A control system (10) for a lifting and lowering apparatus for a vehicle, controls the operation of an elevator drive arrangement in response to actuation of controls by an operator and after interrogation of a number of vehicle conditions. Among the conditions are the location of the lifting and lowering apparatus as determined by upper (21) and lower (22) limit sensors, and actuators that can be manipulated by the operator. In the event of malfunction or an incorrect vehicle condition, operation of the elevator drive is precluded. A malfunction can result in the issuance of a disabling signal that shuts off the engine. Other conditions that are monitored include the parking brake setting (27), the transmission being in neutral (26), the motion of the vehicle (25), and the availability of accessory power (23). Outputs (73, 74, 75) are provided for issuing audible and/or visual warnings. The logic is implemented in integrated circuitry (40).
<table>
<thead>
<tr>
<th>Code</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL</td>
<td>Albania</td>
</tr>
<tr>
<td>AM</td>
<td>Armenia</td>
</tr>
<tr>
<td>AT</td>
<td>Austria</td>
</tr>
<tr>
<td>AU</td>
<td>Australia</td>
</tr>
<tr>
<td>AZ</td>
<td>Azerbaijan</td>
</tr>
<tr>
<td>BA</td>
<td>Bosnia and Herzegovina</td>
</tr>
<tr>
<td>BB</td>
<td>Barbados</td>
</tr>
<tr>
<td>BE</td>
<td>Belgium</td>
</tr>
<tr>
<td>BF</td>
<td>Burkina Faso</td>
</tr>
<tr>
<td>BG</td>
<td>Bulgaria</td>
</tr>
<tr>
<td>RJ</td>
<td>Benin</td>
</tr>
<tr>
<td>BR</td>
<td>Brazil</td>
</tr>
<tr>
<td>BY</td>
<td>Belarus</td>
</tr>
<tr>
<td>CA</td>
<td>Canada</td>
</tr>
<tr>
<td>CF</td>
<td>Central African Republic</td>
</tr>
<tr>
<td>CG</td>
<td>Congo</td>
</tr>
<tr>
<td>CH</td>
<td>Switzerland</td>
</tr>
<tr>
<td>CI</td>
<td>Côte d'Ivoire</td>
</tr>
<tr>
<td>CM</td>
<td>Cameroon</td>
</tr>
<tr>
<td>CN</td>
<td>China</td>
</tr>
<tr>
<td>CU</td>
<td>Cuba</td>
</tr>
<tr>
<td>CZ</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>DE</td>
<td>Germany</td>
</tr>
<tr>
<td>DK</td>
<td>Denmark</td>
</tr>
<tr>
<td>EE</td>
<td>Estonia</td>
</tr>
<tr>
<td>ES</td>
<td>Spain</td>
</tr>
<tr>
<td>FI</td>
<td>Finland</td>
</tr>
<tr>
<td>FR</td>
<td>France</td>
</tr>
<tr>
<td>GA</td>
<td>Gabon</td>
</tr>
<tr>
<td>GB</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>GE</td>
<td>Georgia</td>
</tr>
<tr>
<td>GH</td>
<td>Ghana</td>
</tr>
<tr>
<td>GN</td>
<td>Guinea</td>
</tr>
<tr>
<td>GR</td>
<td>Greece</td>
</tr>
<tr>
<td>HU</td>
<td>Hungary</td>
</tr>
<tr>
<td>IE</td>
<td>Ireland</td>
</tr>
<tr>
<td>IL</td>
<td>Israel</td>
</tr>
<tr>
<td>IS</td>
<td>Iceland</td>
</tr>
<tr>
<td>IT</td>
<td>Italy</td>
</tr>
<tr>
<td>JP</td>
<td>Japan</td>
</tr>
<tr>
<td>KR</td>
<td>Kenya</td>
</tr>
<tr>
<td>KG</td>
<td>Kyrgyzstan</td>
</tr>
<tr>
<td>KP</td>
<td>Democratic People’s Republic of Korea</td>
</tr>
<tr>
<td>KR</td>
<td>Republic of Korea</td>
</tr>
<tr>
<td>KZ</td>
<td>Kazakhstan</td>
</tr>
<tr>
<td>LC</td>
<td>Saint Lucia</td>
</tr>
<tr>
<td>LI</td>
<td>Liechtenstein</td>
</tr>
<tr>
<td>LK</td>
<td>Sri Lanka</td>
</tr>
<tr>
<td>LR</td>
<td>Liberia</td>
</tr>
<tr>
<td>LS</td>
<td>Lesotho</td>
</tr>
<tr>
<td>LT</td>
<td>Lithuania</td>
</tr>
<tr>
<td>LU</td>
<td>Luxembourg</td>
</tr>
<tr>
<td>LV</td>
<td>Latvia</td>
</tr>
<tr>
<td>MC</td>
<td>Monaco</td>
</tr>
<tr>
<td>MD</td>
<td>Republic of Moldova</td>
</tr>
<tr>
<td>MG</td>
<td>Madagascar</td>
</tr>
<tr>
<td>MK</td>
<td>The former Yugoslavia</td>
</tr>
<tr>
<td>ML</td>
<td>Mali</td>
</tr>
<tr>
<td>MN</td>
<td>Mongolia</td>
</tr>
<tr>
<td>MR</td>
<td>Mauritania</td>
</tr>
<tr>
<td>MW</td>
<td>Malawi</td>
</tr>
<tr>
<td>MX</td>
<td>Mexico</td>
</tr>
<tr>
<td>NE</td>
<td>Niger</td>
</tr>
<tr>
<td>NL</td>
<td>Netherlands</td>
</tr>
<tr>
<td>NO</td>
<td>Norway</td>
</tr>
<tr>
<td>NZ</td>
<td>New Zealand</td>
</tr>
<tr>
<td>PL</td>
<td>Poland</td>
</tr>
<tr>
<td>PT</td>
<td>Portugal</td>
</tr>
<tr>
<td>RO</td>
<td>Romania</td>
</tr>
<tr>
<td>RU</td>
<td>Russian Federation</td>
</tr>
<tr>
<td>SD</td>
<td>Sudan</td>
</tr>
<tr>
<td>SE</td>
<td>Sweden</td>
</tr>
<tr>
<td>SG</td>
<td>Singapore</td>
</tr>
<tr>
<td>SI</td>
<td>Slovenia</td>
</tr>
<tr>
<td>SK</td>
<td>Slovakia</td>
</tr>
<tr>
<td>SN</td>
<td>Senegal</td>
</tr>
<tr>
<td>SZ</td>
<td>Swaziland</td>
</tr>
<tr>
<td>TD</td>
<td>Chad</td>
</tr>
<tr>
<td>TG</td>
<td>Togo</td>
</tr>
<tr>
<td>TJ</td>
<td>Tajikistan</td>
</tr>
<tr>
<td>TM</td>
<td>Turkmenistan</td>
</tr>
<tr>
<td>TR</td>
<td>Turkey</td>
</tr>
<tr>
<td>TT</td>
<td>Trinidad and Tobago</td>
</tr>
<tr>
<td>UA</td>
<td>Ukraine</td>
</tr>
<tr>
<td>UG</td>
<td>Uganda</td>
</tr>
<tr>
<td>US</td>
<td>United States of America</td>
</tr>
<tr>
<td>UZ</td>
<td>Uzbekistan</td>
</tr>
<tr>
<td>VN</td>
<td>Viet Nam</td>
</tr>
<tr>
<td>YU</td>
<td>Yugoslavia</td>
</tr>
<tr>
<td>ZW</td>
<td>Zimbabwe</td>
</tr>
</tbody>
</table>
Control System for Powered Cargo Bed

Background of the Invention

FIELD OF THE INVENTION

This invention relates generally to systems for controlling the operation of lift arrangements for vehicles, and more particularly, to a control system that interrogates sensors of a variety of vehicle and lift arrangement conditions before permitting energization of the lift arrangement drive.

DESCRIPTION OF THE RELATED ART

A well-known disadvantage in the use of pick up trucks and the like is that of loading and unloading, particularly heavy or awkward cargo when a loading dock of appropriate height is not available. A number of approaches have been attempted in the prior art to ameliorate this problem, including the selectable lowering of the cargo bed of the vehicle, or a portion thereof. It is readily understood, however, that if mobile lifts are to be operated safely, certain vehicle conditions must be examined before a cargo area of a vehicle can safely be lowered or raised. For example, the vehicle preferable should not be traveling during lift actuation. In addition, the lift itself should be examined to determine whether it is overloaded.

There is a need, therefore, for a control arrangement that will preclude the operation of a cargo lift unless certain predetermined vehicle and/or lift conditions are within predetermined parameters.

It is, therefore, an object of this invention to provide a control system for a powered cargo lifting and lowering portion of a vehicle.
It is another object of this invention to provide an arrangement that monitors certain vehicle conditions before allowing a cargo lift to be operated.

It is also an object of this invention to provide an arrangement that monitors certain conditions of the lift arrangement before allowing same to be operated.

It is a further object of this invention to provide a system that will control the operation of a vehicle engine in response to indication of intended actuation of the powered cargo lifting and lowering portion of the vehicle.

It is additionally an object of this invention to provide a system that will monitor the powered cargo lifting and lowering portion of the vehicle to determine the presence of fault.

**Summary of the Invention**

The foregoing and other objects are achieved by this invention which provides, in a first system aspect thereof, a control system for a lifting and lowering apparatus for a vehicle having a vehicle drive arrangement. In accordance with the invention, there is provided an elevator drive arrangement for effecting vertical displacement of a lifting and lowering apparatus relative to the vehicle. The elevator drive arrangement has a first input for receiving electrical energy for powering the elevator drive arrangement, whereby the lifting and lowering apparatus is displaced between uppermost and lowermost positions. An upper limit detector has an upper limit output for producing an upper limit electrical characteristic having a first characteristic state responsive to the lifting and lowering apparatus being in a predetermined upper position relative to the vehicle, and a second characteristic responsive to the lifting and lowering apparatus being
in another position. Similarly, a lower limit detector has a lower limit output for producing a lower limit electrical characteristic having a first characteristic state responsive to the lifting and lowering apparatus being in a predetermined lower position relative to the vehicle, and a second characteristic that is responsive to the lifting and lowering apparatus being in another position. There is additionally provided an operator interface having an up actuator that is manipulable by the operator for producing an output of the operator interface and up indication. There is also provided a down actuator that is manipulable by the operator for producing at an output of the operator interface a down indication. In accordance with this aspect of the invention, there is provided a vehicle drive displacement system for disabling the vehicle drive arrangement in response to a disable-vehicle-drive indication. A controller has an upper limit input for receiving an upper limit signal responsive to the upper limit electrical characteristic, a lower limit input for receiving a lower limit signal responsive to the lower limit electrical characteristic, an operator input coupled to the operator interface, and a disable-vehicle-drive output for providing the disable-vehicle-drive indication.

In one embodiment of the invention, wherein the vehicle is of the type having a vehicle drive engine having an ignition system having enabled and disabled conditions, the vehicle drive disabling system includes an ignition system disabling system for urging the ignition system into the disabled condition, whereby the vehicle drive engine is disabled. The ignition system is of the type that has active and inactive states, the active state being available only during the enabled condition, such as when power is available. However, the inactive state is available during enabled and disabled conditions. That is,
in the context of a conventional vehicle, power may be applied to the ignition system, but the engine may not be operating.

In another embodiment of the invention, the controller is additionally provided with an indicator output for producing an indicator signal responsive to a fault determination by the controller arrangement. The indicator output may be, in certain embodiments, coupled to an audible warning device, or a visual warning device, such as an indicator on the instrument panel of the vehicle or on a portion of the vehicle visible from the exterior thereof. For example, the operator interface portion of the system may be installed in a housing tethered by a cable to the vehicle, and may have thereon visual or audible indicators.

In still a further embodiment of the invention, the controller is provided with a parking brake input for receiving a parking brake signal responsive to a parking brake condition of the vehicle. Thus, the controller would be enabled to determine whether the parking brake of the vehicle should be applied in order to permit operation of the lifting and lowering arrangement. Similarly, the controller is provided in certain embodiments with a neutral safety input for receiving a neutral safety signal responsive to a neutral transmission condition of a drive transmission of the vehicle. Such an input would permit the controller to determine whether the lift arrangement should be operated during periods that the transmission of the vehicle is in neutral, or otherwise disengaged.

In an advantageous embodiment of the invention, the controller is provided in the form of an integrated logic circuit having a plurality of logic circuit input for receiving a respective plurality of input logic signals, in a plurality of logic circuit outputs for
providing a respective plurality of output logic signals, the output logic signals being responsive to the input logic systems. In one embodiment of this integrated circuit aspect of the invention, the plurality of logic circuit inputs may include an upper limit input for receiving an upper limit signal responsive to the upper limit electrical characteristic; a lower limit input for receiving a lower limit signal responsive to the lower limit electrical characteristic; an ignition enablement input for receiving a signal responsive to the enabled and disabled states of the ignition system; an up actuation input responsive to the up indication of the up actuator of the operator interface; and a down actuation input responsive to the down indication of the down actuator of the operator interface. In a further embodiment, as previously discussed, the logic circuit may have inputs for a parking brake input that receives a parking brake signal responsive to a parking brake condition of the vehicle, and a neutral safety input for receiving a neutral safety signal responsive to a neutral transmission condition of the drive transmission of the vehicle. In addition, a logic circuit input is provided in certain embodiments of the invention for receiving an accessory power signal responsive to the availability of accessory power.

As indicated, the integrated logic circuit is provided with a plurality of logic circuit outputs that include, for example, an up enablement output for providing an up drive signal to the elevator drive arrangement for effecting upward displacement of the lifting and lowering apparatus relative to the vehicle. Also, there is provided a down enablement output for providing a down drive signal to the elevator driver arrangement for effecting downward displacement of the lifting and lowering apparatus relative to the vehicle. In other embodiments, the logic circuit outputs include a drive disablement
output for providing a signal to a vehicle drive disabling system for urging the vehicle
drive into a disabled condition. In still further embodiments, the logic circuit outputs
include an indicator output for producing a signal for indicating the predetermined
controller system condition, and a lock output for activating a lock arrangement of the
vehicle.

Further in regard of the integrated logic circuit aspect of the invention, each logic
circuit input has associated therewith a logic circuit input interface circuit for receiving
a respective one of the input logic signals. Such an input interface circuit may include
an amplifier. In addition, each of the logic circuit outputs is provided with an associated
logic circuit output interface circuit via which is provided a respective one of the output
logic signals. The logic circuit output interface circuits, in one embodiment of the
invention, each include a semi-conductor switch that drives the coil of an associated
isolating relay. In this matter, the integrated logic circuit is electrically isolated from the
elevator drive arrangement, as well as other vehicle systems, such as the lock arrange-
ment, the engine disabling system, and the warning indicators.

In accordance with a further aspect of the invention, a control arrangement for
a lifting and lowering apparatus for a vehicle having a vehicle driver arrangement is
provided with an integrated circuit having a plurality of circuit inputs for receiving a
respective plurality of input signals. The integrated circuit has a plurality of circuit
outputs for providing a respective plurality of output signals. As discussed, there is
provided a plurality of input interface circuits, each associated with a respective one of
the circuit inputs for receiving a respective one of the input signals. Additionally, there
is provided a plurality of output interface circuits, each associated with a respective one of the circuit outputs for providing a respective one of the output signals. An operator interface is provided with an up actuator that is manipulable by the operator for producing at an up output of the operator interface an up indication signal. The up output is coupled to one of the input interface circuits. Also, the operator interface is provided with a down actuator that is manipulable by the operator for producing at a down output of the operator interface a down indication, the down output being coupled to another of the input interface circuits. A logic system is arranged in the integrated circuit for producing at a predetermined one of the plurality of output interface circuits an up signal for causing the lifting and lowering apparatus to be urged upward, and for producing at a further predetermined one of the plurality of output interface circuits a down signal for causing the lifting and lowering apparatus to be urged downward.

In accordance with one embodiment of this further aspect of the invention, the control arrangement is provided with a housing for holding the up actuator and the down actuator of the operator interface. A communication arrangement is provided for propagating an operator signal to the integrated circuit from the housing. Such a communication arrangement could be of any known type, such as a cable tether, or a radio or infra red communication system.

In addition to the foregoing, there is provided a name assignment system for assigning a variable name to each of the circuit inputs and the circuit outputs. In one embodiment, the name assignment system is incorporated within the integrated circuit.
As previously discussed in connection with the first aspect of the invention, the plurality of circuit inputs include an upper limit input for receiving an upper limit signal responsive to the upper limit electrical characteristic; a lower limit input for receiving a lower limit signal responsive to the lower limit electrical characteristic; an ignition enablement input for receiving a signal responsive to the enabled and disabled states of the ignition system; an up actuation input responsive to the up actuation of the up actuator of the operator interface; and a down actuation input responsive to the down actuation of the down actuator of the operator interface. Additionally, the plurality of circuit inputs includes a parking brake input for receiving a parking brake signal responsive to a parking brake condition of the vehicle, and a neutral safety input for receiving a neutral safety signal responsive to a neutral transmission condition of a drive transmission of the vehicle. Also, in a further embodiment there is provided an accessory power input for receiving an accessory power signal responsive to the availability of accessory power.

With respect to the plurality of circuit outputs, there is provided an up enablement output for providing an up drive signal to the lifting and lowering apparatus for effecting upward displacement of the lifting and lowering apparatus relative to the vehicle. Additionally, there is provided a down enablement output for providing a down drive signal to the lifting and lowering arrangement for effecting downward displacement of the lifting and lowering arrangement relative to the vehicle. In a further embodiment, the circuit outputs include a drive disablement output for providing a signal to the vehicle drive disabling arrangement for urging the vehicle drive into a disabled condition. Also,
the circuit outputs include, in certain embodiments, an indicator output for producing a
signal for indicating a predetermined control arrangement condition, and a lock output
for activating the lock arrangement of the vehicle.

In this further aspect of the invention, there are further provided, as previously
noted, a plurality of input interface circuits, each associated with a respective one of the
circuit inputs for receiving a respective one of the input signals, in a plurality of output
interface circuits, each associated with a respective one of the circuit outputs for
providing a respective one of the output signals. Additionally, there is provided a
plurality of relays, each associated with a respective one of the plurality of output
interface circuits for isolating electrically the integrated circuit.

In accordance with a method aspect of the invention, a method of operating a
lifting and lowering apparatus for a vehicle having a vehicle drive arrangement, includes
the steps of:

(a) interrogating an operator interface device for determining whether the lifting
and lowering apparatus is desired to be lifted or lowered;

(b) interrogating a lifting and lowering apparatus locator arrangement to
determine the location of the lifting and lowering apparatus relative to the vehicle;

(c) interrogating a vehicle drive sensing arrangement to determine whether the
vehicle is in motion; and

(d) determining whether to produce a motion signal for lifting or lowering the
lifting and lowering apparatus in response to the interrogations of steps (a), (b), and (c).
In one embodiment of this method aspect of the invention, prior to performing step (d) there are provided the further steps of:

interrogating a parking brake sensor for determining a parking brake condition of the vehicle; and

interrogating a neutral safety sensor for determining a transmission gearing condition of a drive transmission of the vehicle.

In another embodiment, there is provided the further step of interrogating an accessory power sensor for determining the availability of accessory power. Prior to performing step (d) there is provided the further step of interrogating a vehicle motion sensor for determining whether the vehicle is in motion. Also, there is provided the step of issuing a vehicle disablement signal for disabling the vehicle drive arrangement.

In still further embodiments of this method aspect of the invention, the performance of step (d) includes the further step of determining whether to produce an up drive signal to the lifting and lowering apparatus for effecting upward displacement of the lifting and lowering apparatus relative to the vehicle or a down drive signal to the lifting and lowering apparatus for effecting downward displacement thereof relative to the vehicle. Additionally, there is provided the step of issuing a motion signal for selectably lifting or lowering the lifting and lowering apparatus.

Brief Description of the Drawing

Comprehension of the invention is facilitated by reading the following detailed description, in conjunction with the annexed drawing, in which:
Fig. 1 is a block and line representation of a specific illustrative embodiment of a lift controller aspect of the invention;

Fig. 2 is a block and line representation of an input portion of the embodiment of Fig. 1;

Fig. 3 is a block and line representation of an output portion of the embodiment of Fig. 1;

Fig. 4 is a flow diagram illustrating certain steps of a method aspect of the invention for disabling the vehicle drive engine when certain vehicle and cargo lift conditions are present; and

Fig. 5 is a flow diagram illustrating certain steps of a method aspect of the invention for raising or lowering the cargo lift arrangement when certain vehicle, cargo lift, and operator conditions are present.

**Detailed Description**

Fig. 1 is a block and line representation of a specific embodiment of a lift controller 10 having a plurality of inputs 20 coupled to an input interface 30. The input interface is coupled to an integrated circuit processor 40 that is coupled at its output to an output interface 50. Output interface 50 has associated therewith a plurality of outputs 60 that will be described below. Integrated circuit processor 40 has incorporated therein a logic system 41 that implements a programmed correlation between information received via input interface 30 to logically correlated output conditions at outputs 60, via output interface 50. In addition, integrated circuit processor 40 has a name assignment memory 42 that, in this specific illustrative embodiment of the invention, may be in the
form of a table for assigning logical names to the various inputs and outputs, as will be described herein. Also as shown, integrated circuit processor 40 has an oscillator 43 coupled thereto for providing conventional timing signals for operating the integrated circuit processor and facilitating timing functions, also as will be described below.

In the specific embodiment shown in Fig. 1, the various inputs 20 include a bed raised input 21, a bed lowered input 22, an accessory power input 23, a spare input 24, an engine input 25, and a neutral input 26. Each of these inputs is arranged to receive a signal that corresponds to a specific vehicle (not shown) or lift system (not shown) condition. Bed raised input 21 receives a signal responsive to whether the vehicle lift system is located at an upward limit thereof. Bed lowered input 22 receives a signal responsive to whether the lift system is located at its lowermost position. Accessory power input 23 receives a signal corresponding to the availability of accessory vehicle power.

Spare input 24 is provided as additional and unused input capacity to the system. Engine input 25 receives a signal responsive to whether the engine (not shown) of the vehicle (not shown) is running. Neutral input 26 receives a signal responsive to whether the vehicle transmission (not shown) is in gear or in a neutral state. All of these inputs, and others that are not shown in the specific illustrative embodiment of the invention represented in this figure, are coupled to input interface 30, which has an electrical structure that will be described in connection with Fig. 2.

Referring to Fig. 2, elements of structure that correspond to those that previously have been discussed are similarly designated. The various inputs 20 discussed
hereinabove with respect to Fig. 1, as well as other inputs, such as parking brake input 27 which receives a signal responsive to whether the parking brake as applied are received at respective inputs of switching amplifiers 31. Each of the switching amplifiers is coupled at its output to integrated circuit processor 40. The various switching amplifiers all are arranged to receive operating energy from a supply, illustratively 12 volts in this specific embodiment, and each is additionally provided with a second input that is coupled to the supply voltage via a resistor 33. Each of the outputs of switching amplifiers 31 is coupled to a five volt supply via a respectively associated one of resistors 35. With this circuitry, each of switching amplifiers 31 produces an output logical signal that presents to integrated circuit processor 40 a signal responsive to the condition of the respectively associated input.

Referring once again to Fig. 1, integrated circuit processor 40, as previously discussed, is coupled at respective outputs thereof to output interface 50. As shown, the upward interface is provided with a plurality of output interface circuits 51 that are coupled to respective relays 52, as shown in Fig. 3.

Fig. 3 shows each output of integrated circuit 40 to be coupled to a respective output interface circuit 54 which is connected to an associated relay 55. Electrical energy for each output interface circuit and its associated relay is provided at an input terminal 56 via a current limiting device, such as breaker 57. Each of output interface circuits 54 is provided with an associated voltage divider formed of resistors 62 and 63 that are joined to one another and to an input of a semiconductor switching element 64. Semiconductor switching element 64 is coupled via a diode 65 to a winding 67 of relay
Actuation of the relay winding by the associated output interface circuit results in a corresponding actuation of contacts that, in this specific embodiment, will cause battery voltage to be, or not to be, as the case may be, applied to the respectively associated one of outputs.

Referring to Fig. 1 once again, outputs include a raise solenoid output that causes the vehicle lift system (not shown) to be raised; a lower solenoid output, which causes the vehicle lift system to be lowered; a visual warning output, which produces a visual indication for the operator (not shown); an outside audible output, which causes an audible alarm to be energized that is audible outside of the vehicle; an inside audible output, which causes an alarm inside the vehicle to be sounded; a lock output, which causes vehicle locks and/or lift bed locks to be enabled; and a kill engine output that causes the vehicle engine to be disabled.

Fig. 4 is a flow diagram illustrating certain steps of a method aspect of the invention, particularly directed to disablement of the vehicle drive engine (not shown) when certain vehicle and cargo lift conditions are present. As shown, the routine is started at function block and proceeds to decision block where it is determined whether the lift is in the raised position. This is achieved, in a specific illustrative embodiment of the invention, by examining the state of an upper limit switch (not shown) in the cargo lift system (not shown). Such a switch would assume a first state when the vehicle lift is in the uppermost position, and a second state when the lift is elsewhere along the path of its travel. If the lift is in the raised position, the routine is returned to the top of decision block whereby the interrogation of the upper limit switch continues
until it is determined that the lift no longer is in the uppermost position. At that point, the routine proceeds to decision block 82.

In decision block 82, it is determined whether the vehicle is in a lowered position. This inquiry can include interrogation of a lower limit switch (not shown), or an indication of intermediate position of the lift, such as between the uppermost and lowermost positions. If it is determined that the lift is in a lowermost position, or a sufficiently lowered position, the routine proceeds to decision block 83 wherein the status of the vehicle parking brake (not shown) is explored. If the parking brake is on, the routine proceeds to decision block 84 wherein the status of the vehicle transmission is examined. If the vehicle is in gear, then a status bid is set to disable the engine, at function block 85. Thus, this routine examines whether the vehicle lift has been lowered, and whether the parking brake is on and the transmission in gear, in order to disable the engine.

Fig. 5 is a flow diagram that illustrates certain steps of a method aspect of the invention for raising or lowering the cargo lift arrangement. The figure illustrates the operation of an arrangement wherein certain vehicle, cargo lift, and operator conditions are present. The routine described in this figure is started at function block 90 which proceeds to query whether the ignition is on at decision block 91. If the ignition is not on, the process will proceed to function block 92 where the execution of logic to determine whether the vehicle is moving is skipped. If the ignition is on, however, the process proceeds to decision block 94 wherein the status of the parking brake is queried. If the parking brake is not on, which at this point in the process would also indicate that
the ignition is on, the process proceeds to function block 95 where logic is executed to disable the vehicle engine. However, if the parking brake is on, the process proceeds to decision block 96 where the status of the transmission is queried. If the transmission is in gear, signifying that the ignition is on, the parking brake is on, and the transmission is in gear, the process proceeds back to function block 95 where the engine is disabled. However, if the transmission is not in gear, then the system queries whether the up button is pushed at decision block 100 or whether the down button is pushed at decision block 102.

If the up button has been pushed, the cargo bed of the vehicle is raised at function block 101. Alternatively, if the down button is pushed, the cargo bed is lowered at function block 103. In a preferred embodiment of the invention, if both buttons have been pushed, then the system enters a lock state at function block 105. If it is determined that neither the up button nor the down button have been pushed, then the process ends at function block 106.

The process of the present invention can include a number of additional subroutines embodied in various sections of the logic code that would be implemented in the embodiment of FIGS. 1, 2, and 3.

One section of logic code is used in a practicable embodiment of the invention to assign variable names to various registers in integrated circuit 40 of Fig. 1. The names are stored in name assignment memory 42, and include, for example, the following input names:

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPLIMIT</td>
<td>Cargo bed in raised condition</td>
</tr>
</tbody>
</table>
ACC_ON          Accessory power on
KILL_ON         Engine disabled
UPSWITCH        Upper limit switch
DOWNSWITCH      Down limit switch
PB_ON           Parking brake on
NEU_SFTY        Neutral safety switch
FUSE_SENSE      Blown fuse indication
LED             Light-emitting diode status indicator
VIS_WARN        Visual warning indicator

The following are names assigned to output registers in this specific illustrative embodiment of the invention:

EXT_AUDIBLE     Actuate external audible warning device
INT_AUDIBLE     Actuate internal audible warning device
UP_SOL          Actuate solenoid for raising the cargo bed
DOWN_SOL        Actuate solenoid for lowering the cargo bed
EG_KILL         Disable engine signal
LOCK            Actuate lock state of lock system for the cargo bed
UNLOCK          Actuate unlock state of lock system for the cargo bed

A further section of the logic code determines whether conditions are appropriate for the vehicle lift to be raised automatically while the vehicle is in motion, in the event the lift system were to lower accidentally without using the operator actuation buttons. This process includes the steps of:
Determining whether the vehicle ignition key is in the "run" position;

If the key is in the "off" position, then execute a routine wherein memory associated with the cargo lift is reset;

Determining whether the parking brake is engaged (If the vehicle ignition key is in the "on" position;

If the parking brake is engaged, execute the routine wherein memory associated with the cargo lift is reset;

Determining whether the vehicle transmission is in gear;

Executing the automatic cargo lift raising routine (If the vehicle is not in gear);

Determining whether the cargo bed has been raised to the full up position within a predetermined period of time;

If the cargo lift is not raised within the predetermined period of time, execute a routine for raising the cargo bed while the vehicle is in motion;

if the cargo lift is not raised after a second predetermined period of time, execute a routine for discontinuing lift drive energy of hydraulic drive to the cargo lift.

Other sections of the logic code serve to measure the timing, or duration, of certain functions of the cargo bed, and if the predetermined time is exceeded, fault indications are established that would not clear until the cargo bed has been raised manually. The fault indication is used, in certain embodiments of the invention, to sound an internal audible alarm, and to disable the vehicle engine once the vehicle has come to a stop.

In a still further section of logic code, the system determines the presence of an internal fuse fault. This section will check whether the ignition is on, and whether the circuit has voltage. If voltage is not present, then a fault indication is issued whereby the
LED indicator is caused to blink. In a preferred embodiment, the LED indicator is installed on a control box that may be tethered by a cable, or otherwise communicates information, to the vehicle. Upon determining that voltage has been restored, the fuse fault indicator is cleared, and the LED indicator on the control box is extinguished.

Although the invention has been described in terms of specific embodiments and applications, persons skilled in the art can, in light of this teaching, generate additional embodiments without exceeding the scope or departing from the spirit of the claimed invention. Accordingly, it is to be understood that the drawing and description in this disclosure are proffered to facilitate comprehension of the invention, and should not be construed to limit the scope thereof.
What is claimed is:

1. A control system for a lifting and lowering apparatus for a vehicle having a vehicle drive arrangement, the control system comprising:
   an elevator drive arrangement for effecting vertical displacement of the lifting and lowering apparatus relative to the vehicle, said elevator drive arrangement having a first input for receiving electrical energy for powering said elevator drive arrangement, whereby the lifting and lowering apparatus is displaced between uppermost and lowermost positions;
   upper limit detector means having an upper limit output for producing an upper limit electrical characteristic having a first characteristic state responsive to the lifting and lowering apparatus being in a predetermined upper position relative to the vehicle, and a second characteristic state responsive to the lifting and lowering apparatus being in another position;
   lower limit detector means having a lower limit output for producing a lower limit electrical characteristic having a first characteristic state responsive to the lifting and lowering apparatus being in a predetermined lower position relative to the vehicle, and a second characteristic state responsive to the lifting and lowering apparatus being in another position;
   operator interface means having an up actuator manipulable by an operator for producing at an output of said operator interface means an up indication, and a down actuator manipulable by the operator for producing at an output of said operator interface means a down indication;
vehicle drive disabling means for disabling the vehicle drive arrangement in
response to a disable-vehicle-drive indication; and
controller means having an upper limit input for receiving an upper limit signal
responsive to the upper limit electrical characteristic, a lower limit input for receiving a
lower limit signal responsive to the lower limit electrical characteristic, an operator input
coupled to said operator interface means, and a disable-vehicle-drive output for providing
the disable-vehicle-drive indication.

2. The control system of claim 1, wherein the vehicle is of the type having
a vehicle drive engine having an ignition system having enabled and disabled conditions,
and said vehicle drive disabling means comprises ignition system disabling means for
urging said ignition system into the disabled condition, whereby said vehicle drive engine
is disabled.

3. The control system of claim 2, wherein said ignition system has active and
inactive states, the active state being available only during the enabled condition, and the
inactive state being available during the enabled and the disabled conditions.

4. The control system of claim 1, wherein said controller means is further
provided with an indicator output for providing an indicator signal responsive to a fault
determination by said controller means.

5. The control system of claim 2, wherein said controller means is further
provided with:

a parking brake input for receiving a parking brake signal responsive to a parking
brake condition of the vehicle; and
a neutral safety input for receiving a neutral safety signal responsive to a neutral transmission condition of a drive transmission of the vehicle.

6. The control system of claim 1, wherein said controller means comprises an integrated logic circuit having a plurality of logic circuit inputs for receiving a respective plurality of input logic signals, and a plurality of logic circuit outputs for providing a respective plurality of output logic signals, said output logic signals being responsive to said input logic signals.

7. The control system of claim 6, wherein said plurality of logic circuit inputs comprises:

an upper limit input for receiving an upper limit signal responsive to the upper limit electrical characteristic;

a lower limit input for receiving a lower limit signal responsive to the lower limit electrical characteristic;

an ignition enablement input for receiving a signal responsive to the enabled and disabled states of said ignition system;

an up actuation input responsive to the up indication of said up actuator of said operator interface means; and

a down actuation input responsive to the down indication of said down actuator of said operator interface means.

8. The control system of claim 7, wherein said plurality of logic circuit inputs further comprises:
a parking brake input for receiving a parking brake signal responsive to a parking
brake condition of the vehicle; and
a neutral safety input for receiving a neutral safety signal responsive to a neutral
transmission condition of a drive transmission of the vehicle.

9. The control system of claim 7, wherein said plurality of logic circuit inputs
further comprises an accessory power input for receiving an accessory power signal
responsive to the availability of accessory power.

10. The control system of claim 6, wherein said plurality of logic circuit
outputs comprises:
   an up enablement output for providing an up drive signal to said elevator drive
   arrangement for effecting upward displacement of the lifting and lowering apparatus
   relative to the vehicle; and
   a down enablement output for providing a down drive signal to said elevator
   drive arrangement for effecting downward displacement of the lifting and lowering
   apparatus relative to the vehicle.

11. The control system of claim 10, wherein said plurality of logic circuit
outputs further comprises a drive disablement output for providing a signal to a vehicle
drive disabling means for urging the vehicle drive into a disabled condition.

12. The control system of claim 10, wherein said plurality of logic circuit
outputs further comprises:
   an indicator output for producing a signal for indicating a predetermined
   controller system condition; and
a lock output for activating a lock arrangement of the vehicle.

13. The control system of claim 6, wherein there are further provided:

a plurality of logic circuit input interface circuits each associated with a respective one of the logic circuit inputs for receiving a respective one of the input logic signals; and

a plurality of logic circuit output interface circuits each associated with a respective one of the logic circuit outputs for providing a respective one of the output logic signals.

14. The control system of claim 13, wherein there is further provided a plurality of relay means, each associated with a respective one of said plurality of logic circuit output interface circuits for isolating electrically said integrated logic circuit from said elevator drive arrangement.

15. A control arrangement for a lifting and lowering apparatus for a vehicle having a vehicle drive arrangement, the control system comprising:

integrated circuit means having a plurality of circuit inputs for receiving a respective plurality of input signals, and a plurality of circuit outputs for providing a respective plurality of output signals;

a plurality of input interface circuits each associated with a respective one of the circuit inputs for receiving a respective one of the input signals; and

a plurality of output interface circuits each associated with a respective one of the circuit outputs for providing a respective one of the output signals.

operator interface means having,
an up actuator manipulable by an operator for producing at an up output
of said operator interface means an up indication signal, the up
output being coupled to one of said input interface circuits, and
a down actuator manipulable by the operator for producing at a down
output of said operator interface means a down indication, the
down output being coupled to one of said input interface circuits;
and
logic means in said integrated circuit means for producing at a predetermined one
of said plurality of output interface circuits an up signal for causing the lifting and
lowering apparatus to be urged upward, and for producing at a further predetermined one
of said plurality of output interface circuits a down signal for causing the lifting and
lowering apparatus to be urged downward.

16. The control arrangement of claim 15, wherein there is further provided:
a housing for holding the up actuator and the down actuator of said operator
interface means; and
communication means for propagating an operator signal to said integrated circuit
means.

17. The control arrangement of claim 15, wherein there is further provided
name assignment means for assigning a variable name to each of the circuit inputs and
the circuit outputs.

18. The control arrangement of claim 17, wherein said name assignment
means is incorporated within said integrated circuit means.
19. The control arrangement of claim 15, wherein said plurality of circuit inputs comprises:

an upper limit input for receiving an upper limit signal responsive to the upper limit electrical characteristic;

a lower limit input for receiving a lower limit signal responsive to the lower limit electrical characteristic;

an ignition enablement input for receiving a signal responsive to the enabled and disabled states of said ignition system;

an up actuation input responsive to the up indication of said up actuator of said operator interface means; and

a down actuation input responsive to the down indication of said down actuator of said operator interface means.

20. The control arrangement of claim 19, wherein said plurality of circuit inputs further comprises:

a parking brake input for receiving a parking brake signal responsive to a parking brake condition of the vehicle; and

a neutral safety input for receiving a neutral safety signal responsive to a neutral transmission condition of a drive transmission of the vehicle.

21. The control arrangement of claim 19, wherein said plurality of circuit inputs further comprises an accessory power input for receiving an accessory power signal responsive to the availability of accessory power.
22. The control arrangement of claim 15, wherein said plurality of circuit outputs comprises:
   an up enablement output for providing an up drive signal to the lifting and lowering apparatus for effecting upward displacement of the lifting and lowering apparatus relative to the vehicle; and
   a down enablement output for providing a down drive signal to the lifting and lowering apparatus for effecting downward displacement of the lifting and lowering apparatus relative to the vehicle.

23. The control arrangement of claim 22, wherein said plurality of circuit outputs further comprises a drive disablement output for providing a signal to a vehicle drive disabling means for urging the vehicle drive into a disabled condition.

24. The control arrangement of claim 22, wherein said plurality of circuit outputs further comprises:
   an indicator output for producing a signal for indicating a predetermined control arrangement condition; and
   a lock output for activating a lock arrangement of the vehicle.

25. The control arrangement of claim 15, wherein there are further provided:
   a plurality of input interface circuits each associated with a respective one of the circuit inputs for receiving a respective one of the input signals; and
   a plurality of output interface circuits each associated with a respective one of the circuit outputs for providing a respective one of the output signals.
26. The control arrangement of claim 25, wherein there is further provided a plurality of relay means, each associated with a respective one of said plurality of output interface circuits for isolating electrically said integrated circuit means.

27. A method of operating a lifting and lowering apparatus for a vehicle having a vehicle drive arrangement, the method comprising the steps of:

(a) interrogating an operator interface device for determining whether the lifting and lowering apparatus is desired to be lifted or lowered;

(b) interrogating a lifting and lowering apparatus locator arrangement to determine the location of the lifting and lowering apparatus relative to the vehicle;

(c) interrogating a vehicle drive sensing arrangement to determine whether the vehicle is in motion; and

(d) determining whether to produce a motion signal for lifting or lowering the lifting and lowering apparatus in response to the interrogations of steps (a), (b), and (c).

28. The method of operating a lifting and lowering apparatus of claim 27, wherein prior to performing step (d) there are provided the further steps of:

interrogating a parking brake sensor for determining a parking brake condition of the vehicle; and

interrogating a neutral safety sensor for determining a transmission gearing condition of a drive transmission of the vehicle.

29. The method of operating a lifting and lowering apparatus of claim 27, wherein prior to performing step (d) there is provided the further step of interrogating an accessory power sensor for determining the availability of accessory power.
30. The method of operating a lifting and lowering apparatus of claim 27, wherein prior to performing step (d) there is provided the further step of interrogating a vehicle motion sensor for determining whether the vehicle is in motion.

31. The method of operating a lifting and lowering apparatus of claim 27, wherein prior to performing step (d) there is provided the step of issuing a vehicle disablement signal for disabling the vehicle drive arrangement.

32. The method of operating a lifting and lowering apparatus of claim 27, wherein the performance of step (d) comprises the further step of determining whether to produce an up drive signal to the lifting and lowering apparatus for effecting upward displacement of the lifting and lowering apparatus relative to the vehicle or a down drive signal to the lifting and lowering apparatus for effecting downward displacement thereof relative to the vehicle.

33. The method of operating a lifting and lowering apparatus of claim 32, wherein there is further provided the step of issuing a motion signal for selectably lifting or lowering the lifting and lowering apparatus.
FIG. 2

21. BED RAISED

22. BED LOWERED

23. ACCESSORY POWER

26. TRANSMISSION NEUTRAL

27. PARKING BRAKE

+12V +12V +5V +5V

INTEGRATED CIRCUIT

SUBSTITUTE SHEET (RULE 26)
FIG. 4

START

IS THE LIFT IN THE RAISED POSITION?

YES

NO

IS THE LIFT IN THE LOWERED POSITION?

YES

NO

IS THE PARKING BRAKE ON?

YES

NO

IS THE VEHICLE IN GEAR? (CHECK NEUTRAL SAFETY SWITCH)

YES

NO

SET BIT TO KILL THE ENGINE

80

81

82

83

84

85
FIG. 5

START  90

91. IS THE IGNITION ON? NO 92. SKIP MOTION LOGIC

YES

94. IS THE PARKING BRAKE ON? NO 95. KILL ENGINE LOGIC

YES

96. IS THE TRANSMISSION IN GEAR?

YES

100. IS UP BUTTON PUSHED?

YES 101. RAISE CARGO BED

NO

105. LOCK STATE IF BOTH BUTTONS PUSHED

102. IS DOWN BUTTON PUSHED?

YES 103. LOWER CARGO BED

NO

END  105

SUBSTITUTE SHEET (RULE 26)
A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) : G05B 19/18
US CL : 364/167.01
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)
U.S. : 2806.151, 2806.15, 70150, 364/478.01, 364/167.11

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)
APS : detect, sensor, logic circuit, interface, brake, lifting, lowering, controller, vehicle, truck, car forklift, monitor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 4,994,973 A (MAKINO et al.) 19 February 1991 (19.02.91), col. 2 line 66 to col. 3 line 9, col. 7 line 58-68, col. 3 lines 24-35, col. 7 lines 65-68, col. 2 line 57 to col. 3 line 9</td>
<td>21, 25, 29</td>
</tr>
<tr>
<td>Y</td>
<td>US 4,520443A (YUKI et al.) 28 May 1985 (28.05.85), fig. 1 parts 262 and 264, col. 10 lines 55-68, col. 2 line 30-57, col. 4 line 16-43, col. 10 56-67</td>
<td>15, 16, 19, 22, 26</td>
</tr>
<tr>
<td>Y</td>
<td>US 5505267A (ORBACH et al.) 09 April 1996 (09.04.96), col. 2 lines 42-57, col. 6 line 7-17, col. 6 lines 18-31, col. 10 lines 56-67, col. 6 40-46, col. 6 1-31, col. 3 11-30.</td>
<td>20, 23, 24, 27, 28</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "B" earlier document published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
  "P" document published prior to the international filing date but later than the priority date claimed
  "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
  "X" document of particular relevance; the claimed invention cannot be considered novel or can be considered to involve an inventive step when the document is taken alone
  "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
  "A" document member of the same patent family

Date of the actual completion of the international search: 13 JANUARY 1999
Date of mailing of the international search report: 01 MAR 1999

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer
WILLIAM GRANT
Telephone No. (703) 308-1108

Form PCT/ISA/210 (second sheet)(July 1992)
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>US 5,376,760 (Horsley) 27 December 1994 (27.12.94)</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>US 4,682,145 (Brawner, Jr.) 21 July 1987 (21.07.87)</td>
<td></td>
</tr>
</tbody>
</table>