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(54) Title: A SYSTEM FOR MITIGATING COLLISIONS OCCURRING IN TRAFFIC

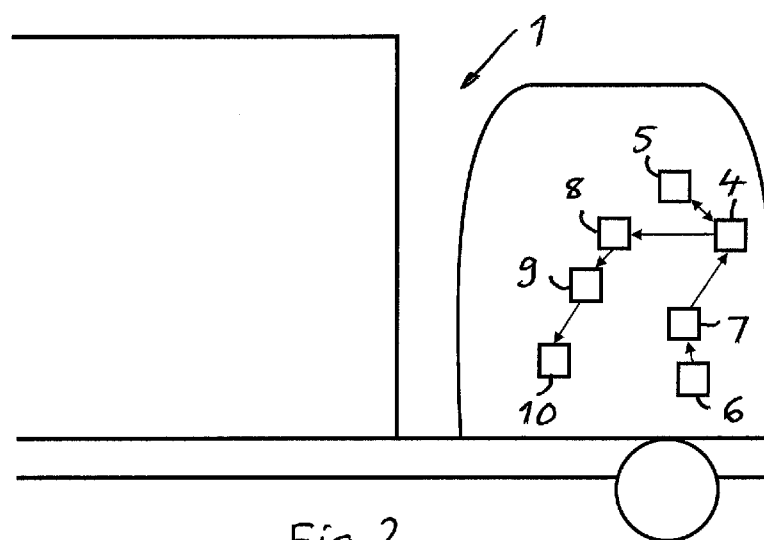


Fig 2

(57) Abstract: A system for mitigating collisions occurring in traffic including motor vehicles comprises on board a host motor vehicle (1) sensors for detection of the status of equipment of the vehicle sensitive to/reacting upon a collision or an expected collision of the vehicle with an object and a transmitter (7) transmitting a distress signal upon such a detection. When a receiver (8) receives said distress signal it will trig a control unit (9) associated therewith to activate a collision mitigating device/system (10) present in the traffic surrounding the motor vehicle.



***A system for mitigating collisions occurring in traffic***

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## TECHINICAL FIELD OF THE INVENTION

The present invention relates to a system for mitigating collisions occurring in traffic including motor vehicles, according to the pre-  
10      amble of claim 1.

The invention also relates to a motor vehicle used in such a system and a method for mitigating collisions occurring in traffic.

## 15      BACKGROUND ART

Technical solutions for coordinating vehicle trains (or so-called platoons) are becoming increasingly frequent. These systems enable a number of motor vehicles to travel much closer to one another than would be possible if a reacting distance for human re-  
20      action were needed. The main advantage of operating in such a platoon formation is the possibility to reduce the fuel consumption of the vehicles considerably as a consequence of the lowering of the air resistance obtained. Another advantage is the possibility to  
25      in some cases make the number of drivers smaller than the number of vehicles. Automated Highway System (AHS), or Smart Road, is one example of this technology, which is designed to provide for driverless cars on specific rights-of-way. The system is most often touted as a means of traffic congestion relief, since it will dra-  
30      stically reduce following distances and headway, thus allowing more cars to occupy a given stretch of road.

Bus Rapid Transit (BRT) is another type of a vehicle train. Here two or more buses are coordinated to travel along a particular line, for instance to transport passengers to/from an airport, or in public  
5 transportation. Of course, a group of trucks or automobiles may be controlled in a corresponding manner to reduce the required number of operators and render the use of fuel more efficient.

Safety is still one of the main aspects that must be considered  
10 when operating a vehicle. Therefore, it must be taken under special consideration when designing automated systems for governing vehicles that operate in a platoon formation. Vehicles participating in a platoon communicate wirelessly with each other. Thereby, it is possible to obtain information from vehicles in front  
15 and behind of each vehicle, which can add to drivers knowledge about what is happening and hence a safer driving experience can be obtained.

Even though systems of the type defined in the introduction are  
20 getting more advanced through advances in technology, safety will always be an issue as long as there are lives involved in the traffic. Most advanced driver assistant systems have a lot of safety measures in place to ensure that no injuries occur in traffic when they are active. However, collisions can still occur due to errors  
25 and uncertainties in traffic making it important to mitigate such collisions.

A system of the type defined in the introduction is known through US 8 552 886 disclosing how a distress signal is transmitted from

a vehicle subjected to a collision to surrounding vehicles. This distress signal may be triggered by the airbag system of the colliding vehicle. However, the distress signal will just inform other participants in the traffic but not help them further to mitigate any collision by other means.

## SUMMARY OF THE INVENTION

The object of the present invention is to provide a system of the type defined in the introduction being improved in at least some aspect with respect to such systems already known.

This object is according to the invention obtained by providing such a system with the features listed in the characterizing part of appended patent claim 1.

By providing such a system with at least one receiver configured to on one hand receive a said distress signal when the host vehicle is in a location making said receiver to be arranged in the traffic surrounding the host vehicle and on the other hand upon receipt of a said distress signal trig a control unit associated with the receiver to activate a collision mitigating device/system present in the said surrounding traffic, injuries inflicted upon participants in said traffic, such as drivers of other vehicles, may be mitigated when a collision is in progress. This means a possibility to significantly reduce the number of accidents with deathly outcome through such a system.

According to an embodiment of the invention the system comprises said receivers arranged on board other motor vehicles. Thus, a

collision mitigating device/system present on board such a motor vehicle may then be activated for protecting the driver of that vehicle. This constitutes the subject of another embodiment of the invention in which said control unit associated with said receiver  
5 is configured to activate collision mitigating devices of said other vehicle, such as tightening a seat belt, preparing an air bag for deployment, filling the vehicle with foam to protect the driver upon imminent impact, locking the steering wheel to avoid jack-knifing, automatically adjusting the position of the steering wheel so that  
10 injury to the driver is minimised if the driver is propelled forward during the collision, etc.

According to another embodiment of the invention said sensors on board the host motor vehicle comprises one or more of the brake  
15 system of the vehicle, airbags, pressure systems in the front, radar, lidar and camera. Such sensors may provide reliable information about a collision or expected collision of a vehicle and they are already there in most modern vehicles, especially heavy motor vehicles.

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According to another embodiment of the invention said control unit associated with a said receiver is configured to use wireless communication, for example Wi-Fi, Telecom, Bluetooth, IR, etc., to activate collision mitigating devices of said other vehicle.

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According to another embodiment of the invention the system is arranged on a group of motor vehicles, such as buses or trucks, configured to operate in a platoon formation and each being a said host vehicle as well as a said other vehicle and comprising a wire-

less interface configured to communicate wirelessly with the wireless interfaces of the other motor vehicles of said group. This constitutes a particularly preferred application of a system for mitigating collisions occurring in traffic according to the present invention although each such vehicle of said group of vehicles is here considered to be a host vehicle and a said other vehicle with respect to the features of the present invention included in each vehicle. One vehicle in this group may be considered to be a master vehicle and the other vehicles slave vehicles controlled by the master vehicle by an automatic controller for platooning using wireless communication between the vehicles for controlling the operation of the vehicles in a platoon formation.

According to another embodiment of the invention the system comprises a said receiver associated with a control unit arranged in the infrastructure surrounding said host vehicle and configured to activate a collision mitigating device belonging to said infrastructure upon receipt of a said distress signal. Such a device belonging to said infrastructure may according to further developments of this embodiment be a traffic barrier, which may be moved to mitigate the consequences of a collision, or a road barrier, especially a road barrier of cushioning material, which may be lowered to an active blocking state for “braking” a vehicle colliding therewith. These measures may be very efficient in mitigating collisions and saving lives.

A motor vehicle according to the present invention is defined in the appended claim directed to such a motor vehicle. Such a motor vehicle may when surrounded by other such vehicles in the traffic efficiently contribute to mitigation of collisions when such appear.

A method for mitigating collisions occurring in traffic is according to the invention provided by the combination of features listed in the appended independent method claim. The advantages of this method and embodiments thereof appear clearly from the above discussion of the system according to the present invention.

The invention also relates to a computer program, a computer program product and an electronic control unit having the features of the claims directed to a computer program, a computer program product and an electronic control unit, respectively.

Other advantageous features as well as advantages of the present invention appear from the description following below.

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## BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a specific description of embodiments of the invention cited as examples. In the drawings:

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Fig 1 is a schematic view illustrating a group of trucks operating in a platoon formation to which a system and a method according to the invention may be applied,

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Fig 2 is a schematic view of a motor vehicle according to the present invention being a part of a system for mitigating collisions according to the present invention,

- Fig 3 is a simplified view from above of a group of vehicles operating in a platoon formation and to which a system for mitigating collisions according to a second embodiment of the invention is applied,
- 5 Fig 4 is a flow chart illustrating the steps carried out in a method according to an embodiment of the invention, and
- 10 Fig 5 is a schematic view illustrating an electronic control unit for implementing a method according to the invention.

## DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

15 The invention is particularly but not exclusively directed to the case of having said sensors and transmitter arranged on board a plurality of motor vehicles driving close to each other in said traffic, in which these motor vehicles may be of any conceivable type,

20 such as passenger cars, but the invention is especially directed to the case of mitigating collisions that may occur when a group of heavy wheeled motor vehicles, such as trucks or buses, are operated in a platoon formation, which is the reason for hereinafter mainly disclosing that application of the invention without in any

25 way restrict the invention thereto.

Fig 1 illustrates schematically a number of heavy wheeled motor vehicles 1 in the form of trucks operating in a platoon formation 2, i.e. a vehicle train, by being driven close to each other, for example

30 with a mutual spacing 3 in the order of 5 m - 15 m, resulting in a

substantial reduction of fuel consumption for each vehicle following upon another vehicle. Embodiments of the present invention will now be described for this type of driving of vehicles without any intention to restrict the invention thereto.

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Fig 2 illustrates schematically one of the vehicles shown in Fig 1, and each of the vehicles operating in the platoon formation has the features now disclosed with reference to Fig 2. Thus, the vehicle has a wireless interface 4 configured to communicate wire-

10 lessly with the wireless interfaces of the other motor vehicles, for example through Wi-Fi, Telecom, Bluetooth or IR. The vehicle has also an automatic controller 5 for the platooning operation of the group of vehicles in question using said wireless interface 4 for controlling the vehicles to maintain the desired mutual spacing.

15

The vehicle has sensors, here summarised by a box 6, configured to detect the status of equipment of the vehicle sensitive to/reacting upon a collision or an expected collision of the vehicle with an object, such as another vehicle, and these sensors may be part of

20 the brake system of the vehicle, airbags, pressure systems in front, radar, lidar and camera. All these types of sensor/equipment may react upon a collision and most of them also upon an expected collision of the vehicle. The vehicle has also a transmitter 7 using the wireless interface 4 to transmit a distress signal to the traffic

25 surrounding the vehicle upon receipt of information from a sensor 6 of detection of a status of collision or expected collision of the vehicle.

A receiver 8 is arranged in the vehicle to receive a said distress

30 signal by using said wireless interface 4 when another vehicle in

the platoon formation is transmitting such a signal and upon receipt of a said distress signal trig a control unit 9 associated with the receiver to activate collision mitigating devices 10 of the vehicle. Such devices may be a seat belt then tightened, an airbag  
5 then prepared for deployment, the steering wheel then locked to avoid jack-knifing or automatically adjusting the position thereof so that injury to the driver is minimized if the driver is propelled forward during the collision, etc. Another option is to cause filling of the vehicle with foam to protect the driver upon imminent impact.

10

Fig 3 illustrates schematically another embodiment of the invention, in which the receiver of the collision mitigating system is not arranged on a vehicle but in the infrastructure. It is illustrated how a road 11 the vehicle 1 is driving on is a road with a traffic barrier  
15 12, and a receiver 8' arranged in connection with the traffic barrier is configured to trig a control unit to activate a collision mitigating device in the form of moving the traffic barrier 12 as indicated by the arrows A in Fig 3 when said distress signal is transmitted by the motor vehicle 1 involved in a collision or an expected collision  
20 and received by the receiver 8'. It is also indicated how another type of receiver 8'' may be arranged in the infrastructure in connection with a road barrier 13, especially a road barrier of a cushioning material, which may be controlled to be lowered to an active blocking state as illustrated by the arrow B when said receiver 8''  
25 receives a said distress signal. It is pointed out that the vehicle 1 may very well be another vehicle than the one transmitting the distress signal while colliding, which for instance may be the vehicle 1', and the actions then carried out by involvement of the receivers 8' and 8'' will be to protect other vehicles such as the vehicle 1 by

for instance mitigate an expected collision thereof with the vehicle 1'.

Fig 4 illustrates a flow chart of a method according to an embodiment of the present invention carried out for mitigating collisions occurring in traffic. The method is started with the step S<sub>1</sub> of asking the question: "Collision or expected collision detected?" When the answer to this question is "Yes" a distress signal is transmitted to the surrounding traffic in a step S<sub>2</sub>. This signal is received by members of the surrounding traffic in a step S<sub>3</sub> and upon such a receipt a collision mitigating device/system is activated in the traffic surrounding the motor vehicle in a step S<sub>4</sub>.

Computer program code for implementing a method according to the invention is with advantage included in a computer program which can be read into the internal memory of a computer, e.g. the internal memory of an electronic control unit of a motor vehicle. Such a computer program is with advantage provided via a computer program product comprising a data storage medium which can be read by a computer and which has the computer program stored on it. Said data storage medium is for example an optical data storage medium in the form of a CD ROM disc, a DVD disc etc., a magnetic data storage medium in the form of a hard disc, a diskette, a cassette tape etc., or a flash memory or a memory of the ROM, PROM, EPROM or EEPROM type. Fig. 5 illustrates very schematically an electronic control unit 14 comprising an execution means 15, e.g. a central processor unit (CPU), for execution of computer software. The execution means 15 communicates with a memory 16, e.g. of the RAM type, via a data bus 17. The control unit 14 comprises also a non-transitory data storage medium 18,

e.g. in the form of a flash memory or a memory of the ROM, PROM, EPROM or EEPROM type. The execution means 15 communicates with the data storage medium 18 via the data bus 17. A computer program comprising computer program code for implementing a method according to the invention, e.g. in accordance with the embodiment illustrated in Fig. 4 is stored on the data storage medium 18.

The invention is of course in no way restricted to the embodiments described above, since many possibilities for modifications thereof are likely to be obvious to one skilled in the art without having to deviate from the scope of invention defined in the appended claims.

## **Claims**

1. A system for mitigating collisions occurring in traffic including motor vehicles (1, 1'), said system comprising on board a host motor vehicle:
- 5
- sensors (6) configured to detect the status of equipment of the vehicle sensitive to/reacting upon a collision or an expected collision of the host vehicle with an object, such as another vehicle, and
  - 10 • a transmitter (7) configured to transmit a distress signal to the traffic surrounding the host vehicle (1, 1') upon receipt of information from a said sensor (6) of detection of a status of collision or expected collision of the vehicle,
- characterized** in that the system further comprises at least
- 15 one receiver (8,8', 8'') configured to on one hand receive a said distress signal when the host vehicle is in a location making said receiver to be arranged in the traffic surrounding the host vehicle and on the other hand upon receipt of a said distress signal trig a control unit (9) associated with the receiver
- 20 to activate a collision mitigating device/system (10) present in said surrounding traffic.
2. A system according to claim 1, **characterized** in that it comprises said receivers (8) arranged on-board other motor vehicles
- 25 cles (1, 1').
3. A system according to claim 2, **characterized** in that said control unit (9) associated with a said receiver (8) is configured to activate collision mitigating devices (10) of said other vehicle,
- 30 cle, such as tightening a seat belt, preparing an air bag for

deployment, filling the vehicle with foam to protect the driver upon imminent impact, locking the steering wheel to avoid jack-knifing, automatically adjusting the position of the steering wheel so that injury to the driver is minimised if the driver is propelled forward during the collision, etc.

4. System according to any of the preceding claims, **characterized** in that said sensors (6) on board the host motor vehicle (1, 1') comprises one or more of the brake system of the vehicle, air bags, pressure systems in the front, radar, lidar and camera.
5. A system according to claim 2, **characterized** in that said control unit (9) associated with a said receiver (8) is configured to use wireless communication, for example Wi-Fi, Telecom, Bluetooth, IR, etc., to activate collision mitigating devices (10) of said other vehicle.
6. A system according to claim 2, **characterized** in that it is arranged on a group of motor vehicles, such as buses or trucks, configured to operate in a platoon formation and each being a said host vehicle (1, 1') as well as a said other vehicle and comprising a wireless interface (4) configured to communicate wirelessly with the wireless interfaces of the other motor vehicles of said group.
7. A system according to any of the preceding claims, **characterized** in that it comprises a said receiver (8', 8'') associated with a control unit (9) arranged in the infrastructure surround-

ing said host vehicle (1, 1') and configured to activate a collision mitigating device (12, 13) belonging to said infrastructure upon receipt of a said distress signal.

- 5     8. A system according to claim 7, **characterized** in that said infrastructure control unit (9) is configured to control the movement of a traffic barrier (12).
- 10     9. A system according to any of the preceding claims, **characterized** in that said infrastructure control unit (9) is configured to control the lowering of a road barrier (13), especially a road barrier of a cushioning material, to an active blocking state.
- 15     10. A motor vehicle comprising:
- sensors (6) configured to detect the status of vehicle equipment sensitive to/reacting upon a collision or expected collision of the vehicle with an object, such as another vehicle,
  - a transmitter (7) configured to transmit a distress signal to the traffic surrounding the host vehicle upon receipt of information from a said sensor (6) of detection of a status of collision or expected collision of the vehicle,
  - a receiver (8) configured to, upon receipt of a said distress signal from another correspondingly equipped motor vehicle in the surrounding traffic informing about a collision or expected collision of that vehicle, trigger a control unit (9) associated with the receiver (8) to activate collision mitigating devices (10) in the vehicle.
- 25     11. A method for mitigating collisions occurring in traffic comprising the steps of
- 30

- detecting the status of equipment on-board a motor vehicle sensitive to/reacting upon a collision or expected collision of the vehicle with an object, such as another vehicle,
  - transmitting a distress signal to surrounding traffic upon de-  
5      tection of a said collision or expected collision,
  - receiving said distress signal when transmitted and
  - activating a collision mitigating device/system (10) present in the traffic surrounding said motor vehicle.
- 10    12. A method according to claim 11, **characterized** in that said steps are carried out for a group of motor vehicles (1,1') operating in a platoon formation, and that the activation of a collision mitigating device/system (10) takes place in one or more motor vehicles of said group receiving a said distress signal  
15      from another motor vehicle of said group.
13. A computer program comprising a computer program code for causing a computer to implement a method according to claim  
20      11 or 12 when the computer program is executed in the computer.
14. A computer program product comprising a non-transitory data storage medium which can be read by a computer and on which the program code of a computer program according to  
25      claim 13 is stored.
15. An electronic control unit comprising an execution means (15), a memory (16) connected to the execution means (15) and a non-transitory data storage medium (18) which is connected to the execution means and on which the computer  
30

program code of a computer program according to claim 13 is stored.

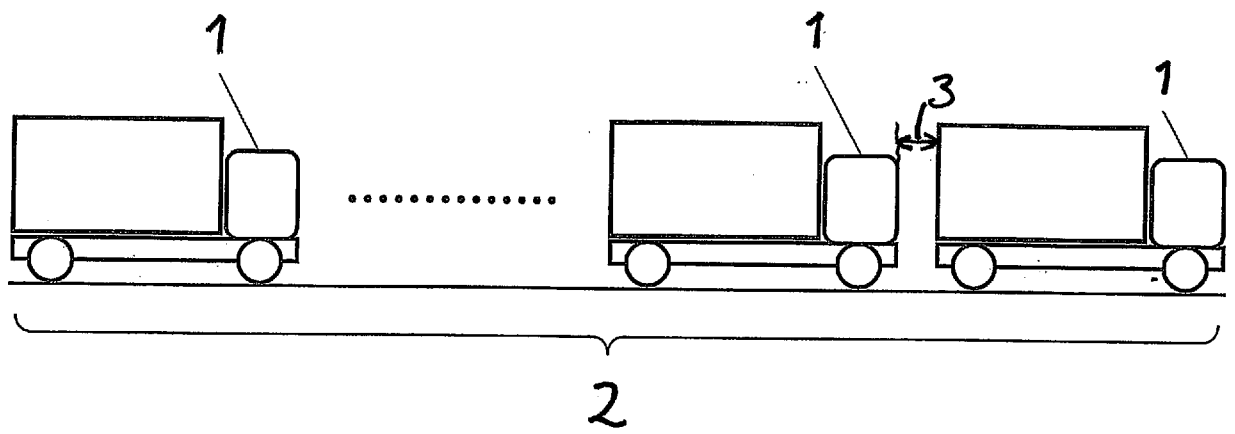


Fig 1

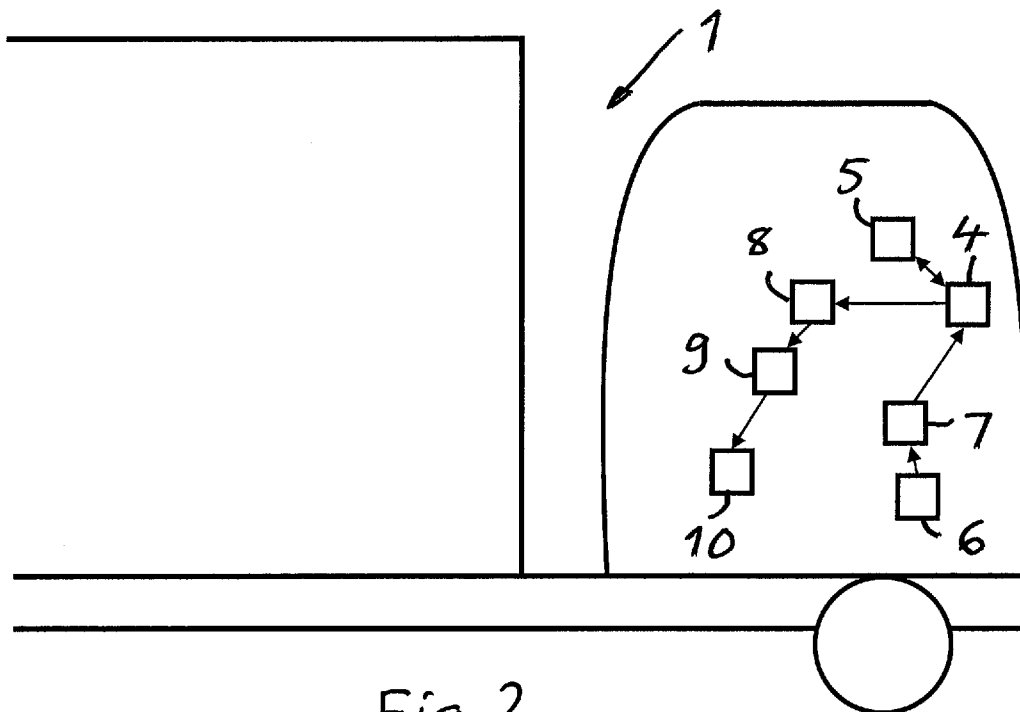


Fig 2

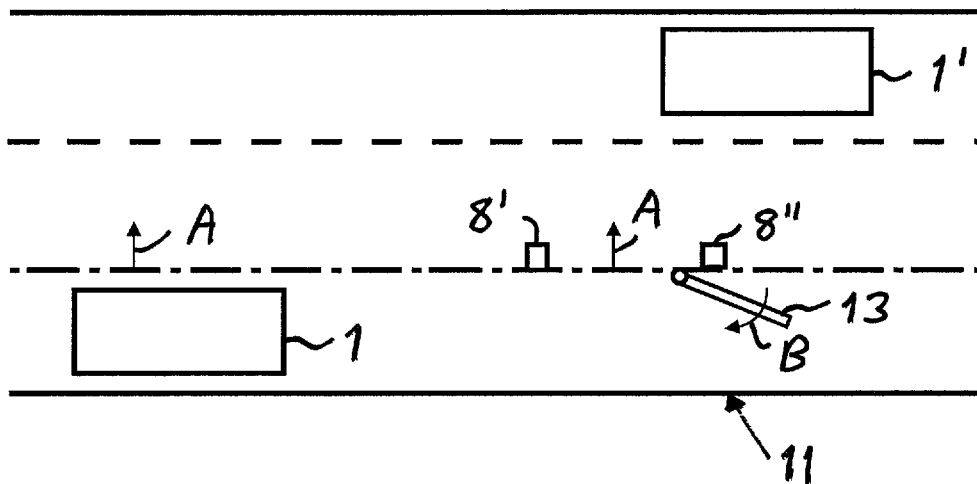


Fig 3

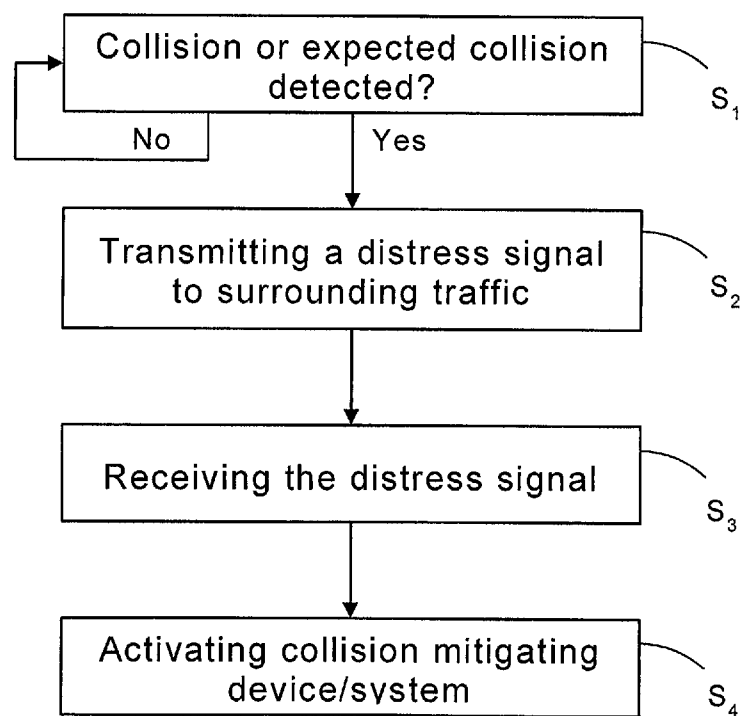


Fig 4

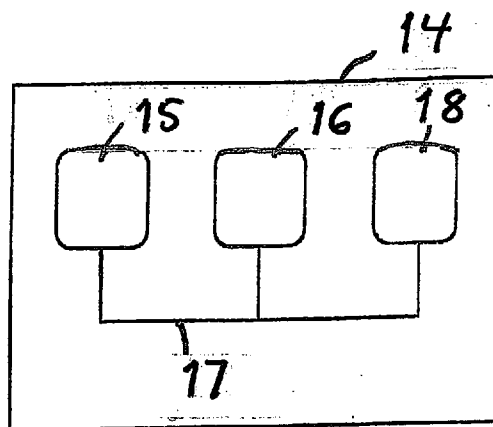


Fig 5

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/SE2017/050657

## A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: B60Q, G08G

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| A         | US 8552886 B2 (BENSOUSSAN PHILIPPE), 24 May 2012 (2012-05-24); abstract; cited int the description<br>--                               | 1-15                  |



Further documents are listed in the continuation of Box C.



See patent family annex.

|                                                                                                                                                                         |                                                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| * Special categories of cited documents:                                                                                                                                | "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                                              |
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Date of the actual completion of the international search

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Date of mailing of the international search report

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International application No.  
PCT/SE2017/050657

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                    |                       |
|-------------------------------------------------------|------------------------------------------------------------------------------------|-----------------------|
| Category*                                             | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|                                                       | -----                                                                              |                       |

**Continuation of:** second sheet

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**B60Q 9/00** (2006.01)

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/SE2017/050657**

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