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(54) Title: TRAILER SECURITY SYSTEM

(57) Abstract: A security system for a trailer, the security system comprising: a detection arrangement (40) to detect activity relating to the trailer; a communication arrangement for two-way communication between the trailer and a remote control centre; and a security arrangement (32, 36, 38) which is selectively activatable, wherein: the communication arrangement is operable to receive an authorisation message indicating whether activity of a certain type is authorised or unauthorised; and upon detection by the detection arrangement of activity relating to the trailer, if an authorisation message is received indicating that the activity is unauthorised, the security arrangement is activated.

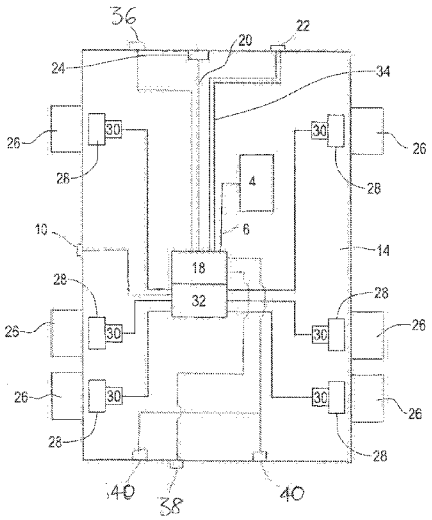


FIG. 1

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Title: TRAILER SECURITY SYSTEM

Description of Invention

The present application relates to a trailer security system, and in particular concerns a system for enhancing the security of the trailer when it is detached from a towing vehicle.

Trailers are often used to transport new and/or valuable goods in large quantities, and are therefore targets for theft. Trailers may be particularly vulnerable to theft if parked in isolation, i.e. detached from a towing vehicle. Miscreants may attempt to gain access to the interior of the trailer to steal goods contained therein. Alternatively, miscreants may attempt to attach a towing vehicle to the trailer and drive away, thus stealing both the trailer and its cargo.

It is an object of the present invention to seek to provide an improved security system for trailers.

Accordingly, one aspect of the present invention provides a security system for a trailer, the security system comprising: a detection arrangement to detect activity relating to the trailer; a communication arrangement for two-way communication between the trailer and a remote control centre; and a security arrangement which is selectively activatable, wherein: the communication arrangement is operable to receive an authorisation message from the remote control centre indicating whether activity of a certain type is authorised or unauthorised; and upon detection by the detection arrangement of activity relating to the trailer, if an authorisation message is received indicating that the activity is unauthorised, the security arrangement is activated.

Advantageously, the communication arrangement is operable to transmit a notifying message to the control centre, the notifying message including information relating to the activity.

Preferably, following transmission of the notifying message, the communication arrangement is operable to receive the authorisation message in response, indicating whether the activity is authorised or unauthorised.

Conveniently, the communication arrangement is operable to receive the authorisation message, prior to detection of the activity, the authorisation message indicating whether, at the time the activity is detected, activity of the type detected is authorised or unauthorised.

Advantageously, the security system further comprises a processor or group of processors operable to instruct the communication arrangement to transmit the notifying message, and to receive the authorisation message from the communication arrangement.

Preferably, the or each processor forms part of a telematics system of the trailer.

Conveniently, the detection arrangement comprises one or more sensors to detect the opening or attempted opening of a door of the trailer.

Advantageously, the detection arrangement comprises a sensor to detect whether pressurised fluid has been introduced into a fluid supply line of the trailer.

Preferably, the detection arrangement comprises an arrangement to detect movement of the trailer.

Conveniently, the detection arrangement comprises a positioning system.

Advantageously, the detection arrangement comprises a sensor to detect rotation of one or more wheels of the trailer.

Preferably, power is provided to an electronic braking system (EBS) of the trailer if unauthorised activity is detected.

Conveniently, the security system further comprises a power source to provide power to the EBS if the trailer is not connected to an external power source.

Advantageously, the security arrangement comprises at least one camera.

Preferably, the security system comprises two or more cameras, wherein one or more of the cameras are selectively activated in dependence upon the type of unauthorised activity that is detected.

Conveniently, one of the cameras is positioned in the vicinity of a door of the trailer, and the camera is activated in response to a determination that the door has been opened or an attempt has been made to open the door.

Advantageously, one of the cameras is positioned adjacent a connection site of the trailer, wherein the cameras activated if it is determined that a connection has been made to the connection site.

Preferably, the trailer comprises at least one parking brake, and the security arrangement comprises a parking valve positioned selectively to allow, in an unlocked position, or prevent, in a locked position, the release of the parking brake by pressurised fluid introduced into the fluid connection and wherein, in response to receipt of an authorisation message indicating that the activity is unauthorised, the parking valve is moved to the locked position.

Conveniently, if unauthorised activity is detected and a towing vehicle is electrically connected to the trailer, the EBS is instructed by the security arrangement to send a braking request to the towing vehicle.

Advantageously, the braking request comprises a message instructing the towing vehicle to exhaust a fluid supply line to the trailer.

Preferably, if unauthorised activity is detected, one or more software features of the EBS are activated or deactivated by the security arrangement.

Conveniently, if unauthorised activity is detected, one or more regions of a memory of the EBS are erased by the security arrangement.

Advantageously, the manner in which the security arrangement is activated is instructed via a communication from the control centre.

Preferably, the manner in which the security arrangement is activated is determined by one or more on-board processors.

Another aspect of the present invention provides a trailer comprising a security system according to any of the above.

A further aspect of the present invention provides a security method for a trailer, comprising the steps of: detecting activity relating to the trailer; receiving an authorisation message from a remote control centre indicating whether the activity is authorised or unauthorised; and if an authorisation message is received indicating that the activity is unauthorised, activating a selectively actuatable security arrangement.

Another aspect of the present invention provides a computer program comprising code adapted to perform all of the steps of the above when run on a computer.

Conveniently, the computer program is embodied on a computer-readable medium.

In order that the present invention may be more readily understood embodiments thereof will now be described, by way of example, with reference to the accompanying figure which shows a schematic view of a trailer embodying the present invention.

Referring firstly to Figure 1, a trailer 14 incorporating a security system embodying the present invention is shown. The trailer 14 has a plurality of wheels 26, each of which is provided with a brake 28 which is operated by an actuator 30. In this example the actuators 30 are pneumatically operable, and are connected to a source of pressurised fluid (in this example compressed air) via a modulator 32. The modulator 32 is electrically operable and receives an electrical signal input from an electronic control unit (ECU) 18.

Together, the ECU 18 and modulator 32 make up the trailer's electronic braking system (EBS).

The trailer 14 has an electrical connector 24 positioned at its front end for electrical connection to a towing vehicle (not shown). A connecting cable 20, comprising a power cable and a data connection such as a CAN bus, extends from the electrical connection 24 to the ECU 18.

The trailer 14 also comprises a fluid connection 22, to which a towing vehicle may be attached for pressurised fluid to be supplied from the towing vehicle. The fluid connection 22 feeds a fluid supply line 34 which extends from the fluid connection 22 to the EBS.

The trailer 14 further comprises a telematics system 4, which contains a location module (such as a GPS locator) and a communication module (such as a GSM system). The telematics system 4 also comprises a rechargeable battery, which is charged when the trailer 14 is connected to an external power source, for instance from the trailer's EBS or from the trailer's lighting circuit. In the example shown the telematics system 4 is connected to the ECU 18 via a connecting cable 6, which comprises a power cable as well as a data connection such as a CAN bus.

One or more wheels 26 of the trailer 14 may have a parking brake, comprising a disc or drum brake arrangement which is held in the "locked" position by the force of a spring. Pressurised fluid must be introduced into the parking brake to overcome the spring pressure and unlock the wheel.

In addition, a manual parking brake is provided, comprising a parking valve which (in the depicted embodiment) forms part of the modulator 32. The parking valve may be operated by a manual brake control 10, which is provided at a convenient location on an exterior of the trailer 14. In an "unlocked" position the parking valve allows fluid from the fluid supply line 34 to enter the spring brake chambers (possibly by way of a separate port of the

EBS), thus releasing the spring brakes. In a "locked" position the parking valve exhausts the spring brakes, causing the spring brakes to remain on and hence parking the trailer 14. In this example when the parking valve is open it is in the locked position, and when the parking valve is closed it is in the unlocked position. When the trailer 14 is parked an operator may set the manual brake control 10 to the "locked" position, so that even if a source of pressurised fluid is attached to the fluid supply line 34, the parking valve will prevent the pressurised fluid from unlocking the parking brake.

In general, when the operator of a towing vehicle moves the trailer 14, the air supply of the towing vehicle may be attached to the fluid supply line 34 of the trailer 14. This is intended to release the parking brake on the trailer 14, allowing the wheels 26 of the trailer 14 to turn as the trailer 14 is towed.

The trailer 14 shown in Figure 1 also includes rear door sensors 40, which are adapted to detect whether the rear doors of the trailer 14 are open or closed. In the depicted embodiment two door sensors are shown, and this may be suitable for a trailer having double doors at its rear end. However, if a single door, or a rolling shutter-type door is provided, only one door sensor may be necessary.

The door sensors 40 are preferably connected to an input of the telematics unit 4, and may also (or alternatively) be connected to the ECU 18.

The trailer 14 shown in Figure 1 also comprises front and rear cameras 36, 38 which are provided on front and rear surfaces of the trailer 14 respectively and positioned with their fields of view facing outwardly.

In use of the security system, a first step is to determine that unauthorised activity connected with trailer is occurring. Unauthorised activity is likely to

comprise either opening (or attempted opening) of the trailer doors, coupling of the trailer 14 to a towing vehicle, and/or movement of the trailer 14.

Opening of, or interference with, the trailer doors can be detected via the door sensors 40.

Connection of the fluid connection 22 to a towing vehicle can be determined, for example, by one or more fluid sensors associated with the fluid connection 22 or the fluid supply line 34. Preferably the or each fluid sensor is connected to an input of the telematics unit 4, and may also (or alternatively) be connected to the ECU 18. It can be determined that the electrical connection 24 is attached to a towing vehicle if the EBS is receiving electrical power.

Movement of the trailer 14 may be detectable via the positioning system of the telematics unit 4, by determining that one or more of the wheels 26 of the trailer 14 are turning, and/or through changes in suspension pressure, e.g. the pressure in suspension bellows which can be transmitted from the actuators 30 to the modulator 32.

If opening/attempted opening of the trailer's doors, connection of the trailer 14 to a source of compressed fluid or electrical power, or movement of the trailer 14 is detected, the next step is to determine whether this activity is unauthorised.

In preferred embodiments, activity can be detected by the telematics unit 4, without the need (initially) for activation of the EBS. As discussed above the telematics unit 4 may receive signals from the door sensors 40 and/or the fluid sensors, and the telematics unit 4 also incorporates a positioning system. The telematics unit 4 may therefore be able to detect opening of the

trailer doors, connection of the trailer 14 to a source of pressurised fluid, or movement of the trailer 14.

The telematics unit 4 may determine whether the activity is authorised or unauthorised in two principal ways.

Firstly, a message can be sent from the telematics unit 4 to a remote control centre, where a determination is made as to whether the detected activity is likely to be unauthorised. The control centre responds with a message indicating that the activity is (or is likely to be) authorised, or that the activity is (or is likely to be) unauthorised.

It is envisaged that the generation of a response from the control centre will be automatic, and will be carried out by a computer or network of computers at, or associated with, the control centre. The control centre may have access to details of the schedule of the trailer 14, which may include: the times at which the trailer 14 is expected to be parked, and the times at which the trailer 14 is expected to be moved; the times at which the trailer 14 is expected to be loaded/unloaded, and the times at which no loading or unloading is expected; and the expected geographical location of the trailer 14 at various times.

The skilled person will understand how, when a message is received from the trailer 14, the control centre may consult the details of the trailer's schedule and make an automatic determination as to whether the activity is (or is likely to be) either authorised or unauthorised.

In other embodiments a human operator at the control centre may consult schedule information and make a determination. In yet further embodiments a human operator will perform a check when an automatic determination is

made that the activity is (or is likely to be) unauthorised, as a fail-safe procedure.

In other embodiments the telematics unit 4 may receive a message from the control centre indicating that any activity is unauthorised (i.e. no legitimate activity is expected). The message may indicate that this remains the case for a specific length of time (e.g. 4 hours or 8 hours), or expires at a certain time (e.g. 9am the following day). Alternatively this may remain the case until a further message is sent indicating that any subsequent activity is authorised. In these embodiments, if activity is detected the telematics unit 4 will simply check whether activity at the present time is authorised or unauthorised, according to the messages that have already been received from the control centre.

In embodiments of the invention, when the telematics unit 4 detects activity and determines that the activity is unauthorised, power is supplied to the trailer's EBS, and the EBS is activated. It will be appreciated that, unless the trailer 14 is connected to an external source of electrical power (e.g. a towing vehicle), this will require an on-board electrical power source.

In embodiments the EBS may be provided with a dedicated battery (not shown) for these purposes. The dedicated battery may be a rechargeable battery which is charged when the trailer 14 is connected to an external power source.

In alternative embodiments the EBS may be powered from the battery of the telematics unit 4.

Once the EBS has been activated, further ways of detecting unauthorised activity may become available. For instance, the EBS may be connected to

receive signals from wheel rotation sensors and pressure sensors in bellows of the suspension system.

If unauthorised activity is detected, the action taken in response to the unauthorised activity may depend on the nature of the activity.

In one embodiment, the EBS is operable to prevent the parking valve from being released, for instance by activating a latching solenoid on the parking valve. This will ensure that pressurised fluid cannot be supplied through the pneumatic line 34 to release the parking brake of the trailer 14. This will ensure that the trailer's wheels 26 remain locked. This is likely to prevent the unauthorised towing of the trailer 14, or will at least make it much more difficult (and much more suspicious-looking) to tow the trailer 14.

If it is detected that the trailer 14 has been connected electrically to a towing vehicle, the EBS may send a "supply line braking request" to the towing vehicle via the connection, which may be a CAN bus. This is a standard ISO11992 message that instructs the towing vehicle to exhaust the pneumatic supply line to the trailer. This causes the trailers parking brake to be applied, thus again stopping the trailer 14 from being moved, or making movement much more difficult and conspicuous.

In embodiments one or both of the front and rear cameras 36, 38 may be activated to capture images. If it is detected that the rear doors of the trailer 14 have been opened, the rear camera 38 may be activated to capture images of people entering the trailer 14 through the rear doors and/or removing goods from the trailer 14 through these doors.

If it is determined that the trailer 14 has been connected to a towing vehicle, or is being towed, the front camera 36 may be activated to capture images of

the towing vehicle and/or individuals driving the towing vehicle or connecting the towing vehicle to the trailer 14.

The telematics unit 4 may also be activated to continue to transmit data from the EBS to the control centre, and this data may include the time, the trailer's location, information as to whether the door sensors 40 have been activated, information as to whether the trailer 14 has been connected to a towing vehicle, information as to whether movement of the trailer 14 has been detected, or camera data. Alternatively, or in addition this information may be stored in a memory of the EBS.

Continuing to compile and transmit/store this information creates a record of events which may be of assistance in apprehending the miscreants, in preparing an effective insurance claim, in locating the trailer 14 and/or its cargo, and in determining which repairs/maintenance will need to be carried out on the trailer 14.

In Embodiments the EBS may, in response to detection of unauthorised activity, switch on or off in-built software features. Features that are deactivated may, for example, include:

- load transfer functions such as those that minimise or maximise load on the towing vehicle axles by balancing the suspension bellows pressures on the trailer axles;
- steering axle assistance devices, e.g. allowing self-steering axle locking in reverse; and
- auxiliary features that assist in loading and unloading of the trailer.

Software features that are activated may include those that provide a perceptible signal to nearby observers, such as the sounding of an auxiliary

beeper, or the flashing of the hazard lamps of the trailer and/or towing vehicle.

The list of software features that are to be activated/deactivated may be stored in a memory of the EBS. Alternatively, the control centre may transmit a command, through the telematics unit 4, instructing which software features are to be activated/deactivated.

Deactivation of software features may comprise reparameterisation of the EBS, or even “re-flashing” (i.e. erasing/deletion) of some or all software in the EBS.

The action that is to be taken in response to the detection of unauthorised activity may be decided by the trailer’s EBS, or may be instructed by way of a command from the control centre.

In the above description reference is made to a telematics system, and this term will be well-understood by those skilled in the art. However, references to a telematics system should be understood as including references to any other type of communication system allowing two-way communication between a trailer and a remote control centre.

It will be understood that this invention provides a practical and flexible system for improving the security of a trailer. In particular, when the trailer is not connected to an external power source the telematics unit will be the only component with its own active power source. In embodiments of the invention the telematics unit detects activity and, based on information from a remote control centre, determines whether the activity is authorised. Then if and only if activity is detected and determined to be unauthorised, the EBS is powered and activated.

When used in this specification and claims, the terms "comprises" and "comprising" and variations thereof mean that the specified features, steps or integers are included. The terms are not to be interpreted to exclude the presence of other features, steps or components.

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS:

1. A security system for a trailer, the security system comprising;

a detection arrangement to detect activity relating to the trailer;

a communication arrangement for two-way communication between the trailer and a remote control centre; and

a security arrangement which is selectively activatable,

wherein:

the communication arrangement is operable to receive an authorisation message from the remote control centre indicating whether activity of a certain type is authorised or unauthorised; and

upon detection by the detection arrangement of activity relating to the trailer, if an authorisation message is received indicating that the activity is unauthorised, the security arrangement is activated.

2. A security system according to claim 1, wherein the communication arrangement is operable to transmit a notifying message to the control centre, the notifying message including information relating to the activity.

3. A security system according to claim 2 wherein, following transmission of the notifying message, the communication arrangement is operable to receive the authorisation message in response, indicating whether the activity is authorised or unauthorised.

4. A security system according to claim 1 or 2 wherein the communication arrangement is operable to receive the authorisation message, prior to detection of the activity, the authorisation message indicating whether, at the time the activity is detected, activity of the type detected is authorised or unauthorised.

5. A security system according to claim 2, wherein the security system further comprises a processor or group of processors operable to instruct the communication arrangement to transmit the notifying message, and to receive the authorisation message from the communication arrangement.

6. A security system according to claim 5 wherein the or each processor forms part of a telematics system of the trailer.

7. A security system according to any preceding claim wherein the detection arrangement comprises one or more sensors to detect the opening or attempted opening of a door of the trailer.

8. A security system according to any preceding claim wherein the detection arrangement comprises a sensor to detect whether pressurised fluid has been introduced into a fluid supply line of the trailer.

9. A security system according to any preceding claim wherein the detection arrangement comprises an arrangement to detect movement of the trailer.

10. A security system according to claim 9 wherein the detection arrangement comprises a positioning system.

11. A security system according to claim 9 of 10 wherein the detection arrangement comprises a sensor to detect rotation of one or more wheels of the trailer.

12. A security system according to any preceding claim wherein power is provided to an electronic braking system (EBS) of the trailer if unauthorised activity is detected.

13. A security system according to claim 12 further comprising a power source to provide power to the EBS if the trailer is not connected to an external power source.

14. A security system according to any preceding claim, wherein the security arrangement comprises at least one camera.

15. A security system according to claim 14, comprising two or more cameras, wherein one or more of the cameras are selectively activated in dependence upon the type of unauthorised activity that is detected.

16. A security system according to claim 14 or 15, wherein one of the cameras is positioned in the vicinity of a door of the trailer, and the camera is activated in response to a determination that the door has been opened or an attempt has been made to open the door.

17. A security system according to any one of claims 14 to 16 wherein one of the cameras is positioned adjacent a connection site of the trailer, wherein the cameras activated if it is determined that a connection has been made to the connection site.

18. A security system according to any preceding claim, wherein the trailer comprises at least one parking brake, and the security arrangement comprises a parking valve positioned selectively to allow, in an unlocked position, or prevent, in a locked position, the release of the parking brake by pressurised fluid introduced into the fluid connection and wherein, in response to receipt of an authorisation message indicating that the activity is unauthorised, the parking valve is moved to the locked position.

19. A security system according to any one of claims 13 to 18, when dependent upon claim 12 wherein, if unauthorised activity is detected and a towing vehicle is electrically connected to the trailer, the EBS is instructed by the security arrangement to send a braking request to the towing vehicle.

20. A security system according to claim 19, wherein the braking request comprises a message instructing the towing vehicle to exhaust a fluid supply line to the trailer.

21. A security system according to any one of claims 13 to 20, when dependent upon claim 12 wherein, if unauthorised activity is detected, one or more software features of the EBS are activated or deactivated by the security arrangement.

22. A security system according to any one of claims 13 to 21, when dependent upon claim 12 wherein, if unauthorised activity is detected, one or more regions of a memory of the EBS are erased by the security arrangement.

23. A security system according to any preceding claim wherein the manner in which the security arrangement is activated is instructed via a communication from the control centre.

24. A security system according to one of claims 1 to 23 wherein the manner in which the security arrangement is activated is determined by one or more on-board processors.

25. A trailer comprising a security system according to any preceding claim.

26. A security method for a trailer, comprising the steps of:

detecting activity relating to the trailer;

receiving an authorisation message from a remote control centre indicating whether the activity is authorised or unauthorised; and

if an authorisation message is received indicating that the activity is unauthorised, activating a selectively actuatable security arrangement.

27. A computer program comprising code adapted to perform all of the steps of claim 26 when run on a computer.

28. A computer program according to claim 27 embodied on a computer-readable medium.

29. A security system substantially as hereinbefore described, with reference to the accompanying figure.

30. A trailer substantially as hereinbefore described, with reference to the accompanying figure.

31. A method substantially as hereinbefore described, with reference to the accompanying figure.

32. A computer program substantially as hereinbefore described, with reference to the accompanying figure.

33. Any novel feature or combination of features disclosed herein.

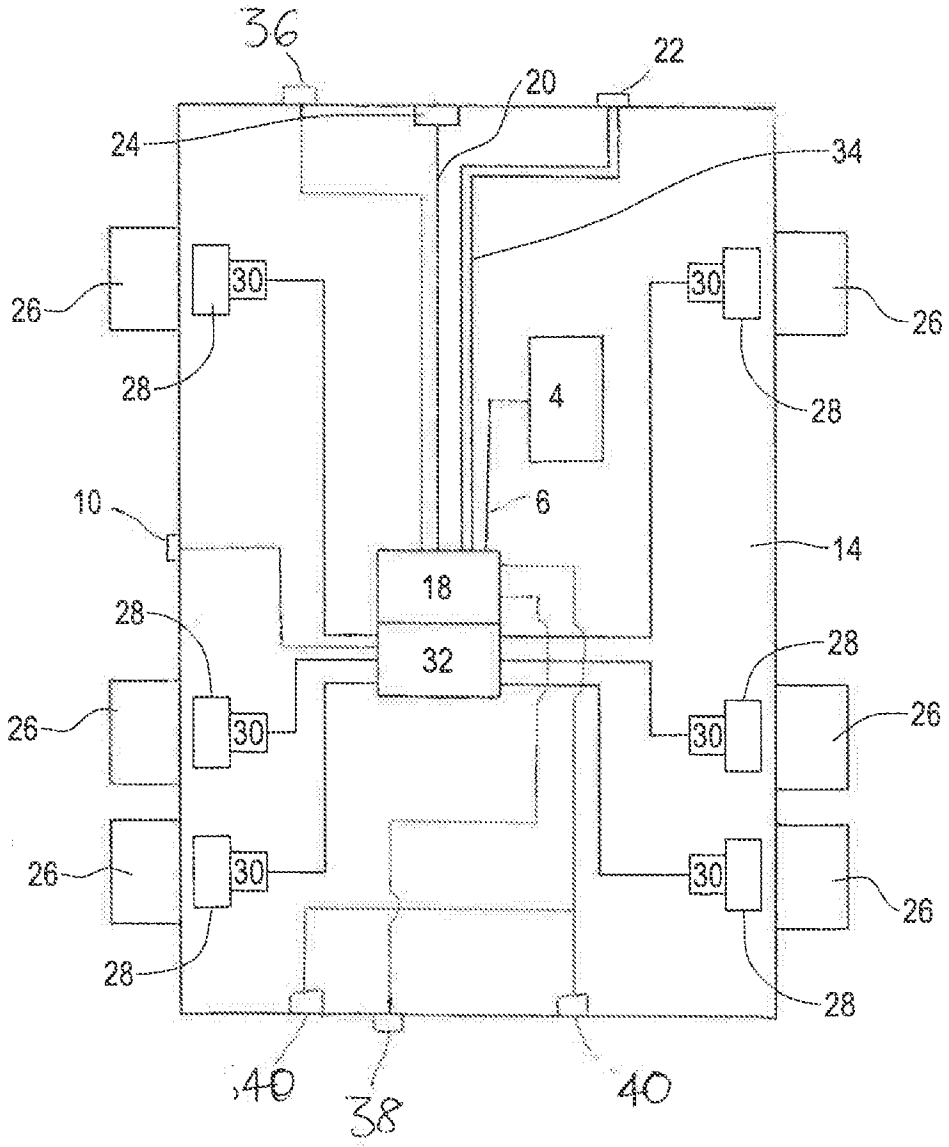


FIG. 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2013/053326

A. CLASSIFICATION OF SUBJECT MATTER
INV. B60R25/20
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)
B60R

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	WO 2006/133535 A1 (KOLOMBO TECHNOLOGIES LTEE [CA]; CHOUCAIR FOUAD [CA]; ARSENAULT MARTIN) 21 December 2006 (2006-12-21) page 16, line 5 - page 17, line 12; figures 5,6	1-3,5-33
X	WO 2009/046512 A2 (HADAR RASTREAMENTO E GERENCIAM [BR]; ESCOLA CRISTIANO BRANCHIERI [BR]) 16 April 2009 (2009-04-16) abstract; figures 1,2 page 3, lines 1-4, 18-20 page 7, lines 13-21	1-3,5-7, 9-13, 18-33

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[X] Further documents are listed in the continuation of Box C.

[X] 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

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Date of the actual completion of the international search	Date of mailing of the international search report
6 March 2014	13/03/2014

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1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2013/053326

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2005/115810 A2 (MITZI S R L [IT]; NAVA MARIO [IT]; PEDRUZZI GIOVANNI [IT]; CORNA GIANF) 8 December 2005 (2005-12-08) abstract; figures 1,3,4 page 7, lines 4-13 page 9, lines 13-22 page 11, lines 5-12 page 12, lines 20-31 page 13, lines 19-23 page 15, lines 9-13	1,2,4-33
X	US 2008/157942 A1 (PAYNE ROBERT L [US]) 3 July 2008 (2008-07-03) abstract; figure 6 paragraphs [0035], [0040] - [0043]	1-7, 9-13, 18-33
X	US 2005/062344 A1 (HOLT JOHN P [US] ET AL) 24 March 2005 (2005-03-24) abstract; figures 3,4,9 paragraphs [0056], [0071]	1-3,5-7, 9-13, 18-33
A	DE 102 03 434 A1 (KOSTAL LEOPOLD GMBH & CO KG [DE]) 31 July 2003 (2003-07-31) abstract; figure 1	21,22
A	WO 2012/112105 A1 (SCANIA CV AB [SE]; SUNDELL PETER [SE]; CLAEZON FREDRICH [SE]) 23 August 2012 (2012-08-23) page 2, lines 20-31; figures 1,2,3	14-17

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2013/053326

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2006133535 A1	21-12-2006	AU 2006257737 A1	21-12-2006
		CA 2509804 A1	15-12-2006
		CN 101287621 A	15-10-2008
		EP 1893435 A1	05-03-2008
		US 2006284476 A1	21-12-2006
		WO 2006133535 A1	21-12-2006
WO 2009046512 A2	16-04-2009	BR PI0703612 A	27-05-2008
		EP 2212874 A2	04-08-2010
		WO 2009046512 A2	16-04-2009
WO 2005115810 A2	08-12-2005	WO 2005115810 A2	08-12-2005
		WO 2005115811 A1	08-12-2005
US 2008157942 A1	03-07-2008	US 2008157942 A1	03-07-2008
		WO 2006089284 A2	24-08-2006
US 2005062344 A1	24-03-2005	NONE	
DE 10203434 A1	31-07-2003	NONE	
WO 2012112105 A1	23-08-2012	CN 103370734 A	23-10-2013
		EP 2676252 A1	25-12-2013
		SE 1150117 A1	15-08-2012
		WO 2012112105 A1	23-08-2012