution of the passenger(s) and/or luggage in the vehicle based on the tyre pressure sensed by the tyre pressure sensors. When the weight and/or the weight distribution of the passenger(s) and/or luggage in the vehicle are different, the tyre pressures of the four tyres of the vehicle are also different from each other. Therefore, by sensing the tyre pressures of the four tyres and doing a calculation based on the sensed tyre pressure, the weight and/or the weight distribution can be obtained and then used for generating the braking assisting signal.

In a sixth aspect of the invention, a braking assisting method for a vehicle, comprising a first step of detecting the weight of passenger(s) and/or luggage in the vehicle, a second step of generating a braking assisting signal based on the weight detected in the first step, and a third step of transmitting the braking assisting signal to a braking system of the vehicle.

In a seventh aspect of the invention, the first step further comprises detecting the weight distribution of passenger(s) and/or luggage in the vehicle, and in the second step the braking assisting signal is generated further based on said weight distribution.

In an eighth aspect of the invention, the first step further comprises detecting one or any combination of the following factors: the distance between the vehicle and other surrounding objects, the speed of the vehicle, the weather condition, and/or the road condition, and in the second step the braking assisting signal is generated further based on one or a combination of said factors.

Additional features of the present invention will become apparent from the following description and appended claims, taken in conjunction with the accompanying drawings.

Brief description of the drawings

Fig. 1 is an illustration a first embodiment of a braking assisting system 100 for a vehicle according to the present invention.

Fig. 2 is an illustration of a second embodiment of a braking assisting system 200 for a vehicle according to the present invention.

Fig. 3 shows several examples of different weight distributions in a vehicle of the second embodiment.

Fig. 4 shows an embodiment of a braking assisting method for a vehicle according to the present invention.

Detailed Description of the Embodiments

The following discussion of the embodiments of the invention directed to a braking assisting system for a vehicle which can brake the vehicle in a more accurate way is merely exemplary in nature, and is in no way intended to limit the invention or its applications or uses.

Fig. 1 is an illustration of a first embodiment of a braking assisting system 100 for a vehicle according to the present invention. In Fig. 1, the system 100 comprises: a detection unit 10 for detecting the weight of passenger(s) and/or luggage in the vehicle, a braking assisting signal generation unit 20 for generating a braking assisting signal based on the weight detected by the detection unit 10, and a signal transmission unit 30 for receiving the braking assisting signal generated by the braking assisting signal generation unit 20 and transmitting the braking assisting signal to a braking system 300 of the vehicle which implements the braking of the vehicle individually by itself or in combination with any other systems of the vehicle. The braking system 300 then brakes the vehicle, based only on the above braking assisting signal generated by the braking assisting signal generation unit 20, or also on a combination of the above braking assisting signal and other braking-related signals given by any other systems included in the

vehicle or even outside of the vehicle. The braking system 300 could be any kind of braking system in the prior art and any other braking system developed in the future.

The detection unit 10 can detect the weight of the passengers and/or luggage in the vehicle by using any existing technology in the art or any technology developed in the future which have the above detecting function directly or indirectly. For example, the detection unit 10 can be a unit which has the weight detection function directly such as mass/weight sensors in the field. The sensors can be mounted within or on any suitable structure that is part of the vehicle, as long as they could detect the weight of the passengers and/or luggage in the vehicle, including but not limited to vehicle seats and rear compartment of the vehicle. Or, for example, the detection unit 10 can comprise tyre pressure sensors and a calculation unit adapted to calculate the weight of the passengers and/or luggage in the vehicle based on the tyre pressures of the four tyres of the vehicle sensed by the tyre pressure sensors. In particular, for example, the calculation unit implements the above calculation based on tyre pressure distribution differences. The detection unit 10 can also be of any other forms as a combination of sensors, cameras, and/or calculation units which function together to achieve the purpose of detecting the weight of the passengers and/or luggage in the vehicle.

After the detection unit 10 detects the weight of the passengers and/or luggage in the vehicle, the weight detected by the detection unit 10 will be provided to the braking assisting signal generation unit 20, and then the braking assisting signal generation unit 20 will generate a braking assisting signal based on the weight of the passengers and/or luggage in the vehicle detected by the detection unit 10. The braking assisting signal may include information which indicates the detected weight, which could be an accurate weight value, a weight range or just descriptive information such as "light" or "heavy". The braking assisting signal may also include information which indicates the recommended braking distance, which also could be an accurate distance value, for example, the most recommended braking distance, or a range defined by a minimum value and a maximum value. The braking assisting signal may also include information indicating a response time of the vehicle which counts from current time to the time of implementing braking action to the vehicle. Moreover, the braking assisting signal may also include any other information which is related to braking of the vehicle.

The signal transmission unit 30 will then receive the braking assisting signal generated by the braking assisting signal generation unit 20 and including one or more of the above-mentioned information as well as other information and transmit the braking assisting signal to a braking system 300 of the vehicle. In addition to the receiving and transmitting of the braking assisting signal generated by the braking assisting signal generation unit 20, the signal transmission unit 30 can also be used to receive other signals, for example, other braking assisting signals, from other units of the vehicle, and then transmit such signals to the braking system 300 of the vehicle. As is known in the art, the above-mentioned other braking assisting signals could be braking assisting signals generated based on distance from other vehicles, vehicle speed, weather condition and/or road condition, etc. Under such circumstances, the signal transmission unit 30 will also transmit such braking assisting signals to the braking system 300 of

the vehicle simultaneously, together with the braking assisting signal generated by the braking assisting signal generation unit 20.

After receiving braking assisting signal from the signal transmission unit 30, the braking system 300 can implement the braking of the vehicle individually by itself or in combination with any other systems of the vehicle. For example, when the braking assisting signal generated by the braking assisting signal generation unit 20 is the only braking assisting signal provided to the braking system 300, the braking system 300 will brake the vehicle only based on the braking assisting signal generated by the braking assisting signal generation unit 20. On the other hand, in the situation where there are other braking assisting signals provided from any other units of the vehicle and then transmitted to the braking system 300, the braking system 300 will brake the vehicle based on a combination of the braking assisting signal generated by the braking assisting signal generation unit 20 and those other braking assisting signals.

Fig. 2 is an illustration of a second embodiment of a braking assisting system 200 for a vehicle according to the present invention.

In particular, the braking assisting system 200 for a vehicle according to the second embodiment of the present invention comprises: a detection unit 101 for detecting the weight of passenger(s) and/or luggage in the vehicle and providing a weight distribution of the passenger(s) and/or luggage in the vehicle, a braking assisting signal generation unit 201 for generating a braking assisting signal based on the weight and the weight distribution provided by the detection unit 101, and a signal transmission unit 301 for receiving the braking assisting signal generated by the braking assisting signal generation unit 201 and transmitting the braking assisting signal to a braking system 300 of the vehicle which implements the braking of the vehicle individually by itself or in combination with any other systems of the vehicle. The braking system 300 then brakes the vehicle based only on the above braking assisting signal generated by the braking assisting signal generation unit 201, or also on a combination of the above braking assisting signal and other braking-related signals given by any other systems included in the vehicle or even outside of the vehicle. The braking system 300 could be any kind of braking system in the prior art and any other braking system developed in the future.

The braking assisting system 200 of the second embodiment is the same as the braking assisting system 100 of the first embodiment described according to Fig.1 except that the detection unit 101 of the braking assisting system 200, in addition to detecting the weight of passenger(s) and/or luggage in the vehicle, further provides the weight distribution of passenger(s) and/or luggage in the vehicle, and that the braking assisting signal generation unit 201 of the braking assisting system 200 generates the braking assisting signal based on said weight and said weight distribution provided by the detection unit 101. In the following, similar descriptions will not be given to the same aspects as those which have been explained above with reference to Fig. 1.

According to the second embodiment shown in Fig.2, the detection unit 101 can detect the weight of the passengers and/or luggage in the vehicle by using any existing technology in the

art and provide a weight distribution of the passenger(s) and/or luggage in the vehicle. After the detection unit 101 finishes the above detection and providing, the weight distribution provided by the detection unit 101 will be provided to the braking assisting signal generation unit 201, and then the braking assisting signal generation unit 201 will generate a braking assisting signal based on the weight and the weight distribution of the passengers and/or luggage in the vehicle provided by the detection unit 101. The signal transmission unit 301 will then receive the braking assisting signal generated by the braking assisting signal generation unit 201 and transmit the braking assisting signal to a braking system 300 of the vehicle. After receiving braking assisting signal from the signal transmission unit 301, the braking system 300 can implement the braking of the vehicle individually by itself or in combination with any other systems of the vehicle. Other variations in all aspects which have been described with reference to the first embodiment also apply to the second embodiment and will be omitted here for avoiding redundancy.

Fig. 3 shows several examples of different weight distributions in a vehicle which has two rows only, wherein Fig. 3a shows that there are three passengers in the vehicle, one is the driver P1 and the other two P2 and P3 sit at the rear row; Fig. 3b shows that there are three passengers in the vehicle, one is the driver P1, the second one is P2 sitting beside P1 at the front row, and the third one P3 sit at the rear row right behind the driver P1; Fig. 3c shows that there are three passengers in the vehicle, one is the driver P1, the second one is P2 sitting beside P1 at the front row, and the third one P3 sit at the rear row right behind P2; Fig. 3d shows that there are four passengers in the vehicle, P1 is the driver, P2 sit beside P1 at the front row, and the other two P3 and P4 sit at the rear row behind P1 and P2 respectively; and Fig. 3e shows that there are five passengers in the vehicle, P1 is the driver, P2 sit beside P1 at the front row, and the other three P3, P4 and P5 sit at the rear row. The weight distributions shown in Fig. 3a, 3b, 3c, 3d and 3e are totally different from each other, thereby, the braking assisting signals generated by the braking assisting signal generation unit 201 of the second embodiment as shown in Fig. 2 are also different from each other.

The vehicle shown in Fig. 3 only has two rows, and the conditions of luggage in the vehicle are not shown in Fig. 3 as well. However, the same or similar principles also apply to vehicles which have three or more rows and/or which carry luggage. And in this description no further explanations will be given to such varieties.

Fig. 4 shows an embodiment of a braking assisting method for a vehicle, comprising a first step of detecting the weight of passenger(s) and/or luggage in the vehicle, a second step of generating a braking assisting signal based on the weight detected in the first step, and a third step of transmitting the braking assisting signal to a braking system of the vehicle. In another embodiment, the first step further comprises detecting the weight distribution of passenger(s) and/or luggage in the vehicle, and in the second step the braking assisting signal is generated further based on said weight distribution. In another embodiment, the first step further comprises detecting one or any combination of the following factors: the distance between the vehicle and other surrounding objects, the speed of the vehicle, the weather condition, and/or

the road condition, and in the second step the braking assisting signal is generated further based on one or a combination of said factors.

The forgoing discussion disclosed and describes merely exemplary embodiments of the present invention. One skilled in the art will readily recognize from such discussion and from the accompanying drawings and claims that various changes, modifications and variations can be made therein without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A braking assisting system for a vehicle, comprising:
a detection unit adapted to detect the weight of passenger(s) and/or luggage in the vehicle,
a braking assisting signal generation unit adapted to generate a braking assisting signal based on the weight detected by the detection unit,
a signal transmission unit adapted to receive the braking assisting signal from the braking assisting signal generation unit and transmitting the braking assisting signal to a braking system of the vehicle.
2. The braking assisting system according to claim 1, characterized in that the detection unit is further adapted to detect the weight distribution of passenger(s) and/or luggage in the vehicle, and the braking assisting signal generation unit is further adapted to generate the braking assisting signal based on said weight distribution.
3. The braking assisting system according to claim 1 or 2, characterized in that the detection unit is further adapted to detect one or any combination of the following factors: the distance between the vehicle and other surrounding objects, the speed of the vehicle, the weather condition, and/or the road condition, and the braking assisting signal generation unit is further adapted to generate the braking assisting signal based on one or a combination of said factors.
4. The braking assisting system according to claim 1, characterized in that the detection unit is weight or mass sensors which detect the weight of passenger(s) and/or luggage in the vehicle directly.
5. The braking assisting system according to claim 2, characterized in that the detection unit comprises tyre pressure sensors adapted to sense the tyre pressure of four tyres of the vehicle and a calculation unit adapted to calculate the weight distribution of the passenger(s) and/or luggage in the vehicle based on the tyre pressure sensed by the tyre pressure sensors.
6. A braking assisting method for a vehicle, comprising
a first step of detecting the weight of passenger(s) and/or luggage in the vehicle,
a second step of generating a braking assisting signal based on the weight detected in the first step, and
a third step of transmitting the braking assisting signal to a braking system of the vehicle.
7. The braking assisting method according to claim 6, characterized in that the first step further comprises detecting the weight distribution of passenger(s) and/or luggage in

the vehicle, and in the second step the braking assisting signal is generated further based on said weight distribution.

8. The braking assisting method according to claim 6 or 7, characterized in that the first step further comprises detecting one or any combination of the following factors: the distance between the vehicle and other surrounding objects, the speed of the vehicle, the weather condition, and/or the road condition, and in the second step the braking assisting signal is generated further based on one or a combination of said factors.

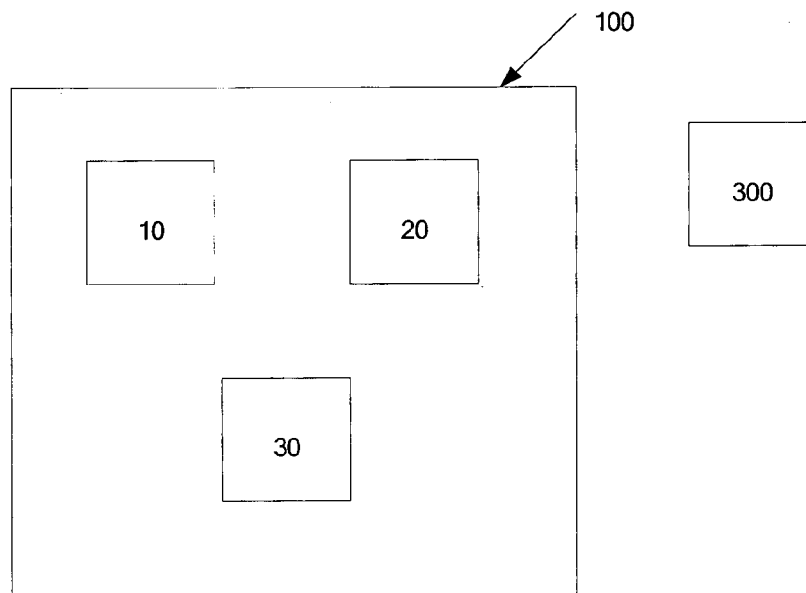


Fig. 1

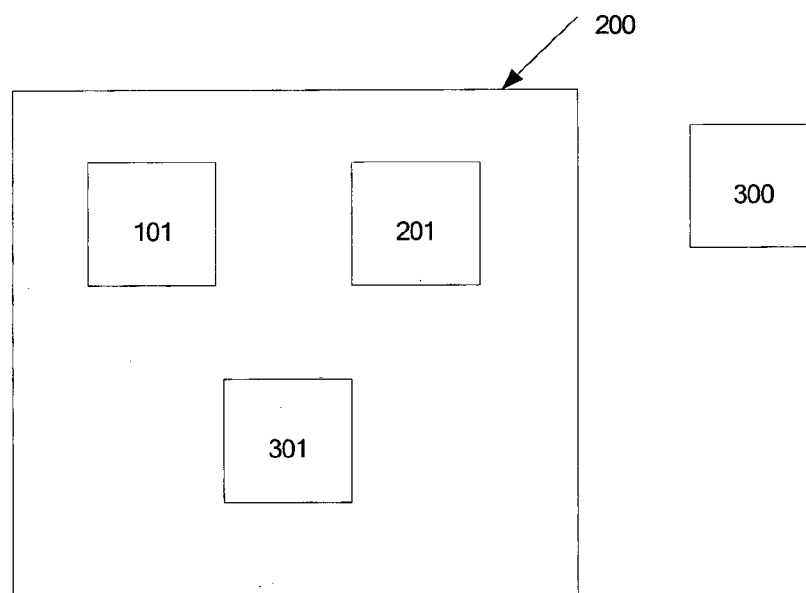


Fig. 2

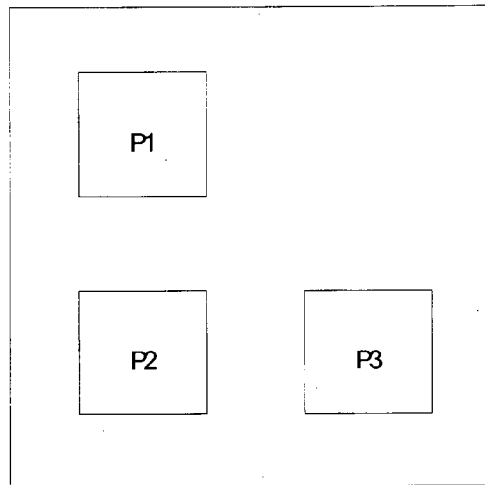


Fig. 3a

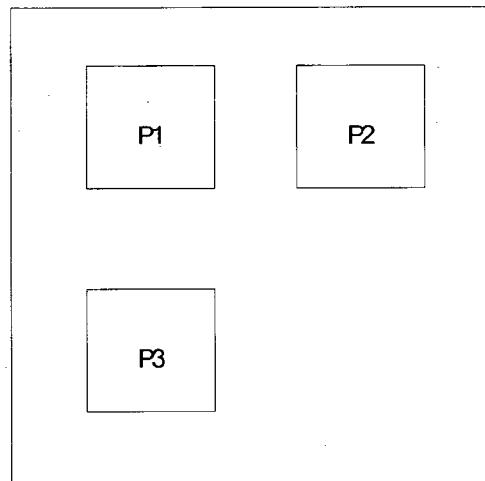


Fig. 3b

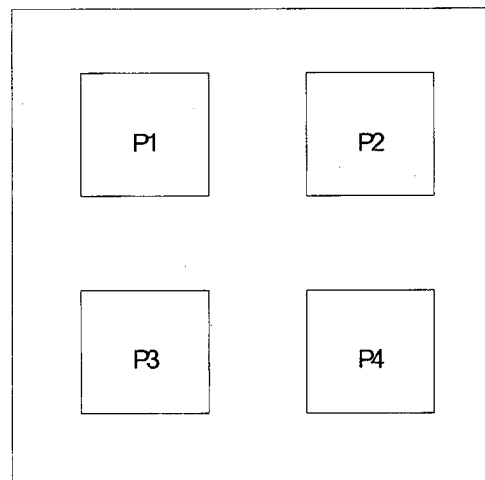


Fig. 3c

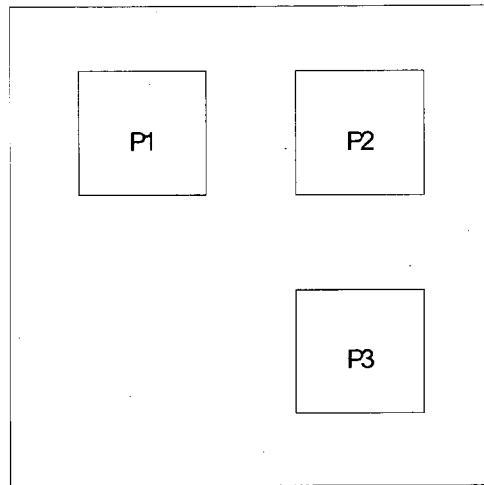


Fig. 3d

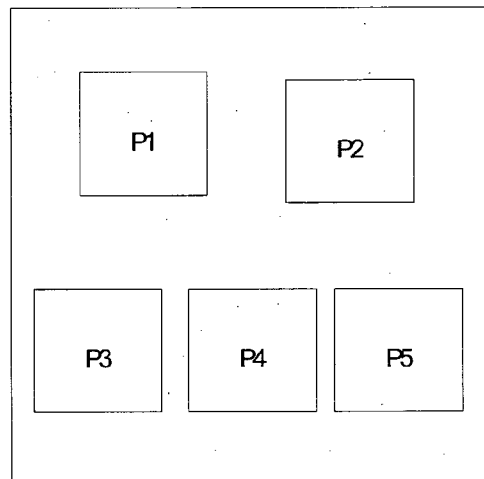


Fig. 3e

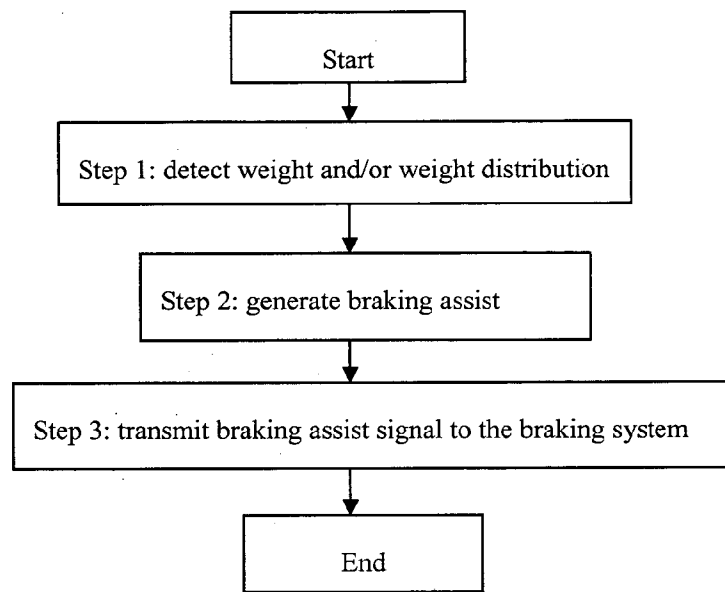


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2017/000254

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60T8/18

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)

B60T

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)

EPO-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	US 2001/029419 A1 (MATSUMOTO SHINJI [JP] ET AL) 11 October 2001 (2001-10-11)	1,2,6
Y	paragraph [0043] - paragraph [0144]; claim	3,4,7,8
A	1	5
X	JP 2007 223365 A (HINO MOTORS LTD) 6 September 2007 (2007-09-06)	1,6
A	paragraph [0008] - paragraph [0063]	5
Y	WO 02/25291 A2 (AMERICAN CALCAR INC [US]; OBRADOVICH MICHAEL L [US])	3,4,7,8
A	28 March 2002 (2002-03-28) page 18, line 28 - page 24, line 16	1,5,6
A	US 2012/083959 A1 (DOLGOV DMITRI A [US] ET AL) 5 April 2012 (2012-04-05) the whole document	1,5,6



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2017/000254

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2001029419 A1	11-10-2001	JP 2001171504 A US 2001029419 A1	26-06-2001 11-10-2001
JP 2007223365 A	06-09-2007	JP 4773842 B2 JP 2007223365 A	14-09-2011 06-09-2007
WO 0225291 A2	28-03-2002	AU 9285701 A CA 2423200 A1 EP 1328420 A2 JP 2004509018 A KR 20030064757 A KR 20070118707 A KR 20080080123 A US 2004036601 A1 US 2006006990 A1 US 2006202808 A1 US 2008030313 A1 US 2014107894 A1 US 2017158206 A1 WO 0225291 A2	02-04-2002 28-03-2002 23-07-2003 25-03-2004 02-08-2003 17-12-2007 02-09-2008 26-02-2004 12-01-2006 14-09-2006 07-02-2008 17-04-2014 08-06-2017 28-03-2002
US 2012083959 A1	05-04-2012	CN 103339009 A CN 103339010 A CN 103370249 A EP 2625079 A2 EP 2625081 A2 EP 2625083 A2 EP 3176666 A1 JP 5973447 B2 JP 6013340 B2 JP 6051162 B2 JP 2013544695 A JP 2013544696 A JP 2013544697 A KR 20130129931 A KR 20130132790 A KR 20140020230 A US 8634980 B1 US 8688306 B1 US 8965621 B1 US 9120484 B1 US 9122948 B1 US 9658620 B1 US 9679191 B1 US 2012083959 A1 US 2012083960 A1 US 2012083964 A1 US 2013297140 A1 US 2014136045 A1 US 2014324268 A1 WO 2012047743 A2 WO 2012047977 A2 WO 2012047980 A2	02-10-2013 02-10-2013 23-10-2013 14-08-2013 14-08-2013 14-08-2013 07-06-2017 23-08-2016 26-10-2016 27-12-2016 19-12-2013 19-12-2013 19-12-2013 29-11-2013 05-12-2013 18-02-2014 21-01-2014 01-04-2014 24-02-2015 01-09-2015 01-09-2015 23-05-2017 13-06-2017 05-04-2012 05-04-2012 05-04-2012 07-11-2013 15-05-2014 30-10-2014 12-04-2012 12-04-2012 12-04-2012