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Warning and message delivery and logging system utilizable in the monitoring of fall arresting and prevention devices and method of same

Abstract

An active interface monitoring and warning system for fall arresting/prevention devices delivering specific fault condition messages to individuals who are subject to accidental falls or other safety hazards when performing construction or the like or when operating elevating construction machinery such as aerial lift work platforms and the like. The invention further provides a data logging system to record and transmit operational conditions, fault conditions and safety infractions.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of U.S. patent application Ser. No. 14/972,788, filed Dec. 17, 2017, which application is a continuation of U.S. patent application Ser. No. 13/369,749, now Issued U.S. Pat. No. 9,245,434, issued Jan. 26, 2016 and claims the benefit of U.S. Provisional Application No. 61/440,957 filed Feb. 9, 2011 and entitled Warning and Message Delivery and Logging System Utilizable in the Monitoring of Fall Arresting and Prevention Devices and Method of Same, which are hereby incorporated herein by reference in their entireties.

FIELD OF THE INVENTION
(1) This disclosed invention relates generally to an active interface monitoring and warning system for fall arresting/prevention devices and is more specifically directed to delivering specific fault condition messages to individuals who are subject to accidental falls or other safety hazards when performing construction or the like or when operating elevating construction machinery such as aerial lift work platforms, bucket trucks and similar type elevating work platforms. The invention further provides a data logging system to record and transmit and alert operators, supervisors and emergency personal of fault conditions and safety infractions, as well as transmit data for safety and regulatory compliance as well as schematic or equipment diagnostic analysis information, track and maintain field inventory, increase productivity and improve efficiencies.
BACKGROUND OF THE INVENTION
(2) Remote monitoring devices have been developed to deliver warning messages and critical information to remote locations. For example, U.S. Pat. No. 6,147,601 to Sandelman et al. describes the delivery of messages from remote equipment for periodic preventative maintenance and for catastrophic failure of HVAC equipment. Quite different from HVAC equipment, construction and aerial lift machinery apparatus presents a significant risk and danger not only to the operators, but to those in proximity to the machinery. To address these issues, safety devices such as lanyards or safety harness detection sensors, motion and high voltage proximity sensors and other warning devices to protect the operator have been developed.
(3) U.S. Pat. No. 6,265,983 to Baillargeon discloses a machinery operator protection system and method, which inhibits the use of machinery unless the operator of the machinery is properly secured with a lanyard and/or body harness to the machinery. Optionally, the method may also include an audible or visual warning alarm to the machinery operator if an attempt is made to use the machinery without proper safety lanyard attachment.
(4) U.S. Pat. No. 6,330,931 to Baillargeon et al. describes a safety lanyard detection sensor and warning device which inhibits operation of the machinery and also can deliver a visual or audible message to the operator that machinery movement is inhibited because of failure to secure the operator with a safety lanyard. In U.S. Pat. No. 6,297,744, also to Baillargeon et al., a warning device delivers messages to the operator to secure their safety lanyard at an initial upward movement of the work platform and delivers messages within the area below the boom and work platform or zone of danger that the boom is moving, expressing that persons below the boom should remain out of the area as the boom descends.
(5) In both Baillargeon U.S. Pat. Nos. 6,330,931 and 6,265,983, the lanyard detection sensor disclosed is located on the lift anchor point and upward movement of the work platform is inhibited via an interlock switch unless the lift operator has attached a safety lanyard to the lift anchor point. An issue in this approach is that the system may be defeated by leaving the safety lanyard attached to the anchor point at all times. An operator may forget or otherwise fail to secure the lanyard to

themselves, and can even leave the work platform and, in such a situation, leave the lanyard on the anchor point allowing operation of the platform without a secure attachment of the lanyard to the body harness of the operator creating a safety hazard. In these real life scenarios, the unprotected lift operators will be able to go up in the work platform without proper utilization of their fall protection apparatus because the interlock sensor has detected the attachment of the lanyard to the anchor point enabling lift movement without the safety lanyard being attached to the harness worn by the lift operator.

(6) The references disclose delivering verbal messages when the lift is descending, warning others below the lift, or when the operator selects upward movement of the lift and the safety lanyard is not attached to the anchor point, the lift will not be operational until the lanyard is attached to the anchor point, but there is no restriction on operation if the lanyard is not attached to the body harness. The references apply strategies to detect a connection of the safety lanyard to the harness and then to the anchor point, but these designs are not readily available to retrofit current lanyard product and therefore present cost prohibitive barriers to adoption of these methods even though benefits in fall prevention may be achieved.

(7) Importantly, this approach of issuing a verbal message only when a fault has occurred may induce the attachment of the safety harness to the anchor point in order to operate the lift, but does not ensure that the lift operator also verifies attachment of the lanyard to their body harness. The limited verbal message may induce action but fails to reinforce this important safety requirement with a fail-safe system and mechanisms as well as through operational monitoring and with a large number of operators working in remote areas or in areas where there is limited or no supervision, there is no disclosure in the references of a way to reinforce and monitor safety procedures, to track safety violations or to subject violators to penalties, fines and other negative ramifications by Supervisory and/or Safety officials at their workplace or by U.S. Occupational Safety and Health Administration (OSHA) and other regulatory agencies charged with enforcement of work platform fall protection safety infractions. This inability to supervise, track and verify adherence to safety protocols may permit operators to bypass and circumvent safety apparatus without acknowledging or understanding that the apparatus has been put into place to prevent accidents that may result in loss of life.

(8) With the widespread use of aerial lift systems, and the critical need for improved methods of training, the references fail to disclose a system which provides audible and/or visual warnings and reinforces safety procedures and training. The references also fail to disclose the monitoring, tracking and analysis of multiple fault conditions. This analysis may be used forensically to evaluate and determine the events that led to an accident, or establish the failure of an operator to adhere to safety protocols and thereby provide an opportunity for training or punishment, and further demonstrate the adherence of an entity to safety procedures and protocols, data that may be used to support the entity before a government agency. The references also do not disclose a monitoring unit capable of monitoring numerous warning devices and sensors cooperatively to provide continual status checks of safety equipment and deliver as necessary appropriate audible and/or visual warnings based on alerts received from this safety equipment. The safety data handling and information flow to the operator is critical where many operators of aerial lift booms and the like make many trips up and down in the aerial lift work platform while servicing telephone poles, cable TV, power lines hardware, or maintain restocking and inventory from warehouse shelving in retail stores and the like. These scenarios are fraught with situations in which the operator may leave the aerial lift basket or platform area to retrieve tools or the like, return to the aerial lift work platform, and forget to attach the safety lanyard to the anchor point on the boom or work platform or to his/her body harness. The operator may also fail to identify the proximity of high voltage lines as the work platform is angled and shifted to more easily access the wires and equipment being serviced. The various accident situations which can occur are quite dangerous and can include the operator subsequently falling from an aerial lift work platform or being electrocuted

from power lines. These accidents tend to be quite severe, resulting in broken bones, head and back injuries, as well as documented cases of permanent paralysis and death.
(9) As a result, the U.S. Occupational Safety and Health Administration (OSHA) has promulgated rules mandating fall protection standards in the workplace. These standards generally mandate that a safety belt be of a length wherein the worker is not able to move enough within the work platform or basket to fall from the platform and therefore is referred to as a fall restraint system. Other standards provide for a lengthened safety lanyard that provides the operator with additional mobility to perform required tasks however this additional slack may be enough to allow the operator to fall and possibly be held hanging by the lanyard and therefore is referred to as a fall arrest system. While these standards generally require the use of fall protection and warning systems and methods in conjunction with the use and operation of aerial lift booms and the like, they do not dictate any positive system of enforcement regarding the use of these fall protection and warning systems nor do any systems exist to properly capture and track infractions by operators failing to secure a safety belt or properly use and react to other safety equipment.
(10) The alternative to the use of positive enforcement has been the use of human safety monitoring personnel (safety monitors) whose job it is to inspect the workplace and inform workers of potential fall hazards. This approach is obviously only effective in situations where the worker is operating in a group context and would be ineffective for service workers that work alone such as telecommunications technicians, electrical workers, arborists, warehouse workers, painters, light and signal maintenance workers, window washers, or maintenance construction workers for example. The use of written fall protection plans and fall protection training are similarly ineffective in this context. Within the context of aerial lift work platforms and the like (where the potential for serious injury resulting from an accidental fall is the greatest), the policies and procedures of OSHA seem to have the least potential for affecting an acceptable solution to this serious safety problem.
(11) Thus, the existing methodologies do not address the human factor involved in the operation of elevating machinery which can pose potentially deadly falls and other hazards to their operators. In fact, government regulations and safety training are insufficient to ensure that safety devices are properly used or in fact used at all. Unfortunately, with the rapid expansion of the construction, telecommunications, and cable TV industries, the use of aerial lift work platform devices has skyrocketed, resulting in a marked increase in accidental falls and subsequent severe injuries to workers in these fields. It is obvious from the record that fall protection training as well as policies and procedures for fall protection are inadequate to solve this problem alone.
(12) While the use of lanyards and other fall prevention devices is widespread within the construction industry, there appears to be no art relevant to systems and methods that permit the use of these devices to be mandated or monitored to ensure their proper use. As a result, accidental falls continue to injure and disable thousands of workers per year.
(13) Accordingly, what is needed is a system and method of reinforcing the safe and efficient use of aerial lift work platform safety devices and the like, and which does not interfere with mechanical operation of the machinery, so that the operator of such a device is properly secured to the aerial lift work platform with a body harness and attached lanyard and the work platform or basket door is properly secured. The operator must also be properly aware of fault conditions in safety equipment such as warnings issued from proximity monitors that high voltage wires are within the work vicinity or that wind speed is excessive creating a dangerous condition. Other similarly ineffective in this context. Within the context of aerial lift work platforms and the like (where the potential for serious injury resulting from an accidental fall is the greatest), the policies and procedures of OSHA seem to have the least potential for affecting an acceptable solution to this serious safety problem.
(14) In addition to tracking and reinforcing safety procedures and protocols, a monitoring and data transmission system could increase productivity, lower costs and improve efficiencies. Access to

schematic information, previous repair reports, availability of inventory and other information could allow an operator at a remote location such as in servicing a downed power line to better determine efficient strategies for repair and/or photograph the location and transmit this data for further analysis and suggestions by supervisors. Further, the system may be integrated with a video monitor to monitor and document work.

(15) A monitoring and data transmission system could effectively accept and record data from of all safety devices and provide proper procedural steps needed to assist the operator to properly react to a variety of fault conditions and/or provide additional information to evaluate field conditions and equipment repair. Such a system should minimize the operational impact on the use of existing lanyard devices and other safety equipment by not requiring the operator/worker to perform extra safety related functions to affect mandatory use and understanding of the equipment. Such a system should also provide warnings and instruction to the operator when a lanyard device is not secured or another fault condition exists, while normally not interfering in operation of the machinery and equipment, unless entirely necessary. Such a system should further track and log safety data including misuse and infractions where an operator bypasses or delays in the use or reaction to a safety warning thereby notifying training personnel and others of the lack of adherence by their operators to safety regulations. A further important feature is that such a system be able to integrate and adapt with existing systems to remove barriers that may prevent adoption of an improved safety system within the aerial lift work platform field.

SUMMARY OF THE INVENTION

(16) According to the teachings of the present invention, a machinery operator protection and data logging and transmission system and method is described which allows access to data, reinforces the use of safety systems, monitors and tracks both proper and improper lift operator performance including the misuse and infractions by the operator in using the machinery without properly performing safety procedures such as securing a lanyard and/or body harness to the machinery, and/or adhering to fault condition warnings is provided.

(17) The disclosed system generally includes a warning system interface that continually monitors lift operations including the monitoring of safety equipment conditions. During operation of the aerial lift apparatus the system may provide reinforcing commands and warnings to an operator based on mechanical and environmental conditions. The commands and warning may use verbal and audible messages to instruct the operator on proper safety procedures for general operation of the lift and specific fault conditions. The warning system interface will further monitor and log general operation of the lift with, date, time and telematics information to track for example the amount of time the operator spends attached to and working and ascending or descending in the lift. Data that may be used to determine efficiency and work performance of operators as well as timing and scope of proper lift maintenance.

(18) The commands and warnings may both monitor and instruct an operator in safe operation such as by reminding an operator of proper safety procedures and logging both adherence to those procedures or fault where the system has detected improper adherence to a procedure. For example, the interface monitoring unit may first remind the operator of the requirement to attach a safety lanyard connection. The system may also monitor a lanyard connection detector for detecting proper attachment of at least one lanyard to the operator and log both proper attachment and a detection fault. The system may further provide repeated verbal warnings to remind the operator that a safety lanyard is not attached, the warning system halting the warnings when the connection detector indicates that the lanyard is properly attached. The fault condition would be logged in a data logging system, such as a lanyard not being properly attached and the time or number of infractions in use or amount of delay in use of the safety system by the operator.

(19) The system would further record the time, date and number of times the safety lanyard was attached and detached from the system and the time, date and number of times the lift was operated in an upward and/or downward movement. This collection of data may then be evaluated and

cross-checked to determine if the attachment and detachment of the safety lanyard coincides with the operation of the lift. For example, if the lift is operated up and down five times over a two day time period, but the safety lanyard has been detected as attached once, then this data may indicate safety lanyard detection device has been circumvented in some manner, thereby providing an opportunity to reinforce training and/or mete out penalties to a repeatedly offending operator.

(20) In monitoring safety equipment, the interface would detect fault conditions and determine appropriate responses to the fault. For example, the interface may translate a fault condition of a wind gust of over 40 mph from a wind speed indicator and issue a verbal message to the operator, “Descend immediately! Warning high wind conditions!” The interface response may be an audible alarm, a verbal command/or the activation of a timed or un-timed interlock that prevents further movement or performs controlled movement of the aerial lift work platform. For example, in response to a fault condition from a proximity warning system detecting that the aerial lift boom/bucket is in an area of danger of high voltage wires, the interface may incorporate a latching relay control system that halts the upward motion of the aerial lift boom/bucket. The interface may also issue audible alarms and messages to the operator such as “Watch your overhead clearance! Warning high voltage! Descend immediately!” In further examples, the interface may issue warnings of an overload of weight within the aerial lift boom/bucket, or issue an instruction to latch the door of the aerial lift boom/bucket if a fault is detected, or instruct the operator that the position of the truck is on a steep or unstable gradient from detection of a fault of a stability warning device. Frequently, a material handling overload may occur from the lifting by the operator of a large weight such as a tree limb that exceeds the specifications and recommendations for use of the aerial lift platform or basket. The detection of a material handling overload may be transmitted from a material handling jib boom or cross arm. This can result in stress fractures and other latent damage to the boom and support assemblies for the basket. While a single infraction may not result in an accident, repeated infractions may overtax the limits of the support structure and result in a tipping over of the truck due to the excessive weight and/or a sheering of boom or support and the basket, either condition resulting in serious harm to the operator and damage to the equipment. An important feature of the monitoring unit, as described in further detail below, is an interface with a load sensor and the issuance of a verbal warning to the operator when the specified load of the aerial lift platform/bucket has been exceeded. Additionally, a reading of the measured load and a logging of the infraction and number of previous infractions may be provided to reinforce and deter continued violations that may result in equipment failure. The interface may further detect if the weight within the aerial lift platform/bucket abruptly changes while the bucket is in a raised position, thereby indicating that the operator may no longer be in the bucket and a load sensor and a sensor positioned on the anchor point, as described in further detail below, may detect if an operator has fallen to the ground or is hanging by the safety lanyard from the bucket. An operator hanging from the bucket in the body harness may experience permanent nerve damage and loss of circulation to the extremities in as little as twenty minutes. The immediacy of assistance to the operator is critical. This event may trigger a response by the monitoring system to immediately contact emergency personal and provide a warning of possible injury to the operator including information such as map coordinates, identification and other information by interfacing the system with a telematics and/or global positioning system (GPS) as described in further detail below.

(21) It is an object of the present invention to integrate a safety warning device to a new or existing aerial lift work platform system to monitor one or more safety devices and to issue verbal messages and warnings to the aerial lift operator upon entering the aerial lift work platform, and/or at the beginning of any motion of the aerial lift apparatus, and/or whenever any dangerous condition becomes evident triggering a response from the monitoring unit.

(22) It is another object of the present invention to isolate the power source of an interface warning and data recovery/transmission system to provide a high degree of isolation of the operator and work platform from electrical systems external to the platform to reduce the risk of electrical shock

to the operator.
(23) It is another object of the present invention to monitor and detect the secure connection of a safety lanyard to a machinery operator of the aerial lift work platform and to issue repeated verbal messages and warnings to attach his/her safety lanyard so that he/she is secured to the aerial lift work platform, the repeated warnings may stop when the secure connection of a safety lanyard to a machinery operator is detected, or alternatively the operation of the work platform may be halted until the secure connection is detected.
(24) It is another object of the present invention to monitor and detect the secure latching of the door of the aerial lift work platform and to issue repeated verbal messages and warnings to secure the door of the aerial lift work platform; the repeated warnings may stop when the secure connection of the door is detected.
(25) It is an object of the present invention to monitor one or more safety devices to detect fault conditions and to translate the fault condition to an audible verbal or visual warning to the aerial lift operator to instruct the operator of the proper safety procedure to undertake based on the fault condition.
(26) It is another object of the present invention that the monitoring system provide access to internal and external data through an intranet and/or internet connection to assist the operator of the lift in access to engineering and fault diagnostic data, access to inventory and material data and control of data through the use of a bar code scanner or other material tracking device interfaced with the monitoring system, and access to telematic and status data for current conditions at the present location or other locations.
(27) It is yet another object of the present invention that a timer begins at the time a first audible or visual warning is detected and that each subsequent warning issued is recorded as a delay and/or infraction by the operator in adhering to safety procedure. Additionally, one or more cameras attached to the boom and/or basket may capture pictures or video of the operator, control systems, work area and work in progress while the boom is in operation. Live video and audio may assist in an emergency to determine the extent of an operator's injuries and may provide vital forensic information after an accident or corroborate the adherence of an operator to appropriate safety procedures.
(28) A further object of the present invention is to record and transmit telematics data associated with an infraction in the use of safety equipment such as; the vehicle identification, the work platform identification, the operator, the date, the time, the location, the infraction and amount of delay etc., the transmitted and received data to be conveyed through different media, including a system computer, hardware connected to a server, a cell phone, a PDA, iPhone, iPod, iPad the internet, etc. The data transmitted may further include a video monitor to monitor and document work.
(29) A still further object of the present invention is to relate the infraction data associated with a particular operator or vehicle and lift device and compile the data for safety compliance reporting and training.
(30) The present invention is directed to a safety protection system for aerial lift apparatus comprising a personnel support platform for supporting and moving personnel to a desired work location; an interface monitoring unit mounted to the personnel support platform for receiving and transmitting data; a plurality of equipment condition detectors located on the personnel support platform of the aerial lift apparatus and communicating with the interface monitoring unit; a data server for at least one of receiving, storing and transmitting data and commands in communicating with the interface monitoring unit; and wherein the data server is provided with at least one information logging database and data received by the data server from the interface monitoring unit on the personnel support platform is input to the database and organized according to predetermined categories.
(31) The present invention is further directed to a method of integrating a safety protection system

into an aerial lift apparatus with safety condition detectors and a data server comprising the steps of providing a personnel support platform for supporting and moving personnel to a desired work location; attaching an interface monitoring unit to the personnel support platform for receiving and transmitting data; locating a plurality of equipment condition detectors on the personnel support platform of the aerial lift apparatus to communicate with the interface monitoring unit; providing a data server for at least one of receiving, storing and transmitting data and commands and communicating with the interface monitoring unit; and organizing transmitted data from the interface monitoring unit to the data server with at least one information logging database according to predetermined categories.
(32) These aspects of the invention are not meant to be exclusive and other features, aspects, and advantages of the present invention will be readily apparent to those of ordinary skill in the art when read in conjunction with the appended claims and accompanying drawings.

Description

DESCRIPTION OF THE DRAWINGS
(1) These and other features and advantages of the present invention will be better understood by reading the following detailed description, taken together with the drawings wherein:
(2) FIG. **1** illustrates a first embodiment of the interface monitoring unit with safety warning devices and a data server;
(3) FIG. **2** illustrates a schematic of one embodiment of the interface monitoring unit;
(4) FIG. **3** illustrates an embodiment of a conventional aerial lift work platform with a vehicle and the interface monitoring unit with a number of safety warning devices;
(5) FIG. **4** illustrates an embodiment of a load sensor warning system with the interface monitoring unit;
(6) FIG. **5**A shows a further embodiment of the load warning system;
(7) FIG. **5**B shows a still further embodiment of the load warning system;
(8) FIG. **6** a first embodiment of a safety lanyard sensor;
(9) FIG. **7** illustrates the safety lanyard sensor of FIG. **4** integrated with the interface monitoring unit and connected to the control panel;
(10) FIGS. **8**A and **8**B show an embodiment of a retrofittable safety lanyard detection system;
(11) FIG. **9**A shows a perspective view of the retrofittable safety lanyard detection system;
(12) FIG. **9**B shows the housing and activation switch of the retrofittable safety lanyard detection system;
(13) FIG. **10** shows a top view of the retrofittable safety lanyard detection system;
(14) FIGS. **11**A and **11**B shows perspective views of the housing of the retrofittable safety lanyard detection system;
(15) FIG. **12** shows a paddle activation switch as a further embodiment of a safety lanyard detection system;
(16) FIG. **13** shows a perspective view the paddle of the paddle activation switch of a further embodiment of a safety lanyard detection system;
(17) FIGS. **14**A-**14**D shows diagrammatic views of the paddle activation switch of a further embodiment of a safety lanyard detection system;
(18) FIG. **15** shows a perspective view of a further embodiment of the paddle activation switch as a further embodiment of a safety lanyard detection system;
(19) FIGS. **16**A-**16**D shows diagrammatic views of a further embodiment of the paddle activation switch of a further embodiment of a safety lanyard detection system;
(20) FIG. **17** shows the paddle activation switch as a safety lanyard detection system with the interface monitoring unit;

(21) FIG. **18** illustrates a first embodiment of the interface monitoring unit with a first embodiment of an isolated power source that may be used with the unit;
(22) FIG. **19** illustrates a first embodiment of the interface monitoring unit with safety warning devices;
(23) FIG. **20** illustrates a flow diagram of the interface monitoring unit with safety warning devices;
(24) FIG. **21** illustrates a conventional aerial lift work platform with vehicle and the interface monitoring unit of the present invention with a number of safety warning devices and a data server;
(25) FIG. **22** illustrates another embodiment of the interface monitoring unit with safety warning devices; and
(26) FIG. **23** illustrates a schematic of a further embodiment of the interface monitoring unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(27) As shown in FIG. **1**, an interface monitoring unit **100** for warning and data recovery and transmission is used in combination with a plurality of safety devices in a fall protection system which provides a single command point for the distribution of alerts and fault condition messages to a machinery operator, and provides instructive reinforcement to create operator compliance of safety regulations and procedures. The interface monitoring unit **100** is shown in communication with several safety warning devices, a data server **102** that provides access to internal and external data through an intranet or internet connection, and optionally an axis point to monitor and control up and down motion of the boom motor **104**. A video monitor **105** to monitor and document work may also be in communication with the interface monitoring unit **100**.

(28) As an example in a first embodiment the equipment condition detector safety devices may be a high voltage proximity warning **106** that detects high voltage at a distance of approximately 1 Oft from the aerial lift work platform or basket, or an environmental condition detector such as a wind speed indicator that warns of high wind conditions **108**, a safety lanyard connection detector **110**, a door lock detector **112**, and overload or load fault warning that detects excessive weight or an abrupt change in weight on the work platform or basket **114** and an outrigger stability warning **116** that measures the vertical grade of the parking area of the vehicle or aerial lift support machinery and sends an alert if the slope is too steep. The data server **102** may be housed within the vehicle or aerial lift support machinery and may be connected locally to the interface monitoring unit or alternatively it may be a wireless connection to a secure intranet or internet server. The data server **102** in conjunction with the interface monitoring unit **100** may send warning messages and data as alerts to one or more email addresses **118**, telephones **120**, tablet, iPods, iPads, or PDAs **122**. The interface monitoring unit **100** may provide organized and categorized data and metadata to the data server **102** based on signals transmitted to and from the vehicle motion controls and/or the equipment condition detectors. Data transmission from the interface monitoring unit may establish predetermined categories and organizational hierarchy through the use of data fields and metadata to efficiently store and access relational data within one or more of the data server databases **230**. The monitoring unit may further interface with a telematics system **121** such as for example a vehicle monitoring system that provides speed and diagnostic information such as tire pressure of the vehicle or other information or a global positioning system (GPS) that provides location of the vehicle in the event of a critical warning and/or provides location information with logged data as described in further detail below.

(29) The interface monitoring unit **100** for monitoring, logging, transmission, storing and receiving of data and other requirements may be provided by the same power source as the AC or DC power supplied by the truck or prime mover via wires up the boom or alternatively from a hydraulic powered generator at the boom end driven by a hydraulic circuit from the truck or prime movers power take off (PTO) circuit. However, to prevent the risk of electrical shock to the operator, insulated aerial lifts do not have wires or conductors in the boom and instead need an isolated and independent battery power source at the boom end and a charging system. In a first embodiment of

the invention for insulated lifts, the power source **115** or charging system is a hydraulic power AC/DC generator with electrical/hydraulic regulation to charge the battery and provide power for the system. Using this unique design of the present invention for insulated aerial lifts as discussed in detail below allows the power source **115** to be isolated thereby maintaining the insulated qualities of the aerial lift while providing power to operate the warning and data recovery/transmission system of the interface monitoring unit **100**. The interface monitoring unit **100** may also be connected to a boom position encoder **117**.

(30) A first embodiment of the components of the interface monitoring unit **100** is shown in FIG. **2**. The unit **100** may have a plurality of data ports **124** to connect directly to one or more safety warning devices. The data ports may be USB, serial, parallel or other connector types to accommodate the data output format of the safety warning device. An I/O bus **126** distributes signals from the external devices to a microprocessor **128**. When an external safety device is connected either directly through data port **124** or using wireless communication to the interface monitoring unit **100**, the communication protocol **129** initially accesses or downloads device drivers **131** or other software protocols to convert and accept communications from the device. Those communications and all subsequent communications are then directed to the microprocessor. An incoming warning or fault condition or signal from the device is interpreted by a message translator **130** and/or alarm translator **132** that reviews a message library **134** and alarm library **136** to forward an appropriate verbal, audible and/or visual communication to the operator. In performing a translation, the interface monitoring unit software may extract warning language and alerts from the external safety device and incorporate these items into the appropriate library, both for immediate and subsequent use. The translated message or alarm may recite specifically the warning provided by the device and may provide additional instructional information and suggested appropriate response actions to be taken by the operator. The message may also be translated into the appropriate language based on a setting on the interface monitoring unit **100** selected by the operator.

(31) A translated message is routed through the microprocessor **128** to the appropriate alarm signal output **138** or voice circuit **140** to the amplifier **142** to be amplified through one or more system speakers **144** and/or through a headphone jack **143** to headphones worn by the operator. In addition to routing and translating the message appropriately, the interface monitoring unit **100** logs the date, time and other information related to the message received. This information that may include the identification of the operator, the location of the truck and the status of the boom encoder that indicates the position of the boom in a raised or lowered position. The information is then transferred to the server or transmitted directly to appropriate supervisory or emergency personal through an appropriate communication protocol to be received by a cell phone, tablet, iPhone, iPod, iPad, or other communication device. As will be discussed in greater detail below the interface monitoring unit **100** provides for data input from an operator or administrator to review and respond to information provided by the unit. In addition to the monitoring of safety and equipment condition detectors, the interface monitoring unit **100** may continually monitor operational conditions of the lift such as the ascending or descending of the lift and the date, time and other information to track efficiencies and work performance of the operator. The unit **100** may have one of an LCD, LED or other display screen **146** with touch screen input or alternatively and/or in addition a keyboard **148** for data entry. Power for the interface monitoring unit **100** may be provided by a PTO circuit from the truck or prime mover or by an isolated battery power source **115** at the boom end and a charging system with power to the unit controlled by a power switch **137**.

(32) The aerial lift or crane elevates personnel or material to the work area utilizing telescopic and/or articulated or scissor booms connected to a turret that may rotate 360 degrees on its axis. The booms of these devices may be insulated or non-insulated, depending upon the requirements of the work area. These devices may be equipped with a personnel platform or bucket that is

permanently attached or removable. These platforms are equipped with controls and other accessories that may require AC or DC power.

(33) As shown in FIG. **3**, a conventional aerial lift boom application has a truck **168** or other support on which an aerial lift boom **150** supports an aerial lift work platform or basket **152** in which an operator **154** works. A control panel **166** has buttons and switches to operate the aerial lift work platform in an upward and downward motion, with safety switches to immediately shut down power as required in an emergency. The aerial lift operator **154** is typically restrained to the aerial lift work platform or basket **152** via a body harness **158** and a safety lanyard **156**. The safety lanyard **156** is connected at each end to fasteners such as snap hooks **162** and extends between the body harness **158** and an attachment point, such as a support anchor point **164** on the boom or work platform. As noted above a failure to properly connect the safety lanyard **156** to the support anchor point **164** may result in injury or death if an operator falls out of the basket **152**.

(34) The interface monitoring unit **100** may further communicate with an overload sensor **114** and display the load limit and the current load of the platform/basket. If the current load is within a specified range of or exceeds the load limit, a verbal and/or visual warning message may be displayed. As noted above repeated infractions by an operator in lifting or placing loads in the basket that exceed load limits can cause stress fractures that overtime will damage the boom support structure and may result in the tipping over of the truck or shearing of the boom. The overload sensor **114** may be for example a support deck **127** positioned with in the floor of the platform/basket to measure changes in loads within the basket. The support deck may be wired directly to a data port **124** of the interface monitoring unit **100**. In further embodiments the overload sensor may be positioned directly along the boom at the lifting cylinder **131**, or at the load pin **133** where the basket is connected to the boom, or at the leveling cylinder **135** that provides for an operator to adjust and level the basket to keep the basket in a stable level position with respect to gradient of ground where the vehicle is parked. The interface monitoring unit **100** provides for wireless connection of any of these overload sensors **114** or of other sensors positioned remotely from the platform/basket. A particular advantage in retrofitting sensors to older equipment and/or in the use of insulated baskets used in high voltage power line work where there is a risk of shock if wires are run to and from the internal insulated portion of the basket.

(35) In addition to the detection of a load that exceeds the load specification of the equipment, the overload sensor **114** may further detect an abrupt change in load when the boom is in a raised position indicating the operator may have fallen out of the platform/basket. In this situation where time is critical, the interface monitoring unit **100** may immediately contact emergency personal and provide telematics information on the identity and location of the truck and operator. The telematics data is more specifically vehicle telematics data indicating for example GPS based location information. Vehicle telematics and tracking is a way of monitoring the location, movements, status and behavior of a vehicle or fleet of vehicles. This is achieved through a combination of a GPS (GNSS) receiver and an electronic device (usually comprising a GSM GPRS modem or SMS sender) installed in each vehicle, communicating with the user (dispatching, emergency or co-coordinating unit) and PC- or web-based software. The data are turned into information by management reporting tools in conjunction with a visual display on computerized mapping software.

(36) A further hazard as described above is the operator falling out of the basket and being left hanging from the safety lanyard. To address this, the anchor point **164** may be configured with a load sensor warning system **139** as shown in FIG. **4**. In a first embodiment, the system **139** may be simply a strain gage or spring **141** and switch **181** that closes sending a signal when a load pulled in any direction on the anchor point **164** is detected. The signal is transmitted through a wire connection to the input data port **124** of the interface monitoring unit **100**, or preferably and as required in the insulated basket systems described above wireless sensors or encoders within the system **139** transmits the signal to the interface monitoring unit **100**.

(37) In an accident of this nature where time is critical to assist the operator and prevent or reduce injury, the interface monitoring unit **100** may immediately contact emergency personal and provide telematics information as previously described. The load warning system **139** may be easily retrofitted to an existing anchor point **164** or may replace an existing anchor point **164**. The load warning system **139** may be a solid state integrated circuit **183** with an internal switch as shown in FIG. **5**A or a hull effect sensor **185** and magnetic switch **181** as shown in FIG. **5**B or another load sensor and transmission system that may be selected and configured based on the variety of anchor point designs that may position the anchor point horizontally or vertically and the space requirements within the platform/basket. In any configuration, a transmission of a fault signal to the interface monitoring unit **100** may trigger the notification to appropriate personal and may further open a communication channel from the emergency personal to the operator and/or may provide access of audio and/or video from remote cameras positioned on or around the work platform to access the situation and status of the operator. The interface monitoring unit may further transmit a signal to emergency personal from a motion sensor or “man down” warning system that would signal if non-movement of the operator was detected over a period of time due to a fall or injury.
(38) In an embodiment of the present invention, the safety detection monitoring system **100** may utilize a safety lanyard detection sensor **110** as described in the references of Baillargeon, but also makes novel improvements which further facilitate that the lift operator **154** will indeed be wearing his/her safety harness **158** and will indeed utilize a safety lanyard **156** which is attached properly at both the anchor point **164** and the harness ring **159**. This is accomplished by incorporating the automatic logging of the date and time of all of the safety lanyard attachments and safety lanyard detachments made by the lift operator **154**. This is further accomplished in this new teaching by also automatically logging all of the UP switch and DOWN switch activations of the lift work platform/bucket **152** made by the lift operator **154**. In many instances, the supervisory and safety staffs where the lift operator **154** is employed may not be or cannot be in the location to visually watch over the lift operator **154** to verify proper fall protection practices are always adhered to but these same supervisory and safety staffs will have access to this logged information regarding the lift operator's time and date stamped proper use of safety lanyard attachments and detachments as well as to the time and date stamped logged usage of the up and down movements of the lift work platform.
(39) The lift operator **154** who may have been inclined to circumvent the anchor point lanyard detection sensor **110** described in the Baillargeon references with intent by for example, placing a screwdriver or other object into the anchor point lanyard detection sensor **110** or the lift operators **154** who simply always leave their safety lanyard **156** snapped off to the anchor point lanyard detection sensor **110** on boom or basket but then fail or forget to attach the other end of lanyard **156** to their harness ring **159** would now be subject to Supervisory and Safety Department discipline at their work facility as well as Regulatory discipline from OSHA and other State and Federal Agencies charged with enforcement of fall protection safety Standards and policies designed to save lives and limit injuries from falls. This is accomplished when the logged entries of the individual lift operator's lanyard attachment time and date stamps are reviewed and indicate many hours of “false attachment” proven by the fact that there were no time and date stamped UP and DOWN switch activations made by the lift operator during those minutes/hours and days immediately following the sensing of an anchor point attachment by the anchor point detection sensor **110**. The interface monitoring unit **100** may further provide data on adherence to safety procedures by recording the proper attachment and detachment of the safety lanyard during lift operation, data that may be used to support adherence to safety procedures to regulatory agencies.
(40) A safety detection sensor **110** may be sewn or affixed within the safety lanyard **156** or be incorporated to the anchor point **164** and/or the harness ring **159** and optionally be wired directly to the boom control panel switches for up movement. A connection of the lanyard **156** by the operator

to the anchor point **164** and/or a connection of the lanyard **156** to the harness ring **159** must be detected by the attachment sensor **110** or an error warning will be sent to the interface monitoring unit **100**. The interface monitoring unit **100** will give an audible verbal warning to attach the lanyard **156** and will log an infraction as described in further detail below. The warnings will be repeated and each additional infraction logged until an attachment of the safety lanyard **156** by the detector **110** is received. Safety lanyards and detectors, as described in U.S. Pat. Nos. 6,265,983 and 6,330,931 to Baillargeon and Baillargeon et al. respectfully may be used, and in further embodiments contemplated in this disclosure, the safety warning monitoring unit **100** may communicate with the detection sensor **110** that may be incorporated in the harness **158** and/or safety lanyard **156** using wireless transmission to provide for the operator **154** having the detection sensor and monitor on at all times as described below.

(41) In one embodiment, the safety detection sensor **110** may be a removable interlock switch **176** secured around the anchor point **164** and may have a connection **175** to a controller **178**. The interlock switch **176** and controller **178** may be integrated with the interface monitoring unit **100** through a connection **177** to the data inputs **124** or through wireless communication thereby providing for the monitoring interface device being adaptable to existing equipment. In one embodiment, the interlock switch block **176** is secured around the anchor point **164** on an existing aerial work platform using screws, bolts or other attachment methods as shown in FIG. **6**. A rounded cutout or other shaped area in the block provides space for an anchor point **164** that may be of one or more various shapes and allows the block **176** to be tightly secured around the anchor point **164**.

(42) Once the block **176** is secured as shown in FIG. **7** a spring plunger **172** is aligned below the anchor point **164** providing a base for a snap hook **162** or other attachment feature of a safety lanyard **156** to rest and compress the plunger **172**, thereby closing against a detector switch **174**. The detector switch **174** sends a signal to the controller **178** that the detector switch **174** is activated indicating the safety lanyard **156** is secured to the anchor point **164**. A further transmission is made from the controller **178** to the interface monitoring unit **100** signaling an attachment of the safety lanyard **156** to the anchor point **164**. Alternatively, the detector switch **174** may include a transmitter **161** and may transmit a signal directly to the receiver **125** of the interface monitoring unit **100**. In addition to the connection **177** to the interface monitoring unit **100**, in further embodiments there may be a connection **179** to the control panel **166** as shown in FIG. **7** to prevent activation of the lift unless a secure detection signal of the safety lanyard **156** to the anchor point **164** is received.

(43) The switch block **176** may be in the form of one or more pieces that are secured together around the anchor point **164**, or be a hinged piece that opens and then closes around the anchor point where it is secured. A variety of activation switches **172** and detectors **174** within the switch block **176** for signaling a connection of the safety lanyard **156** to the anchor point **164** are also contemplated. A similar interlock switch block **176** may be shaped to mate with the shape of the harness ring **159** providing a similar plunger **172** or other type detector switch **174** to signal a connection of the safety lanyard **156** to the harness **158**, thereby defeating a common safety issue, where the operator hooks the lanyard **156** only to the anchor point **164** and leaves the other end hanging within the work platform/bucket unattached.

(44) A secure detected connection of the safety lanyard **156** to the anchor point **164** and/or to the safety harness **158** is an important feature of the present invention, and various alternative approaches for this detection are contemplated within the scope of this invention. Each of the further embodiments as described below provides communication from the safety lanyard detector **110** to the interface monitoring unit **100**. A fault in this connection when the operator **154** accesses control of the lift may result in logging of a violation in the use of safety equipment, for example, data indicating the identification of the operator, date, time, the location of the infraction and other information may be logged each time operation of the lift is attempted without an attachment. The

interface monitoring unit **100** may further display or emit a visual and/or auditory warning to the operator **154** to secure the safety restraint, thereby reinforcing and training the operator of the proper safety procedures required in operation of the lift.

(45) The controller **178** and/or the interface monitoring unit **100** may further override of control of the lift, preventing the movement of the lift until a lanyard connection signal has been detected. The controller **178** and interface monitoring unit **100** may be mounted near the control panel **166** within or along the aerial lift basket **152**, and either the controller **178** or the interface monitoring unit **100** may be wired or be integrated through a wireless connection to the control panel **166** to stop or control movement of the aerial lift basket **152** if the safety lanyard detector switch **174** is not activated when the aerial lift moves. As further described, embodiments that provide for minimal modifications of existing safety lanyards **156** and other safety devices and that will easily integrate with the interface monitoring unit **100** to provide specific warnings and safety instruction reinforcement and training to an aerial lift operator are important in order to assist in adoption of the interface monitoring warning system **100** on both currently used and new aerial lift equipment.

(46) As an example of a retrofit for the safety lanyard **156**, a pivot hub attachment detector **160** that includes a latch actuator **151**, a detector arm **153**, a hub housing **155**, a pressure or magnetic switch **157** and a transmitter **161** is affixed to the snap hook **162** as shown in FIGS. **8**A and **8**B. This configuration may also be adapted to be manufactured with the snap hook to provide an integrated safety lanyard detector **110** within the snap hook **162**. The latch actuator **151** and detector arm **153** are affixed to the hub housing **155** at a spindle **149** that allows the latch actuator **151** and detector arm **153** to rotate around the spindle **149**. The rotation of the latch actuator **151** and the detector arm **153** coincides with the rotation of the clip **169** of the snap hook with the latch actuator **151** closing with the snap hook clip **169** to secure the snap hook **162** around a portion of the anchor point **164** or harness ring **159**.

(47) The detector arm **153** is pushed and rotated around the spindle **149** by the anchor point **164** or harness ring **159** shown in cross-section in FIG. **8**B. In forcing the detector arm **153** up and around the spindle **149**, the base **145** of the detector arm **153** contacts the pressure or magnetic switch **157** sending a signal to the transmitter **161** that is within or affixed to the hub housing **155**. The signal indicates a closed connection of the snap hook **162** and a secure connection of the lanyard **156** to one of either the anchor point **164** or the harness ring **159**. The signal transmitted is identified by a wireless receiver **125** such as the one shown in FIG. **23** that is incorporated within the interface monitoring unit **100** and the secure connection of the lanyard **156** is logged with telematic information to the server **102**. Alternatively, the receiver may be affixed to one or both of the anchor point **164** and the harness ring **159** with the receiver serving as the safety lanyard detector **110** that subsequently transmits the signal to the safety warning monitoring unit **100**. As previously described, with a detection of the attachment of the safety lanyard **156**, the interface monitoring unit **100** may stop the audible or visual warnings to the operator to attach the lanyard and in further embodiments send a signal to the boom controls **166** to allow operation of the boom.

(48) The detector arm **153** is held continuously to the magnetic or pressure switch **157** by the support of the anchor point **164** or ring harness **159** while the lanyard **156** is secured to the anchor point **164** or ring harness **159**. When the snap hook **162** is opened a spring **163** connected between the latch actuator **151** and an extender **167** of the detector arm draws the detector arm **153** to a closed position with the latch actuator **151** and snap hook clip **169** disconnecting the detector arm **153** from the magnetic switch **157**. Upon disconnection of the switch **157** a signal is also transmitted to the receiver **125** and the interface monitoring unit **100** logs to the server **102** that a disconnection has been made. In further embodiments, the interface monitoring unit **100** may after receiving the detached signal determine if the boom is in a raised position by polling the position of the boom arm encoder **117**. Additionally, the interface monitoring unit **100** may determine from the operation controls **166** if the boom is moving to an up or down position. A signal may also be sent to the boom controls **166** to halt movement of the boom. Audible and/or visual warnings may also

be issued to instruct the operator to reattach the safety lanyard **156**. A time interval for reaction time of the operator to respond to the infraction may also be recorded.
(49) As shown in FIGS. **9**A and **9**B, one pivot hub actuator assembly **160** is positioned on one side of the safety lanyard **156** with the housing **155** being formed with a rounded rectangular cutout to accommodate the lanyard attachment **165**. A mating hub housing **155** is positioned around the snap hook **162** and safety lanyard **156** opposing the actuator assembly **160**. The hub actuator assembly **160** is secured to the opposing hub housing using bolts or other appropriate hardware through bolt holes **173** that may be provided to align and secure the housings together around the lanyard attachment **165**. A top view of the pivot hub attachment is shown in FIG. **10** and perspective views of the hub housing **155** are shown in FIGS. **11**A and **115**. A first housing may be extended as shown in FIG. **11**B to accommodate and enclose the transmitter **161** within the housing or alternatively the pressure or magnetic switch **157** and the transmitter **161** may be affixed to the hub housing **155**.
(50) In a further embodiment more suited to manufacturing of new lanyards as opposed to retrofitting, a continuity connection could be wired between a first snap hook **162** on one end of the lanyard **156** and a second snap hook **162** on the other end of the lanyard **156**. In this embodiment, a single transmitter **161** may be affixed to only one end of the lanyard **156**. Upon activation and/or deactivation of one or both of the pressure or magnetic switches **157** a signal would be transmitted through a wire affixed along the lanyard **156** to the transmitter **161**. The transmitter **161** would then relay the signal to the local anchor point **164** and/or harness ring receiver **159** or to the interface monitoring unit receiver **125** indicating a connection has been made or has been detached at one or both of the anchor point **164** and harness ring **159**. The attachment or detachment may then be logged with telematics and other information of system parameters by the interface monitoring unit **100** based on the signals transmitted.
(51) In a further embodiment, the activation switch **157** and transmitter **161** may be positioned at one and/or both of the anchor point **164** and harness ring **159**. In this embodiment as shown in FIG. **12**, a paddle **187** having a contiguous surface area is dimensioned to mate with one or more configurations of connector rings **189** of an anchor point **164** and/or harness ring **159**. The paddle **187** may be of any shape and/or curvature, as shown in FIG. **13**, that when positioned against the connector ring **189**, the circumference of the ring is within the surface area of the paddle **187**. In this way, the connection of a snap hook **162** or other linked attachment to the ring **189** will displace the paddle **187** forcing it to rotate around a hinge **191** and contact an activation switch **157** within the housing **193** thereby transmitting a signal of attachment to the receiver **125**.
(52) In a first embodiment, a switch actuator **197** extends from an eyelet **199** of the paddle **187**, as shown in FIGS. **14**A-**14**D, contacting a magnetic, pressure, optical or other switch **157** as the paddle is displaced from the ring **189** and rotates around the hinge spindle **191**. An attachment or detachment of the snap hook **162** to the ring **189** transmits a signal to the receiver **125** of the interface monitoring unit **100**. The housing **193** may be positioned on a mounting bracket **195**, as shown in FIG. **12**, or may be a block housing with either configuration capable of being bolted to the inside or edge of the basket **152**, or of being affixed to the boom **150**.
(53) In this further embodiment, as shown in FIG. **15**, the housing **193** may be a metal or plastic composite of a square or rectangular shape. A brace **201** may support the paddle **187** which rotates on a spindle or hinge **191**. A spring **163** may be provided in compression with the hinge **191** to maintain the paddle **187** in a normally closed position. In this manner the paddle **187** must be pushed out and away from the connecting ring **189** by the snap hook **162** or other attachment mechanism forcing the paddle to rotate around on the spindle **191** and actuate the detector switch **157**. The housing **193** may also provide a compartment or cutout for attachment of a transmitter **161** to relay a signal to a receiver **125** within a controller **178** or at the interface monitoring unit **100**. Diagrammatic views of the paddle detector switch **187** are shown in FIGS. **16**A-**16**D. The paddle detector system is activated as the snap hook **162** is attached to the anchor point **164** as shown in FIG. **17**.

(54) In addition to the threat of falling over the top edge of the aerial lift work platform **152**, there exists a fall hazard presented by the door **170** of the aerial lift work platform. A door lock detector **112** may be installed to send a warning signal if the door is not properly secured. The door latch detection system **112** may detect both a primary interlock door latch and/or a secondary door security system such as the connection of a chain or strap in addition to a door latch. One or more other safety devices for fall protection and other hazards may be affixed to or used within the aerial lift system, and in this first embodiment six separate devices are shown, however these are shown as an example and the interface monitoring unit **100** may be used with one or all of these devices as well as with other devices, for example warnings or reminders to the operator to be sure to place wheel chocks or safety cones, etc. are contemplated within the scope of this disclosure. These types of reminders can be programmed into the device by safety coordinators and/or manufacturers in such a manner as to reinforce safety procedures and may be set to trigger based upon how many times the lift operator has activated the lift up motion, for example every five times the lift goes up, the operator is reminded to place or verify that cones and wheel chocks are positioned properly.
(55) The interface monitoring unit **100** for a fall protection system may be affixed to the aerial lift boom **150**, the work platform or basket **152** or an extension thereof, or may be strapped to the operator **154** with the use of headphones to deliver instructions and warning messages. Each safety detection device may be directly connected to the interface monitoring unit **100** through one or more data ports **124** of FIG. **2**, or alternatively as shown in FIG. **23**, a remote wireless transmitter **123** may be directly connected to the safety device and a data receiver **125** within the interface monitoring unit **100** may receive warnings and fault conditions remotely through an RF or wireless transmission.
(56) The power source **115** for the interface monitoring unit **100** may also be affixed to the aerial lift boom **150**, or affixed within or to the work platform or basket **152** or an extension thereof so that wires or conductors are not used to reduce the risk of electrical shock to the operator. In an embodiment of the present invention, the power source **115** may be a charging system **250** and battery **258**, with a hydraulic power AC/DC alternator/generator **252** with electrical/hydraulic regulation to charge the battery **258** and provide power for the interface monitoring unit **100**.
(57) The hydraulic powered AC/DC generating system **252** may be mounted at the boom tip or personnel platform of an aerial lift, crane or scissor lift, above the insulated portion of the boom if so equipped. The powered system **252** provides a continuous AC or DC power source at the personnel platform **152** in order to provide power for the interface monitoring unit **100** and/or for wireless controls, fiber optic controls, battery charging, work light, hydraulic or electrical actuators, two-way communications, telematics, and all other AC or DC power needs to operate, control, communicate, Increase productivity and protect the equipment and/or the operator. The present invention addresses this need and eliminates the requirement for battery removal and recharge as well as provides a permanent power source for controls and accessories. By providing power above the insulation, the invention meets power requirements at the platform **152** while continuing to maintain the insulating qualities of the aerial lift.
(58) In operation as shown in FIG. **18**, the AC/DC generating system **252** has a hydraulic motor **254** connected to hydraulic input and output lines that are tapped off of the hydraulic fluid lines that maneuver boom **150** and hold the work platform **152** in place. The fluid pump and other components of this hydraulic system are within the truck **168** or prime mover. Control valves within a hydraulic regulator **260** control the operation of the hydraulic motor **254**. The hydraulic motor **254** powers an AC generator **252** that is connected to an electrical regulator/rectifier **256** that converts the AC output to DC to charge a battery **258**. A terminal block **268** connected to the AC generator **252** (not shown) or battery **258** provides electrical connections to power the interface monitoring unit **100** or other power systems within the work platform **152** providing both AC and DC power where necessary to accommodate power requirements.
(59) By tapping off of the existing truck hydraulic system, the charging system and battery remain

isolated from any external electrical systems within the truck or boom controller, preventing the risk of electrical shock for the operator **154** within the basket **152**. The hydraulic powered AC/DC generating system **252** may be scaled to provide adequate power requirements within a range of 2-1000 watts depending upon the power needs of the interface monitoring unit **100** and other powered components within the basket **152**.

(60) The interface monitoring unit **100** monitors and records status and fault conditions from one or more safety devices. The status monitoring may be constant for certain safety equipment such as; a high voltage proximity warning device, or wind speed detector or intermittent for other safety devices where a no fault condition is detected and then periodically checked for status changes. The poling time interval may be determined by the specific safety equipment. In addition to status checks the interface monitoring unit **100** receives all output data from a directly or remotely connected safety device and immediately translates the condition to a visual or audible warning, an alert, and/or an instruction to properly inform the operator **154** of the fault and the proper safety procedure for fault recovery.

(61) As shown in FIG. **19**, the interface monitoring unit **100** may have one or more safety devices connected through its data ports **124** and any output from a device is captured and translated. In the example shown, the interface monitoring unit **100** detects the vehicle is parked properly on a shallow enough gradient so no warning **180** is issued by the outrigger stability sensor **116**. The door latch to the basket **152** is properly secured so no warning **182** is issued by the safety door interlock **112**. The weight of the work platform or basket is within tolerance limits so no warning **184** is issued by the aerial lift overload sensor. However, attachment of the safety lanyard is not detected and a warning **37** is received by the interface monitoring unit **100**. The interface monitoring unit **100** receives the warning and evaluates the fault condition within the message translator **188** or the alarm translator **190**. In this example the interface monitoring unit **100** verbalizes a reminder to the operator that the safety lanyard **156** is not attached **192**. The warning will be repeated until attachment of the safety lanyard **156** is detected. The date, time, operator name, job information, vehicle or lift device and fault condition are transmitted by the interface monitoring unit **100** to the data server **194**. After the warning is repeated a timer measures the delay of attachment of the safety lanyard **156** and sends a fault infraction message to the data server at intervals of approximately every ten (10) seconds until an attachment of the safety lanyard is detected. The attachment of the safety lanyard **156** is also logged to provide for analysis of the lift operator's adherence to safety protocols and procedures as described above.

(62) Operator name, vehicle or lift device job information and other telematics information may be determined from data input by the operator or from the specific vehicle, or specific lift device and/or from log information on the data server. In a further preferred embodiment, the lanyard connection detector **110** includes an iButton auto-identification device such as that made by Dallas Semiconductor Corporation of Dallas, Texas. These devices and other comparable devices are essentially semiconductor memories which are accessed using two electrical connections: (1) power/data and (2) ground. These programmable memory devices are roughly the size of a conventional lithium battery and may be sewn within the safety lanyard and stored with the operator's name, training level and other information regarding which operator used which aerial lift at what time. The iButton further includes status memory that may function as a current sensor and be used to determine how many times the aerial lift boom operator failed to attach or removed his/her safety lanyard prior to and during operation of the aerial lift work platform. This with the data logging features of the interface monitoring unit **100** can be useful in safety monitoring and compliance control by government agencies such as OSHA as well as providing indications to safety management as to which aerial lift operators require additional safety training.

(63) When a safety warning is received the interface monitoring unit **100** determines an appropriate verbal, audible or visual alarm warning for conditions that require immediate attention and reaction or a verbal message is issued to reinforce a safety procedure or reiterate an earlier announced

warning. As shown in FIG. **20**, a specific warning may be verbalized to instruct the operator in the proper procedure. For example, a fault condition from a weight overload sensor may verbalize “Weight Limit Exceeded!” “Lift Unstable!” “Descend Immediately!” **202** or if the door latch is not detected verbalize “Halt Movement!” “Secure Door!” **200** or other reinforcing instructions to the operator to affect an immediate response and prevent the operator from continuing in an unstable condition.

(64) The interface monitoring unit **100** may also upon powering up, communicate with one or more telematics systems **121** to transmit the GPS coordinate location, vehicle, operator and job information to the data server **194** and send test signals **204** to each safety device to confirm proper operation. The unit may further receive diagnostic information from the boom **117** and verbalize error information **198** reducing a common cause of failure and injury; or may instruct the operator to “Move the Vehicle!” **196** because an unstable slope in the parking of the vehicle is detected from the outrigger stability device. A further benefit from the unit is the display and/or recitation of a checklist **206** of preferred safety procedures. For example, simple instructional steps **208-216** may be expressed and upon completion of each step the operator may acknowledge the completion by selecting or entering an affirmative response **218**. If an affirmative response is received and a proper condition from the safety device is detected, the warning will stop **220**. If the proper condition is not detected **222** the warning will repeat **224** and the infraction will be logged by the interface monitoring unit **100** and be transmitted to the data server **194**. Each repeated warning and delay in curing the fault condition will be logged and sent to the server to provide tangible records of an operator's failure to respond to a safety requirement. In addition to the logging of infractions, the detection of sensors may also be logged with additional status and telematics information to provide for a forensic analysis of adherence of the lift operator to safety standards, and/or to assist in understanding any failures or infractions that led up to and may have contributed to an accident.

(65) The verbal commands and detection of fault conditions with data logging of infractions allows a clear picture of an operator's adherence to safety procedures in the field where they may not normally be supervised. A data log for an operator may be sent to an internal data server **102** as shown in FIG. **21**. The data server comprising a computer **226**, software **228** and databases **230** such as information logging databases that may allow each individual record **232** including safety adherence, safety infractions, telematics, diagnostic and other data of an operator to be compiled into individual reports **234**, or be combined with other operator reports **236** into companywide statistical reports **238** for quality review and training. In a compiled report **238** issues over a period of time may be highlighted, providing an opportunity for training on specific faults, thereby reinforcing proper procedures and keeping the operator alert and respectful of the dangers that are inherent in this type of machinery operation. Data logging as well provides a company with statistical information to support the success or failures of their approaches to safety training, and demonstrates to government organizations like OSHA the tangible commitment of a company to reduce accidents and injuries in the use of their industrial equipment.

(66) The interface monitoring unit **100** and logging of infractions also provides for distribution of a serious issue or fault condition using email, text messaging to a PDA, iPod, tablet or other device to alert other operators of the condition or to provide direct calls to emergency personal in the case of accident or injury. Alternatively, the data server **102** may distribute logged data information to superiors, training personal and operators to address issues as efficiently as possible.

(67) In a further embodiment as shown in FIG. **22**, the interface monitoring unit **100** may be integrated with the power and motion controls **104** of the boom motor using boom position encoders **117** or other devices so that in the event of a serious fault condition movement of the boom may be stopped or controlled to immediately move the aerial lift work platform downwards or otherwise away from the danger zone. For example, if a fault condition from a proximity warning device **240** signals high voltage wires within a vicinity of the work area the interface monitoring unit **100** may issue a verbal warning “Warning High Voltage!” and stop the boom motor

control **104** from ascending. In a further embodiment, position encoders **117** could detect the height of the boom end above a specific distance such as a height above the standard range of 18 feet to 26 feet for telecom and cable wires where power wires are mounted at a distance of 48″ above this standard height. For example, the height of the boom could be monitored and if the height including the height of the operator exceeded a preset minimum height of a safe working distance, a warning such as “Look out for Power Wires Above” could sound. These position encoders **117** may be used on articulated, telescopic, scissor or articulated/telescopic aerial lifts and platforms.
(68) In a further example, a fault condition from a wind speed indicator may be translated by the interface monitoring unit **100** as “Excessive Wind Speed!” “Descend Immediately” and the boom may be controlled to carefully descend away from the imminent danger. Appropriate alarms from the interface monitoring unit would also signal in either case.
(69) In instances where it is desirable to maintain a high degree of isolation of the operator **154** and the work platform **152** from electrical systems external to the platform for example in power line maintenance machinery, a direct wiring of safety devices may pose an electrical shock risk to the operator **154**. The 1/0 device **126** for attachment of safety devices to the interface monitoring unit **100** may be replaced with RF range or wireless range remote transmitters **123** as shown in FIG. **23**. A remote transmitter would be affixed to the output of each of the safety devices and any output signal from the device would be transmitted and received by data input receiver **125** on the interface monitoring unit **100**. After initialization by the interface monitoring unit **100** with a test signal to a safety device, device drivers through the communication protocol circuit would be downloaded and communication with the device through the remote transmitter would be initiated. The removal of wire connections to the devices allows devices to be positioned farther away from the operator, but still have warnings directed at the operator from the interface monitoring unit **100**, an important feature in a noisy industrial environment. A wireless remote connection also allows the interface monitoring unit **100** to be used in electrically sensitive areas where a spark or shock could cause damage.
(70) The approach given in these embodiments have the advantage of providing additional safety support for the operator in the event of a potential fall, or external hazard to the aerial lift work platform. Further by utilization of the auto-identification semiconductor device or other systems, and data logging it is possible to determine problem areas in training and address specific concerns to improve the overall adherence in the use of safety equipment and procedures. This is a highly desirable result given that most aerial lift operators are unsupervised in the field and as such there is very little positive monitoring which can be performed once the aerial lift operator is on the job and using the aerial lift.
(71) Accordingly, a system and method for providing an interface monitoring unit for safety and fall arresting equipment is presented. Significantly, this system takes a positive approach to preventing injury to aerial lift boom operators and the like with respect to injuries caused by falls and similar accidents. It should be realized that the present invention may be incorporated into a more widespread aerial lift safety threat management system for incorporating specific verbal, audible and/or visual alarms that permit safety feedback information to be given to the operator. The interface monitoring unit specifically configured to integrate with both new and existing safety equipment to promote wide spread adoption of the device to assist in the prevention of injuries in the use of aerial lift work platforms. In these circumstances, the aerial lift operator can be informed of corrective safety measures should he/she attempt to operate the aerial lift work platform without proper safety measures in place.
(72) Modifications and substitutions by one of ordinary skill in the art are considered to be within the scope of the present invention which is not to be limited except by the claims which follow.

Claims

1. A method of integrating a safety protection system into an aerial lift apparatus comprising the steps of: providing a work platform for supporting and moving a person to a work location; attaching a monitoring system to the work platform for receiving and transmitting data; locating a plurality of detectors on the work platform to communicate with the monitoring system; providing a server for at least one of receiving, storing and transmitting data and commands and communicating with the monitoring system; receiving a first operational condition from a first of the plurality of detectors indicating activation of a switch of the work platform; receiving a fault condition from a second of the plurality of detectors indicating detachment of a lanyard; issuing a warning from the monitoring system; repeating the warning until receiving a second operational condition from the second of the plurality of detectors indicating attachment of the lanyard indicating the fault condition is cured; logging the first operational condition with a first date and time, the fault condition from the second of the plurality of detectors with a second date and time, and a fault message at intervals after the warning is issued until the fault condition is cured, and the second operational condition from the second of the plurality of detectors to the server provided for at least one of receiving, storing and transmitting data and commands and communicating with the monitoring system; and organizing the transmitted data from the monitoring system to the server with at least one database according to predetermined categories.
2. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 1 further comprising the steps of transmitting a signal to halt movement of the work platform; and transmitting the signal to the server for recording in a predetermined category in the database.
3. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 2 further comprising the steps of: associating data or metadata of said first date and time and said second date and time with the signal to halt movement of the work platform by the monitoring system; and transmitting said data to the server for recording in the predetermined category in the database.
4. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 1, wherein the monitoring system is in wireless communication with the server.
5. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 1 further comprising the step of: storing within a memory storage device of the monitoring system at least one of a message library and an alarm signal library containing respective message and alarm data.
6. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 1, wherein the monitoring system is in wireless communication with at least one of the plurality of detectors.
7. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 1, wherein the monitoring system is powered from an independent power source using a hydraulic motor with the work platform to electrically insulate the work platform to prevent risk of electrical shock to an operator of the aerial lift apparatus.
8. The method of integrating the safety protection system into the aerial lift apparatus as set forth in claim 1 further comprising the step of: providing, via the monitoring system, active controls for an operator to receive and access one of at least diagnostic, training, and safety procedural data.
9. A method comprising the steps of: receiving, by a monitoring system in communication with a plurality of detectors attached to a work platform, a first operational condition from a first detector of the plurality of detectors, the first operational condition indicating movement of the work platform; receiving, by the monitoring system, a fault condition from a second detector of the plurality of detectors, the fault condition indicating detachment of a lanyard; issuing, from the monitoring system, a warning; repeating, by the monitoring system, the warning; receiving, by the monitoring system, a second operational condition from the second detector, the second operational

condition indicating the fault condition is cured; in response to receiving the second operational condition, ceasing issuance of the warning; and logging, by the monitoring system at a server in communication with the monitoring system, the first operational condition and the fault condition in association with a date and time, and a fault infraction message at intervals after the warning is issued until the fault condition is cured, and the second operational condition.

10. The method as set forth in claim 9, further comprising the steps of: transmitting, to the server for recording in a predetermined category in a database, a signal to halt movement of the work platform.

11. The method as set forth in claim 10 further comprising the step of: transmitting date and time data or metadata to the server for recording in the appropriate predetermined category in the database.

12. The method as set forth in claim 9, wherein the monitoring system is in wireless communication with the server.

13. The method as set forth in claim 9 further comprising the step of: storing within a memory storage device of the monitoring system at least one of a message library and an alarm signal library containing respective message and alarm data.

14. The method as set forth in claim 9, wherein the monitoring system is in wireless communication with at least one of the plurality of detectors.

15. The method as set forth in claim 9, wherein the monitoring system is powered from an independent power source using a hydraulic motor with the work platform to electrically insulate the work platform to prevent risk of electrical shock.

16. The method as set forth in claim 9 further comprising the step of: providing, via the monitoring system, active controls for an operator to receive and access one of at least diagnostic, training, and safety procedural data.

17. The method as set forth in claim 9, wherein the first operational condition indicating movement of the work platform comprises and indication of activation of a switch of the work platform.
