

TRAINING DEVICE**Technical Field**

This invention relates to training devices and, more particularly, to lift training simulators.

5 Background Art

In the lift industry, it is important to always try to increase the technical competence of the service force. A major problem, however, is that in order to conduct on-the-job training, it is often necessary to "borrow" a lift car from a customer and thereby cause him inconvenience due to service degradation.

To alleviate the problem, a lift training device for simulating a certain relay-based lift system with logic and software which interfaces with corresponding pushbuttons
15 simulative of actual hall landing pushbuttons and lanterns, a simulated in-car passenger operating panel, and other simulated indicators is disclosed in European Patent Application No. 89 303 545.1. The lift training device provides a microprocessor-based simulator of a relay-based
20 lift system in a portable case which may be carried home by a student in conjunction with a home study program sponsored by his employer. Such a microprocessor-based simulator provides the opportunity for student inputs in the nature of hall calls, car calls, inspection modes and various other conditions simulative of conditions in a
25 relay-based lift system. In response to the student's inputs, the simulator provides outputs which the student is required to interpret in order to successfully "trouble-shoot" a simulated "problem" which may be entered by an
30 instructor or by the student himself selecting switch settings in accordance with instructions in a training manual.

Development of such a simulator, of a relay-based lift system, involves a degree of engineering and programming
35 which is of relatively manageable proportions. When faced

with the task of producing a similar simulator of a microprocessor-based lift system on the other hand, using the same approach, the engineering and programming requirements become so substantial that the costs become prohibitive. The reason for this is that such modern controls have such a high degree of complexity and increased functional capability over the prior art relay-based systems that to write a simple, software-based simulation thereof would require an investment comparable to that made for the actual control itself.

One way to solve the problem would be to construct a full-scale microprocessor-based lift system in a training facility. Or, to reduce costs associated with a full-scale hoistway, one could equip the training facility with a simulated miniature hoistway with miniature sensors for sensing the movement of a miniature car and counterweight driven by a small motor and gearbox. The simulated hoistway could be interfaced by means of simulated signals with an actual, full-scale, microprocessor-based lift controller. The students would then be enabled, under the guidance of an instructor, to troubleshoot faults introduced by him. The students, however, would all have to come to the same training facility.

A similar simulator could be made to train servicemen on a full-scale microprocessor-based lift controller mounted on wheels. Such would be portable between training facilities. It is, of course, quite expensive to produce any significant number of full-scale simulators, as above described, mounted on wheels for use in various training facilities throughout a country or region. Although such a full-scale training simulator would provide the opportunity for the instructor to hook up an actual software service tool to the actual lift controller for demonstration purposes, such a tool would ordinarily be used only in his hands and would not be generally accessible to all the students who might merely watch the instructor's actions and each might not follow completely

the materials presented, due to the pace of instruction conceivably being too fast for some. Moreover, it would be quite burdensome to assemble the simulator at each site and to transport it, due to its weight and bulk. Nonetheless, this type of simulator would be particularly effective because it would enable the instructor to push actual pushbuttons and demonstrate actual lift movement and sensing with the resulting control actions with tell-tale displays, all before the eyes of the students.

Or, training instructors could use an actual microprocessor-based lift controller, the heart of which is typically mounted on a printed circuit board, to attempt to teach how to use a service tool without anything more than the printed circuit board itself powered by a stepped down AC voltage from a wall outlet. In such a case, the instructor could focus a video camera onto a service tool connected to the PC board and have a large video display presented to the class of student servicemen for demonstrating the various modes of accessing the software stored on the printed circuit board. Although the various input/output signals ordinarily used by an installed system in real time to interface with such a circuit board would not be present, this method would still be useful in showing the accessing of various memory locations. It would lack, however, the functional capabilities as well as the kind of "hands-on" feeling that would be offered by a full-scale simulator, such as previously described, but at substantial cost.

To carry the foregoing one step further, a special power supply could be designed to be capable of powering numerous such printed circuit boards in order to teach several students at once how to use a service tool with each having a service tool in his hands so that he could enjoy the actual "hands-on" feeling, although the combination still would not have the capability of demonstrating sensing, resulting control actions, and tell-tale displays before the eyes of the students.

Disclosure of Invention

The object of the present invention is to provide a portable training device simulative of a microprocessor-based lift system.

5 According to the present invention, a lift training device is provided by utilizing a portion of an actual microprocessor-based lift controller in conjunction with a plurality of actuatable input devices for providing input signals to a simulator comprising software, logic, or both,
10 simulative of operative lift signaling devices, for providing simulated signals to a microprocessor-based lift control which in turn provides signals back to the simulator and enable the simulator to provide a plurality of output signals to a corresponding plurality of output
15 devices for manifesting lift conditions, including a plurality of electrical terminal blocks simulative of actual terminal blocks in a microprocessor-based lift controller wherein a volt meter or volt-ohm meter may be used to check actual voltages, resistances, or both.

20 In further accord with the present invention, the microprocessor-based lift controller may comprise a printed circuit board for an actual controller having a microprocessor and memory mounted thereon.

25 In still further accord with the present invention, the microprocessor-based lift controller, e.g., a microprocessor on a printed circuit board, the simulator software or logic, or both, and input/output devices may be packaged in a case which provides portability.

30 In accordance still further with the present invention, the microprocessor-based lift controller may be of the type that contains software which may ordinarily be accessed by a special service tool which is used as an aid in making various changes to the lift system (in the software) and for diagnosing various problems which may
35 arise in a lift system. In such a case, the tool may be plugged into the controller and the student may thus be trained to use the tool on the simulator.

In still further accord with the present invention, the simulator may include means for selecting simulated faults in order to provide means for training in fault finding techniques. The means for selecting faults may be provided in a manner that is invisible to the student for use only by the instructor or may be provided for use by the student in connection with self-study materials. Or, both techniques may be used. The simulator software or logic, simulative of lift controls and hoistway signaling devices, may be designed to decode the selected fault and provide a signal manifestation simulative of the effect of the selected fault on a real system.

In further accord with the present invention, the input/output devices may comprise, alone or in combination, a plurality of actuatable (or "actuable") up-down pushbuttons simulative of hall call buttons, a plurality of car call buttons simulative of an in-car operating panel, a floor indicating device indicative of which floor the car is at, a speech module for annunciating messages, a control panel which may include various switches and indicators simulative of various lift conditions and a display which may simulate lift and car door position and motion.

By utilizing an actual microprocessor-based lift controller in conjunction with logic simulative of hoistway signaling devices and a human interface in the form of I/O devices, including terminal blocks carrying voltages simulative of voltages that would appear on actual terminal blocks in an actual controller cabinet, the task of producing a simulator for a microprocessor-based lift system is reduced to manageable proportions, while still providing a very real simulation. Further, by incorporating an actual lift microprocessor controller (without cabinet, wiring, etc.), simulator logic and I/O devices in a portable case, a student can actually be loaned the case to take home and study at his own convenience. This takes away the need to spend large

amounts of time in the classroom with other students and an instructor and allows the student to go at his own pace, at his convenience, using instructional materials provided by the employer. Whenever such complex lift systems are
5 installed, it is usually difficult to obtain access from a busy building without interrupting the level of service provided to the occupants. Thus, the present invention helps to avoid much of the on-the-job training which would otherwise be required for accessing and troubleshooting
10 today's modern microprocessor-based lift systems.

Great flexibility is provided by the disclosed combination of simulated fault conditions with student I/O devices or even an actual service tool (which may be plugged into the simulator) in simulating typically
15 encountered faults. The provision of terminal blocks is particularly useful in aiding the student in learning troubleshooting techniques relating to the interface between the "controller" and the "wiring" external thereto.

Thus, the present invention provides the lift industry
20 with a tremendous training advantage over prior practices and will result in an increased level of sophistication in the service force as well as reduced cost in training and interruption of service.

These and other objects, features and advantages of
25 the present invention will become more apparent in light of the following detailed description of an embodiment thereof, given by way of example only, as illustrated in the accompanying drawings.

Brief Description of the Drawings

30 Fig. 1 is a schematic illustration of a lift simulator, according to the present invention.

Fig. 2 is an illustration of a prior art lift system which may be simulated by the device of Fig. 1;

35 Fig. 3 is an illustration of a training device according to the present invention; and

Figs. 4-8 are detailed illustrations of portions of Fig. 3.

Fig. 1 illustrates a training device 10, according to the teachings of the present invention, wherein an actual microprocessor-based lift control 12 provides control signals on a line 14 to a simulator 16 in response to a plurality of simulated signals on a line 18 from the simulator 16 which in turn are initiated by one or more of a plurality of signals on a line 20 from a plurality of input devices 22 for actuation by an individual student who will typically be studying how to troubleshoot a lift system using the training device 10 in conjunction with textual materials provided to him by his employer. The control signals on line 14 will typically cause the simulator to provide a number of output signals on a line 24 to one or more output devices 26 for observation by the individual student or to other output devices, such as a speech module 28 for simulating the announcement of various lift conditions to in-car "passengers" or a plurality of electrical terminal blocks 30 which will carry voltages which simulate voltages on actual terminal blocks within an actual lift controller. In an actual lift controller, terminal blocks each have a plurality of studs, each of which is typically used as an interconnecting point between internal controller wiring and wiring external thereto. The provision of terminal blocks with simulated voltages on the studs thereof, according to an important teaching of the present invention, provides the student with a unique opportunity to learn an important part of how to use a lift wiring diagram, particularly at the controller-hoistway interface. The individual student may utilize a volt meter or a volt-ohm meter (VOM) to test the voltages or resistances of various points on the terminal blocks.

A test tool 32, which may be a hand-held tool, may be provided to the individual student in order that he may

hook up the tool 32 by means of a cable 34 to the lift control 12 in order to access resident software thereon. In this way, the individual student's employer may train him on how to troubleshoot the system by means of the software used to control the system.

Fig. 2 is an illustration of an example of a prior art lift system manufactured, for example, by the Applicant lift company wherein a microprocessor-based lift controller 36 receives demand signals on a line 38 from intending passengers in cars or hallways by means of pushbuttons (not shown) interfacing with various remote stations 40 located in the lift cars and mounted in the hallways adjacent to hoistway doors. In response to the demand signals on line 38, the controller 36 provides command signals on lines 42, 44 to relay logic 46 and to a variable frequency control unit (VFCU) 48. In response thereto, the relay logic unit 46 provides various signals on line 50 to the VFCU, and the VFCU 48 provides power on a line 52 to a lift hoist motor 54 which is coupled by means of a coupling 56 to a tachometer 58 that provides a speed feedback signal on a line 60 to the VFCU 48. Current feedback may be provided as well on a line 62 to the VFCU 48. AC power is provided on a line 64 to the VFCU 48 from a utility or an emergency power source for conversion to DC, typically prior to conversion to VFAC.

A position transducer device (PTD) 66 provides leveling and door zone relay signals on a line 68 to relay logic 46, and inductor signals on a line 70 to the controller 36 for indicating passage of the car past a floor. The relay logic 46 is also in communication with the remote stations 40 by means of the serial communication link 38, previously discussed.

Thus, the broad features of a prior art microprocessor-based lift system have been shown and are of the general type that needs to be serviced by competent servicemen and which the training device 10 of Fig. 1 is designed to simulate in order to enable the effective

training of such persons on an individual basis, for example, with actual training materials provided by the employer so that the individual student can work at his own pace, at home or in an office, rather than on-site. Although a VF system has been shown with particular hardware configurations, the invention is not restricted to training devices simulative of merely VF systems, but is broadly applicable to any microprocessor-based system.

Fig. 3 illustrates a training device 10a which embodies all of the concepts previously disclosed in connection with Fig. 1, except that the test tool 32 is not shown in Fig. 3. We have used similar numerals in Fig. 3 to those used in Fig. 1 for similar components, except for using the appended suffix "a". A microprocessor-based lift control 12a is shown mounted within the top half of a portable case and comprises a limited car board (LCB) of the Applicants having Part No. A9693A. The LCB 12a is one of a plurality of circuit boards which are inserted in a card cage in a controller, such as the controller 36 of Fig. 2 which may be an Otis Lift Company MRQ lift or SPEC 60 lift system controller. Such boards may include counter board (CUB), a speed check and input/output board (SC I/O), and a ring car board (RCB). Be that as it may, such details are not particularly important for understanding the present invention which utilizes a microprocessor-based lift control, such as the LCB, but which may cover any such "brains" of a lift system made by any manufacturer and which in general will provide control signals on a line 14 in response to real or simulated signals provided on a line 18, and which may or may not be capable of communicating with a test tool, such as tool 32, as shown in Fig. 1.

Referring back to Fig. 3, a plurality of 110 V AC output signals on a plurality of lines 14a are provided to a simulator 16a (not shown) under a faceplate 80. The simulator 16a, in response to the control signals on line 14a, among other signals to be described below, provides

110 VAC input signals on a line 18a and 30 VDC input signals on a line 18b to the LCB 12a.

5 The simulator 16a may be comprised of software embodied in hardware, i.e., stored in read-only-memory (ROM) to be used in conjunction with a general purpose microprocessor or may be comprised entirely of discrete logic or may be any combination of the foregoing. That is a design choice left up to the particular manufacturer who seeks to train his employees in the troubleshooting of its equipment.

10 Various input devices 22a, 22b, 22c, 22d, 22e, 22f, 22g, 22h, 22i, 22j, 22k, among others, are provided for actuation by the individual student in order to provide signals on lines (not shown) 20a, to the simulator 16a, in order to begin a training sequence, for example. Referring to Fig. 4, a number of pushbuttons, including a down pushbutton 22a for simulating an intending passenger at the sixth "floor" is provided, along with a number of other up-down pushbuttons 22b, 22c, 22d, 22e for simulating intending passengers at "floors" 5, 4, 3, and 2, respectively. An up pushbutton 22f is provided for actuation by the individual student in order to simulate an intending passenger at the first floor or lobby. In response to the actuation of one of these pushbuttons in Fig. 4, an associated remote station 40a (not shown) will provide an appropriate signal on a serial link 38a to the control 12a, which will in turn provide an appropriate command signal to the "relay logic" 46 and the "VFCU" 48 as simulated by the simulator 16a which will in turn provide a simulated lift car motion by providing output signals on a line 24a (not shown) to a plurality of lamps or LEDs 82 shown in Fig. 4 arranged in a vertical column. These may be illuminated in a moving group of several lamps or LEDs which will simulate a moving car up and down a hoistway. Car door opening may be simulated by a corresponding plurality of horizontal lamps or LEDs arranged to intersect the vertical column at each "floor". These lamps or LEDs

for simulating car motion to the student should be understood to form part of the output devices 26 shown in Fig. 1, according to the present invention.

Referring now to Fig. 5, additional output devices are shown. These include a representation 84 of a speed check and input/output board (SC I/O) 84, which includes a plurality of signal lines, each of which is represented by an LED and an identifying alphanumeric which may correspond to a jack and pin or simply a signal mnemonic. As previously explained, the SC I/O board interfaces with both the LCB and the VFCU in an Otis system, such as is shown in Fig. 2. The identity of the signals identified by jack and pin numbers on the SC I/O representation 84 are further identified by signal mnemonics interfacing with the LCB representation 86 and the VFCU board representation shown in Fig. 5. Thus, the simulator 16a will provide an appropriate signal for illuminating one or more of the LEDs within the representation 84 corresponding to the energization of a corresponding signal in a real system, such as the prior art system of Fig. 2 at the appropriate time in order to simulate, for the individual student, the actual signals that would be encountered in a real installation. Thus, the student will observe, for example, one or another of an encoded speed command (SPO,SP1) being illuminated to simulate a mode command signal being sent from the LCB 86 to the SC I/O "board" 84.

Similarly, referring to Fig. 6, various signals which may exist on lines 42, 50 as shown in the prior art system of Fig. 2 may be illuminated one or several at a time to indicate the activation of the respective signals whose mnemonics appear above associated LEDs in Fig. 6.

In order to provide input devices 22 of Fig. 1 suitable for simulating an intending passenger within a lift car, a simulated car operating panel 22j is provided as shown in detail in Fig. 7. There, various floor pushbuttons 1-6 allow the individual student to simulate the selection of a floor where an in-car "passenger" wishes

to "go". Also provided are various other switches and test points which of course may vary, depending on the lift manufacturer and application.

5 Referring now to Fig. 8, a number of selectable fault conditions 22k are provided which may be used by the individual student to simulate various faults according to instructions provided in his training materials. A display device 90 may show the floor at which the "car" is presently located, as would a car operating panel, for
10 example.

Although the invention has been shown and described with respect to a preferred embodiment thereof, it should be understood by those skilled in the art that the foregoing and various other changes, omissions, and
15 additions in the form and detail thereof may be made therein without departing from the scope of the invention.

CLAIMS



1. A training device simulative of a lift system for use by a student, comprising:

5 a plurality of input devices for actuation by said student for providing a corresponding plurality of input signals;

a simulator, responsive to said input signals for providing a plurality of condition signals indicative of a corresponding plurality of simulated lift conditions;

10 a microprocessor-based lift control, responsive to said condition signals, for providing a plurality of command signals wherein said simulator is responsive to said command signals for providing a plurality of output signals; and

15 a plurality of output devices, responsive to said output signals, for manifesting said conditions by providing information for said student, wherein said output devices include a plurality of electrical terminal blocks responsive to selected condition signals for providing
20 output signals simulative of actual voltages in said lift system.

2. A training device substantially as hereinbefore described with reference to the accompanying drawings.