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Title: A SAFETY ARRANGEMENT

Description of Invention

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THE PRESENT INVENTION relates to a safety arrangement, and more particularly relates to a safety arrangement for use with a vehicle which is configured to tow a trailer.

15 A towing vehicle, such as a tractor is provided with a tow hitch, tow bar or trailer hitch which is used to connect the vehicle to a trailer in order for the vehicle to tow the trailer. The tow hitch on the vehicle constitutes a first part of a tow hitch system which engages with a second part of the tow hitch system which is carried by the trailer. The trailer is releasably attached to the vehicle by
20 coupling the first and second parts of the tow hitch system. The parts of the tow hitch system are usually coupled by bringing the parts of the tow hitch system into engagement with one another and securing the parts together with a locking member, such as a tow pin.

25 It is important that the trailer is coupled correctly to the vehicle before the vehicle starts towing the trailer because otherwise the trailer may become disengaged from the vehicle and cause an accident. Accidents can be minimised by a user checking the tow hitch connection manually before the vehicle begins to move. The problem with this system is that checking the tow
30 hitch connection manually every time a trailer is coupled to the vehicle is time consuming and potentially dangerous for the user.

The problem is particularly apparent in airports where towing vehicles are coupled with many different trailers in quick succession as the vehicle tows
35 trailers across the airport site where many other road vehicles and aeroplanes

5 operate. In this situation, the driver of the vehicle often wastes a significant amount of time leaving the vehicle to check the tow hitch connection each time a new trailer is hitched to the vehicle.

The present invention seeks to provide an improved safety arrangement.

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According to one aspect of the present invention, there is provided a safety arrangement for use with a tow hitch system for connecting a trailer to a vehicle, the tow hitch system comprising a first part and a second part that are releasably attachable to one another, one part being carried by the vehicle and
15 the other part being carried by the trailer, wherein the safety arrangement comprises: a connection sensor which is configured to sense the status of the connection between the first and second parts of the tow hitch system and to provide a connection error signal in the event that the first and second parts are not attached securely to one another; and a movement restriction module which
20 is configured to receive the connection error signal from the connection sensor, the movement restriction module being operable, in use, to restrict movement of the vehicle upon receipt of the connection error signal from the connection sensor so that movement of the vehicle is restricted in the event that the parts of the tow hitch system are not attached securely to one another.

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Preferably, the movement restriction module is, in use, connected to the fuel supply system of a vehicle and is configured to cut off the fuel supply to the engine of the vehicle upon receipt of the connection error signal from the connection sensor.

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Conveniently, the movement restriction module is, in use, connected to the brake system of the vehicle and is configured to activate the brake system to restrict movement of the vehicle upon receipt of the connection error signal from the connection sensor.

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5 Advantageously, wherein the movement restriction module is, in use, connected to the ignition system of the vehicle and is configured to disable the ignition system to immobilise the vehicle upon receipt of the connection error signal from the connection sensor.

10 Preferably, the arrangement further comprises: a time delay module which is configured to delay the transmission of the connection error signal to the movement restriction module by a time delay value.

Conveniently, the time delay value is approximately 7 seconds.

15 Advantageously, the time delay module is configured to provide a variable time delay value.

Preferably, the arrangement further comprises: a vehicle movement direction
20 sensor which is configured, in use, to sense the direction in which the vehicle will move, the vehicle movement detection system being configured to provide an override signal to the movement restriction module which deactivates the movement restriction module so that the movement restriction module does not restrict movement of the vehicle if the vehicle movement direction sensor
25 senses that the vehicle will move in a direction which is at least partly towards the trailer.

Conveniently, the vehicle movement direction sensor is connected to the power supply of a reversing light of the vehicle to detect when power is supplied to the
30 reversing lights.

Advantageously, the arrangement further comprises: a bypass switch, which, when activated, is configured to bypass the movement restriction module so that the movement restriction module does not restrict the movement of the
35 vehicle.

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Preferably, the connection sensor comprises a position sensor which is configured to sense the position of a tow hitch lever which is, in use, operable to connect and disconnect the first and second parts of the tow hitch system.

10 According to another aspect of the present invention, there is provided a vehicle comprising the safety arrangement as defined in of any one of the claims hereinafter.

According to a further aspect of the present invention, there is provided a
15 method of connecting a trailer to a vehicle using a tow hitch system, the tow hitch system comprising a first part and a second part that are releasably attachable to one another, one part being carried by the vehicle and the other part being carried by the trailer, wherein the method comprises: engaging the first and second parts of the tow hitch system to one another; sensing the status
20 of the connection between the first and second parts of the tow hitch system using a connection sensor and providing a connection error signal in the event that the first and second parts are not attached securely to one another; and restricting movement of the vehicle using a movement restriction module in response to a connection error signal from the connection sensor so that
25 movement of the vehicle is restricted in the event that the parts of the tow hitch system are not attached securely to one another.

In order that the invention may be more readily understood, and so that further features thereof may be appreciated, embodiments of the invention will now be
30 described, by way of example, with reference to the accompanying drawings in which:

Figure 1 is a schematic diagram of a vehicle coupled to a trailer,

5 Figure 2 is a side view of a tow hitch system incorporating an embodiment of the invention,

Figure 3 is a schematic diagram of the vehicle of figure 1 with a tow hitch control lever in a disengaged position,

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Figure 4 is a view corresponding to figure 3, with the tow hitch control lever in an engaged position,

15 Figure 5 is a schematic diagram showing the tow hitch control lever and a sensor arrangement, with the tow hitch control lever in the disengaged position,

Figure 6 is a view corresponding to figure 5, with the tow hitch control lever in the engaged position,

20 Figure 7 is a schematic diagram of the electrical connections in a safety arrangement of an embodiment of the invention, and

Figure 8 is an alternative schematic diagram of the wiring of a safety arrangement of an embodiment of the invention.

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Referring initially to figure 1 of the accompanying drawings, a safety arrangement of an embodiment of the invention is for use with a vehicle 1 which is operable to tow a trailer 2. The vehicle 1 may be any kind of vehicle which is configured to tow a trailer. In one embodiment, the vehicle 1 is a tractor of the type used in an airport to tow non-motorised equipment, such as baggage trolleys about the airport.

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The vehicle 1 carries a tow hitch, tow bar or trailer hitch which forms a first part of a tow hitch system 3 which is used to releasably attach the trailer 2 to the vehicle 1. The following description will refer to the first part 4 of the tow hitch

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5 system 3 being a tow hitch which is carried by the vehicle 1, as shown in figure 1.

A second part 5 of the tow hitch system 3 is carried by the trailer 2. The second part 5 is configured to be releasably attached to the first part 4 of the tow hitch system 3 to releasably attach the trailer 2 to the vehicle 1.

Referring now to figures 2 and 3 of the accompanying drawings, the first part 4 of the tow hitch system 3 comprises an elongate tow bar 6 which is a generally planar member that is provided with a first locking aperture 7. The second part 15 5 of the tow hitch system 3 is a generally planar member which is provided with a second locking aperture 8. The first and second parts 4, 5 of the tow hitch system 3 are configured to be releasably attached to one another by co-aligning the locking apertures 7, 8 and inserting a locking pin 9 through the locking apertures 7, 8. In this embodiment, the locking pin 9 is moveably attached to 20 the vehicle 1 and is configured to be moved between an unlocked position, as shown in figure 2 where the locking pin 9 is spaced apart from the locking apertures 7, 8, to a locked position in which the locking pin 9 extends through the locking apertures 7, 8.

25 Referring now to figure 3 of the accompanying drawings, in a preferred embodiment of the invention, the locking pin 9 is coupled to a tow hitch lever 10 by a coupling mechanism 11. The tow hitch control lever 10 is pivotally mounted within the vehicle 1 adjacent the driver's seat so that the position of the tow hitch control lever 10 can be adjusted manually by the driver of the vehicle 1. In this embodiment, when the tow hitch control lever 10 is pivoted 30 forwardly, as shown in figure 3, the coupling mechanism 11 raises the locking pin 9 to disengage the locking pin 9 from the locking apertures 7, 8.

Referring now to figure 4 of the accompanying drawings, when the tow hitch control lever 10 is pivoted rearwardly to an engaged position, the coupling 35

5 mechanism 11 moves the locking pin downwardly, through the locking apertures 7, 8.

Referring now to figure 5 of the accompanying drawings, the tow hitch control lever 10 is coupled to a sensor arm 12 which is positioned beneath the tow hitch control lever 10. The sensor arm 12 is configured to pivot in unison with the tow hitch control lever 10. The sensor arm 12 carries an indicator element 13 which extends perpendicularly outwardly from one end of the sensor arm 12.

In this embodiment, the indicator element 13 comprises a generally planar body 14 which is provided with an angled end 15. The indicator element 13 is configured to engage a connection sensor in the form of a microswitch 16 when the tow hitch control lever 10 is moved from the disengaged position to the engaged position. In this embodiment, the connection sensor is a microswitch. However, in other embodiments, the connection sensor is another type of proximity or contact sensor.

The angled end 15 of the indicator element 13 contacts the microswitch 16 and activates the microswitch 16 when the tow hitch control lever 10 is in the engaged position, as shown in figure 4.

The microswitch 16 is connected to provide a signal to a control unit 17. The microswitch 16 senses the position of the tow hitch control lever 10 which indicates the status of the connection between the first and second parts 4, 5 of the tow hitch system 3. The microswitch 16 provides a connection error signal to the control unit 17 in the event that the first and second parts 4, 5 are not attached securely to one another.

In this embodiment, the microswitch 16 provides the connection error signal by providing a connection to the positive voltage rail of the vehicle. In another embodiment, the connection error signal is in the form of a different voltage

5 connection provided by the microswitch 16. In a yet further embodiment, the connection error signal is an interruption or a reduction in a voltage that occurs when the microswitch 16 is activated.

10 The safety arrangement further comprises a movement restriction module 18 which is connected to the control unit 17 and which is configured to receive the connection error signal from the microswitch 16. The movement restriction module 18 is operable, in use, to restrict movement of the vehicle 1 upon receipt of the connection error signal from the microswitch 16.

15 In one embodiment, the movement restriction module 18 is a device which is connected to the fuel supply system of the vehicle 1 and which is configured to cut off the fuel supply to the engine of the vehicle 1 upon receipt of the connection error signal from the connection sensor 10. In other embodiments, the movement restriction module is another device which is operable to restrict
20 movement of the vehicle 1, such as a device which activates the brakes of the vehicle 1 or which disables the ignition system of the vehicle 1.

Referring now to figures 7 and 8 of the accompanying drawings, a control arrangement for use with the safety arrangement comprises a switching
25 system 19. At least part of the switching system 19 may be provided within the control unit 17. However, in other embodiments, at least one part of the switching system 19 is provided remotely from the control unit 17.

The wiring diagram for the safety arrangement, which is illustrated
30 schematically in figures 7 and 8, comprises a power inlet 20 which, in this embodiment, is connected to the positive power rail of the vehicle which is connected to the positive terminal of the vehicle's battery. A fuse 21 is connected in series with the power inlet. The microswitch 16 is connected in series with the fuse 21. The outlet of the microswitch 16 is connected to a timer
35 module 22 which is in turn connected to the negative or ground rail 23 of the

5 vehicle which is connected to the negative or ground terminal of the vehicle's battery.

When the microswitch 16 is activated, the microswitch 16 conveys the connection error signal which, in the preferred embodiment, is in the form of a
10 voltage from the positive power rail of the vehicle which is applied across the timer module 22 to activate the timer module 22 to begin timing a time delay. The function of the timer module 22 will be described in more detail below.

The switching system 19 is, in this embodiment, in a form of a relay switch
15 arrangement which comprises a bypass switch 24, a relay contact switch 25 and a timer contact switch 26 which are connected in parallel with one another. The parallel arrangement of the switches 24-26 is, in this embodiment, connected in series with an engine oil pressure switch power supply 27 and in series with a fuel cut-off solenoid 28 which is in turn connected to the negative
20 or ground rail 23 of the vehicle.

The fuel cut-off solenoid 28 of this embodiment acts as a vehicle movement restriction module which, when activated, by one of the switches 24-26 of the switching system 19 cuts off fuel to the engine of the vehicle to restrict or
25 prevent the engine from moving the vehicle. In other embodiments, instead or in addition to the fuel cut-off solenoid 28, the movement restriction module comprises an arrangement which, when activated, applies the brakes of the vehicle or interrupts the ignition system of the vehicle to restrict or prevent movement of the vehicle.

30 The safety arrangement further comprises a vehicle movement direction sensor which, in this embodiment, is in the form of a reverse light power sensor 29. The reverse light power sensor 29 is coupled to the reversing light power supply of the vehicle to sense when power is supplied to the reversing light, and
35 hence when the vehicle is in a reverse gear. The reverse light power sensor 29

- 5 is connected to the relay contact switch 25 and is configured to conduct power from the reversing light power supply to the relay contact switch 25 to activate the relay contact switch when the vehicle is in a reverse gear.

When at least one of the switches 24-26 is closed, power is supplied to the fuel
10 cut-off solenoid 28 which permits fuel to be supplied to the engine of the vehicle. In the event that all of the switches 24-26 are open, no power is supplied to the fuel cut-off solenoid 28 which results in the cut-off solenoid 28 cutting off the fuel supply to the engine of the vehicle to restrict or prevent the engine from moving the vehicle.

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The operation of the safety arrangement will now be described in conjunction with the vehicle 1 and the trailer 2, as shown in figure 1.

In order to couple the trailer 2 to the vehicle 1, the first and second parts 4, 5 of
20 the tow hitch system 3 are brought into engagement with one another and the tow hitch control lever 10 is moved from the disengaged position to the engaged position. The indicator element 13 engages with and activates the microswitch 16. This results in power being applied to the timer module 22 which activates the timer module 22. When the timer module 22 is activated, the timer module
25 22 activates the timer contact switch 26 which disconnects the power supply to the fuel cut-off solenoid 28 which in turn cuts off the fuel supply to the engine of the vehicle. This shuts down the engine and prevents the engine from moving the vehicle 1.

30 The timer module 22 times a predetermined or a variable time delay value. In a preferred embodiment, the time delay value is approximately 7 seconds. The time delay provided by the timer module 22 enables the vehicle 1 to pick up speed, thereby reducing the possibility of the trailer 2 becoming disengaged from the vehicle 1.

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5 In the event that a user confirms that the first and second parts 4, 5 of the tow hitch system 3 are attached securely to one another, the user can operate bypass switch 24 to provide power to the fuel cut-off solenoid 28 to enable fuel to be supplied to the engine of the vehicle to enable the vehicle to drive normally.

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In the event that the vehicle movement direction sensor senses power to the reverse light of the vehicle, the relay contact 25 of the switching system 19 is activated to provide power to the fuel cut-off solenoid 28 to enable fuel to be supplied to the engine of the vehicle. The vehicle is therefore able to drive
15 whilst in reverse gear, for instance, to couple the vehicle 1 to the trailer 2.

It is to be appreciated that the safety arrangement of an embodiment of the invention restricts or prevents movement of a vehicle which is engaged with, but not securely attached to a trailer. Nevertheless, the safety arrangement of an
20 embodiment of the invention permits movement of the vehicle in a direction which will not disengage the trailer from the vehicle. For instance, the safety arrangement permits the vehicle to move in a direction which is towards the trailer.

25 In a preferred embodiment, the tow hitch 4 of the vehicle 1 is provided at the rear of the vehicle 1 and so the vehicle moves in a direction towards the trailer when the vehicle reverses. It is, however, to be appreciated that in other embodiments, the safety arrangement is configured for use with a vehicle with a tow hitch on the front of the vehicle and the safety arrangement is configured to
30 sense when the vehicle moves in a forward direction, towards a trailer which is to be attached to the vehicle.

In the embodiments described above, the first part 4 of the tow hitch system 3 is carried by the vehicle 1 and the second part 5 of the tow hitch system 3 is
35 carried by the trailer 2. However, it is to be appreciated that in other

5 embodiments the first part 4 of the tow hitch system 3 is provided on the trailer
2 and the second part 5 of the tow hitch system 3 is provided on the vehicle 1.
In these embodiments, the components of the safety arrangement which are
described above as being carried by the vehicle 1 may instead be provided on
the trailer 2.

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Embodiments of the invention seeks to minimise the problems associated with
vehicles which attempt to tow a trailer which is not attached securely to the
vehicle. Embodiments of the invention also seek to minimise the time required
to attach a trailer to a vehicle by avoiding the need for a user to check the tow
15 hitch connection between the vehicle and the trailer.

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
20 Presence of other features, steps or components.

5 Claims

1. A safety arrangement for use with a tow hitch system for connecting a trailer to a vehicle, the tow hitch system comprising a first part and a second part that are releasably attachable to one another, one part being carried by the vehicle and the other part being carried by the trailer, wherein the safety arrangement comprises:

a connection sensor which is configured to sense the status of the connection between the first and second parts of the tow hitch system and to provide a connection error signal in the event that the first and second parts are not attached securely to one another; and

a movement restriction module which is configured to receive the connection error signal from the connection sensor, the movement restriction module being operable, in use, to restrict movement of the vehicle upon receipt of the connection error signal from the connection sensor so that movement of the vehicle is restricted in the event that the parts of the tow hitch system are not attached securely to one another.

2. The safety arrangement of claim 1, wherein the movement restriction module is, in use, connected to the fuel supply system of a vehicle and is configured to cut off the fuel supply to the engine of the vehicle upon receipt of the connection error signal from the connection sensor.

3. The safety arrangement of claim 1 or claim 2, wherein the movement restriction module is, in use, connected to the brake system of the vehicle and is configured to activate the brake system to restrict movement of the vehicle upon receipt of the connection error signal from the connection sensor.

4. The safety arrangement of any one of the preceding claims, wherein the movement restriction module is, in use, connected to the ignition system of the

5 vehicle and is configured to disable the ignition system to immobilise the vehicle upon receipt of the connection error signal from the connection sensor.

5. The safety arrangement of any one of the preceding claims, wherein the arrangement further comprises:

10 a time delay module which is configured to delay the transmission of the connection error signal to the movement restriction module by a time delay value.

6. The safety arrangement of claim 5, wherein the time delay value is
15 approximately 7 seconds.

7. The safety arrangement of claim 5 or claim 6, wherein the time delay module is configured to provide a variable time delay value.

20 8. The safety arrangement of any one of the preceding claims, wherein the arrangement further comprises:

a vehicle movement direction sensor which is configured, in use, to sense the direction in which the vehicle will move, the vehicle movement detection system being configured to provide an override signal to the
25 movement restriction module which deactivates the movement restriction module so that the movement restriction module does not restrict movement of the vehicle if the vehicle movement direction sensor senses that the vehicle will move in a direction which is at least partly towards the trailer.

30 9. The safety arrangement of claim 8, wherein the vehicle movement direction sensor is connected to the power supply of a reversing light of the vehicle to detect when power is supplied to the reversing lights.

10. The safety arrangement of any one of the preceding claims, wherein the
35 arrangement further comprises:

5 a bypass switch, which, when activated, is configured to bypass the movement restriction module so that the movement restriction module does not restrict the movement of the vehicle.

11. The safety arrangement of any one of the preceding claims, wherein the
10 connection sensor comprises a position sensor which is configured to sense the position of a tow hitch lever which is, in use, operable to connect and disconnect the first and second parts of the tow hitch system.

12. A vehicle comprising the safety arrangement of any one of the preceding
15 claims.

13. A method of connecting a trailer to a vehicle using a tow hitch system, the tow hitch system comprising a first part and a second part that are releasably attachable to one another, one part being carried by the vehicle and
20 the other part being carried by the trailer, wherein the method comprises:

engaging the first and second parts of the tow hitch system to one another;

sensing the status of the connection between the first and second parts of the tow hitch system using a connection sensor and providing a connection
25 error signal in the event that the first and second parts are not attached securely to one another; and

restricting movement of the vehicle using a movement restriction module in response to a connection error signal from the connection sensor so that movement of the vehicle is restricted in the event that the parts of the tow hitch
30 system are not attached securely to one another.