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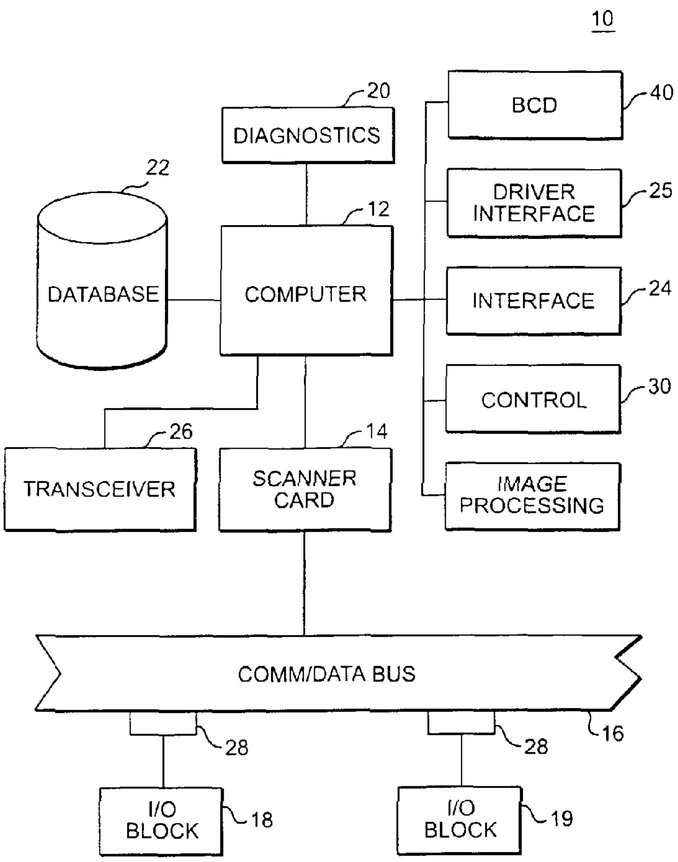
(54) Title: BUS DIAGNOSTIC AND CONTROL SYSTEM AND METHOD



(57) Abstract: A system and method allow for remote control of a bus or other vehicle and for collection of bus operating and diagnostic data collected from a bus onboard data collection and control system. The system allows for wireless communication between the bus and a local bus oeprating center. The bus operating center may inlcude an Internet web side and an Internet server that receives the data from the bus. The data may be aggregated for several buses, or may be retained on an individual bus basis. The system and method provides for non-intrusive diagnosis of teh bus or other vehicl. The system includes an onboard computer that contains vehicle operating and diganosis programs. The computer may be interfaced locally at the bus, or remotely from another location. Parameter values of bus components may be displayed using human to machine interfaces. The interfaces may include virtual objects that represent actual bus components or that are used to display component parameters in a readily readable fashion.

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Bus Diagnostic and Control System and Method

Related Applications

This application claims the benefit of U.S. Provisional Application Serial No. 60/225736, filed August 17, 2000.

Technical Field

The technical field relates to systems and methods used to monitor the status and control the operation of a motor vehicle.

Background

Most engine-powered vehicles use monitoring devices to detect the presence of various undesirable operating conditions, such as engine over heating, low oil pressure, and low fuel, and include indicators to warn the operator of such conditions. Not all of the various monitored parameters have the same importance. For example, an engine air filter or a hydraulic fluid filter may gradually clog during operation of the vehicle. The vehicle operator should be warned of such clogging, but generally there is no need to immediately remedy the situation, and the vehicle can be operated until for some time before servicing and maintenance. A low fuel condition requires more immediate attention from the operator. A loss of engine oil pressure or a loss of hydraulic fluid represent conditions which require immediate operator attention to prevent damaging the vehicle.

Current monitoring systems detect the undesirable conditions and signal the vehicle operator by means of dial indicators, indicator lamps, or audible means. The efficiency of these systems depends upon the operator's careful attention to all of the various indicators and upon his judgement as to which may call for immediate correction. As the complexity of a vehicle increases, the number of monitored parameters generally increases. Therefore, the operator is required to direct more attention to the increasing number of indicators, and less attention to operating the vehicle.

When considering single vehicles, current on-board monitoring systems, and current diagnostic systems, focus on the parameters and test measurements of a single vehicle. No system exists to allow monitoring of a fleet of vehicles from a single remote location. Further, current systems do not allow trend analysis of a fleet of vehicles by aggregating trouble reports or similar data, and do not provide real-time or near-real-time assistance to local operators and repair technicians.

Current on-board monitoring systems also do not allow for real-time monitoring of on-board parameters at one or more remote locations and do not allow for remote vehicle control. For example, current monitoring systems do not provide a remote location with the ability to shut off an operating vehicle's engine.

Another drawback of current on-board monitoring systems is the need to perform partial or complete disassembly of components or systems to determine the nature and extent of an abnormal condition. This disassembly may be costly in terms of time and replacement parts, and may cause further damage to the vehicle.

Summary

A vehicle electrical and diagnostic system includes a communications bus installed in the vehicle. Input/output (I/O) blocks are coupled to the communications bus. Also coupled to the bus is an industrial computer. The computer drives the vehicle's operating program. The computer also acts as an interface between the vehicle's systems and a human technician. The I/O blocks receive data from sensors installed in various locations within the vehicle and provide the data to the computer using the communications bus.

The computer may be used locally or remotely to diagnose the vehicle's components. The operating program on the vehicle may also be used to remotely control the vehicle. In an embodiment, one or more buses are coupled, using a wireless communications network to a hub or local bus operating center. Such a center may be part of a metropolitan transit authority, for example. As many as 256 or more such buses may be associated with each hub, and the transit authority may use many hubs for its fleet of transit buses. The buses use the wireless communications network to pass operating and diagnostic data in a real-time, near real-time and delayed manner. The transmitted data may be collected and stored at an Internet web site that may be associated with the hub. The data may then be accessed by a central support system that also accesses the Internet web site. The accessed data may be used to help make management, design and engineering decisions regarding the buses. For example, the central support system can collect engine trend analysis data that may indicate premature wear of engine piston rings. Using this data, the central support system can allocate more spare piston rings to its supply center, and may review engine design to improve wear characteristics.

The hub or the central support center may also use received operating data to monitor operation of one or more buses. The hub or the central support system may issue control signals to control operation of one or more bus components or systems. For example, the central support system may send control signals to open a switch in a bus engine control circuit to cause the bus engine to shutdown. Technicians at the central control system may access programming identical to that onboard the bus, and may, using a HMI, select a "switch" to open. This operation then sends the control signal through the Internet web site and to the bus onboard computer to cause the bus programming to initiate the switch open command.

The hub or central support center and the bus 100 may use a geo-satellite positioning system (GPS) to maintain an accurate track of location of the bus. Using bus location information, the hub may optimize bus routing, steering the bus around obstacles, and may allocate other bus resources based on real-time routing and bus location information provided by the GPS.

Description of the Drawings

The detailed description will refer to the following drawings wherein like numbers refer to like elements, and wherein:

Figure 1 is an overall block diagram of a diagnostic and control system that may be used with a bus or similar vehicle;

Figure 2 illustrates a node that may be used with the system of Figure 1;

Figure 3a is a block diagram of an environment that uses the system of Figure 1;

Figure 3b is a block diagram of a bus location device that may be used with the system of Figure 1;

Figure 3c illustrates an operation of the systems and components of Figures 1 - 3b;

Figure 4 is a block diagram of an alternative environment that uses the system of Figure 1;

Figure 5 is a block diagram of yet another environment that uses the system of Figure 1;

Figures 6a and 6b illustrate examples of interfaces used with the system of Figure 1;

Figure 7 is a block diagram of a software system operating on the system of Figure 1;

Figure 8 is a block diagram of programming modules used to construct interfaces and programming for use with the system of Figure 1;

Figures 9 - 30 illustrate graphical human to machine interfaces that may be used with the system of Figure 1;

Figure 31 illustrates a human to machine interface displaying a virtual display device; and

Figures 32a - 48 illustrate ladder programs used in the bus operating system of Figure 1.

Detailed Description

A vehicle diagnostic and control system provides for monitoring and maintenance of systems on a bus, and for controlling the operation of the bus systems. Figure 1 is an overall block diagram of a bus diagnostic and control system 10. The system 10 includes a computer 12, a scanner card 14 coupled to the computer 12, a data bus 16 coupled to the scanner card 14, and input/output nodes 18 coupled to the data bus 16. The computer 12 includes programming to monitor the status of and to control a bus. The programming may include a diagnostics program 20 and a control program 30. These programs will be described in more detail later. The system 10 may include a local database 22 that stores data related to the bus. The system 10 may also include a vehicle information center, or interface, 24 that may be used by a technician to directly access data in the database 22 and to access the computer 12. The system 10 may also include a driver interface 25 that may be used to present limited information to the bus driver. The system 10 may include image processing functions that interact with a bus-mounted television or video camera (see Figure 4).

The system 10 may be attached to other computers and may act as an interface to vehicle components or subsystems such as diesel engine, transmission and anti-lock brake subsystems. The system 10 integrates or centralizes diagnostics an controls of various vehicle subsystems. The system 10 may include a receiver/transmitter (transceiver) 26 that may be used to receive signals from a source external to the system 10 and to transmit information to the source. Finally, the system 10 may include a bus location device (BLD) 40 that, used in conjunction with a geo-satellite positioning system (GPS), generates precise bus location and kinematic motion information. The use of the BLD 40 and a GPS will be described in detail later.

In an embodiment, the system 10 is installed on, and is part of a bus, such as a commuter bus used for urban transportation. The system 10 gathers information about various bus systems, and either stores the information in the database 22, provides the information to a remote location, or processes the information according to programming provided with the computer 12. The results of the processing may be stored in the database 22, provided to the remote location, or displayed on the interface 24.

As noted above, the driver interface 25 may also provide information from the system 10 to the driver. The information may be provided in real time. Such information may include bus location information, such as that generated by a geo-satellite positioning system (GPS) that may be incorporated into the system 10. For example, the interface 25 may show a may of the area in the vicinity of the bus, including roads, bus routes, bus stops, and other information, and may show a current position of the bus by moving a representation of the bus over a bus route. The driver interface 25 may also incorporate a heads-up display feature that projects digital images of various bus parameters and other data so that the bus driver may view the data without distracting attention from driving.

The driver interface 25 may incorporate a speech recognition device to receive spoken commands from the bus driver. The spoken commands may be used to override remote control features of the bus, to request specific information relative to driving conditions, such as roadway conditions, weather conditions, traffic conditions, or other information needed by the bus driver for safe operation of the bus. Such information requests may be passed by the system 10 to a remote location, and the information may then be provided by radio control links, for example. The information may be displayed as text or graphical information on the driver interface 25. For example, a location of a traffic jam astride a bus route may be displayed by showing a map of the bus route with the location of the traffic jam superimposed. The bus driver may then use the information to avoid the traffic jam, to apprize passengers of potential delays, or to seek a way around the traffic jam.

While the system 10 is intended for use with a bus, the system 10 is not so limited. The system 10 may be adapted for use with any type of motor vehicle, including commercial trucks, and automobiles. The system 10 may also be adapted for use with other devices, including boats and ships, airplanes, and trains, for example.

The computer 12 may be an industrial computer, such as a 6181 Industrial Computer. The computer 12 is provided in an industrially hardened package to operate in the environment of a moving vehicle in all weather conditions.

The data bus 16 is an open communication network that connects devices such as photoelectric sensors, inductive proximity sensors, motor starters, drives, valve manifolds, and simple operator interfaces, or nodes having attached devices, together without the need for a separate I/O system. Devices may be removed and replaced from the network (the data bus 16) while the data bus 16 is under power without a separate programming tool. The data bus 16 may be a flat cable or a round cable capable of providing both power and communication to the nodes 18. The data bus 16 includes passive multiport taps 28, which may connect using a drop cable. The taps 28 may include 4 or 8 micro quick-disconnect ports in sealed versions to connect up to 8 physical devices or logical nodes.

The scanner card 14 allows the computer 12 to scan the data bus 16 in order to obtain status information related to various bus system components. The scanned information may then be stored in the database 22, and may be sent to an external location on a real-time or periodic basis, or when polled by the external location. For example, the database 22 may store the most recent hours worth of operating data for the bus, and the computer 12 may then provide all or part of the saved data to the external location. The data may be provided to the external location periodically, such as once per hour, or upon request for the stored data. Alternatively, the data may be sent to the external location at the time of its collection by the scanner card 14.

The transceiver 26 may incorporate a wireless communications device, such as a wireless modem, for example. The transceiver 26 may communicate over a wireless telephone network, such as a cellular telephone network, for example. The transceiver 26 may also be used to communicate with an Internet web site, and information related to the bus may subsequently be stored in a database accessible through the Internet web site.

Figure 2 illustrates an example of a node 18 used with the system 10 of Figure 1. The node 18 may include a semi-sealed housing that is capable of operating in close proximity to the sensor environment. The illustrated node 18 is a 10 amp 8X8 block that uses low voltage dc power and provides for 8 inputs and 8 outputs. Other configurations for the node 18 are also possible. The node 18 may be specifically designed for each application. That is, the node 18 may be adapted to a specific model or make of a bus, or other vehicle, or may be adapted for a specific use of a bus or other vehicle. Differences in specifications may include variations in input and output current and voltage, status light configurations, remote monitoring features, and number of attached devices, for example.

The system 10 may be used to transmit information to, and receive information from a location external to the bus in which the system 10 is installed. Figure 3a is a block diagram of an environment in which a bus 100, traveling over road 102, with the system 10 installed, communicates with a remote location 110. The remote location 110 may be affiliated with or be a part of a local transit authority, and the bus 100 may be one of a fleet of busses operated by the local transit authority. The remote location 110 may in turn communicate with a service center 120. The service center 120 could be affiliated with, or be part of a facility that manufactures buses such as the bus 100. As shown in Figure 3a, the system 10 installed on the bus 100 communicates with the remote location 110 using a wireless voice/data network 130. The network 130 may be a cellular telephone network, a satellite communications network, including communications satellite 132, or other wireless network. The method of communication may involve Internet Protocols (IP), or other protocols for transmitting voice and/or data. The network 130 may also allow for direct, wired connection between the system 10 and the remote location. In this alternative configuration, the bus 100 may be driven to the remote location 110 and the system 10 may be wired into a diagnostics computer at the remote location 110.

The remote location 110 communicates with the service center 120 using a communications network 140. The communications network 140 may be a landline network, such as a public switched telephone network (PSTN), for example. The communications network 140 may also be a wireless network, or any other network capable of communicating voice and/or data.

Also included in the environment shown in Figure 3a is a GPS that employs GPS satellite 114. Although one GPS satellite is shown, the GPS should be understood to use a standard number of such satellites, which is typically four satellites. The GPS is shown augmented with a GPS ground station 112 to provide centimeter location accuracy, and to derive bus attitude and position coordinates and bus kinematic tracking information. The GPS ground station 112 communicates with buses on designated roadways (e.g., the bus 100 traveling on a road 102) using a communications network (or radio control link) 115 for the purpose of receiving bus location and bus trajectory information and broadcasting control information to respective buses. The BLD 40, onboard the bus 100, may use the GPS integrated with bus video scanning, radar/lidar, and onboard speedometer and/or accelerometers to provide accurate bus location information. The bus location information may be combined with information concerning road conditions and other obstacles to ensure optimum bus routing.

As shown in Figure 3a, the GPS satellites 114 transmits GPS ranging signals 113 to the bus 100 on the road 102. The GPS ranging signals 113 are modulated with pseudo-random ranging codes that permit precise determination of the distance from individual GPS satellites 114 to the bus 100. The distance calculations are based on accurately measured time delays encountered by the GPS ranging signals 113 transmitted from individual GPS satellites 114 to the bus 100. GPS makes use of very accurate atomic clocks and precisely known earth orbits for individual GPS satellites 114 to make such precise position calculations. A multi-channel GPS receiver may be used in the bus 100 to simultaneously track and determine ranges from multiple GPS satellites 114 to enhance real-time location calculation times.

The accuracy and response time performance of the real-time GPS system (i.e., the BLD 40) may degrade as the GPS ranging signals 113 encounter ionospheric and atmospheric propagation delays while traveling from the GPS satellite 114 to the bus 100. These delays give rise to uncertainties in the exact position of the bus 100 when calculated using time-based triangulation methods. That is, because the propagation times from the GPS satellite 114 may vary depending on ionospheric and atmospheric conditions, the calculated range to individual GPS satellites 114 is only known within certain tolerance ranges. Clock uncertainties likewise give rise to errors. Consequently, some uncertainty exists in the position information derived using the GPS satellite ranging signals 113.

Differential GPS (DGPS) may be used to remove errors caused by uncertainties in propagation times in GPS ranging calculations. Differential GPS makes use of auxiliary ranging information from a stationary GPS receiver, the position of which is very precisely known. The use of differential GPS is illustrated in Figure 3a, in which the GPS ground station 112 represents the stationary GPS receiver. The GPS ground station 112 receives the GPS ranging signals 113 from the GPS satellite 114. The GPS ground station 112 is connected through control links to the remote location 110 where precise GPS ground station location information is computed and stored. Because the GPS ground station 112 is stationary, very accurate location information can be determined.

GPS receivers use two PRN codes, the C/A and P codes to determine unambiguous range to each satellite. These codes are transmitted with "chip" rates of 1.203 MHZ and 10.23 MHZ respectively, resulting in wavelengths of about 300 meters and 30 meters, respectively. Hence the location resolution using these codes alone may be insufficient for a real-time bus tracking. GPS satellites transmit on two frequencies, L1 (1575.42 MHZ) and L2 (1227.6 MHZ). The corresponding carrier wavelengths are 19 and 24 centimeters. In known techniques of range measurement, the phase of these signals is detected, permitting range measurements with centimeter accuracy. Various techniques are known to resolve these ambiguities in real time for kinematic positioning calculations. Using known methods, the GPS ground station 112 may be used both to transmit auxiliary ranging codes 116 to the bus 100 using the radio control link 115 and to assist in carrier phase ambiguity resolution to permit precise bus tracking data.

The environment shown in Figure 3a is configured so that buses, such as the bus 100, are in separate radio contact with the GPS ground station 112, and receive the auxiliary ranging codes 116. The GPS ground station 112 and the bus 100 are in the same general location. The GPS ground station 112 might be positioned, for example, to cover the principal highway, such as the road 102, used by the bus 100. Alternatively, the GPS ground station 112 may be located to serve an entire metropolitan area with buses in the metropolitan area communicating with the GPS ground station 112 using the radio control links 115. The GPS ground station 112 receives the same GPS ranging signals 113 from the GPS satellites 114 that are received by the bus 100. Based on the calculated propagation delay at a given instant for the GPS ranging signals 113, the remote location 110 may compute the predicted position of the GPS ground station 112 using a known GPS code and carrier ranging and triangular calculation methods. Because the remote location 110 has the true and accurate location of the GPS ground station 112, the remote location 110 may very precisely determine propagation delays caused by ionospheric and atmospheric anomalies encountered by the GPS ranging signals 113.

Because the GPS ground station 112 is in the same general vicinity as the bus 100, the GPS ranging signals 113 that are received at the bus 100 should encounter the same propagation delays as the GPS ranging signals 113 that are received at the GPS ground station 112. Then, the instantaneous propagation delay information (the auxiliary ranging codes 116) may be communicated by the radio control links 115 to the bus 100, enabling the BLD 40 in the bus 100 to correct ranging calculations based on received GPS radio signals 113. This correction eliminates position information uncertainty at the bus 100. Using DGPS and carrier phase ranging, very accurate location information can be derived for the bus 100 and propagation correction information can be broadcast on the radio control link 115 using, for example, a signal of known frequency that may be monitored by all buses, such as the bus 100, in the vicinity of the GPS ground station 112.

The radio control link 115 from the GPS ground station 112 may also be used to command processing equipment in the bus 100 to use particular GPS ranging calculation methods. The radio control link 115 connecting the bus 100 to the GPS ground station 112 may be a full-duplex communication link that permits bi-directional communication between the GPS ground station 112 and the bus 100. Using the radio control link115, status information may be transmitted from the GPS ground station 112 to the bus 100 and from the bus 100 back to the GPS ground station 112. Each bus may transmit a unique identification code to the GPS ground station 112. For example, each bus 100 in the vicinity of the GPS ground station 112 may transmit precise location, velocity and acceleration vectors to the remote location 110 using the GPS ground station 112. To facilitate optimum routing of the bus 100, and for other control and monitoring purposes, the remote location 110 may store in a database 118, locations of known obstacles, such as traffic jams, special events, road construction, and accidents that could impede the travel of the bus 100. This obstacle information, combined with real-time bus location information, can be used by the remote location to send alternate route information to the bus 100. Such real-time bus routing can be used to keep the bus 100 on schedule and allow the bus 100 to still make all its required stops.

The bus 100 may compute its own precise attitude, with respect to X, Y, and Z reference planes using conventional technology. The attitude of the bus 100 on the road 102 may be detected by using multiple GPS antennae mounted on the extremities of the bus 100 and then comparing carrier phase differences of GPS signals 113 simultaneously received at the bus 100 using conventional technology. Relative to a desired path of travel or relative to true or magnetic north, the precise deviation of the longitudinal or transverse axis of the bus 100 may be precisely measured along with the acceleration forces about these axis. These inputs may be sent to the computer 12 (see Figure 1) or a specialized GPS processor, where the inputs are analyzed and evaluated along with a multitude of other inputs to provide tracking and control of the bus 100. Using this system, operators at the remote location 110 may recognize whether the bus 100 is stationary, moving along its intended path on the road 102, skidding or spinning, for example, and what corrective action is needed to counteract whatever unusual attitude the bus 100 may need to regain control.

Communication between the bus 100 and the GPS ground station 112 may be implemented using multiple access communication methods including frequency division multiple access (FDMA), timed division multiple access (TDMA), or code division multiple access (CDMA) in a manner to permit simultaneous communication with and between a multiplicity of buses, and, at the same time, conserve available frequency spectrum for such communications. Broadcast signals from individual buses 100 to the GPS ground station 112 permits simultaneous communication with and between a multiplicity of buses 100 using such radio signals.

In an embodiment, the BLD 40 may include a GPS receiver, a GPS transceiver, radar/lidar, and other scanning subsystems in a single, low cost, very large scale integrated (VLSI) circuit. The same is also true of other sub-systems used on the bus 100, including the computer 12.

As illustrated in Figure 3b, the BLD 40 may be implemented using control circuit 33 to interconnect and route various signals between and among the illustrated subsystems. These components may be in addition to, or take the place of components shown in Figure 1. A GPS receiver 32 is used to receive GPS radio signals 113. A GPS transceiver 34 is used to transmit and receive over the radio control link 115 between the bus 100 and the GPS ground station 112. The transceiver 26 receives and transmits auxiliary control signals and messages from multiple sources including other buses. The GPS receiver 32, the GPS transceiver 34, and the transceiver 26 include necessary modems and signal processing circuitry to interface with the control circuit 33. As described above, the GPS transceiver 34, as well as the transceiver 26, may be implemented using frequency division, time division or code division multiple access techniques and methods as appropriate for simultaneous communication between and among multiple buses and GPS ground stations. In an alternate embodiment, not shown, the GPS transreceiver 34 also may be a cellular radio linked to the communications satellite 132 using conventional technology. Additionally, the bus 100 may have several GPS receivers 32 positioned on the extremities of the bus 100 for use in determining bus attitude relative to a reference plane and direction using conventional phase comparison technology.

In addition to, or as part of the computer 12 of Figure 1, a GPS ranging computer 36 receives GPS signals from the GPS receiver 32 to compute bus attitude and position, and velocity and acceleration vectors for the bus 100. The GPS ranging signals 113 are received from multiple GPS satellites 114 by the GPS receiver 32 for processing by the GPS ranging computer 36. The GPS transceiver 34 receives GPS correction signals from the GPS ground station 112 to implement differential GPS calculations using the GPS ranging computer 36. Such differential calculations involve removal of uncertainty in propagation delays encountered by the GPS ranging signals 113.

Figure 3c illustrates an operation of the systems and components of Figures 1 - 3b. The bus 100 may be part of a metropolitan transit system that provides daily commuter bus service. On a given day, the bus 100 departs from a remote location (e.g., a local hub 150) and travels over a route 142, making three stops at bus stops 143 to pick up and let off passengers. The bus 100 is scheduled to complete the route 142 in a specific time that includes a wait at each of the bus stops 143. Intersecting the route 142 are two-way streets 144 and 146. Also shown on the route 142 is an obstacle 147 that completely blocks access over the route 142. The obstacle 147 may be road construction on the route 142, a traffic accident that occurred shortly after departure of the bus 100 from the hub 150, or any other impediment to travel of the bus 100.

The bus 100 is equipped with the BLD 40 that permits GPS ranging to determine the bus location in real time, and to provide the real-time bus location information to the hub 150. The bus 100 and the hub 150 may also employ DGPS to enhance bus location accuracy.

Because the obstacle 147 blocks the route 142, the bus 100 must be rerouted. The hub 150 receives obstacle information, and stores the information in the database 118. Using fuzzy logic or similar techniques, processors 37 at the hub 150 may determine that the bus 100 cannot complete its normal travel plan for that time and day. The processors 37 may then determine that the bus 100 must reroute along the streets 144 and 146. The reroute information may be passed to the bus 100 using the radio control link 115, or other communications network (Figure 3a). The reroute information may be displayed on the bus as a representation on a GPS-based map that highlights the new route, shows the location of the obstacle, and either computes a required speed to remain on schedule, or provides an indication of the expected delay in reaching all the stops 143 based on the reroute plan. The reroute information may be shown on the driver interface 25 (Figure 1).

Using bus location information provided by the bus 100 to the hub 150, the processors 37 at the hub 150 may determine that the bus 100 will not complete the route 142 in time to allow the bus 100 to travel over its next scheduled route. This determination may be based on computing remaining travel time using nominal bus speed over the route 143, the length of the route 142, and nominal stop times at the bus stops 143. The processors 37 may receive a continuous, or near-continuous stream of bus position information from the bus 100. This bus location information allows the processors 37 to continually update the expected route completion time for the bus 100 over the route 142. Using this information, the processors 37 may provide an alert to operators at the hub 150 that indicates that another bus should be called out of standby to cover for the bus 100.

Using the GPS system, the hub 150 may determine other conditions of the bus 100. For example, the processors may monitor a length of time the bus 100 remains in a stationary condition while on the route 142. The processors may determine the stationary condition of the bus 100 based on GPS ranging that shows the bus 100 is in a same position over time. The stationary condition may also be determined based on signals sent to the hub 150 from the bus

100 that report the output of certain sensors, such as a speedometer, accelerometers, and other instruments. The bus 100 may be stationary because of traffic lights along the route 142, while picking up and off loading passengers, or because of a traffic jam, for example. A lengthy stationary period may indicate that the bus 100 has encountered a mechanical or electrical fault, has been involved in an accident, or that something has happened to the bus driver. The processors at the hub 150 may be programmed to monitor bus stationary periods and to provide an alert if a specified maximum time is exceeded.

A television camera having a wide angle lens may be mounted at the front of the bus such as the front end of the roof or bumper to scan the road ahead of the bus at an angle encompassing the sides of the road and intersecting roads. The analog signal output of camera is digitized in an A/D convertor and passed directly to and through a video preprocessor and to the control circuit 33 to an image field analyzing computer may be implemented as part of the computer 12 and may be programmed using neural networks and artificial intelligence as well as fuzzy logic algorithms to identify objects on the road ahead such as other vehicles, pedestrians, barriers and dividers, turns in the road, and signs and symbols, and generate identification codes, and detect distances from such objects by their size (and shape) and provide codes indicating same for use by a decision control computer, which may be incorporated as an element of the computer 12 shown in Figure 1. The decision control computer generates coded control signals that are applied through the control circuit 33 or are directly passed to various warning and bus operating devices such as a braking servo, a steering servo or drive(s), and accelerator servo; a synthetic speech signal generator, which sends trains of indicating and warning digital speech signals to a digital-analog converter connected to a speaker driver; a display that may be a heads-up display or part of the driver interface 25 (Figure 1); a head light controller for flashing the head lights, a warning light control for flashing external and/or internal warning lights; and a horn control.

The image field analyzing computer may use images provided by the above described television camera along with high speed image processing to detect various hazards in dynamic image fields with changing scenes, moving objects and multiple objects, more than one of which may be a potential hazard. Wide angle vision and the ability to analyze both right and left side image fields and image fields behind the bus may also be used. The imaging system may detects hazards, and may also estimate distances based on image data for input to the decision control computer.

Figure 4 is a block diagram of an alternate environment for communicating with the bus 100. The local hub 150 receives wireless communications from the bus 100 and transmits wireless communications to the bus 100. The local hub 150 may communicate with a number of buses, including the bus 100. The local hub 150 may communicate with a large number of buses. For example, the hub 150 may communicate with as many as 256 or more buses. Additional local hubs may be included in the environment to increase the number of buses to be controlled. For example, in a large urban transit system, one or more local hubs may be established at each local transit authority bus center. Each such bus center may be responsible for dispatching, operating and maintaining hundreds of commuter buses, or more.

Local hubs, such as the local hub 150, may communicate with a central service center 154, which may be established for the urban transit system. Communications between the local hubs and the central service center 154 may be by a wired communications network, such as the PSTN. The local hubs may also communicate directly with a remote service center, such as a service center 156 established at the bus manufacturer's facility, for example.

Using either of the environments shown in Figures 3a or 4, a remote location may communicate with a bus control system, such as the system 10 shown in Figure 1, to access data stored in a database on a bus, and to send data to the bus control system. For example, the remote location may access the database 22 to determine operating conditions of the bus engine, transmission and brake system, status of the bus lighting system, position of doors, destination of the bus, bus speed, and other bus data. The data thus obtained may be used for remote diagnostics and troubleshooting, including determining what parts and/or tools may be needed to repair a bus. The environments may also be used to determine the geographical location (latitude and longitude, for example) of the bus. Such bus location information may be provided by incorporation of a GPS system, such as the BLD 40 shown in Figure 3b, in the system 10. The remote location may also communicate with the bus to control specific bus functions. For example, the remote location may shut down the bus engine, change the indicated destination, close a door, or turn on the bus headlights. The remote location may also update the software used by the computer 12 by sending a revised program over the communications network.

In addition to remote access of the bus data, the system 10 (see Figure 1) allows a local technician to interface on-site with the computer 12 and the database 22. In particular, the technician may use the system 10 to perform complex diagnostics of devices or components connected to the data bus 16. Using a wired or wireless interface to the computer 12, the technician may obtain current or recorded data relating to bus operations. For example, the technician may access the database 22 to determine engine oil pressure over the previous hour. The technician may then use this information to determine a trend in the operation of the engine. Thus, the system 10 may be used for both preventive and corrective maintenance.

Figure 5 illustrates yet another environment 160 that may use the bus system of Figure 1. The environment 160 includes a manufacturer's facility 161 that manufactures vehicles, such as transits buses. The facility 161 includes a customer service support department and an engineering department. The customer support department may include access to technical advice, repair parts and documentation. The engineering department may receive information from local bus operators, trend information regarding performance of the buses, and bus operating data. The engineering department may use these data to make design changes, and to assist the customer service department.

Using a communications network 162, the facility 161 may be coupled to one or more Internet web sites that are associated with local bus operating centers, or hubs. The web sites may employ standard Internet file servers to store and manipulate data. The local bus operating centers may located anywhere in the world. In Figure 5, three local bus operating centers, namely the centers 176, 186 and 196 are shown. The three centers may be part of a single transit system, and may be located within one metropolitan area. Alternatively, the local bus operating centers may be located in different metropolitan areas. In the example shown, the local bus operating center 176 includes two groups of buses. Group A 173 includes buses 0-251 and Group B 175 includes buses 252-514. However, the local bus operating center may operate more than two groups of buses. Individual buses in the groups 173 and 175 provide information to, and may receive information from a web site 170 that is run by, or for, the benefit of the bus operating center 176. Other local bus operating centers, such as the local bus operating centers 186 and 196, may operate one or more groups of buses, with each group of buses directly controlled by and reporting to local bus operating centers.

Communication between the individual buses and the local bus operating centers may be primarily by wireless means, such as cellular communications means. The buses may also communicate with the local bus operating centers by wired means when the buses arrive at the local bus operating centers and can be directly coupled to the local bus operating centers. The information provided by the buses may be gathered at the local bus operating centers, and then immediately, or periodically posted to the associated web sites. From the web sites, the bus information may be transmitted to the facility 161.

In operation, the system shown in Figure 5 may require that individual buses provide real-time, near real-time and historical data to the center 161. Real-time data may include readouts form monitors installed on the buses. Examples of such monitored parameters include bus speed, position of entry and exit doors, application of parking brake. Near real-time information may include an amount of time (i.e., the elapsed time) the entry or exit doors are open, bus speed averaged over some interval, and other information that is delayed in transmission. Historical data may include a summary of engine oil pressure during operating time for a specific period, such as a day, for example.

Real-time and near real-time data may be supplied using wireless communications means, where the data are measured and collected on a bus, transmitted to a local center, such as the center 176, processed and transmitted to a web site such as the web site 170, and transmitted to the center 161. In this embodiment, the bus maintains constant or near constant communication with its local bus operating center. The data to be sent to the local bus operating center 176 may be transmitted continuously using techniques well known in the art. Alternatively, the local bus operating center 176 may periodically poll buses assigned to the local bus operating center 176 to retrieve data from the buses.

Historical data, such as a days worth of engine oil pressure readings (taken for example as average engine oil pressure, or oil pressure readings taken at intervals) may be transmitted to the web site 170 when the bus returns to the local bus operating center. Such historical data may be provided by direct wired connection between the bus and processors at the web site. Alternatively, the historical data may be provided using wireless means.

The system 160 may also be used to control operation of one or more buses. A technician or operator at either a local bus operating center, such as the center 176, or at the customer support center 161, may access a bus operating program, such as the bus control program 30 (see Figure 1). The same technician can access bus operating data on a real-time or near real-time basis. Using the program 30, the technician may order send an engine STOP command to the bus 100 that causes a electrical switch in the engine run control system to open. Referring to Figure 33a, for example, the technician can select a FRONT SELECTED FRT_SEL switch 939 (address N11:2) and, by clicking on with a pointing devices, such as a mouse, cause the switch 939 to open, which causes an ENGINE IGNITION ENG_ECU_IGN interlock 940 to open, stopping the engine of the bus 100. Such an operation might be warranted in an emergency such as a driver who has suffered a heart attack, for example. Access to other portions of the bus programming allows remotely located technicians to start, stop, or otherwise operate other components and systems on the bus 100.

In another embodiment, the system 160 may include multiple local bus operating centers or hubs that collect information form buses and that send control signals to the buses, and which in turn provide the collected information to, and receive control signals from and intermediate station between the hub and the customer support center 161. In yet another embodiment, the customer support center 161 may incorporate an central Internet web site, and each of the local operating bus centers may provide information to the central Internet web site. In still another embodiment, the buses may provide some or all of their collected data directly to the central Internet web site, and may receive control signals directly from the customer control center. Such direct communication with the customer control center may be by wireless means including cellular and PCS communications systems.

Figures 6a and 6b illustrate examples of the interface 24 (see Figure 1) that may be used by a local technician to interact with the system 10 of Figure 1. In Figure 6a, the interface 24 includes a panel 200, which in turn includes a display portion 202 and a user input portion 204. The display portion 202 may be a liquid crystal display, for example. Alternatively, the display portion 202 may be any flat panel display or may be a CRT display. The user input portion 204 is shown as an alpha-numeric keyboard. Alternatively, the user input portion 204 may include a voice recognition module and one or more pointing devices such as a mouse, a touch pad, or a track ball. The display portion 202 and the user input portion 204 may also incorporate a touch sensitive screen. In Figure 6a, the display portion 202 is shown with a graphical user interface (GUI) (or human to machine interface (HMI)) 206. The HMI 206 shows various views of a bus, such as the bus 100, and data related to the bus. The HMI 206 also incorporates interactive features and links to other data related to the bus.

Figure 6b illustrates an HMI 208 displayed on the display portion 202. The HMI 208 shows database addresses, status, and descriptions of specific components of a sub-system of a bus.

The interface 24 shown in Figures 6a and 6b may be hardwired into the system 10, and the associated hardware devices, including the display portion 202 may be contained in a semi-permanent fashion in a housing that is built into the bus 100. Alternatively, the interface 24 may include a portable interfaces, such as a lap top computer, a personal data assistant (PDA), or a similar device. In this alternative embodiment, the interface 24 may communicate with the computer 12 by wired or wireless means. For example, the interface 24 may include a PDA that receives and transmits data between the computer 12 and the interface 24 using radio frequency signaling. When the interface 24 is portable, such interface may be installed in the bus 100, or may be brought to the bus 100 when on-site checks of the system 10 are desired.

Figure 7 is a block diagram of a control software system 220 used to operate and diagnose the system 10 of Figure 1. The software system 220 may be loaded on the computer 10, and periodically may be updated, either by on-site loading of revised software, or by transmission of programming changes using, for example, the communications networks 140 and 152 of Figure 4. The software system 220 may include the diagnostics module 20 control module 30 shown in Figure 1. The systems diagnostic module 20 may include separate diagnostics packages for the bus engine, transmission, anti-lock brake system (ABS), and electrical system. The system diagnostics module 20 may also include access to historical data stored in the database 22. The controller module 30 may include the software engine that executes the bus operating system. The operating system may include ladder programs that are described in more detail with reference to Figures 31a - 48.

The data transfer module 232 includes the programming necessary to communicate data at high data rates between the computer 12 and the interface 24 or the remote location 110 (see Figures 1 and 3). The programming may include TCP/IP protocols and ethernet

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protocols, for example. The operating system module 234 includes the computer operating program. The computer operating program may be based on Windows NT, for example.

Figure 8 is a block diagram of a software system 250 that may be used to create the HMIs. The HMIs allow an on-site technician (i.e., a technician on the bus 100, for example), and a technician at a remote location, such as the central service center 156 of Figure 4, to monitor and trouble shoot the bus 100 electrical, pneumatic, and mechanical systems. The software system 250 may also be used to create one or more ladder programs that are used for control and diagnostics of the bus.

Figures 9 - 29 illustrate HMIs created using the programming of Figure 8. In Figure 9, an introductory page 290 is shown. The introductory page 290 includes a login page 291, which may include a user name entry block and a password block that are used to control access to further pages or HMIs. Upon successful login, a main page 300, illustrated in Figure 10, is displayed. The main page 300 includes a date block 301 and a time block 303. A status section 309 allows the technician to quickly determine the status of the bus primary systems, such as the engine, transmission, brake (ABS), heating ventilation and air conditioning (HVAC), destination and computer control (CC) systems. As shown in Figure 10, each of the bus primary systems has an associated ON or OFF light to indicate the system status. That is, depending on satisfying specific criteria in the ladder programming system, each primary system will have either an ON light or an OFF light lit. The ON light may indicate that all components in a primary system are operating correctly or are otherwise in condition to allow operation of the system. Conversely, the OFF light may indicate a problem with a component, or simply that the system or component is off or otherwise not in operation.

Also shown in Figure 10 are front and rear start indicators. Specifically, the front start system includes a front start ON indication 305. The rear start system includes a rear start ON indication 307. When a front start is enabled, the front start ON indicator 303 may be activated and the rear start ON indicator may be deactivated. Finally, the main page 300 includes buttons, or links 310 to other pages and diagnostic software packages, and a close button 302 that is used to close operations accessible from the main page 300.

Figure 11 illustrates an electrical panel page 320. The page 320 includes a view of the bus 100. The page 320 gives the technician an interactive view 321 of the bus electrical panels. From the page 320, the technician is able to view the bus doors open and close, the exterior lights flashing, wheel chair ramps operating, headlights operating and the destination sign working. The page 320 may also be used to verify operation of bus sub-systems including the destination sign, bus operating mode, state of interlocks and passenger (stop request) sub-systems. The page 320 includes interactive features such as displays of various modules, that, when selected, link the technician to more information related to the modules. As shown, the view 321 includes a rear deck module 333, side modules 335, exit door module 331, entrance door module 336, side console module 325, front panel module 323 and driver's area panel module 327. The operation of these modules will be explained later in detail. Each of the panels or modules shown in Figure 11 may be used to link to a page that displays more information about the panel or module. The technician may activate the link by selecting a desired panel or module using, for example, a mouse, and then activating the link by clicking on the mouse. The page 320 also includes a link 337 to an electrical system page and a link 339 to the main page 300. Other links, pull-down menus, and interactive and color graphics display elements may be included on the page 320.

Figure 12 illustrates a vehicle diagnostic page 340. The page 340 includes representations 341a-c of the bus 100. The representations 341a-c may include interactive features that show various changes in the bus 100 during operation or diagnostic testing. For example, the representation 341 a may show the entrance door as open when the actual entrance door is opened on the bus 100, either during operation of the bus 100, or during diagnostic testing of the bus 100. Similarly, the representation 341c may show the left turn signal blinking when the left turn signal is activated on the bus 100.

The page 340 also includes a diagnostics section 343. The diagnostics section includes buttons that may be used to access various diagnostic pages to test bus features. For example, a stop request button may be used to access a diagnostics test page to test the passenger stop request feature. An example of a diagnostics test page will be described in detail later. Other diagnostic pages accessible from the page 340 include entrance door, exit door, back-up lights, high beam, RH turn lights, LH turn lights, kneeling raise, kneeling down, W/C ramp up, W/C ramp down, curbside lights, streetside lights, and hazard lights. The page 340 also includes a destination sign window 344, and interlock window 345, a retarder on window 346, a day run window 347, and a brake application window 348. The windows may be interactive and may be used to link to other pages related to the specified features. Alternatively, the windows may only provide an indication that the associated feature is activated. For example, the brake application window may be highlighted when the bus brake pedal is pushed. Finally, the page 340 also includes a link 338 to the electrical system overview page 320 and a link 339 to the main page 300.

Figure 13 illustrates a rear deck panel page 350. Similar pages are available for other panels and modules. The page 350 includes a graphical representation 351 of the rear deck panel and graphical representations 353, 355, 357 and 359 of components of the rear deck panel. The page 350 also includes links 337, 338 and 339 to other pages. Using the page 350, the technician may access individual nodes or diagnostic software. For example, the technician may link to pages for rear deck #2 node 3 (353), rear deck #2 node 2 (355), rear deck #1 node #1 (359), and transmission diagnostics 357.

Figure 14 illustrates a node page 360 for the rear deck #1, node #1. The page 360 includes a feature section 361 that displays, in column format, various bus components that are coupled to rear deck #1, node #1. An address column 365 includes addresses that correspond to physical locations of components of the bus 100. An indicator column 366 includes one of four possible indications. The indications are an input, an output, a short circuit, and an open circuit, as shown in legend 363. The indicator output shows that a particular component provides an output to the system 10. The input indicator shows that the component receives an input from the system 10. A component may both provide an output and receive an input.

The short circuit and open circuit indicators may light when a component is subject to a malfunction. A sensing circuit, operating in parallel with the monitored component, may be used to provide the short or open condition.

The indicators may also include graphical representations of lights that change color to indicate a status of a particular function. For example, an indicator for the function "Low Oil Press. Sw." may change color to indicate that oil pressure is above the minimum specified, or that a low oil pressure interlock is closed to allow the bus engine to operate. In another example, a green indicator light for an Engine Ignition function may indicate that the engine ignition system electronic control unit is receiving power. The function column 367 includes a name of the function monitored. Some functions in the function column 367 may include an active link to an object in the database 22 (see Figure 1). The linked object may be displayed by selecting and activating the link. For example, a function Low Oil Press. Sw. may include a link to a virtual oil pressure gage that is stored as an object in the database 22. Displaying the virtual oil pressure gage allows the technician to monitor in real-time, or in a replay mode, actual oil pressure, even if the bus 100 does not include an actual (physical) oil pressure gage. The use of the links will be described in more detail later.

Finally, the page 360 includes links to other pages. These links include the electrical panel overview link 338, the electrical systems overview link 337, the main system link 339 and a rear deck panel link 364. Also included on the page 360 is a graphical representation 368 of the node #1.

Figure 15 illustrates a node page 370 for rear deck #1 node 3. The page 370 includes a graphical representation 374 of a transit block, address column 375, indicator column 376 and function column 377. Also included are links 337, 338, 339 and 364 to other pages.

Figures 16 - 29 illustrate other node pages that are available with the system 100 of Figure 1.

Figure 30 illustrates an HMI 800 that may be used to monitor operation of a bus subsystem, and to perform diagnostics and trouble shooting. The HMI 800 includes a virtual gage 802 that may be used to display, in real-time, or near real time, a measured parameter in bus subsystem. The gage may also be programmed to display historical data, such as data stored in the database 22 of Figure 1. In the illustrated example, the bus subsystem may be an engine oil subsystem, and the virtual gage 802 may be programmed to display measured oil pressure at an outlet of an oil pump. The gage 802 may operate based on transfer of data between the bus subsystem and the processor driving the HMI 800. The gage 802 may also provide a visual indication when the bus subsystem itself does not include an actual oil pressure gage. The HMI 800 is also shown capable of displaying oil pressure data in a graphical format 804 over a time period selected by the technician. Such graphical display may use real-time or near real time data, or data stored in the database 22. The HMI 800 may include a schematic 806 showing the location of a pressure sensor 807 in the engine oil subsystem. The HMI may include a two or three-dimensional drawing showing the location of the pressure sensor 807 in the actual bus. The HMI 800 may include other troubleshooting and diagnostics features, such as procedures to remove the pressure sensor, a list of symptoms, possible causes, and suggested corrective actions. Other features may include types/sizes of tools needed to repair a problem, a machinery history record for the pressure sensor and other engine oil subsystem components, a parts list, and a link to automatically order any listed part from the bus manufacturer. The HMI may also include a link to the bus manufacturer that transfers selected data, such as data that allows the bus manufacturer to aggregate data related to the performance of specific bus components.

When the HMI 800 is displayed, the technician may then link to other objects in the database 22 that correspond to a function by, for example, selecting the desired function, and "clicking-on" with a mouse or other pointing device. The technician will then be presented with a page showing the corresponding virtual object. The virtual object may be selected to display a current (and varying) value, or may display historical data stored in the database 22.

The pressure gage 802 (or other virtual object displayed on an HMI) may be linked, or tagged to a specific item in a ladder program that is used to operate the bus. For example, the gage 802 may be tagged to the item PLC_POWER (at address N:10:1) shown in Figure 31a.

Figures 31a - 48 illustrate representative ladder programs that may be used to control and diagnose the bus. While ladder programming is illustrated, other programming methods may be used. The ladder programs may be accessed at a remote location, or on site on the bus. The ladder functions indicate which parameters must be satisfied in order for the bus to perform a specific function. Taking Figure 32a as an example, the ladder program shows the specific conditions that must be satisfied in order to perform a power start of the bus 100. As shown in Figure 32a, for a rear start, a rear selected switch must be closed (a rear start means that the bus engine is started from the engine compartment, as opposed to the driver's station).

When accessed from a remote location, the ladder programs may allow the technician to remotely control functions of the bus. A pull down menu tied to the program ladder may include force select and force de-select functions that permit the technician to remotely operate components of the bus 100. Continuing with the example of Figure 32a, a technician at a remote location may desire to enable rear start of a bus, but the displayed ladder program indicates the rear selected switch is open. The technician may, using an appropriate pointing device, a mouse for example, select the rear selected switch, "right click" to display a pull down menu, and select a force select feature from the menu. This process send a signal to the system 10 on the bus 100, causing the rear selected switch to close.

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In the claims:

1. A system for control and operation of buses, comprising:

a bus, comprising:

one or more input/output (I/O) blocks coupled to bus components,

a data bus coupled to the I/O blocks,

a scanner card coupled to the data bus, the scanner card reading data signals off the data bus and providing signals to the I/O blocks using the data bus,

a computer coupled to the scanner card and controlling operation of the scanner card, wherein the computer comprises:

diagnostics modules that determine a status of bus components, and

a control module that provides control functions to bus components,

an interface coupled to the computer, wherein the interface comprises:

a display that displays human to machine interfaces indicative of the bus components, and

a user input that provides commands from a user to the computer,

a bus database that stores parameter values for the bus components;

a hub that receives data related to operation of the bus, wherein the hub comprises an Internet web site, and wherein the bus data are posted on the Internet web site; and

a remote location that accesses the Internet web site to receive the bus data.

2. The system of claim 1, wherein the remote location access programming used by the control module and uses the accessed programming to control one or more operations of the bus.

3. A system for remote control of buses and for data retrieval from the buses, comprising:

a bus, comprising:

a control module using programming to control operation of one or more bus systems, and a transmit/receive device that communicates with a remote location to provide data related to the one or more bus systems and to receive control signals directing an operation of one or more of the one or more bus systems.

4. A system for controlling and diagnosing operation of a bus, comprising:

one or more input/output (I/O) blocks coupled to bus components;

a data bus coupled to the I/O blocks;

a scanner card coupled to the data bus; the scanner card reading data signals off the data bus and providing signals to the I/O blocks using the data bus;

a computer coupled to the scanner card and controlling operation of the scanner card, wherein the computer comprises:

diagnostics modules that determine a status of bus components, and

a control module that provides control functions to bus components;

an interface coupled to the computer, wherein the interface comprises:

a display that displays human to machine interfaces indicative of the bus components, and

a user input that provide commands from a user to the computer; and

a database that stores parameter values for the bus components.

5. The system of claim 4, wherein the interface is installed on the bus.

6. The system of claim 4, further comprising a remote interface installed at a location remote from the bus, wherein the computer communicates with the remote interface using a wireless communication module.

7. The system of claim 4, wherein the database further comprises virtual objects, each of the virtual objects corresponding to a component of the bus, wherein the virtual objects are displayed to indicate real-time variation of a parameter of the bus component.

8. The system of claim 7, wherein a virtual object is displayed as part of a human to machine interface.

9. The system of claim 4, wherein the control module comprises one or more ladder programs, and wherein a ladder program comprises one or more features required to operate a bus component.

10. The system of claim 9, wherein the ladder program comprises a remote operation function that permits remote control of the one or more features.

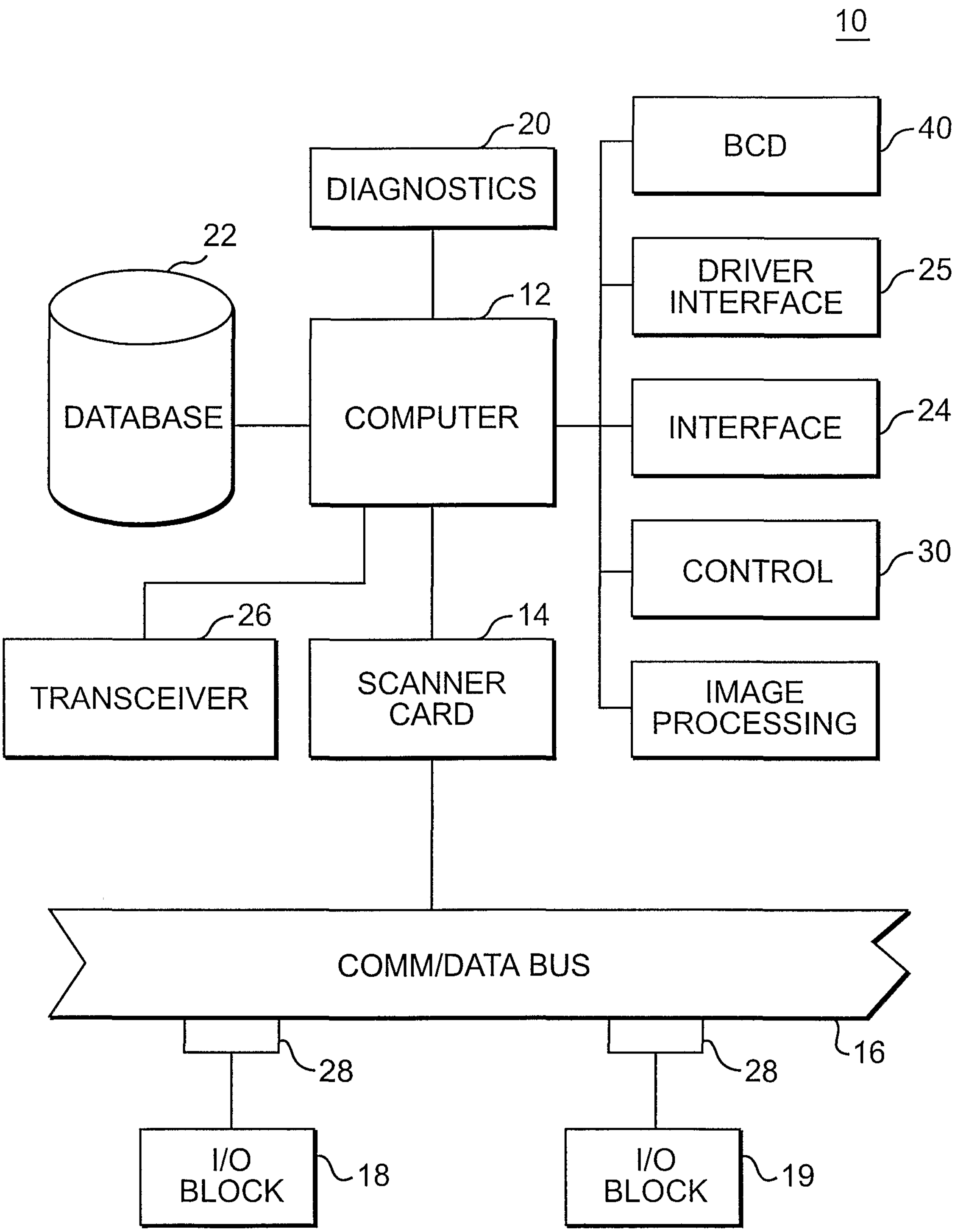

10
DIAGNOSTICS
20
DATABASE
22
COMPUTER
12
BCD
40
DRIVER INTERFACE
25
INTERFACE
24
CONTROL
30
IMAGE PROCESSING
TRANSCEIVER
26
SCANNER CARD
14
COMM/DATA BUS
16
28
28
I/O BLOCK
18
I/O BLOCK
19

FIG. 1

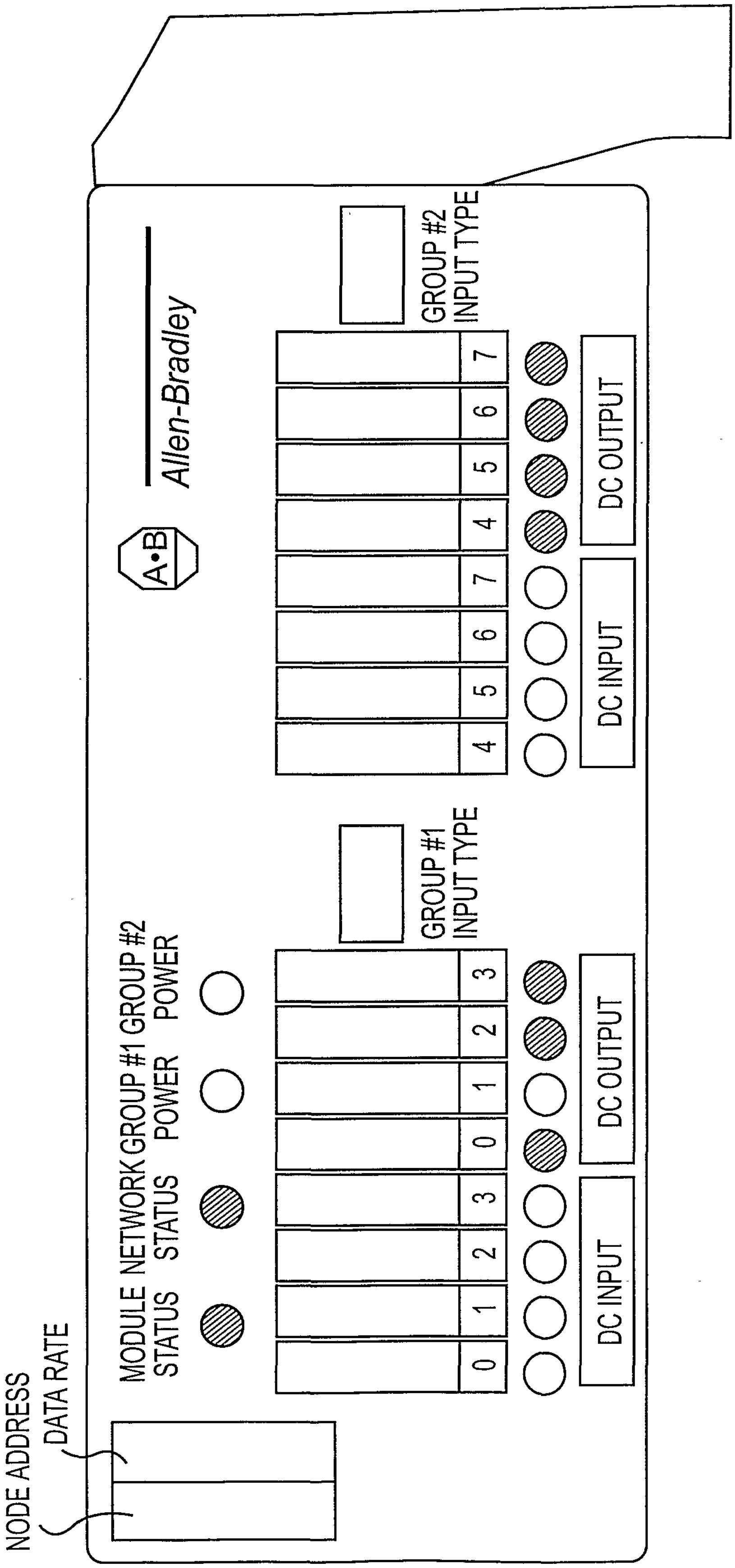

NODE ADDRESS
DATA RATE
MODULE STATUS
NETWORK STATUS
GROUP #1 POWER
GROUP #2 POWER
A•B
Allen-Bradley
GROUP #1 INPUT TYPE
GROUP #2 INPUT TYPE
0 1 2 3
0 1 2 3
4 5 6 7
4 5 6 7
DC INPUT
DC OUTPUT
DC INPUT
DC OUTPUT

FIG. 2

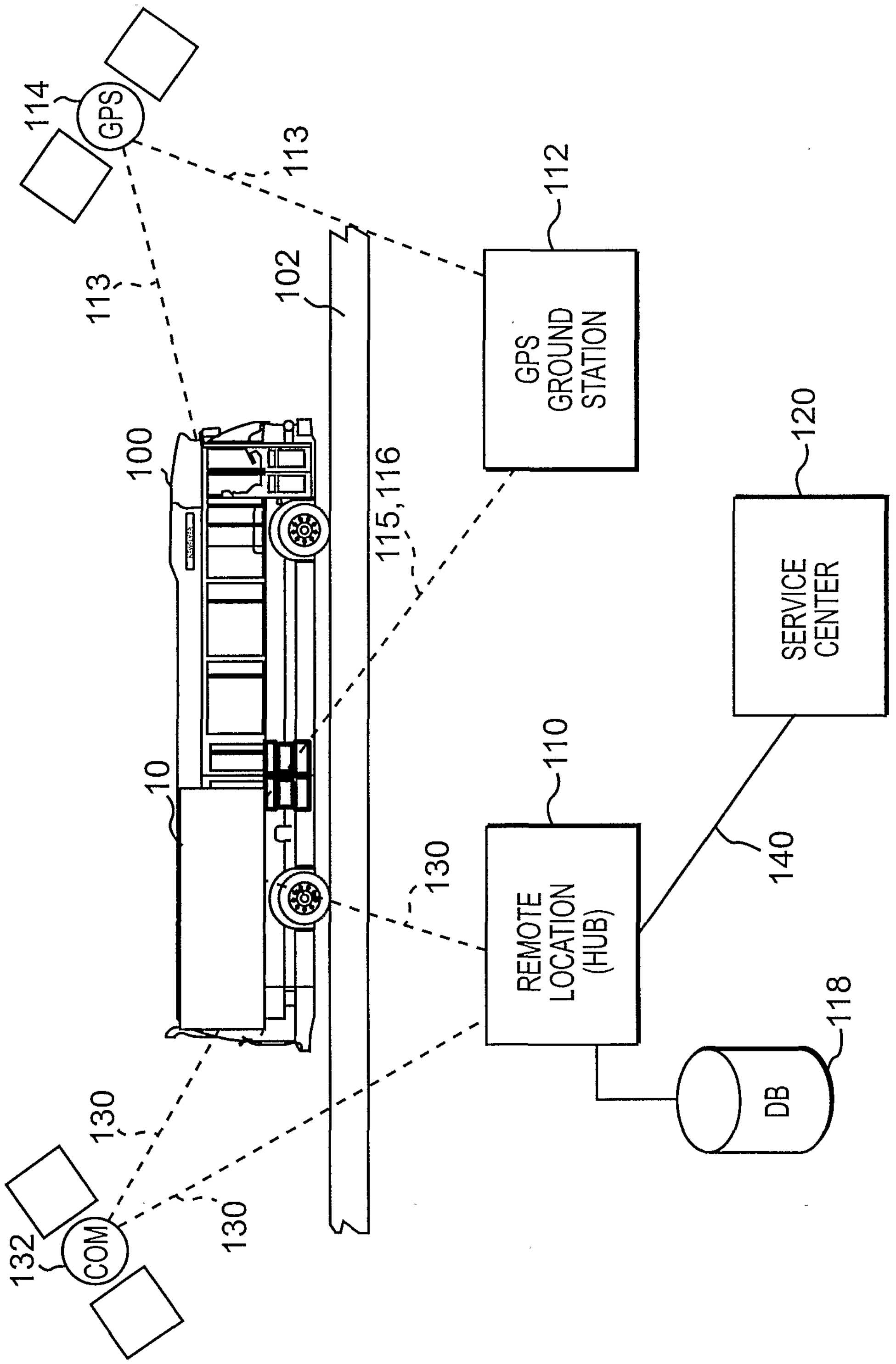

114
GPS
113
113
112
102
GPS GROUND STATION
100
115,116
10
120
SERVICE CENTER
110
REMOTE LOCATION (HUB)
130
140
118
DB
130
130
132
COM
130

FIG. 3a

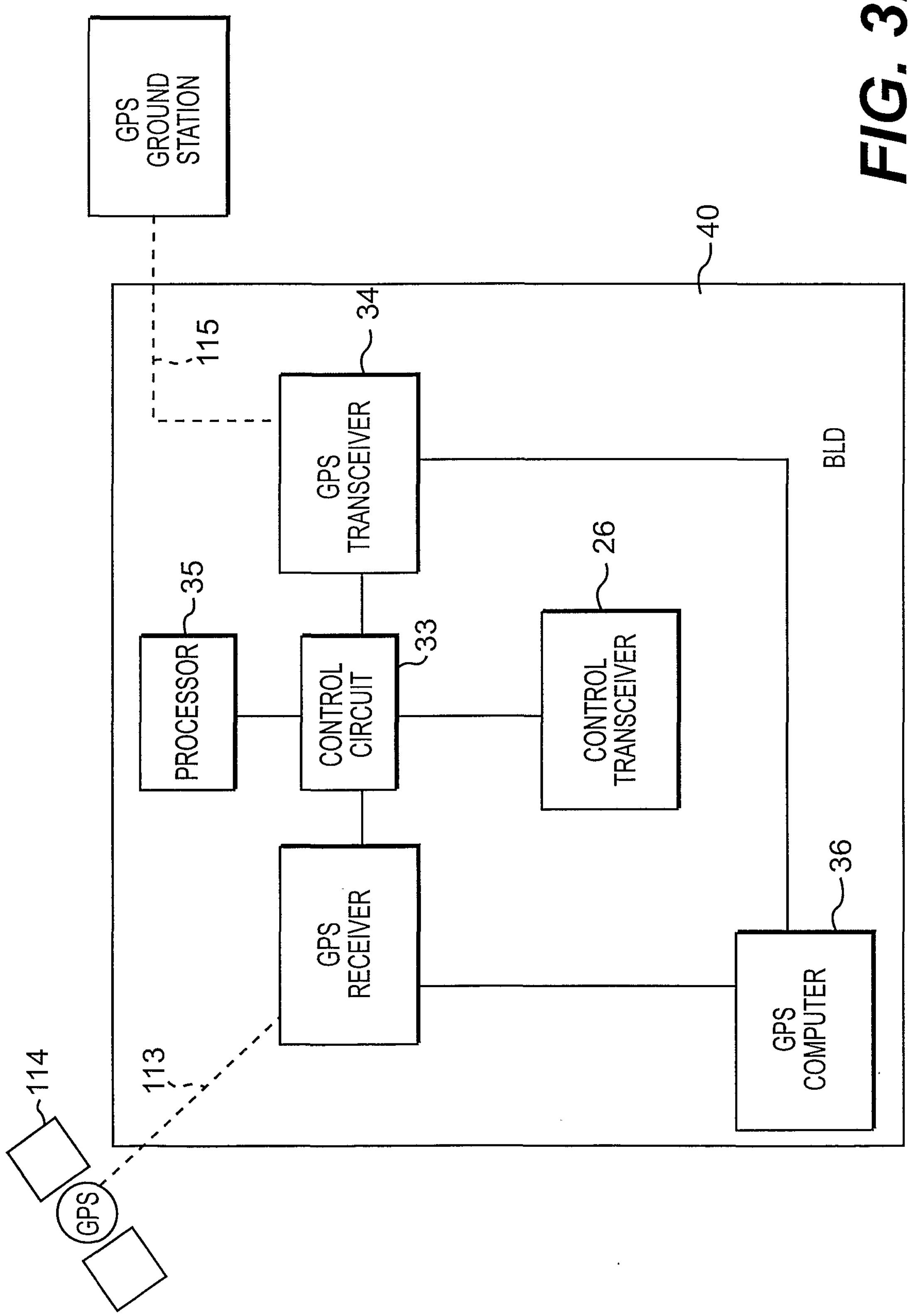

GPS GROUND STATION
40
115
34
GPS TRANSCEIVER
BLD
35
PROCESSOR
CONTROL CIRCUIT
33
26
CONTROL TRANSCEIVER
GPS RECEIVER
36
GPS COMPUTER
113
114
GPS

FIG. 3b

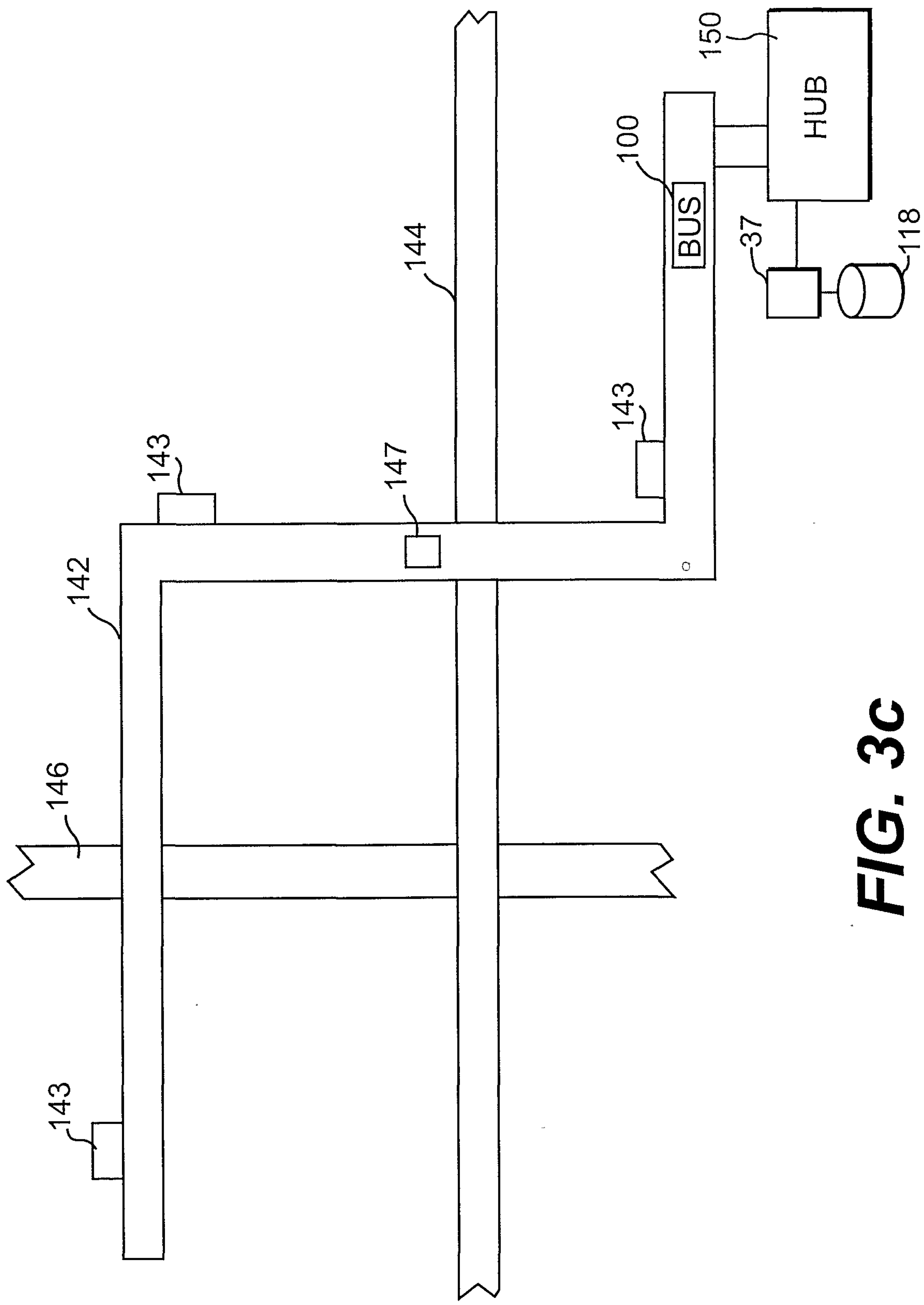


FIG. 3c

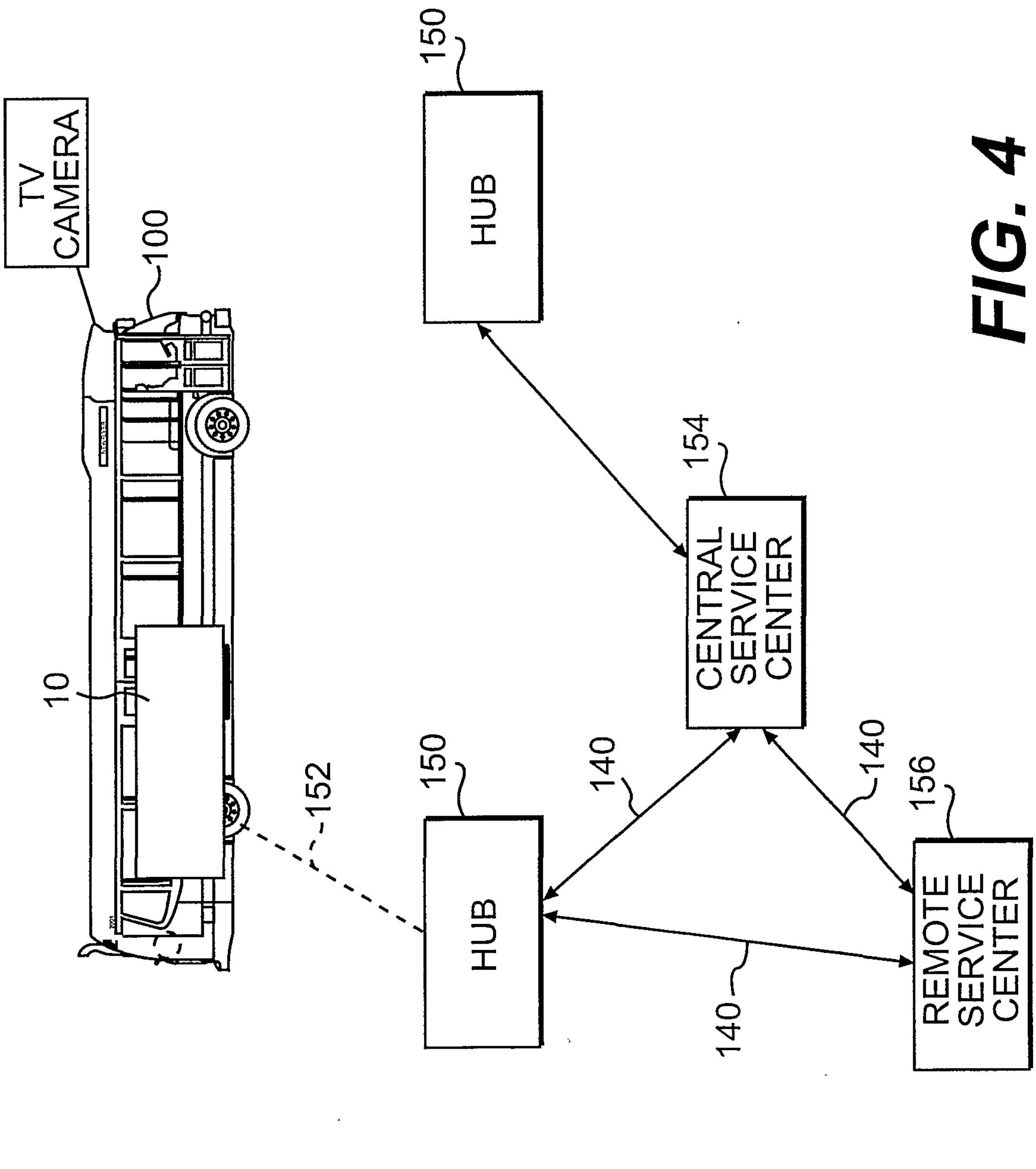

TV
CAMERA
100
10
152
HUB
150
HUB
150
CENTRAL
SERVICE
CENTER
154
REMOTE
SERVICE
CENTER
156
140
140
140

FIG. 4

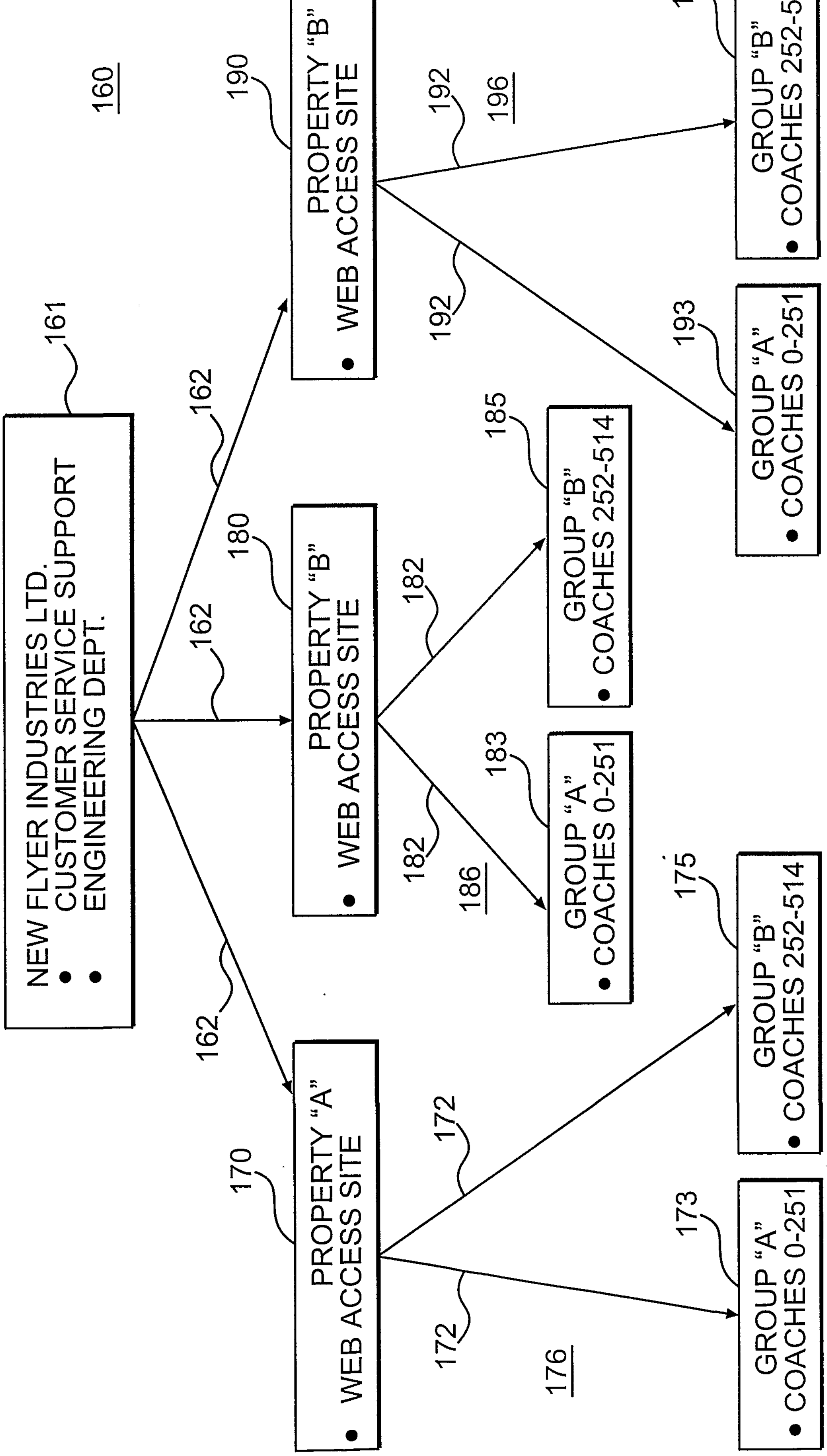

160
NEW FLYER INDUSTRIES LTD.
• CUSTOMER SERVICE SUPPORT
• ENGINEERING DEPT.
161
162
162
162
PROPERTY "A"
• WEB ACCESS SITE
170
172
172
176
GROUP "A"
• COACHES 0-251
173
GROUP "B"
• COACHES 252-514
175
PROPERTY "B"
• WEB ACCESS SITE
180
182
182
186
GROUP "A"
• COACHES 0-251
183
GROUP "B"
• COACHES 252-514
185
PROPERTY "B"
• WEB ACCESS SITE
190
192
192
196
GROUP "A"
• COACHES 0-251
193
GROUP "B"
• COACHES 252-514
195

FIG. 5

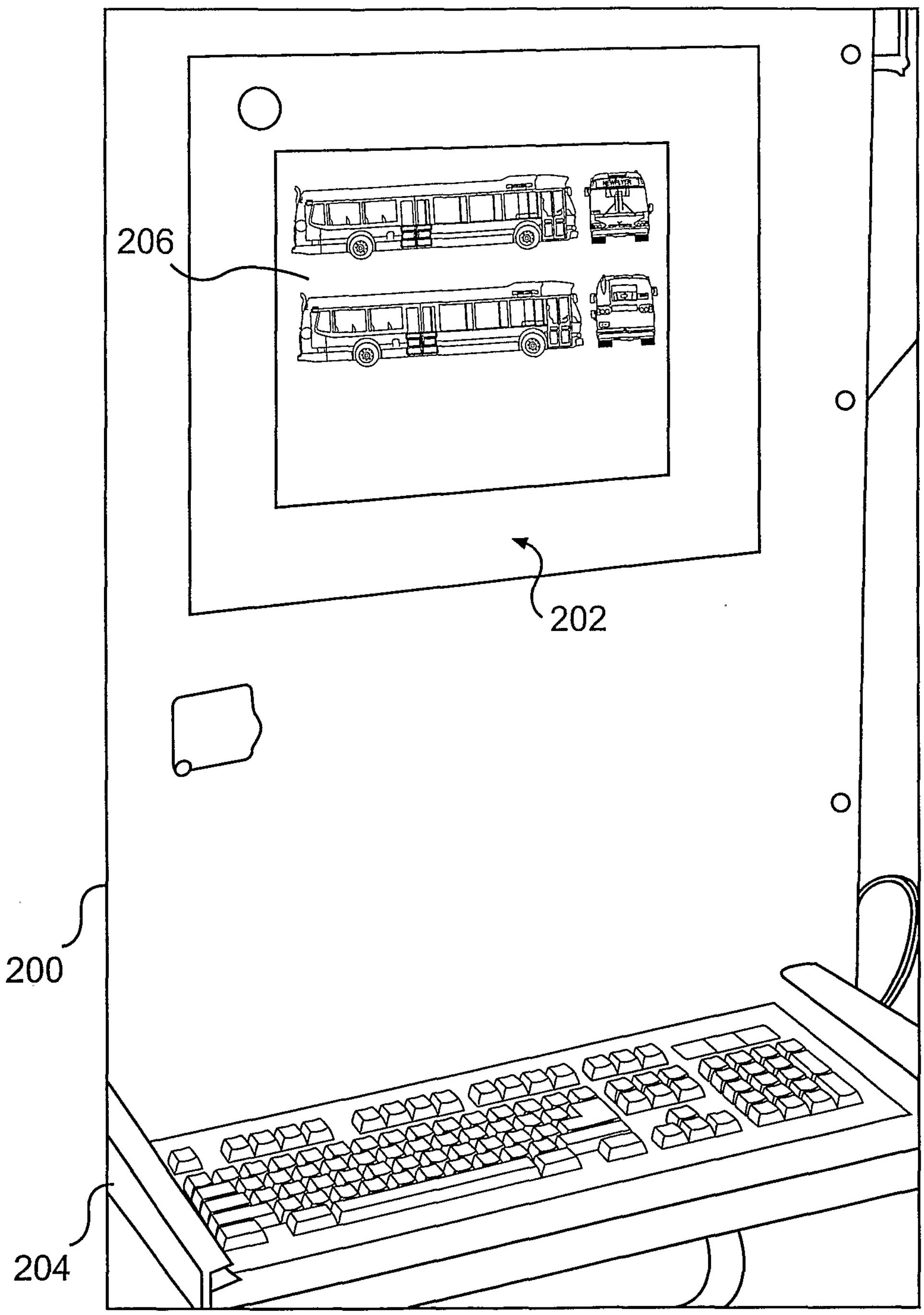
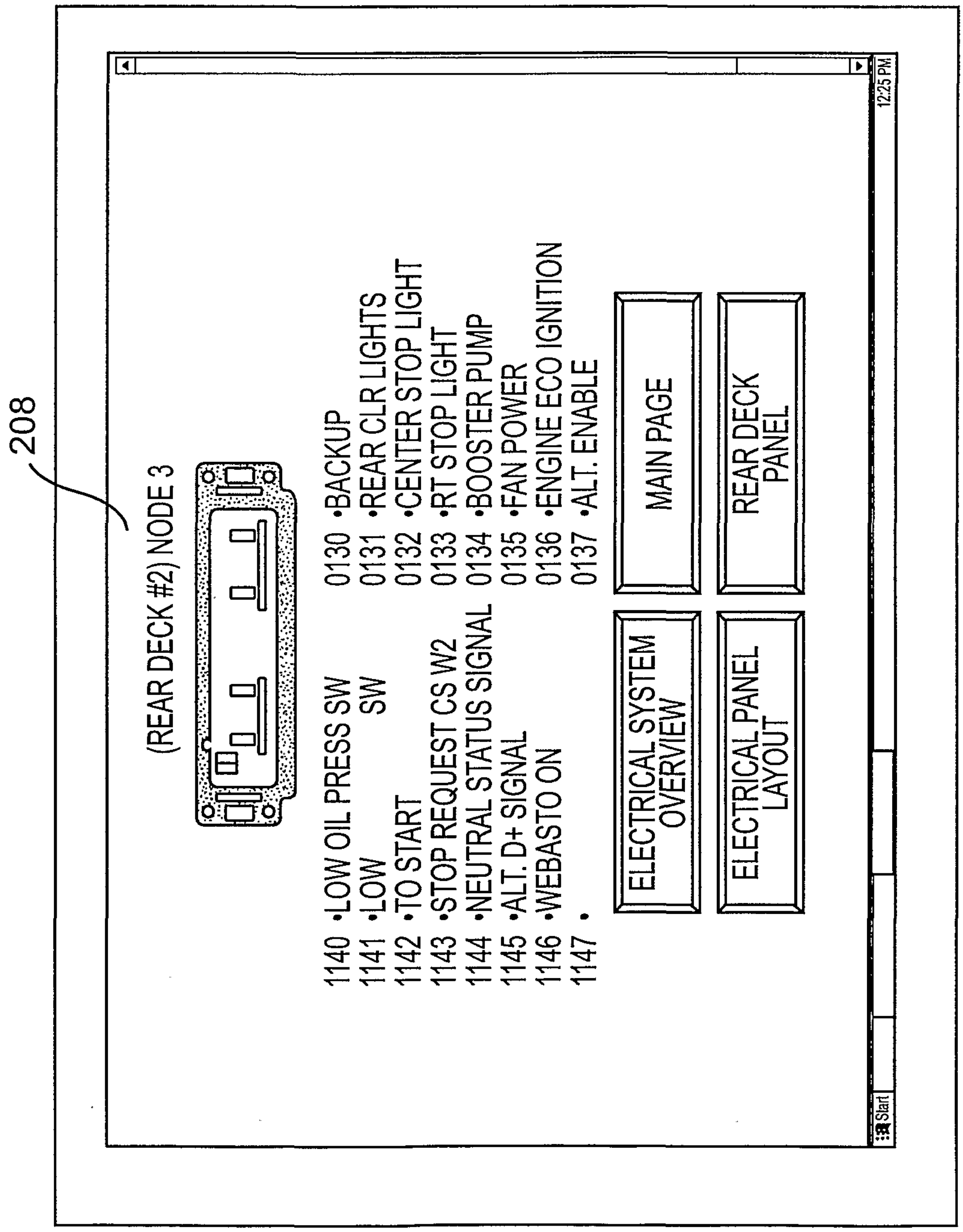


FIG. 6a



208
(REAR DECK #2) NODE 3
1140 •LOW OIL PRESS SW
1141 •LOW SW
1142 •TO START
1143 •STOP REQUEST CS W2
1144 •NEUTRAL STATUS SIGNAL
1145 •ALT. D+ SIGNAL
1146 •WEBASTO ON
1147 •
0130 •BACKUP
0131 •REAR CLR LIGHTS
0132 •CENTER STOP LIGHT
0133 •RT STOP LIGHT
0134 •BOOSTER PUMP
0135 •FAN POWER
0136 •ENGINE ECO IGNITION
0137 •ALT. ENABLE
ELECTRICAL SYSTEM OVERVIEW
MAIN PAGE
ELECTRICAL PANEL LAYOUT
REAR DECK PANEL
Start
12:25 PM

FIG. 6b

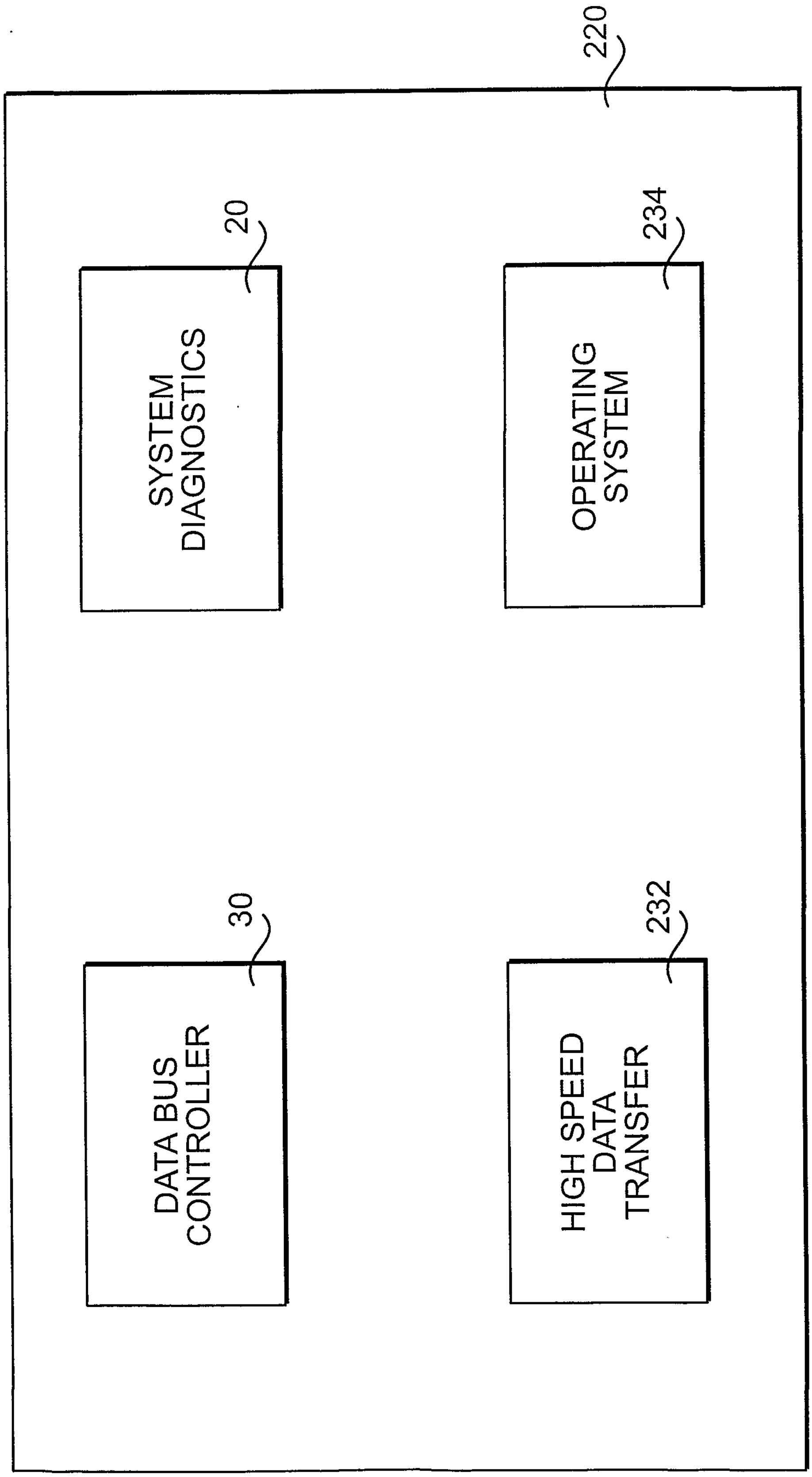

220
SYSTEM DIAGNOSTICS
20
OPERATING SYSTEM
234
DATA BUS CONTROLLER
30
HIGH SPEED DATA TRANSFER
232

FIG. 7

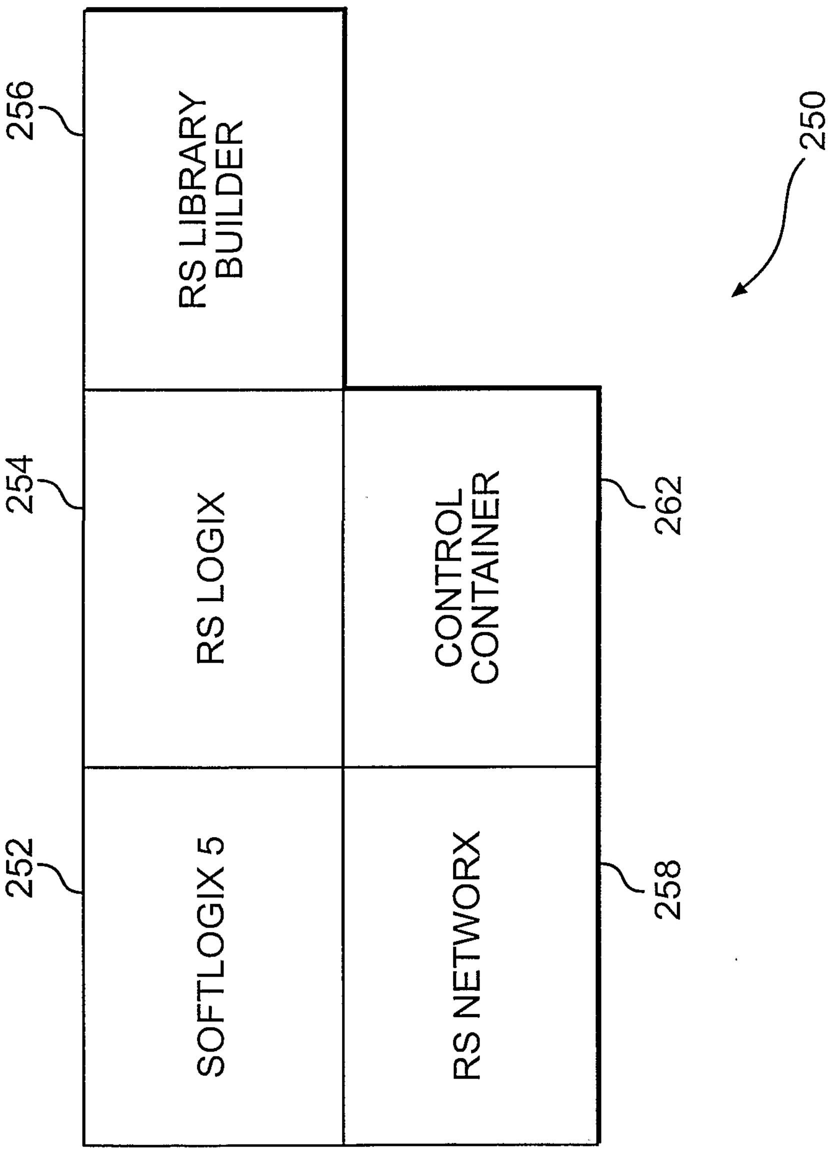

RS LIBRARY BUILDER
256
RS LOGIX
254
SOFTLOGIX 5
252
CONTROL CONTAINER
262
RS NETWORX
258
250

FIG. 8

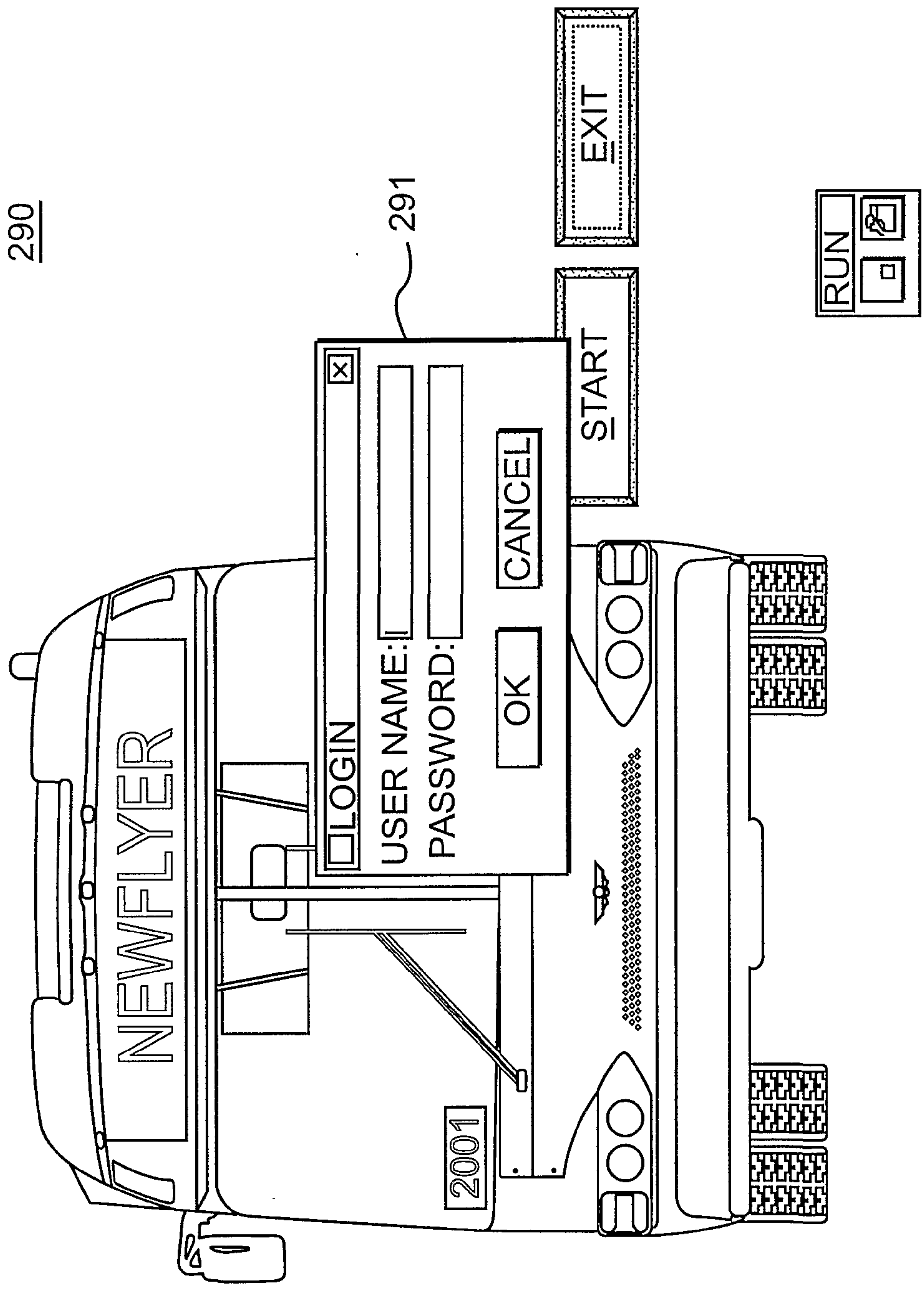

290
291
NEWFLYER
2001
LOGIN
USER NAME:
PASSWORD:
OK
CANCEL
START
EXIT
RUN

FIG. 9

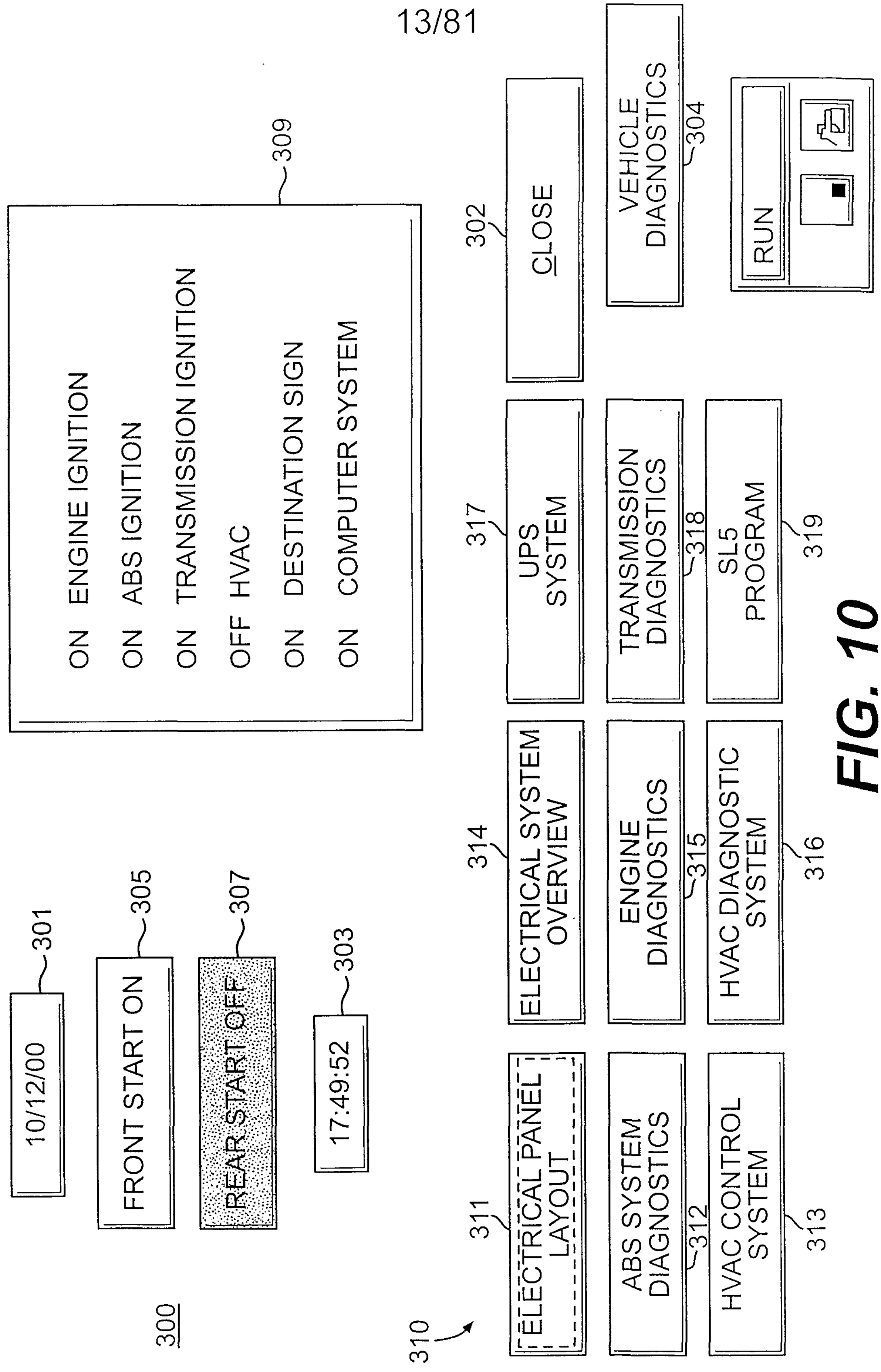
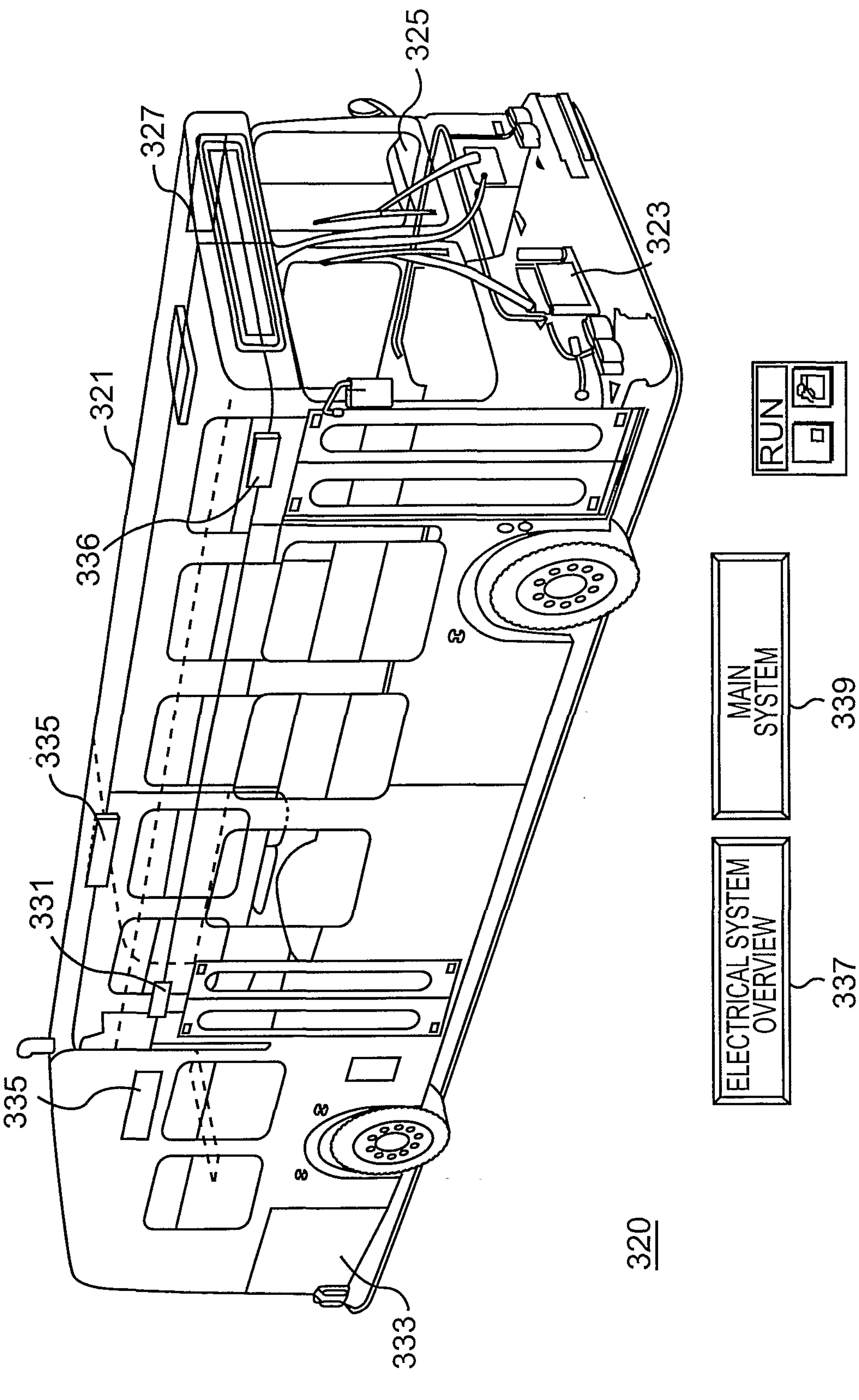
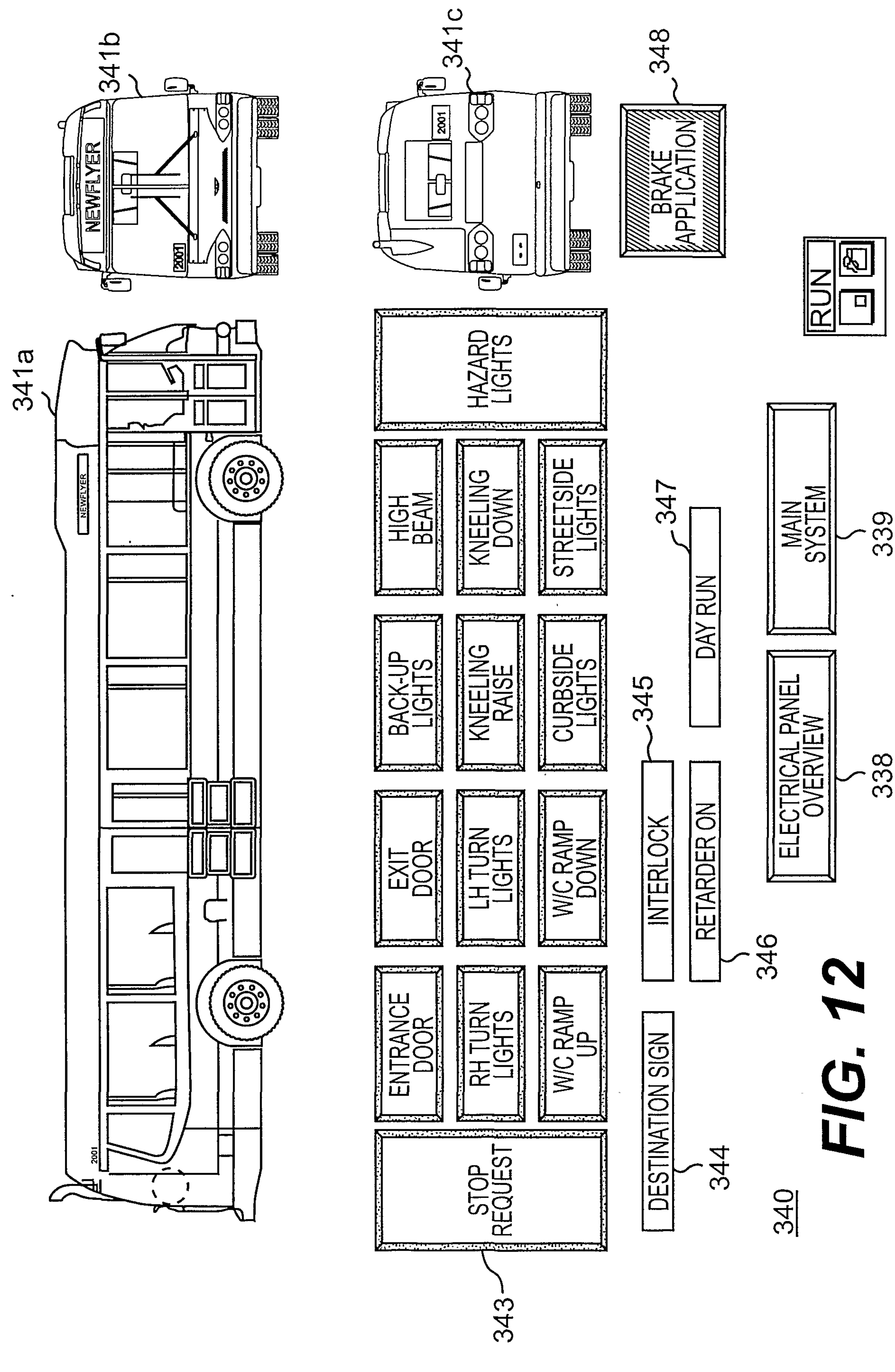

300
10/12/00
301
FRONT START ON
305
REAR START OFF
307
17:49:52
303
309
ON ENGINE IGNITION
ON ABS IGNITION
ON TRANSMISSION IGNITION
OFF HVAC
ON DESTINATION SIGN
ON COMPUTER SYSTEM
310
311
ELECTRICAL PANEL LAYOUT
ABS SYSTEM DIAGNOSTICS
312
HVAC CONTROL SYSTEM
313
314
ELECTRICAL SYSTEM OVERVIEW
ENGINE DIAGNOSTICS
315
HVAC DIAGNOSTIC SYSTEM
316
317
UPS SYSTEM
TRANSMISSION DIAGNOSTICS
318
SL5 PROGRAM
319
302
CLOSE
VEHICLE DIAGNOSTICS
304
RUN

FIG. 10

FIG. 11


325
327
323
321
336
335
331
335
333
320
RUN
MAIN SYSTEM
339
ELECTRICAL SYSTEM OVERVIEW
337



341a
341b
341c
NEWFLYER
2001
348
BRAKE APPLICATION
RUN
HAZARD LIGHTS
HIGH BEAM
KNEELING DOWN
STREETSIDE LIGHTS
BACK-UP LIGHTS
KNEELING RAISE
CURBSIDE LIGHTS
EXIT DOOR
LH TURN LIGHTS
W/C RAMP DOWN
ENTRANCE DOOR
RH TURN LIGHTS
W/C RAMP UP
STOP REQUEST
343
DESTINATION SIGN
344
INTERLOCK
345
RETARDER ON
346
DAY RUN
347
ELECTRICAL PANEL OVERVIEW
338
MAIN SYSTEM
339
340

FIG. 12

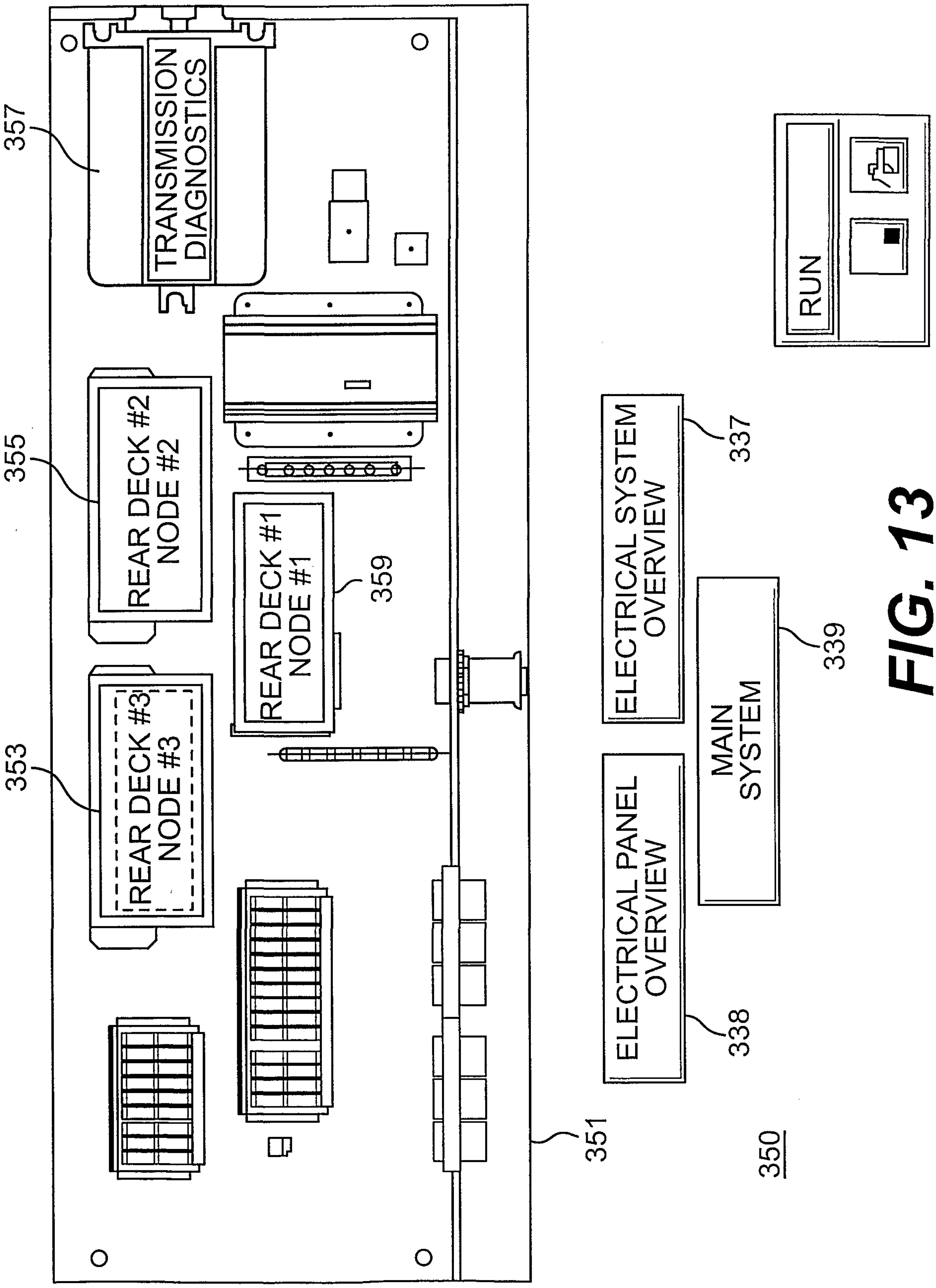

TRANSMISSION DIAGNOSTICS
357
REAR DECK #2 NODE #2
355
REAR DECK #1 NODE #1
359
REAR DECK #3 NODE #3
353
351
ELECTRICAL SYSTEM OVERVIEW
337
MAIN SYSTEM
339
ELECTRICAL PANEL OVERVIEW
338
RUN
350

FIG. 13

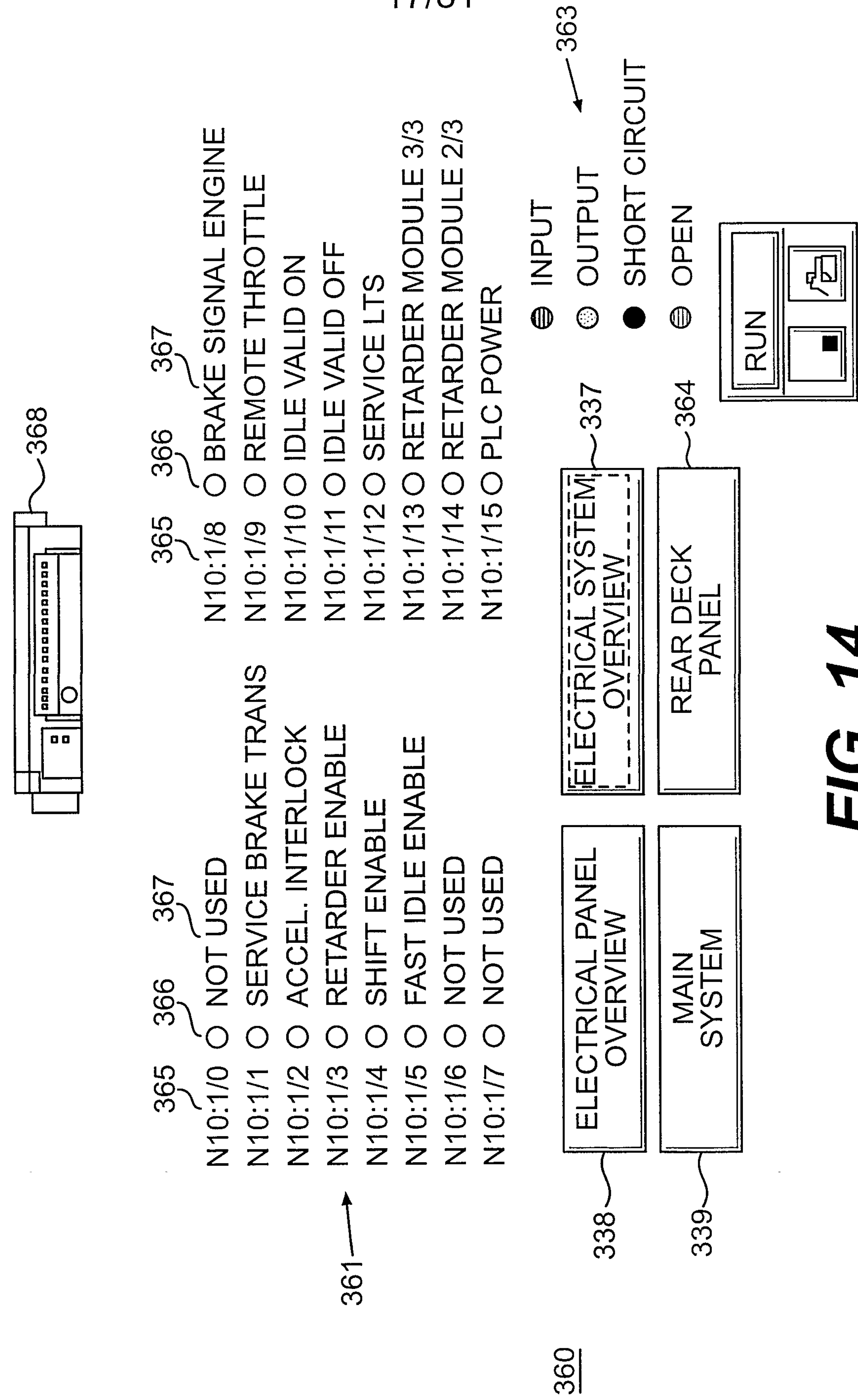

360
361
365
366
367
368
N10:1/0 NOT USED
N10:1/1 SERVICE BRAKE TRANS
N10:1/2 ACCEL. INTERLOCK
N10:1/3 RETARDER ENABLE
N10:1/4 SHIFT ENABLE
N10:1/5 FAST IDLE ENABLE
N10:1/6 NOT USED
N10:1/7 NOT USED
N10:1/8 BRAKE SIGNAL ENGINE
N10:1/9 REMOTE THROTTLE
N10:1/10 IDLE VALID ON
N10:1/11 IDLE VALID OFF
N10:1/12 SERVICE LTS
N10:1/13 RETARDER MODULE 3/3
N10:1/14 RETARDER MODULE 2/3
N10:1/15 PLC POWER
363
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
338
ELECTRICAL PANEL OVERVIEW
339
MAIN SYSTEM
337
ELECTRICAL SYSTEM OVERVIEW
364
REAR DECK PANEL
RUN

FIG. 14

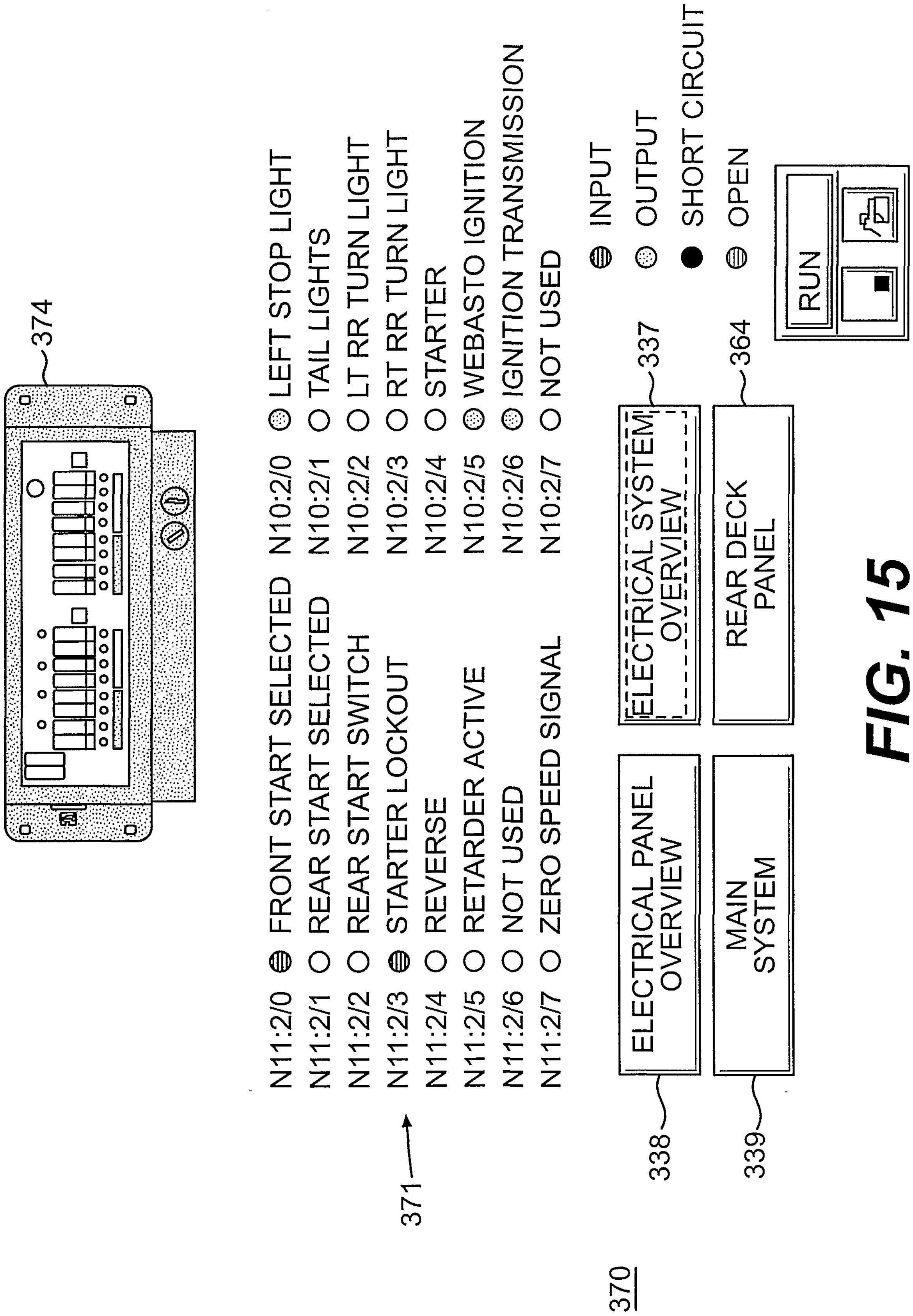

374
N11:2/0 FRONT START SELECTED
N11:2/1 REAR START SELECTED
N11:2/2 REAR START SWITCH
N11:2/3 STARTER LOCKOUT
N11:2/4 REVERSE
N11:2/5 RETARDER ACTIVE
N11:2/6 NOT USED
N11:2/7 ZERO SPEED SIGNAL
N10:2/0 LEFT STOP LIGHT
N10:2/1 TAIL LIGHTS
N10:2/2 LT RR TURN LIGHT
N10:2/3 RT RR TURN LIGHT
N10:2/4 STARTER
N10:2/5 WEBASTO IGNITION
N10:2/6 IGNITION TRANSMISSION
N10:2/7 NOT USED
371
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
ELECTRICAL PANEL OVERVIEW
338
ELECTRICAL SYSTEM OVERVIEW
337
MAIN SYSTEM
339
REAR DECK PANEL
364
RUN
370

FIG. 15

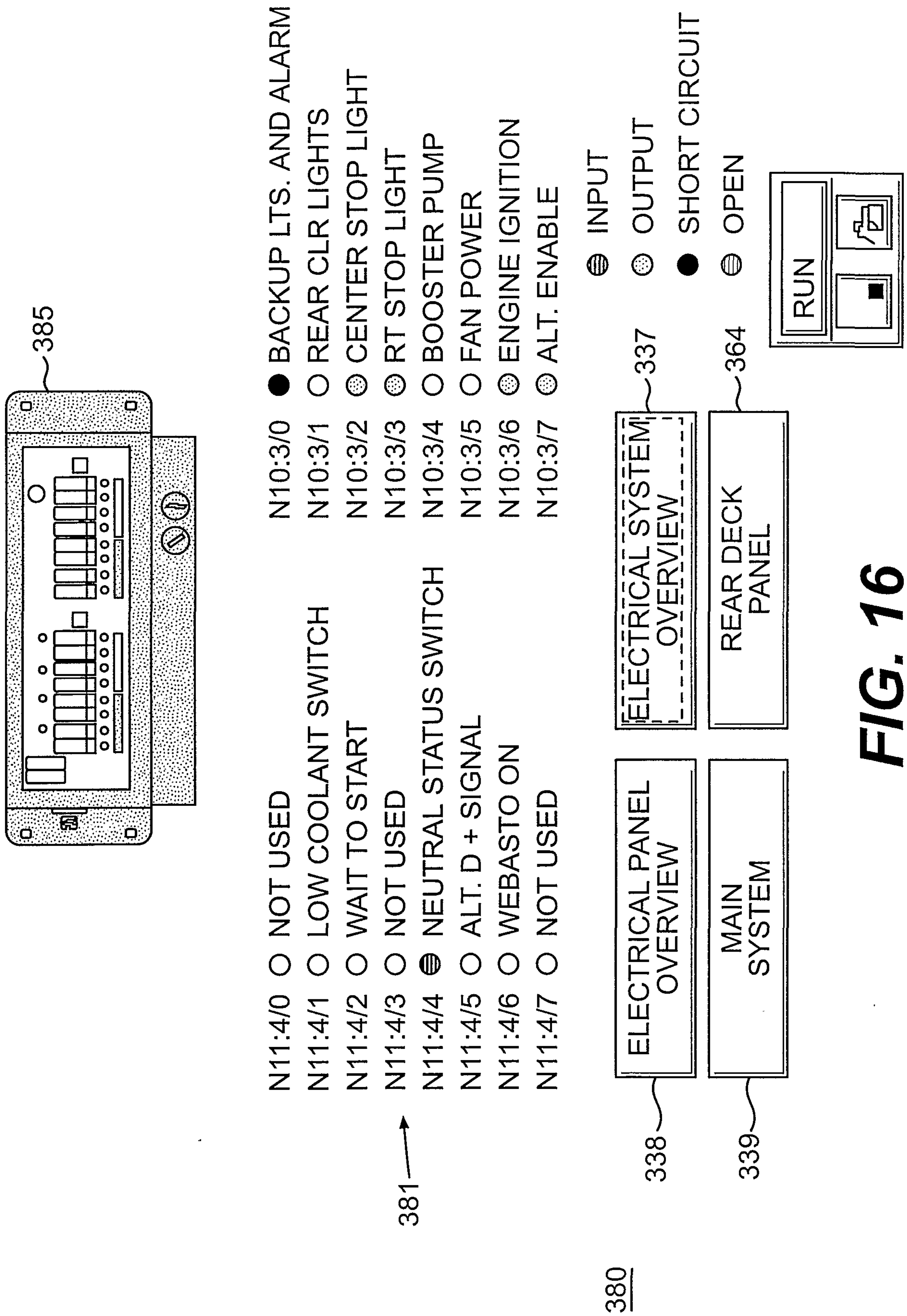

385
N11:4/0 NOT USED
N11:4/1 LOW COOLANT SWITCH
N11:4/2 WAIT TO START
N11:4/3 NOT USED
N11:4/4 NEUTRAL STATUS SWITCH
N11:4/5 ALT. D + SIGNAL
N11:4/6 WEBASTO ON
N11:4/7 NOT USED
N10:3/0 BACKUP LTS. AND ALARM
N10:3/1 REAR CLR LIGHTS
N10:3/2 CENTER STOP LIGHT
N10:3/3 RT STOP LIGHT
N10:3/4 BOOSTER PUMP
N10:3/5 FAN POWER
N10:3/6 ENGINE IGNITION
N10:3/7 ALT. ENABLE
381
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
337
338
MAIN SYSTEM
REAR DECK PANEL
364
339
RUN
380

FIG. 16

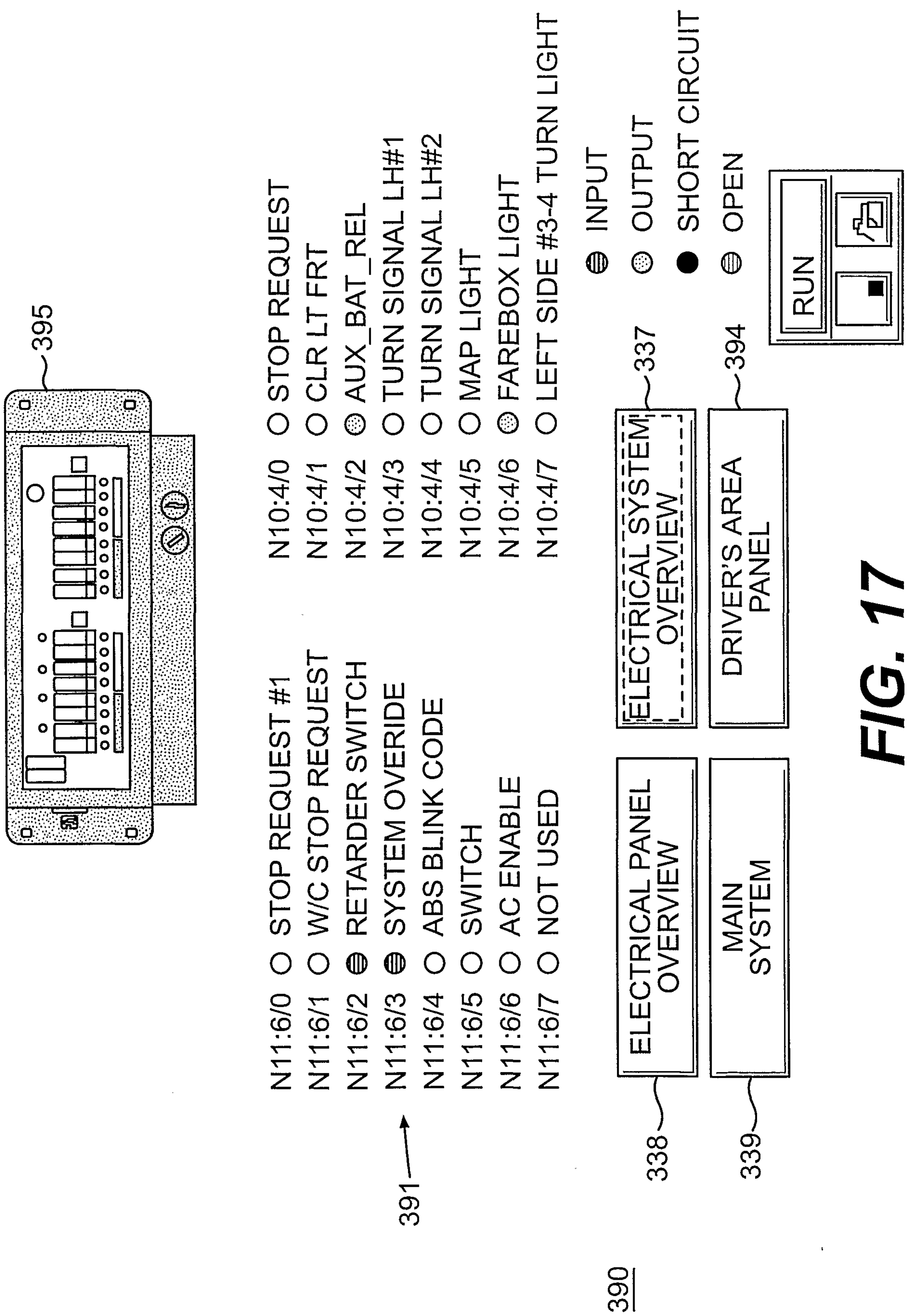

395
N11:6/0 STOP REQUEST #1
N11:6/1 W/C STOP REQUEST
N11:6/2 RETARDER SWITCH
N11:6/3 SYSTEM OVERIDE
N11:6/4 ABS BLINK CODE
N11:6/5 SWITCH
N11:6/6 AC ENABLE
N11:6/7 NOT USED
N10:4/0 STOP REQUEST
N10:4/1 CLR LT FRT
N10:4/2 AUX_BAT_REL
N10:4/3 TURN SIGNAL LH#1
N10:4/4 TURN SIGNAL LH#2
N10:4/5 MAP LIGHT
N10:4/6 FAREBOX LIGHT
N10:4/7 LEFT SIDE #3-4 TURN LIGHT
391
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
RUN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
DRIVER'S AREA PANEL
338
337
339
394
390

FIG. 17

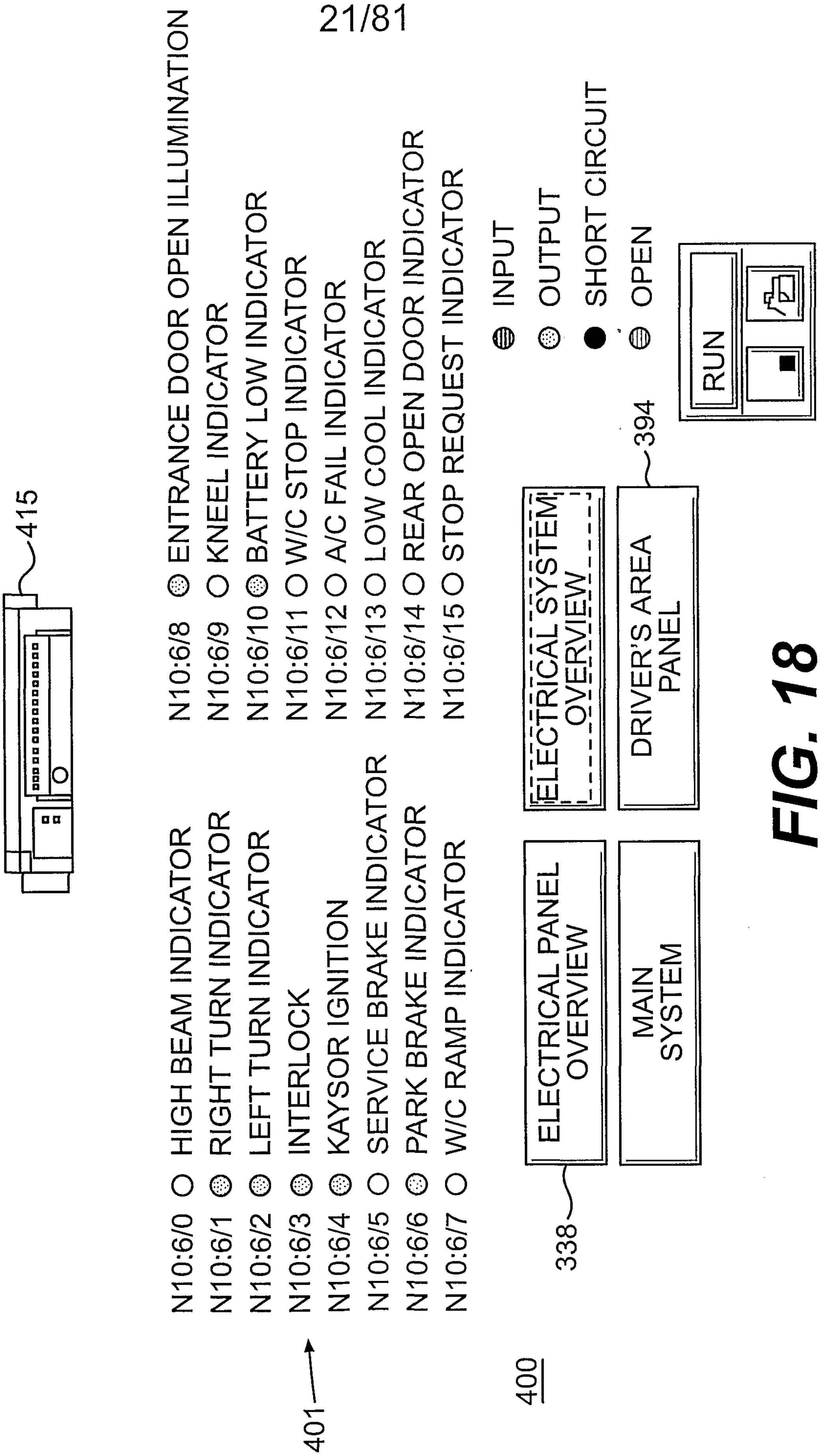

415
401
N10:6/0 HIGH BEAM INDICATOR
N10:6/1 RIGHT TURN INDICATOR
N10:6/2 LEFT TURN INDICATOR
N10:6/3 INTERLOCK
N10:6/4 KAYSOR IGNITION
N10:6/5 SERVICE BRAKE INDICATOR
N10:6/6 PARK BRAKE INDICATOR
N10:6/7 W/C RAMP INDICATOR
N10:6/8 ENTRANCE DOOR OPEN ILLUMINATION
N10:6/9 KNEEL INDICATOR
N10:6/10 BATTERY LOW INDICATOR
N10:6/11 W/C STOP INDICATOR
N10:6/12 A/C FAIL INDICATOR
N10:6/13 LOW COOL INDICATOR
N10:6/14 REAR OPEN DOOR INDICATOR
N10:6/15 STOP REQUEST INDICATOR
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
400
338
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
DRIVER'S AREA PANEL
394
RUN

FIG. 18

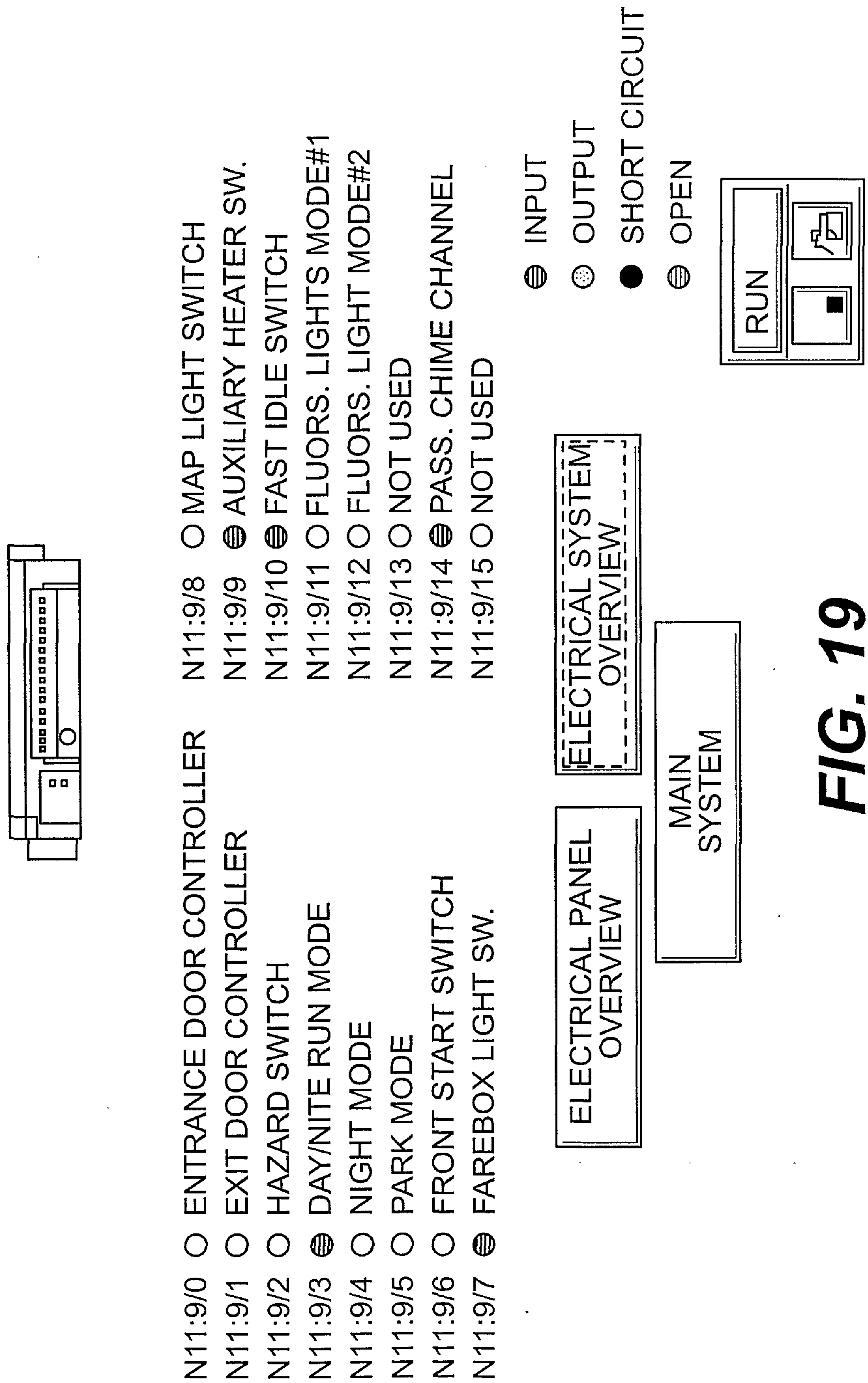

N11:9/0 ENTRANCE DOOR CONTROLLER
N11:9/1 EXIT DOOR CONTROLLER
N11:9/2 HAZARD SWITCH
N11:9/3 DAY/NITE RUN MODE
N11:9/4 NIGHT MODE
N11:9/5 PARK MODE
N11:9/6 FRONT START SWITCH
N11:9/7 FAREBOX LIGHT SW.
N11:9/8 MAP LIGHT SWITCH
N11:9/9 AUXILIARY HEATER SW.
N11:9/10 FAST IDLE SWITCH
N11:9/11 FLUORS. LIGHTS MODE#1
N11:9/12 FLUORS. LIGHT MODE#2
N11:9/13 NOT USED
N11:9/14 PASS. CHIME CHANNEL
N11:9/15 NOT USED
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
RUN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM

FIG. 19

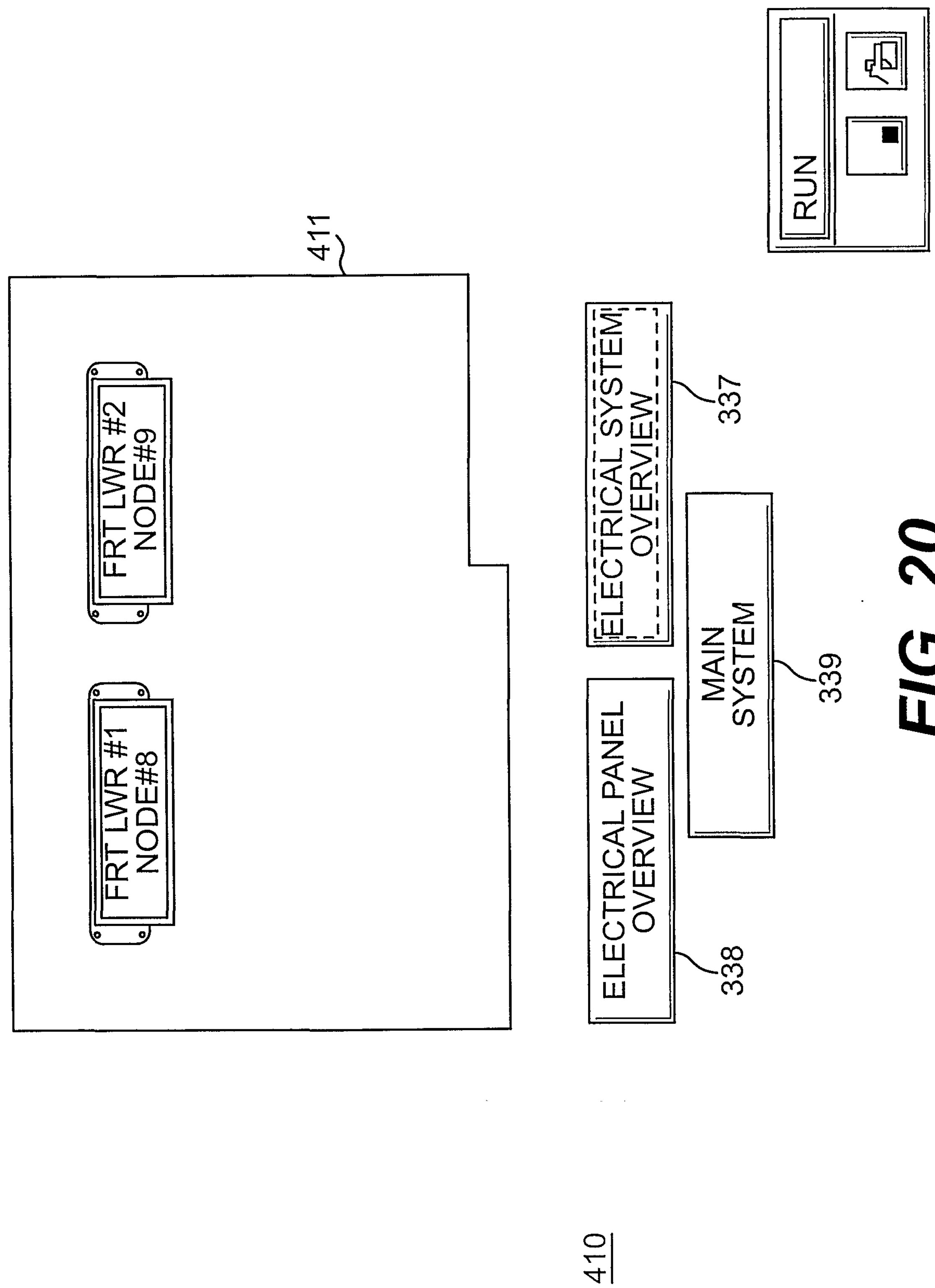

RUN
411
FRT LWR #2
NODE#9
FRT LWR #1
NODE#8
ELECTRICAL SYSTEM
OVERVIEW
337
MAIN
SYSTEM
339
ELECTRICAL PANEL
OVERVIEW
338
410

FIG. 20

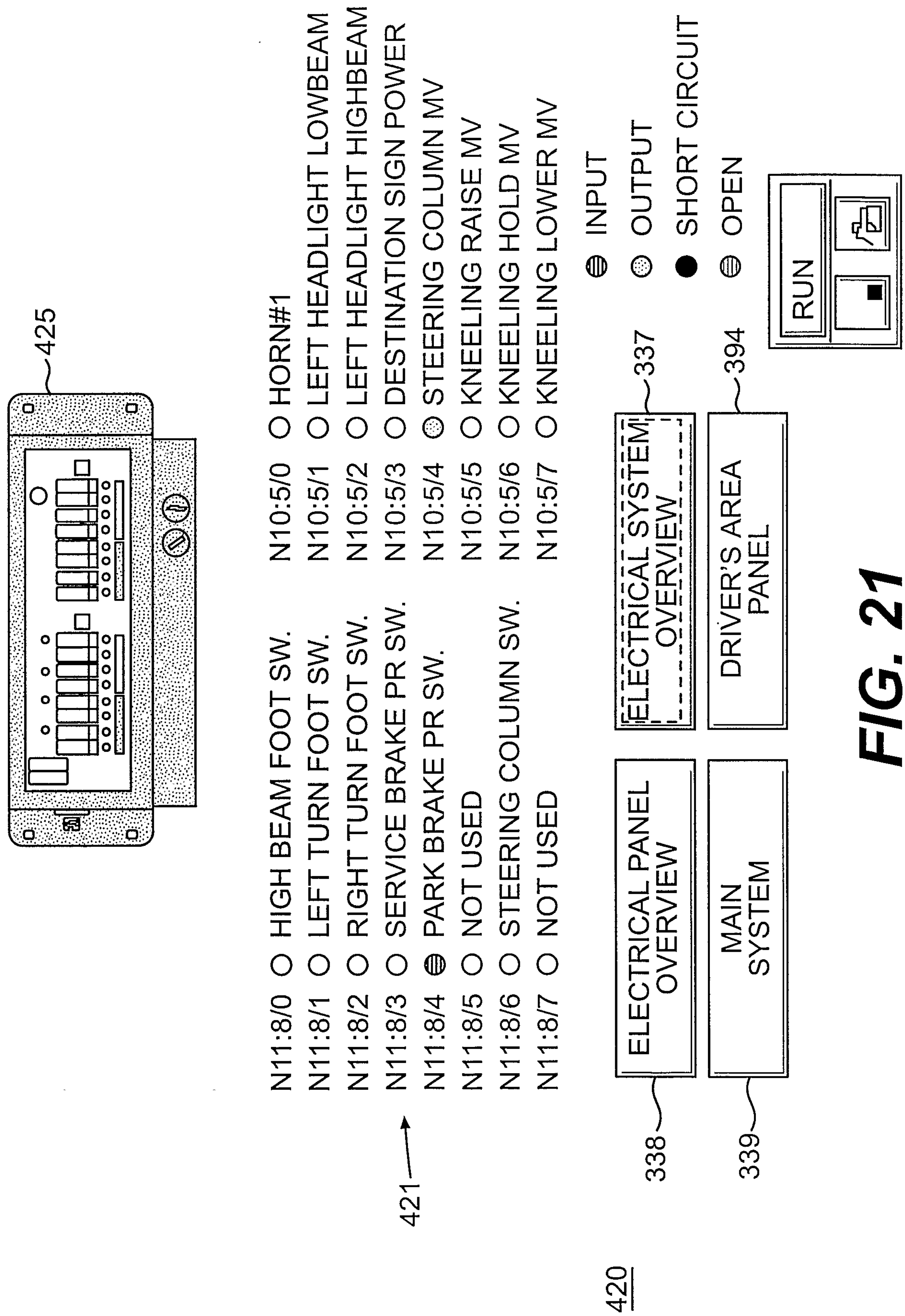

425
N11:8/0 HIGH BEAM FOOT SW.
N11:8/1 LEFT TURN FOOT SW.
N11:8/2 RIGHT TURN FOOT SW.
N11:8/3 SERVICE BRAKE PR SW.
N11:8/4 PARK BRAKE PR SW.
N11:8/5 NOT USED
N11:8/6 STEERING COLUMN SW.
N11:8/7 NOT USED
N10:5/0 HORN#1
N10:5/1 LEFT HEADLIGHT LOWBEAM
N10:5/2 LEFT HEADLIGHT HIGHBEAM
N10:5/3 DESTINATION SIGN POWER
N10:5/4 STEERING COLUMN MV
N10:5/5 KNEELING RAISE MV
N10:5/6 KNEELING HOLD MV
N10:5/7 KNEELING LOWER MV
421
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
337
338
MAIN SYSTEM
DRIVER'S AREA PANEL
394
339
RUN
420

FIG. 21

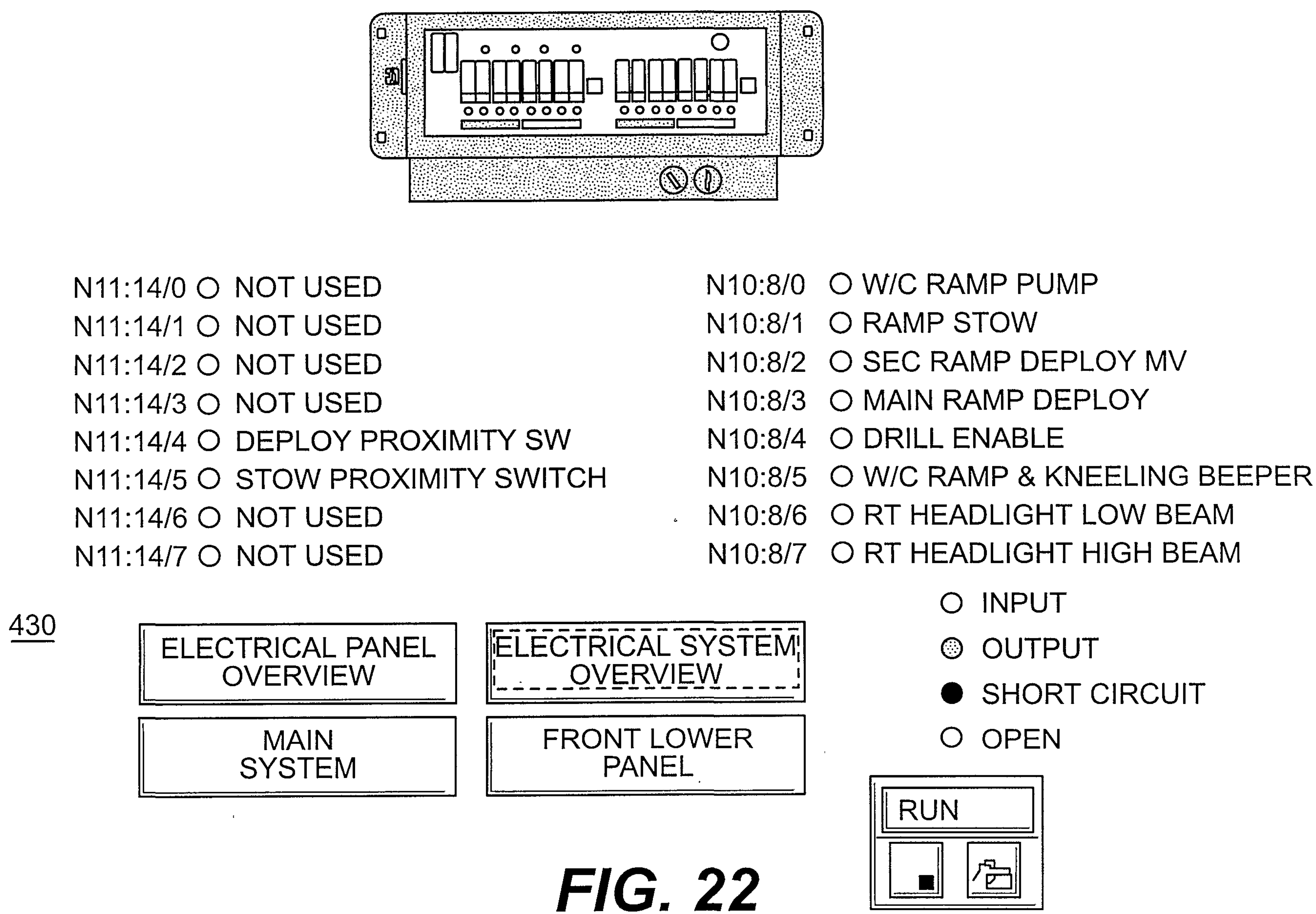

N11:14/0 NOT USED
N11:14/1 NOT USED
N11:14/2 NOT USED
N11:14/3 NOT USED
N11:14/4 DEPLOY PROXIMITY SW
N11:14/5 STOW PROXIMITY SWITCH
N11:14/6 NOT USED
N11:14/7 NOT USED
N10:8/0 W/C RAMP PUMP
N10:8/1 RAMP STOW
N10:8/2 SEC RAMP DEPLOY MV
N10:8/3 MAIN RAMP DEPLOY
N10:8/4 DRILL ENABLE
N10:8/5 W/C RAMP & KNEELING BEEPER
N10:8/6 RT HEADLIGHT LOW BEAM
N10:8/7 RT HEADLIGHT HIGH BEAM
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
430
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
FRONT LOWER PANEL
RUN

FIG. 22

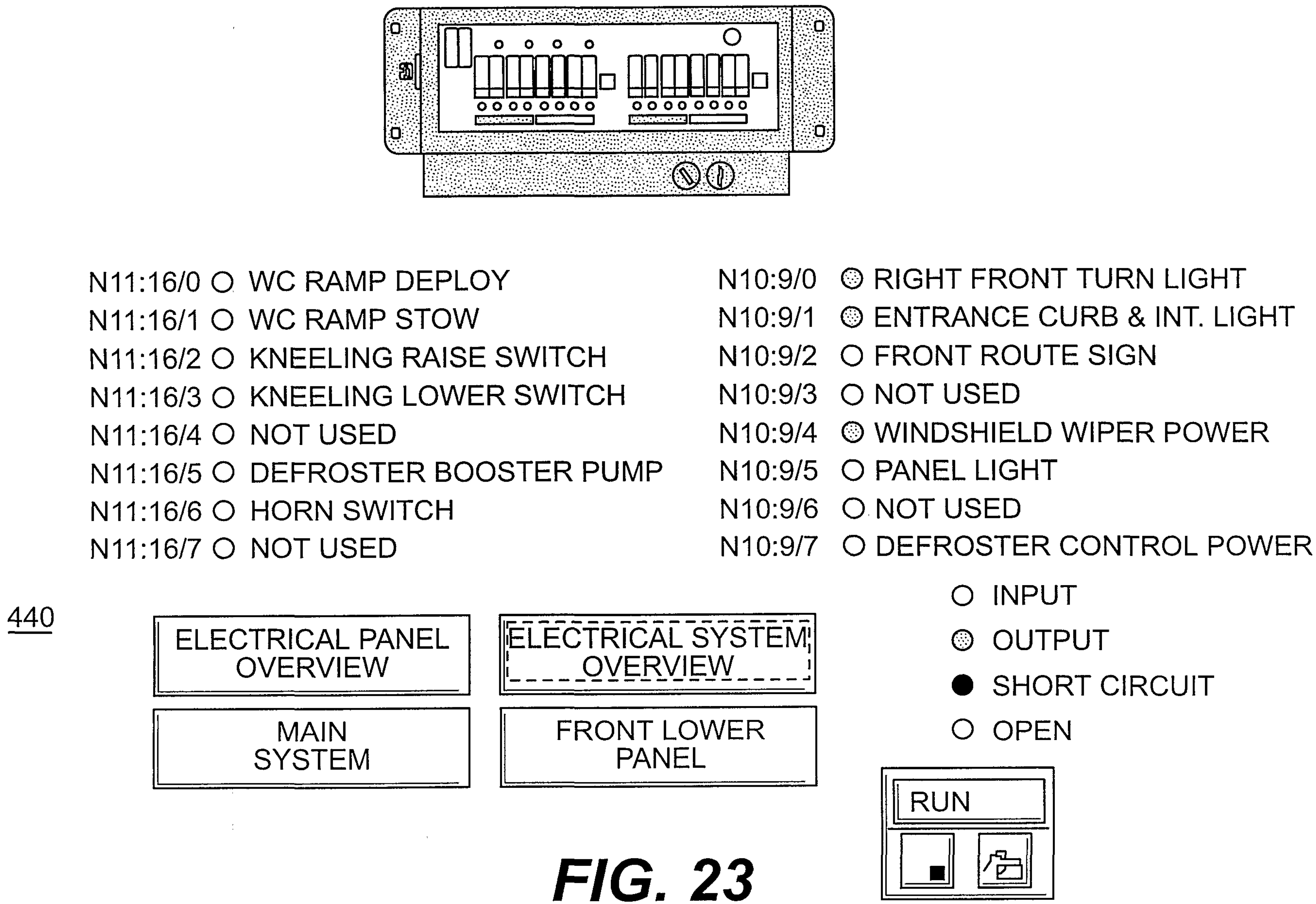

N11:16/0 WC RAMP DEPLOY
N11:16/1 WC RAMP STOW
N11:16/2 KNEELING RAISE SWITCH
N11:16/3 KNEELING LOWER SWITCH
N11:16/4 NOT USED
N11:16/5 DEFROSTER BOOSTER PUMP
N11:16/6 HORN SWITCH
N11:16/7 NOT USED
N10:9/0 RIGHT FRONT TURN LIGHT
N10:9/1 ENTRANCE CURB & INT. LIGHT
N10:9/2 FRONT ROUTE SIGN
N10:9/3 NOT USED
N10:9/4 WINDSHIELD WIPER POWER
N10:9/5 PANEL LIGHT
N10:9/6 NOT USED
N10:9/7 DEFROSTER CONTROL POWER
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
440
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
FRONT LOWER PANEL
RUN

FIG. 23

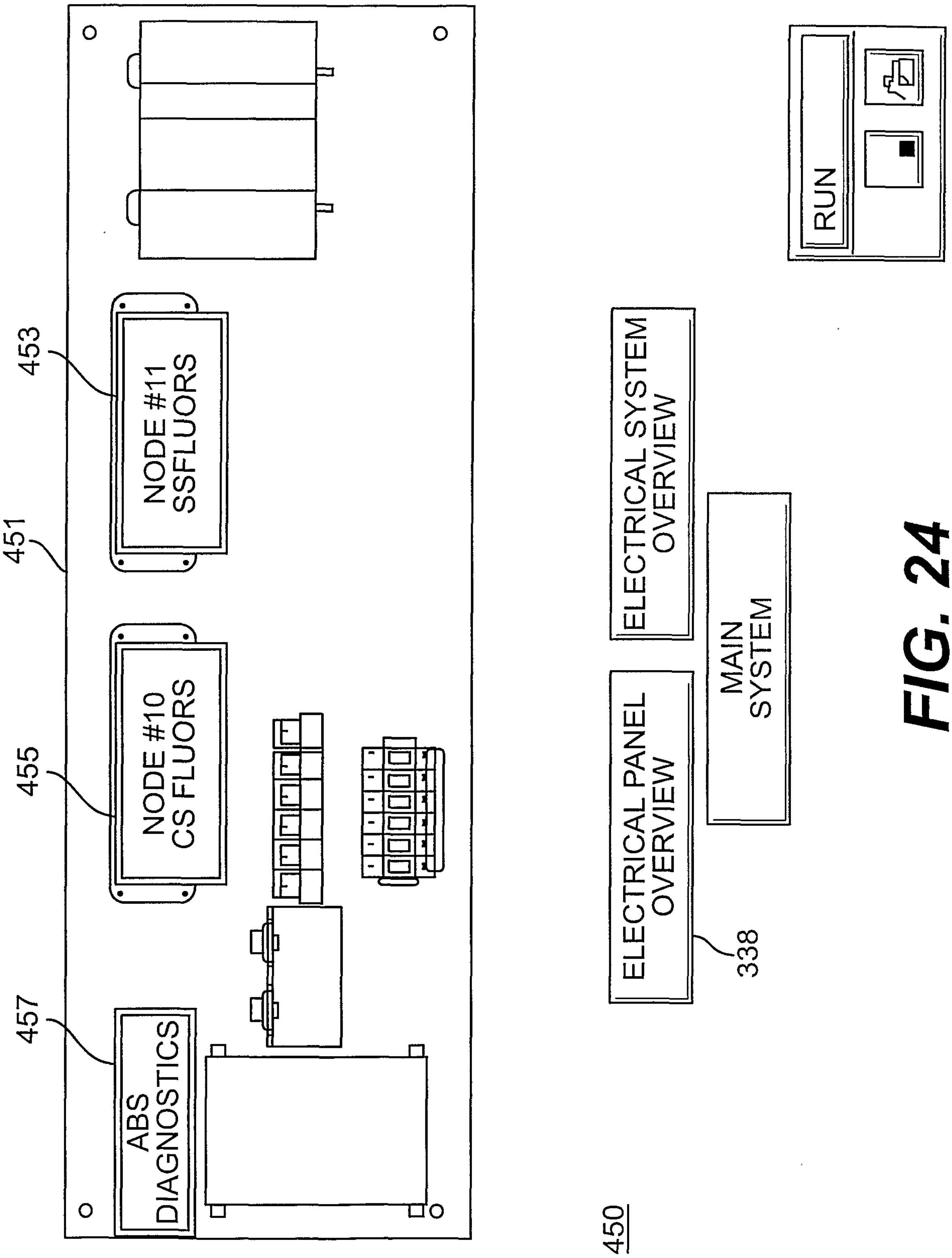
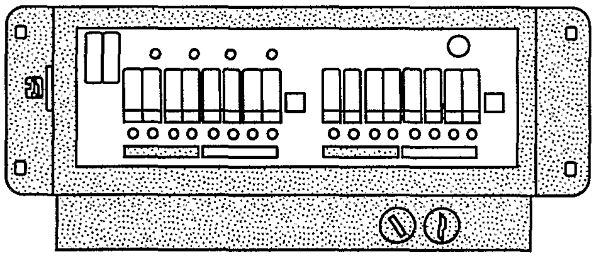

453
NODE #11
SSFLUORS
451
455
NODE #10
CS FLUORS
457
ABS
DIAGNOSTICS
RUN
ELECTRICAL SYSTEM
OVERVIEW
MAIN
SYSTEM
ELECTRICAL PANEL
OVERVIEW
338
450

FIG. 24



N11:18/0	NOT USED	N10:10/0	NOT USED
N11:18/1	NOT USED	N10:10/1	FL_LT_1&2_CS
N11:18/2	NOT USED	N10:10/2	FLUORS LIGHT NO. 1 & 2
N11:18/3	NOT USED	N10:10/3	FLUORS LIGHT NO. 3 & 4
N11:18/4	NOT USED	N10:10/4	FLUORS LIGHT NO. 5 & 6
N11:18/5	NOT USED	N10:10/5	FLUORS LIGHT NO. 7 & 8
N11:18/6	NOT USED	N10:10/6	SERVO POWER SS
N11:18/7	NOT USED	N10:10/7	SERVO POWER CS

INPUT
OUTPUT
SHORT CIRCUIT
OPEN

ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
CURBSIDE PANEL

RUN

FIG. 25

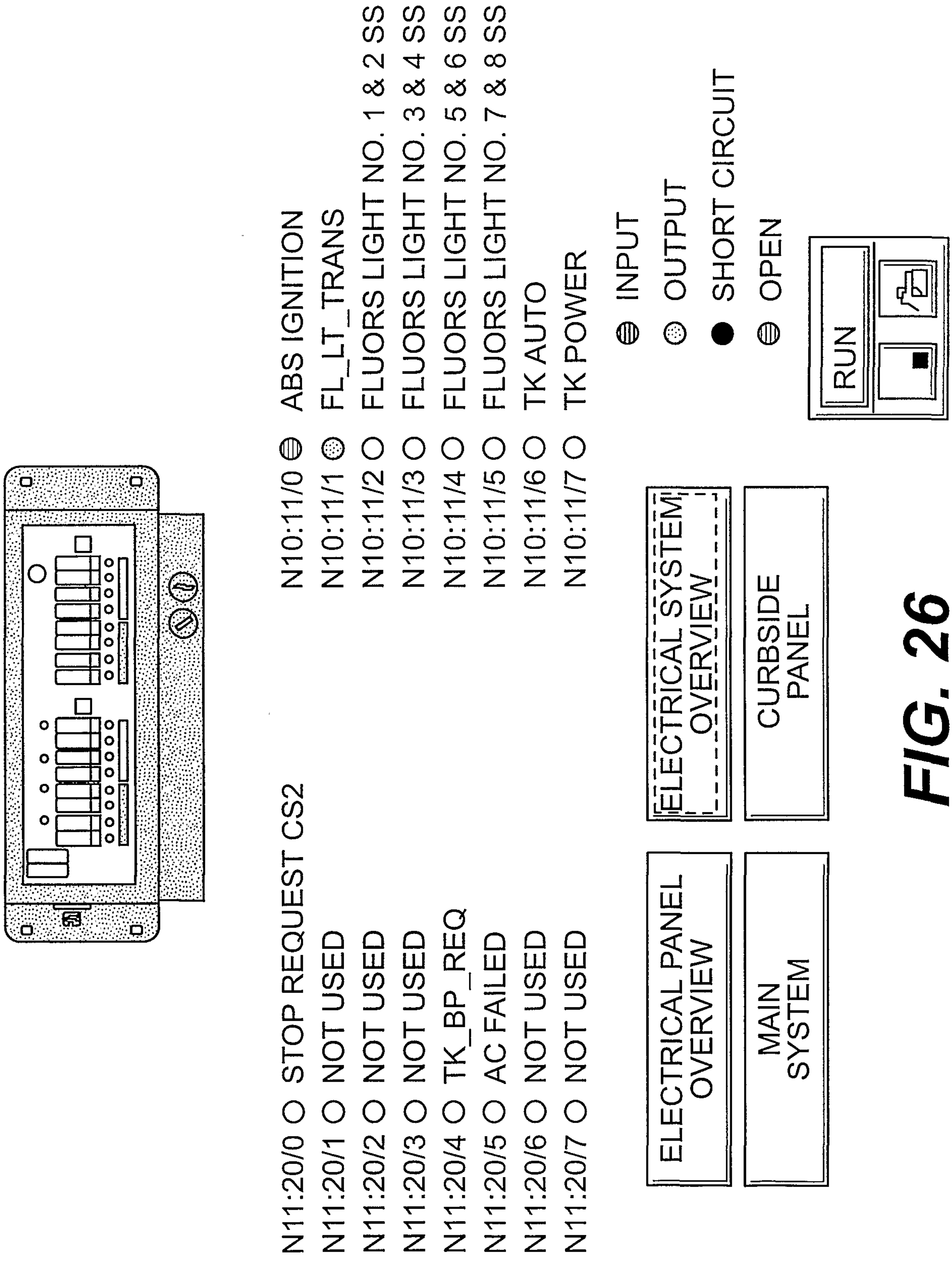

N11:20/0 STOP REQUEST CS2
N11:20/1 NOT USED
N11:20/2 NOT USED
N11:20/3 NOT USED
N11:20/4 TK_BP_REQ
N11:20/5 AC FAILED
N11:20/6 NOT USED
N11:20/7 NOT USED
N10:11/0 ABS IGNITION
N10:11/1 FL_LT_TRANS
N10:11/2 FLUORS LIGHT NO. 1 & 2 SS
N10:11/3 FLUORS LIGHT NO. 3 & 4 SS
N10:11/4 FLUORS LIGHT NO. 5 & 6 SS
N10:11/5 FLUORS LIGHT NO. 7 & 8 SS
N10:11/6 TK AUTO
N10:11/7 TK POWER
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
CURBSIDE PANEL
RUN

FIG. 26

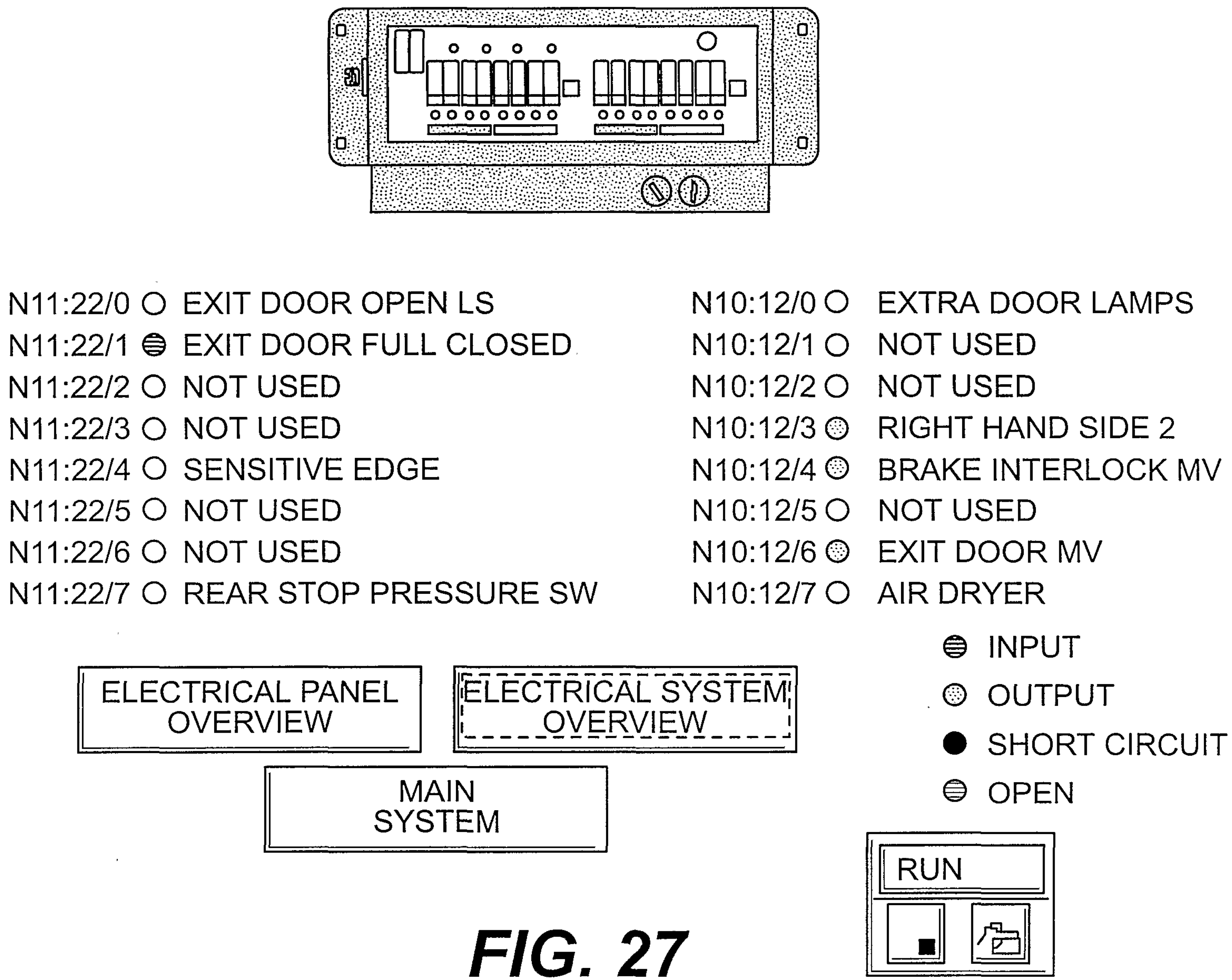

N11:22/0 EXIT DOOR OPEN LS
N11:22/1 EXIT DOOR FULL CLOSED
N11:22/2 NOT USED
N11:22/3 NOT USED
N11:22/4 SENSITIVE EDGE
N11:22/5 NOT USED
N11:22/6 NOT USED
N11:22/7 REAR STOP PRESSURE SW
N10:12/0 EXTRA DOOR LAMPS
N10:12/1 NOT USED
N10:12/2 NOT USED
N10:12/3 RIGHT HAND SIDE 2
N10:12/4 BRAKE INTERLOCK MV
N10:12/5 NOT USED
N10:12/6 EXIT DOOR MV
N10:12/7 AIR DRYER
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
RUN

FIG. 27

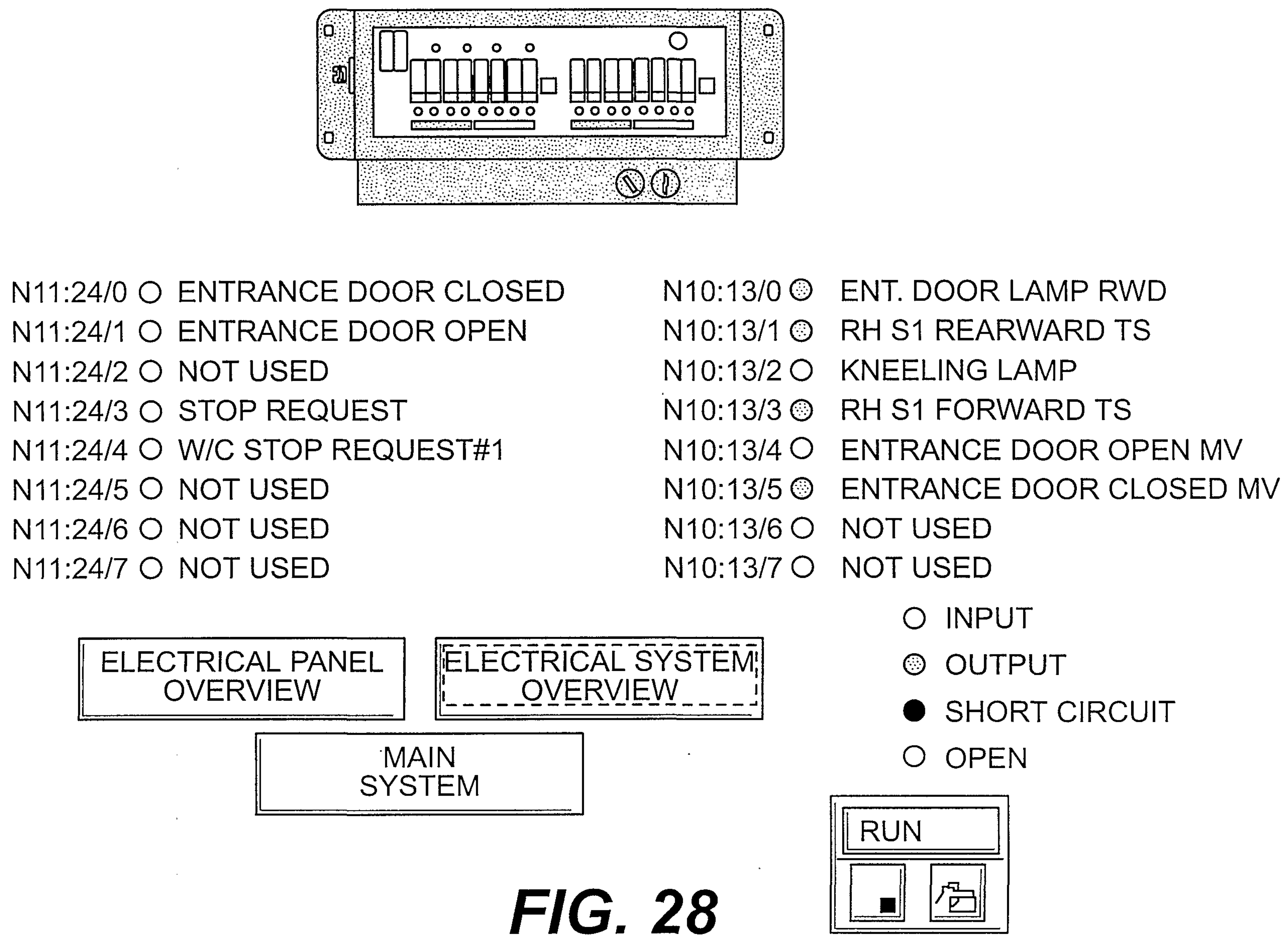

N11:24/0 ENTRANCE DOOR CLOSED
N11:24/1 ENTRANCE DOOR OPEN
N11:24/2 NOT USED
N11:24/3 STOP REQUEST
N11:24/4 W/C STOP REQUEST#1
N11:24/5 NOT USED
N11:24/6 NOT USED
N11:24/7 NOT USED
N10:13/0 ENT. DOOR LAMP RWD
N10:13/1 RH S1 REARWARD TS
N10:13/2 KNEELING LAMP
N10:13/3 RH S1 FORWARD TS
N10:13/4 ENTRANCE DOOR OPEN MV
N10:13/5 ENTRANCE DOOR CLOSED MV
N10:13/6 NOT USED
N10:13/7 NOT USED
INPUT
OUTPUT
SHORT CIRCUIT
OPEN
ELECTRICAL PANEL OVERVIEW
ELECTRICAL SYSTEM OVERVIEW
MAIN SYSTEM
RUN

FIG. 28

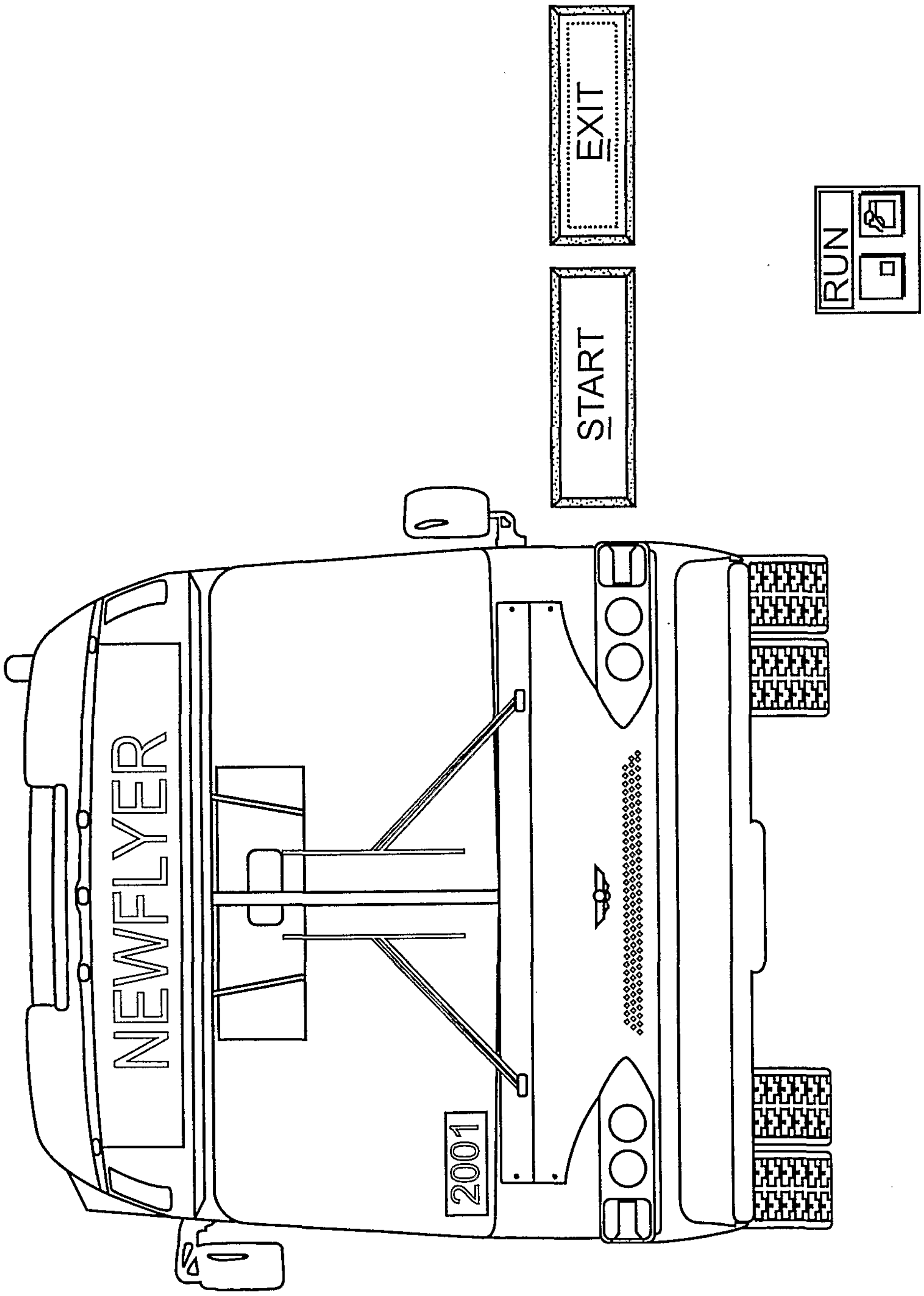


FIG. 29

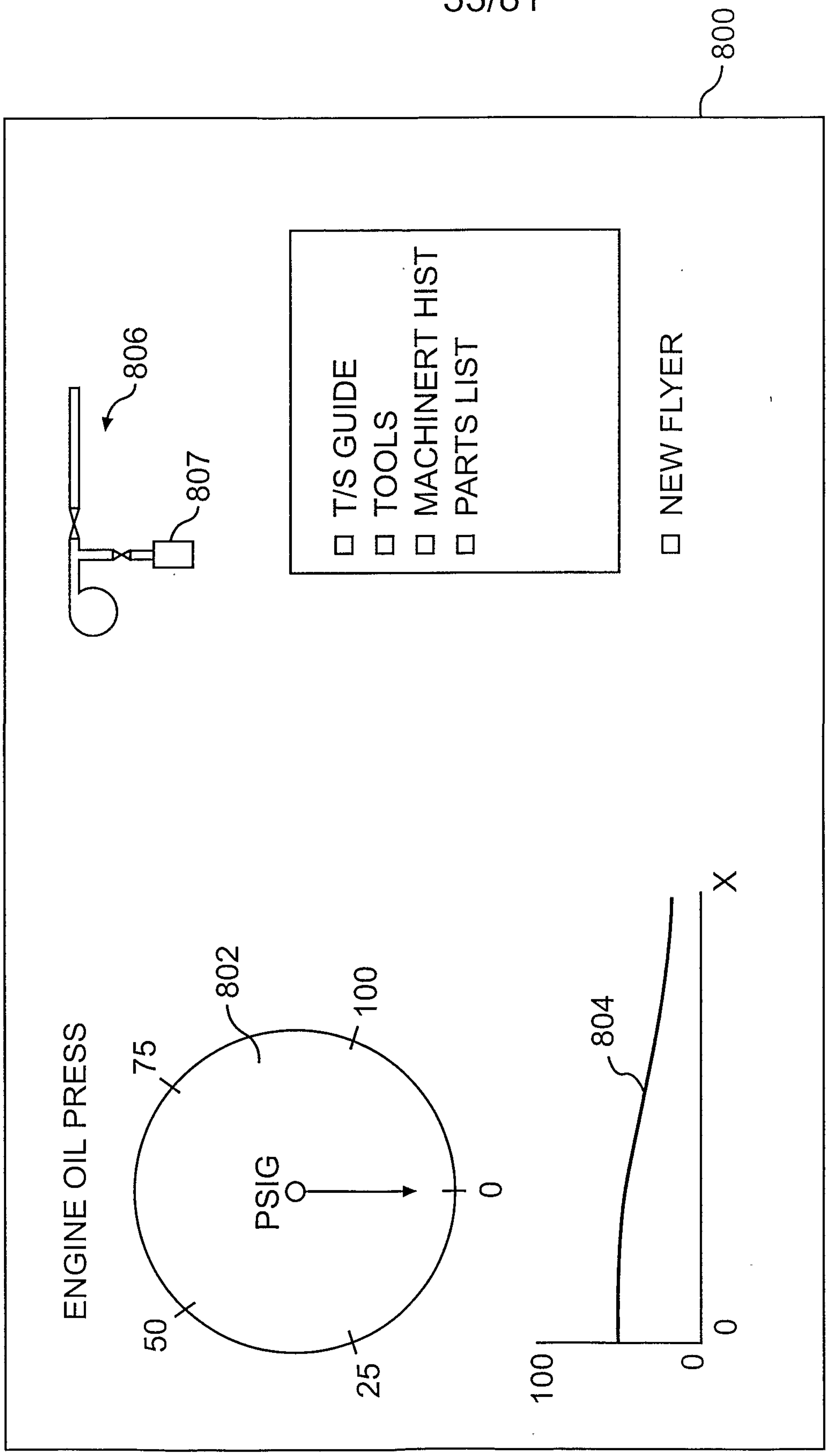

800
ENGINE OIL PRESS
PSIG
0
25
50
75
100
802
804
100
0
0
X
806
807
T/S GUIDE
TOOLS
MACHINERT HIST
PARTS LIST
NEW FLYER

FIG. 30

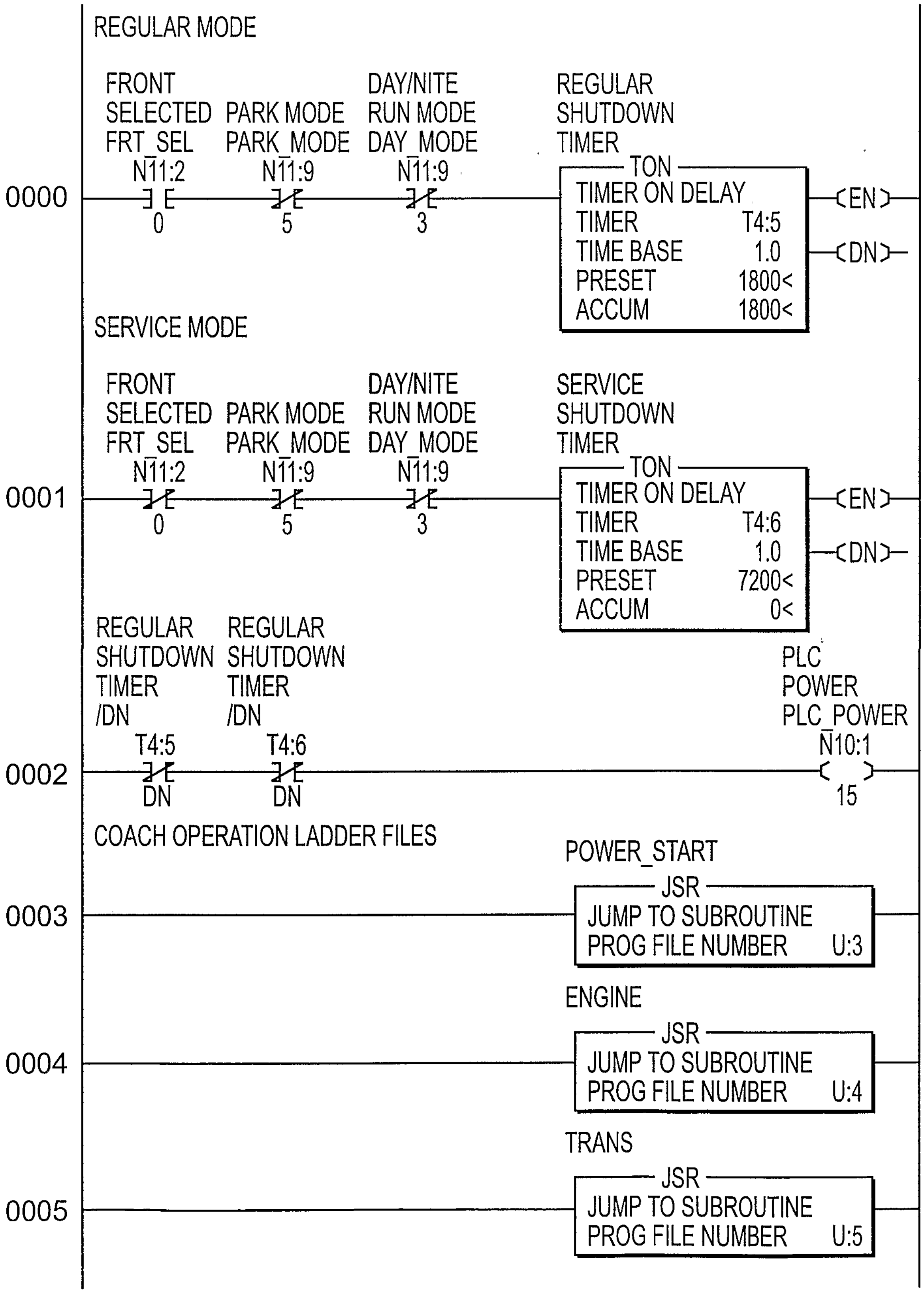
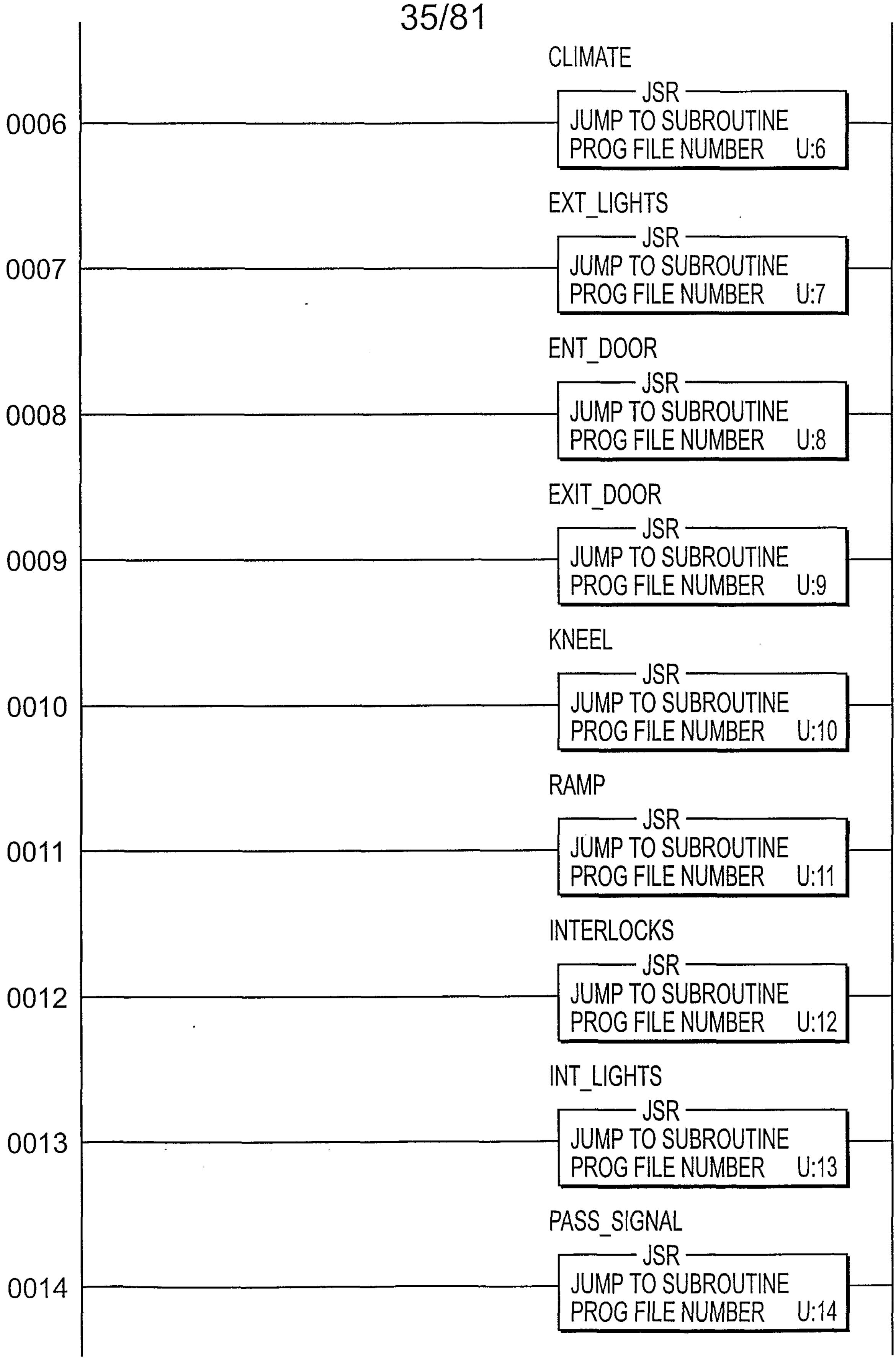

REGULAR MODE
FRONT SELECTED FRT_SEL N11:2 0
PARK MODE PARK_MODE N11:9 5
DAY/NITE RUN MODE DAY_MODE N11:9 3
REGULAR SHUTDOWN TIMER
TON
TIMER ON DELAY
TIMER T4:5
TIME BASE 1.0
PRESET 1800<
ACCUM 1800<
EN
DN
0000
SERVICE MODE
FRONT SELECTED FRT_SEL N11:2 0
PARK MODE PARK_MODE N11:9 5
DAY/NITE RUN MODE DAY_MODE N11:9 3
SERVICE SHUTDOWN TIMER
TON
TIMER ON DELAY
TIMER T4:6
TIME BASE 1.0
PRESET 7200<
ACCUM 0<
EN
DN
0001
REGULAR SHUTDOWN TIMER /DN T4:5 DN
REGULAR SHUTDOWN TIMER /DN T4:6 DN
PLC POWER PLC_POWER N10:1 15
0002
COACH OPERATION LADDER FILES
POWER_START
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:3
0003
ENGINE
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:4
0004
TRANS
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:5
0005

FIG. 31a



CLIMATE
0006
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:6
EXT_LIGHTS
0007
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:7
ENT_DOOR
0008
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:8
EXIT_DOOR
0009
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:9
KNEEL
0010
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:10
RAMP
0011
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:11
INTERLOCKS
0012
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:12
INT_LIGHTS
0013
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:13
PASS_SIGNAL
0014
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:14

FIG. 31b

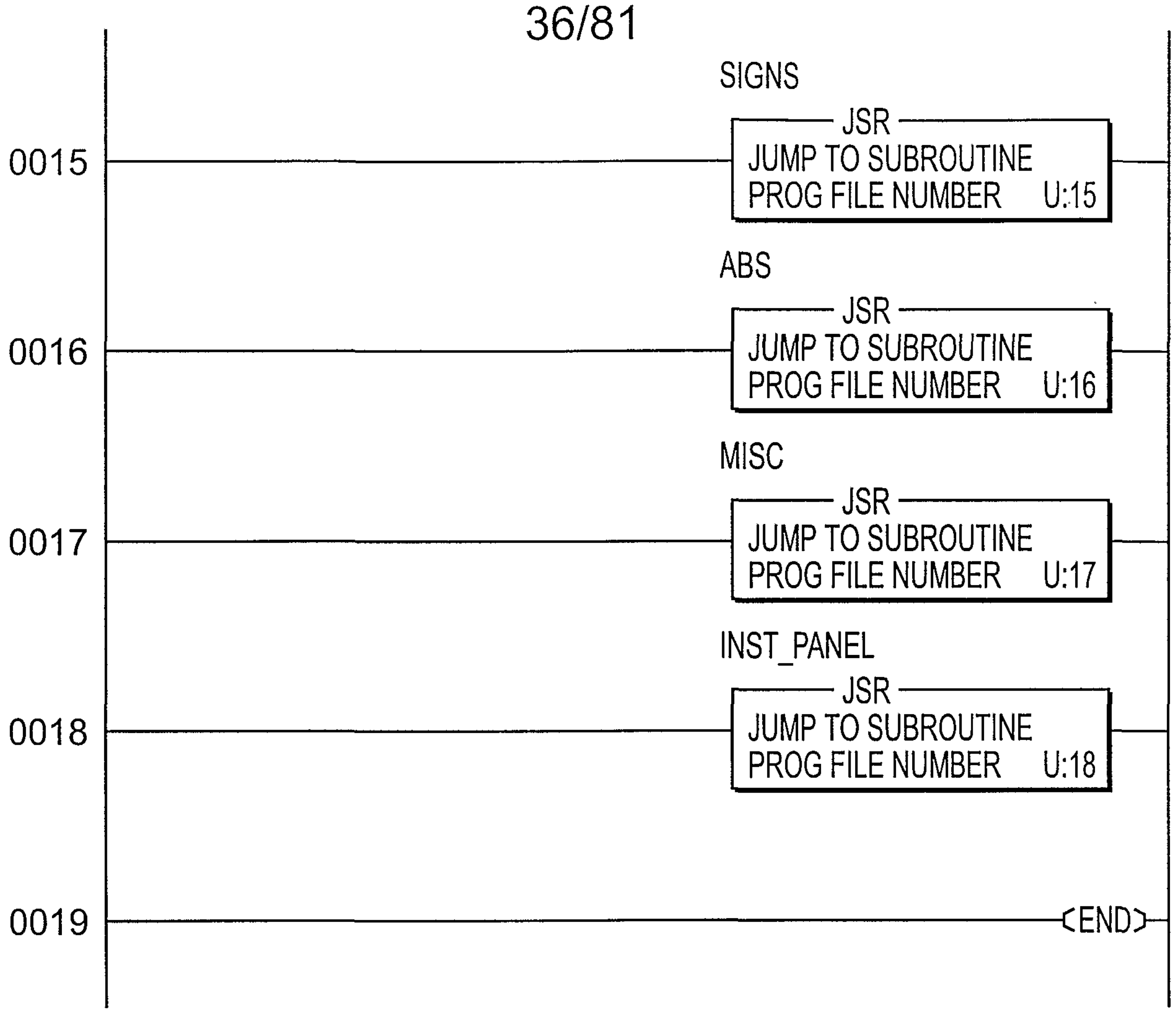

SIGNS
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:15
0015
ABS
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:16
0016
MISC
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:17
0017
INST_PANEL
JSR
JUMP TO SUBROUTINE
PROG FILE NUMBER U:18
0018
0019
END

FIG. 31c

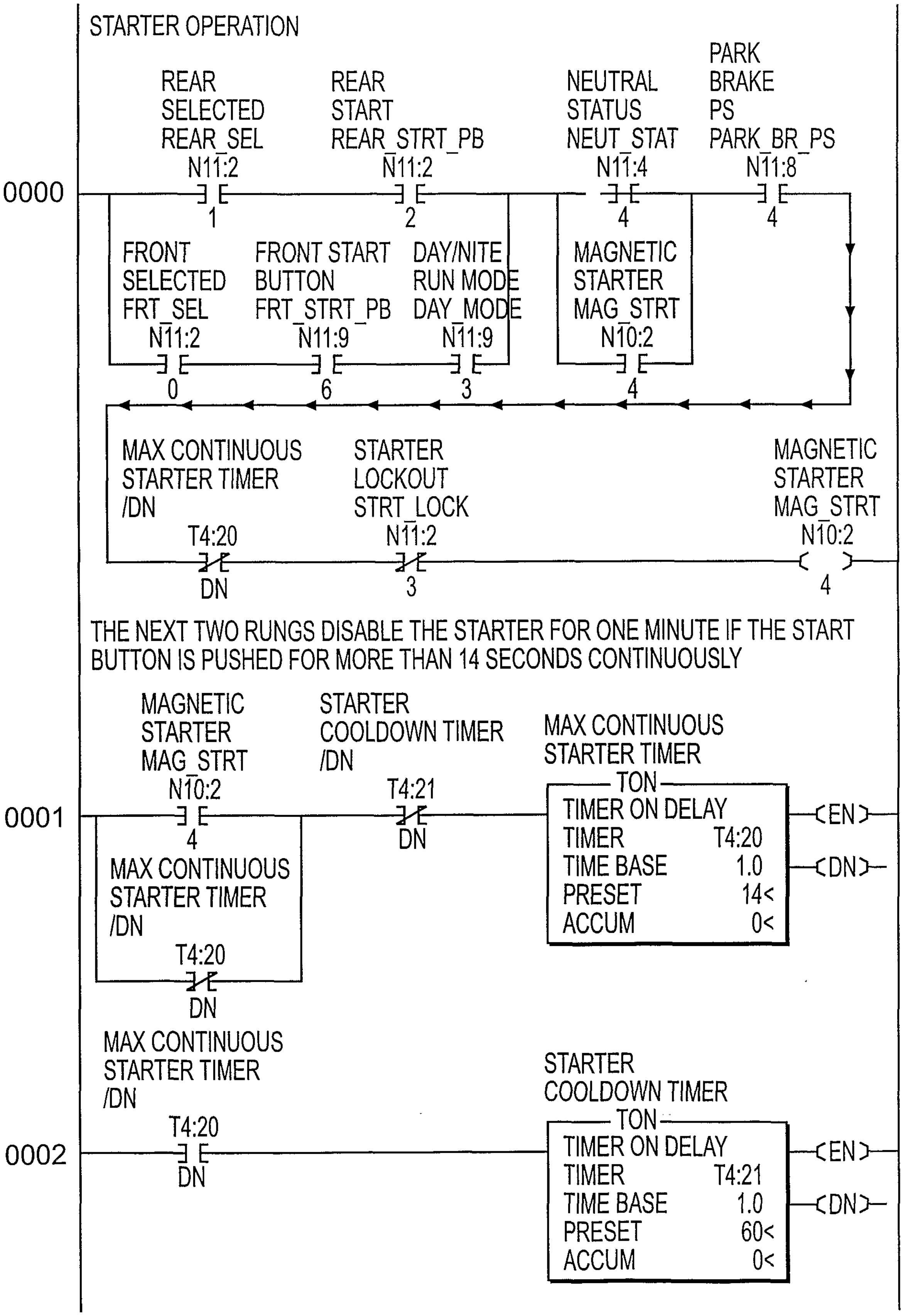

STARTER OPERATION
REAR SELECTED REAR_SEL N11:2 1
REAR START REAR_STRT_PB N11:2 2
NEUTRAL STATUS NEUT_STAT N11:4 4
PARK BRAKE PS PARK_BR_PS N11:8 4
0000
FRONT SELECTED FRT_SEL N11:2 0
FRONT START BUTTON FRT_STRT_PB N11:9 6
DAY/NITE RUN MODE DAY_MODE N11:9 3
MAGNETIC STARTER MAG_STRT N10:2 4
MAX CONTINUOUS STARTER TIMER /DN T4:20 DN
STARTER LOCKOUT STRT_LOCK N11:2 3
MAGNETIC STARTER MAG_STRT N10:2 4
THE NEXT TWO RUNGS DISABLE THE STARTER FOR ONE MINUTE IF THE START BUTTON IS PUSHED FOR MORE THAN 14 SECONDS CONTINUOUSLY
0001
MAGNETIC STARTER MAG_STRT N10:2 4
STARTER COOLDOWN TIMER /DN T4:21 DN
MAX CONTINUOUS STARTER TIMER
TON
TIMER ON DELAY
TIMER T4:20
TIME BASE 1.0
PRESET 14<
ACCUM 0<
EN
DN
MAX CONTINUOUS STARTER TIMER /DN T4:20 DN
0002
MAX CONTINUOUS STARTER TIMER /DN T4:20 DN
STARTER COOLDOWN TIMER
TON
TIMER ON DELAY
TIMER T4:21
TIME BASE 1.0
PRESET 60<
ACCUM 0<
EN
DN

FIG. 32a

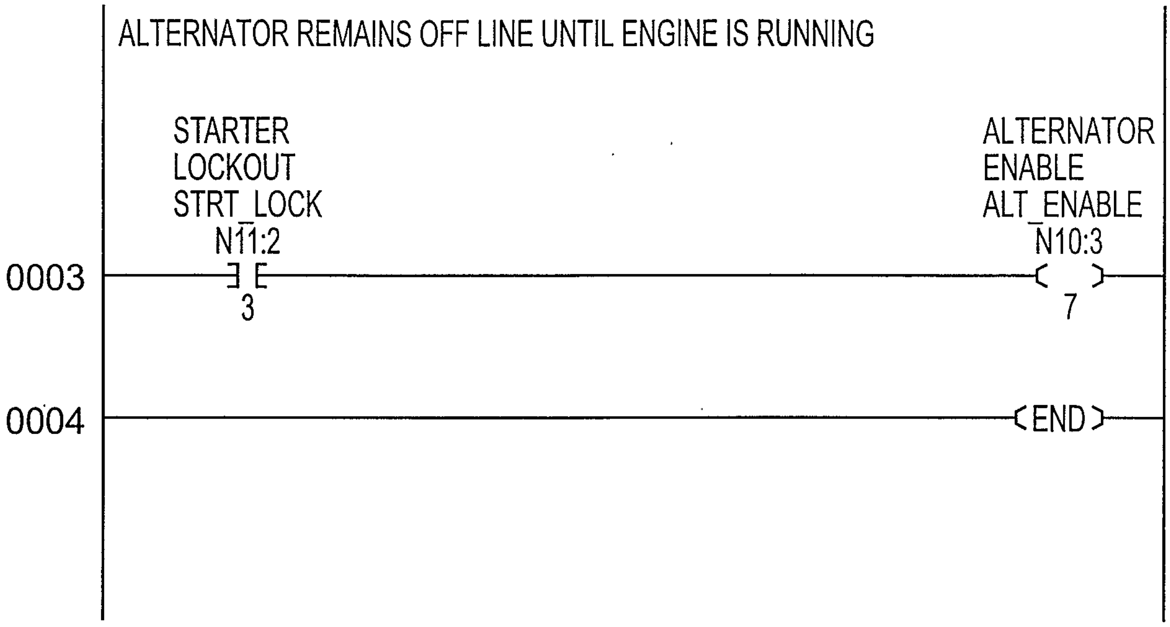

ALTERNATOR REMAINS OFF LINE UNTIL ENGINE IS RUNNING
STARTER
LOCKOUT
STRT_LOCK
N11:2
3
ALTERNATOR
ENABLE
ALT_ENABLE
N10:3
7
0003
0004
END

FIG. 32b

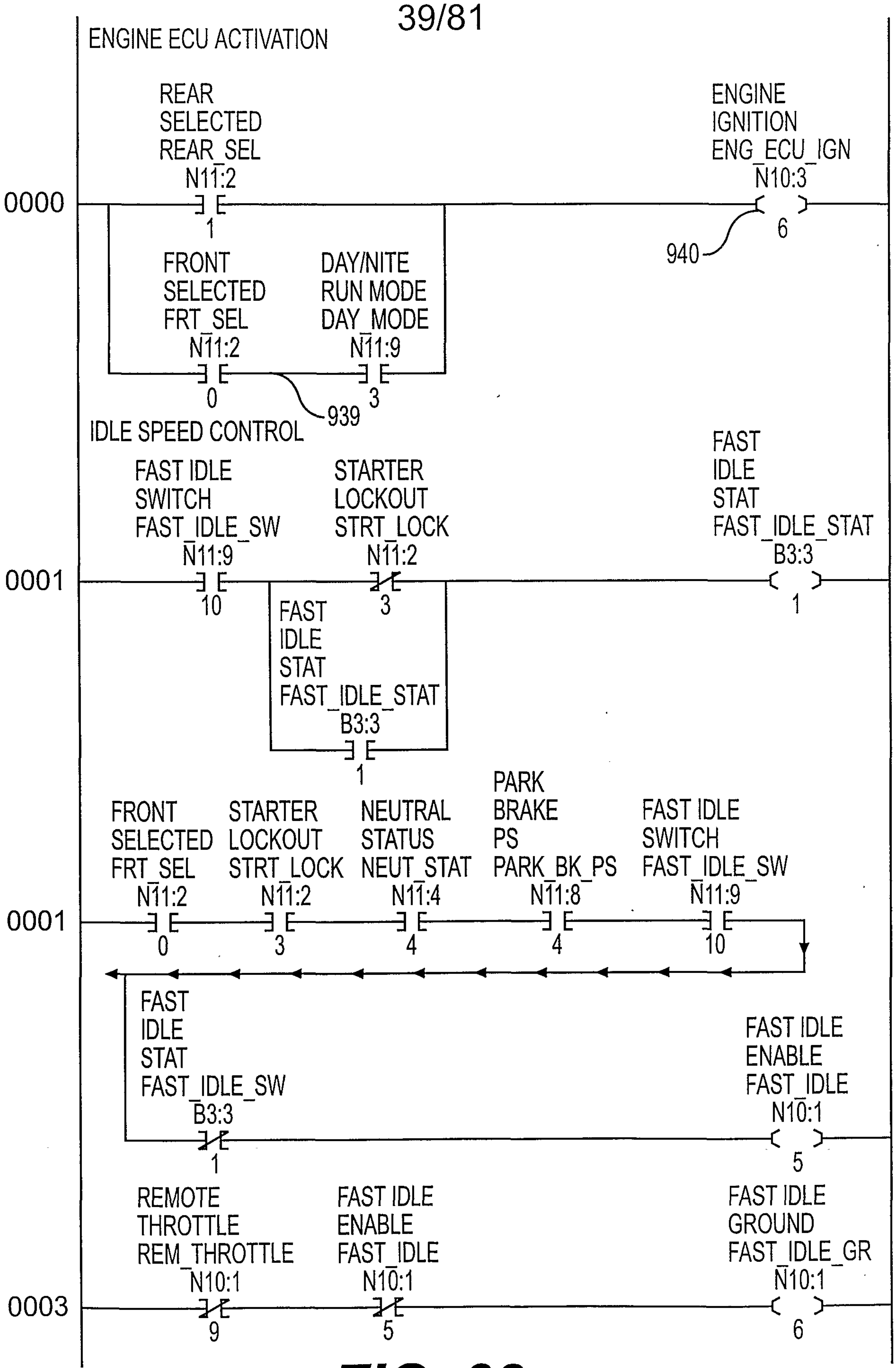

ENGINE ECU ACTIVATION
0000
REAR SELECTED REAR_SEL N11:2 1
FRONT SELECTED FRT_SEL N11:2 0
DAY/NITE RUN MODE DAY_MODE N11:9 3
939
ENGINE IGNITION ENG_ECU_IGN N10:3 6
940
IDLE SPEED CONTROL
0001
FAST IDLE SWITCH FAST_IDLE_SW N11:9 10
STARTER LOCKOUT STRT_LOCK N11:2 3
FAST IDLE STAT FAST_IDLE_STAT B3:3 1
FAST IDLE STAT FAST_IDLE_STAT B3:3 1
0001
FRONT SELECTED FRT_SEL N11:2 0
STARTER LOCKOUT STRT_LOCK N11:2 3
NEUTRAL STATUS NEUT_STAT N11:4 4
PARK BRAKE PS PARK_BK_PS N11:8 4
FAST IDLE SWITCH FAST_IDLE_SW N11:9 10
FAST IDLE STAT FAST_IDLE_SW B3:3 1
FAST IDLE ENABLE FAST_IDLE N10:1 5
0003
REMOTE THROTTLE REM_THROTTLE N10:1 9
FAST IDLE ENABLE FAST_IDLE N10:1 5
FAST IDLE GROUND FAST_IDLE_GR N10:1 6

FIG. 33a

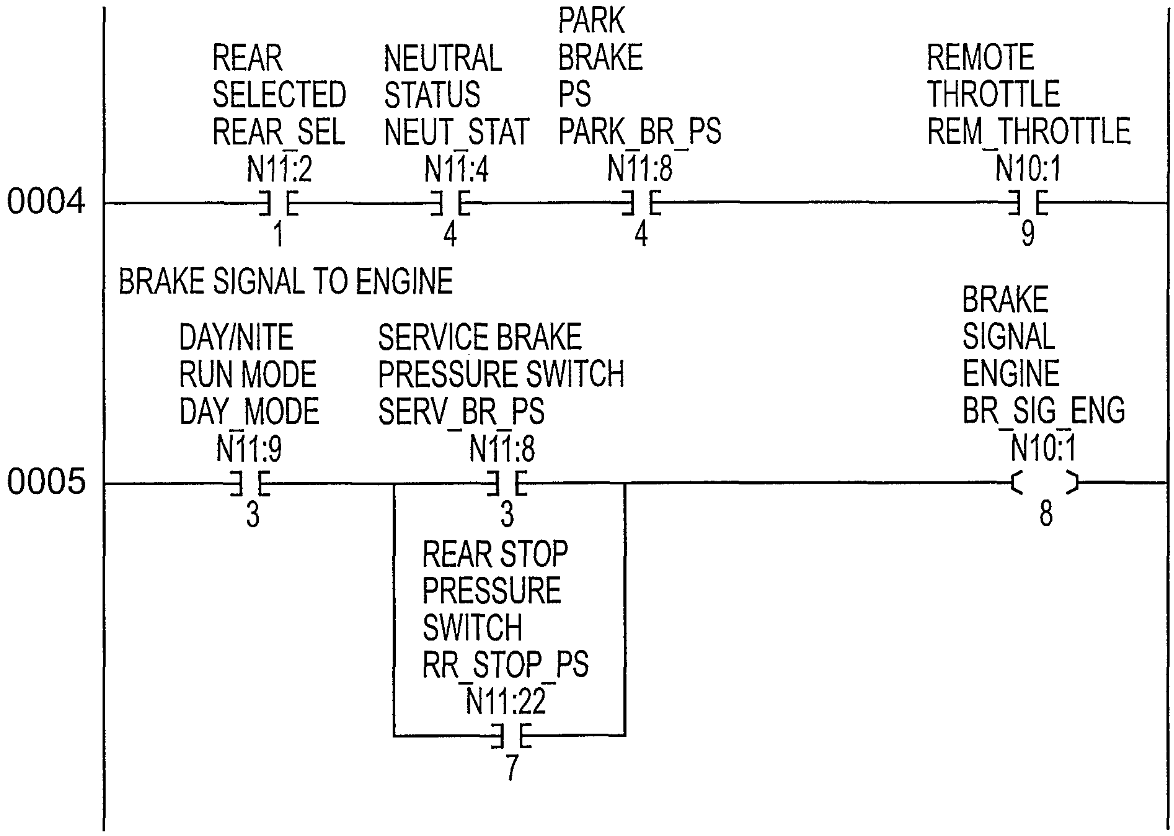

0004
REAR SELECTED REAR_SEL N11:2 1
NEUTRAL STATUS NEUT_STAT N11:4 4
PARK BRAKE PS PARK_BR_PS N11:8 4
REMOTE THROTTLE REM_THROTTLE N10:1 9
BRAKE SIGNAL TO ENGINE
0005
DAY/NITE RUN MODE DAY_MODE N11:9 3
SERVICE BRAKE PRESSURE SWITCH SERV_BR_PS N11:8 3
REAR STOP PRESSURE SWITCH RR_STOP_PS N11:22 7
BRAKE SIGNAL ENGINE BR_SIG_ENG N10:1 8

FIG. 33b

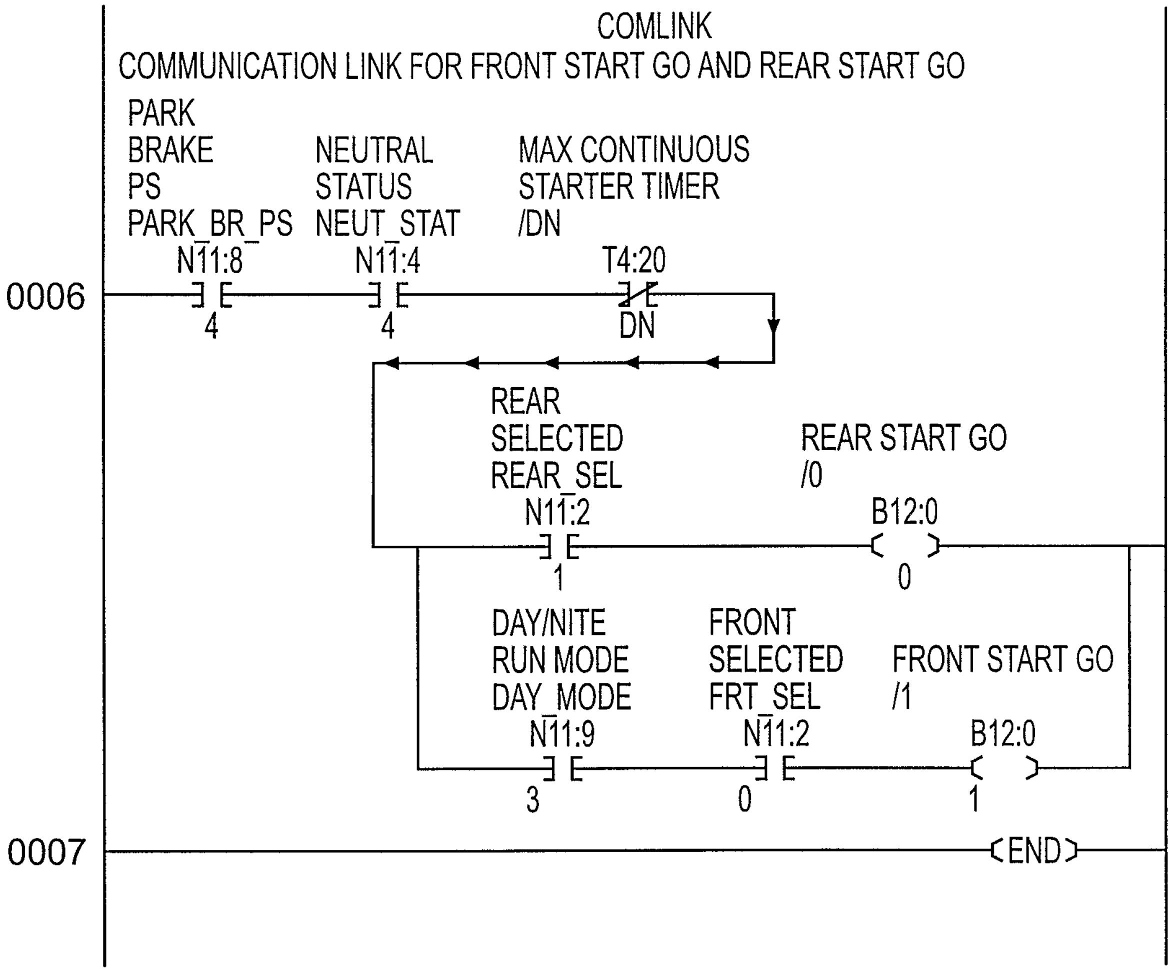

COMLINK
COMMUNICATION LINK FOR FRONT START GO AND REAR START GO
PARK BRAKE PS
PARK_BR_PS
N11:8
4
NEUTRAL STATUS
NEUT_STAT
N11:4
4
MAX CONTINUOUS STARTER TIMER
/DN
T4:20
DN
0006
REAR SELECTED
REAR_SEL
N11:2
1
REAR START GO
/0
B12:0
0
DAY/NITE RUN MODE
DAY_MODE
N11:9
3
FRONT SELECTED
FRT_SEL
N11:2
0
FRONT START GO
/1
B12:0
1
0007
END

FIG. 33c

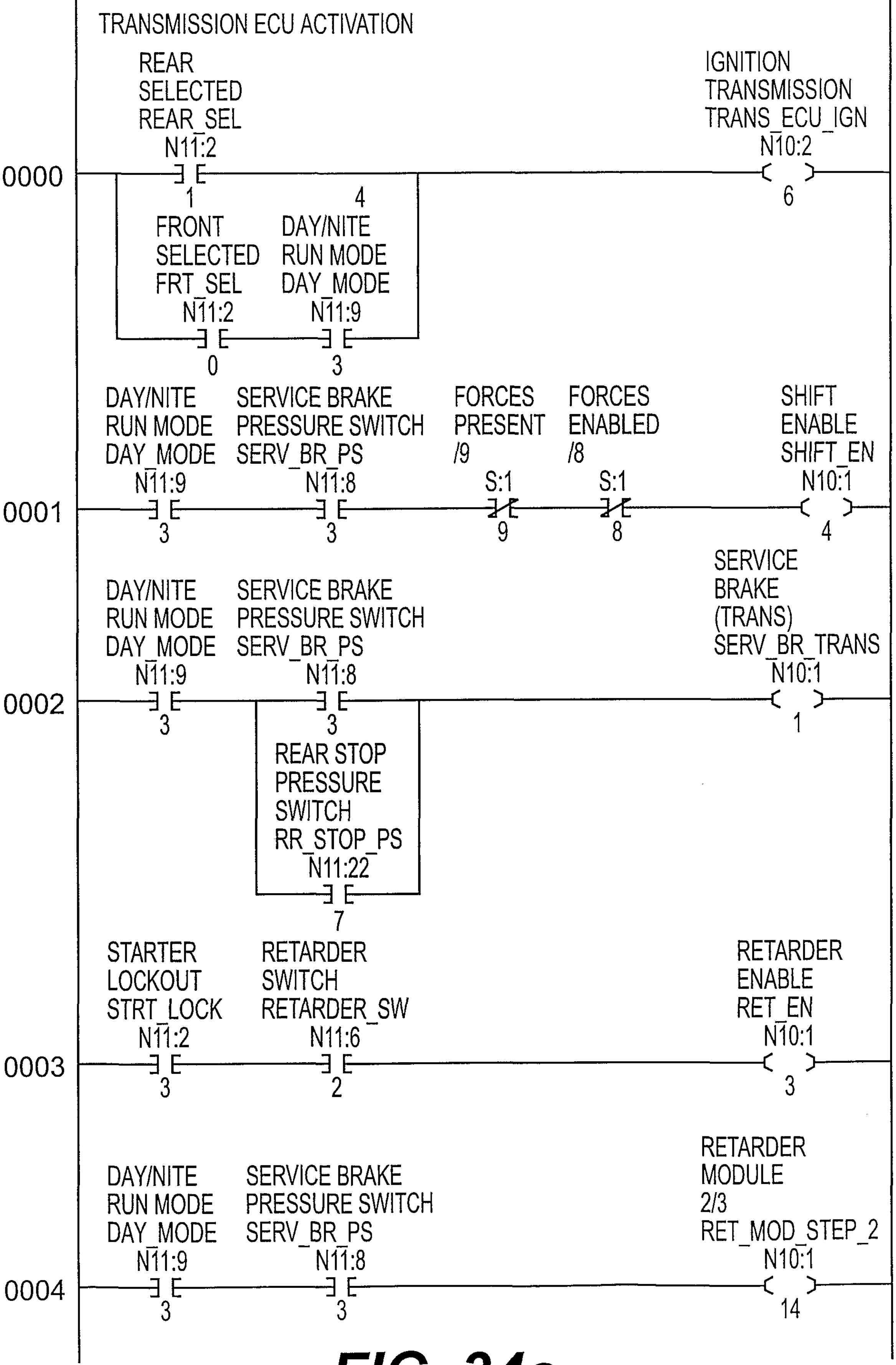

TRANSMISSION ECU ACTIVATION
0000
REAR SELECTED REAR_SEL N11:2 1
FRONT SELECTED FRT_SEL N11:2 0
DAY/NITE RUN MODE DAY_MODE N11:9 3
4
IGNITION TRANSMISSION TRANS_ECU_IGN N10:2 6
0001
DAY/NITE RUN MODE DAY_MODE N11:9 3
SERVICE BRAKE PRESSURE SWITCH SERV_BR_PS N11:8 3
FORCES PRESENT /9 S:1 9
FORCES ENABLED /8 S:1 8
SHIFT ENABLE SHIFT_EN N10:1 4
0002
DAY/NITE RUN MODE DAY_MODE N11:9 3
SERVICE BRAKE PRESSURE SWITCH SERV_BR_PS N11:8 3
REAR STOP PRESSURE SWITCH RR_STOP_PS N11:22 7
SERVICE BRAKE (TRANS) SERV_BR_TRANS N10:1 1
0003
STARTER LOCKOUT STRT_LOCK N11:2 3
RETARDER SWITCH RETARDER_SW N11:6 2
RETARDER ENABLE RET_EN N10:1 3
0004
DAY/NITE RUN MODE DAY_MODE N11:9 3
SERVICE BRAKE PRESSURE SWITCH SERV_BR_PS N11:8 3
RETARDER MODULE 2/3 RET_MOD_STEP_2 N10:1 14

FIG. 34a

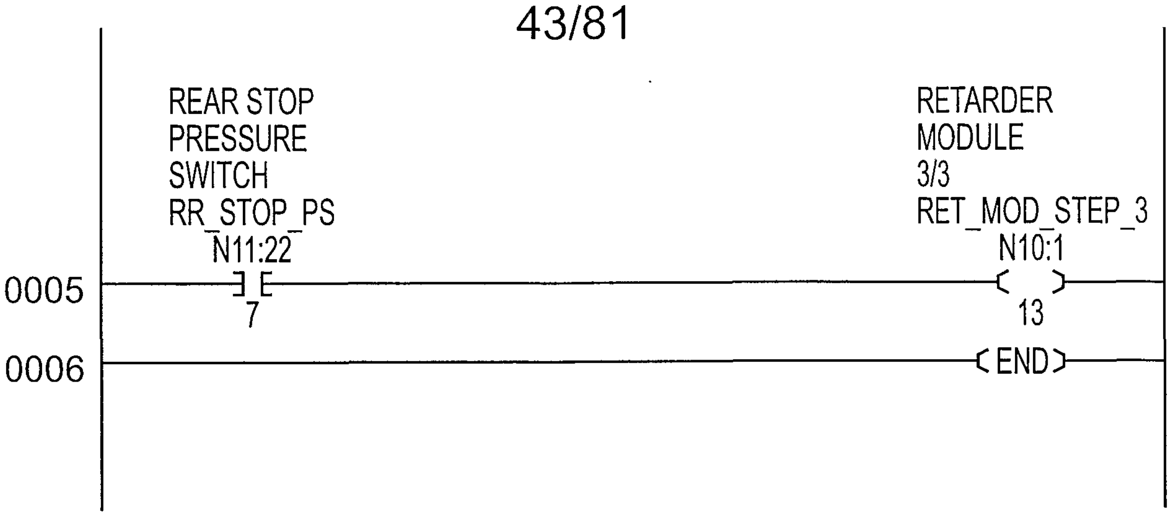

REAR STOP
PRESSURE
SWITCH
RR_STOP_PS
N11:22
7
RETARDER
MODULE
3/3
RET_MOD_STEP_3
N10:1
13
0005
0006
END

FIG. 34b

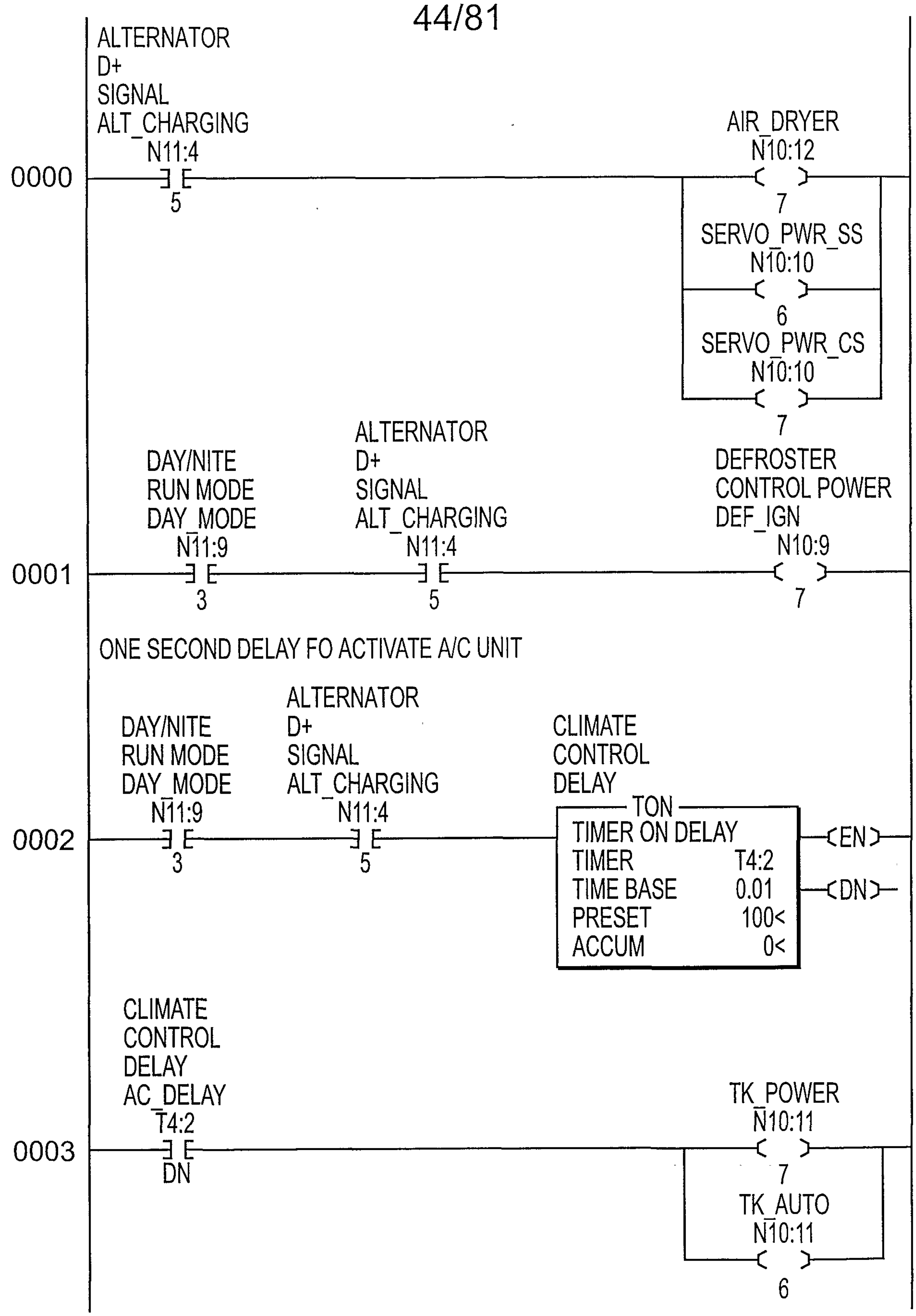

ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
0000
AIR_DRYER
N10:12
7
SERVO_PWR_SS
N10:10
6
SERVO_PWR_CS
N10:10
7
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
DEFROSTER
CONTROL POWER
DEF_IGN
N10:9
7
0001
ONE SECOND DELAY FO ACTIVATE A/C UNIT
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
CLIMATE
CONTROL
DELAY
TON
TIMER ON DELAY
TIMER T4:2
TIME BASE 0.01
PRESET 100<
ACCUM 0<
EN
DN
0002
CLIMATE
CONTROL
DELAY
AC_DELAY
T4:2
DN
0003
TK_POWER
N10:11
7
TK_AUTO
N10:11
6

FIG. 35a

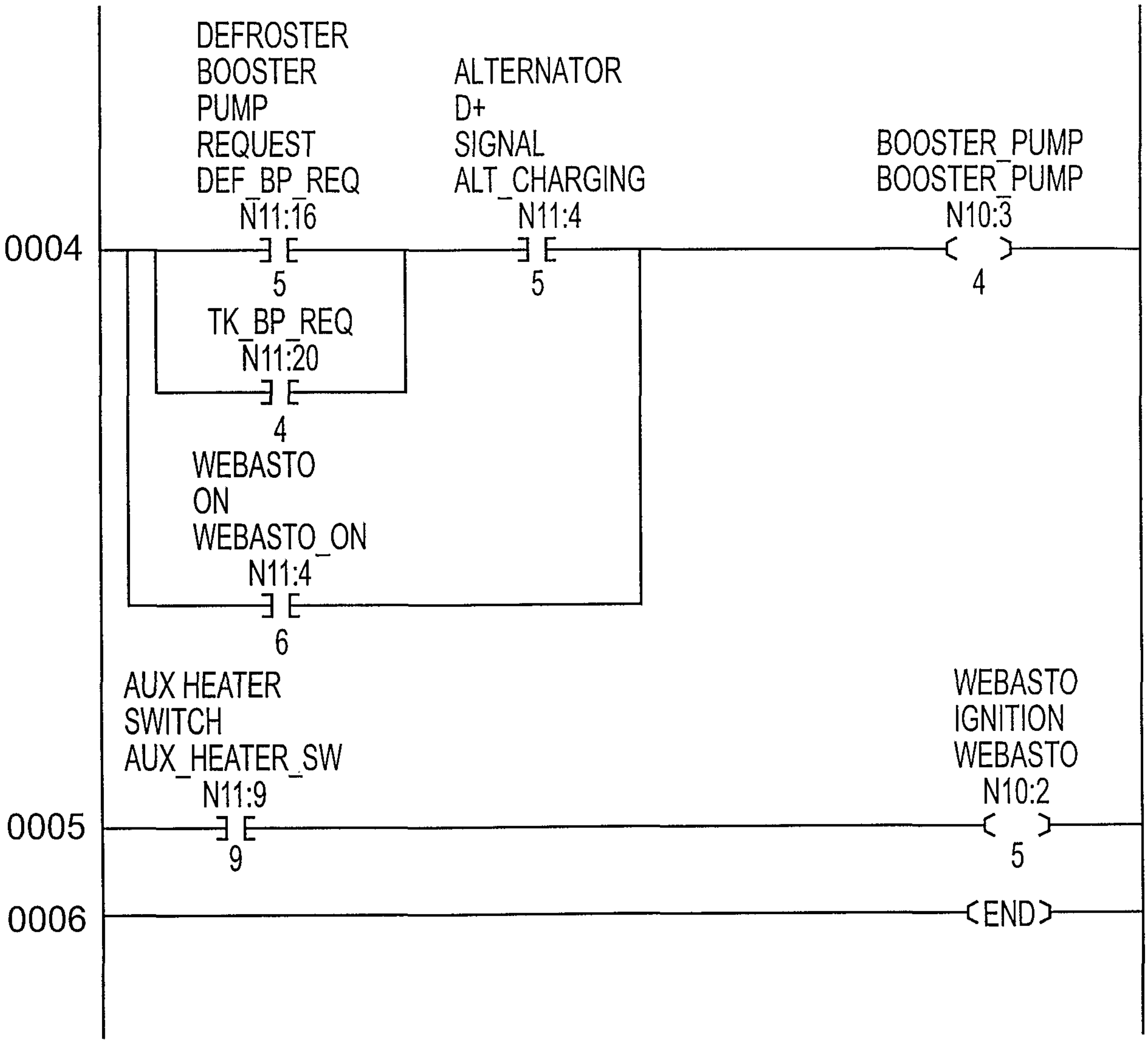
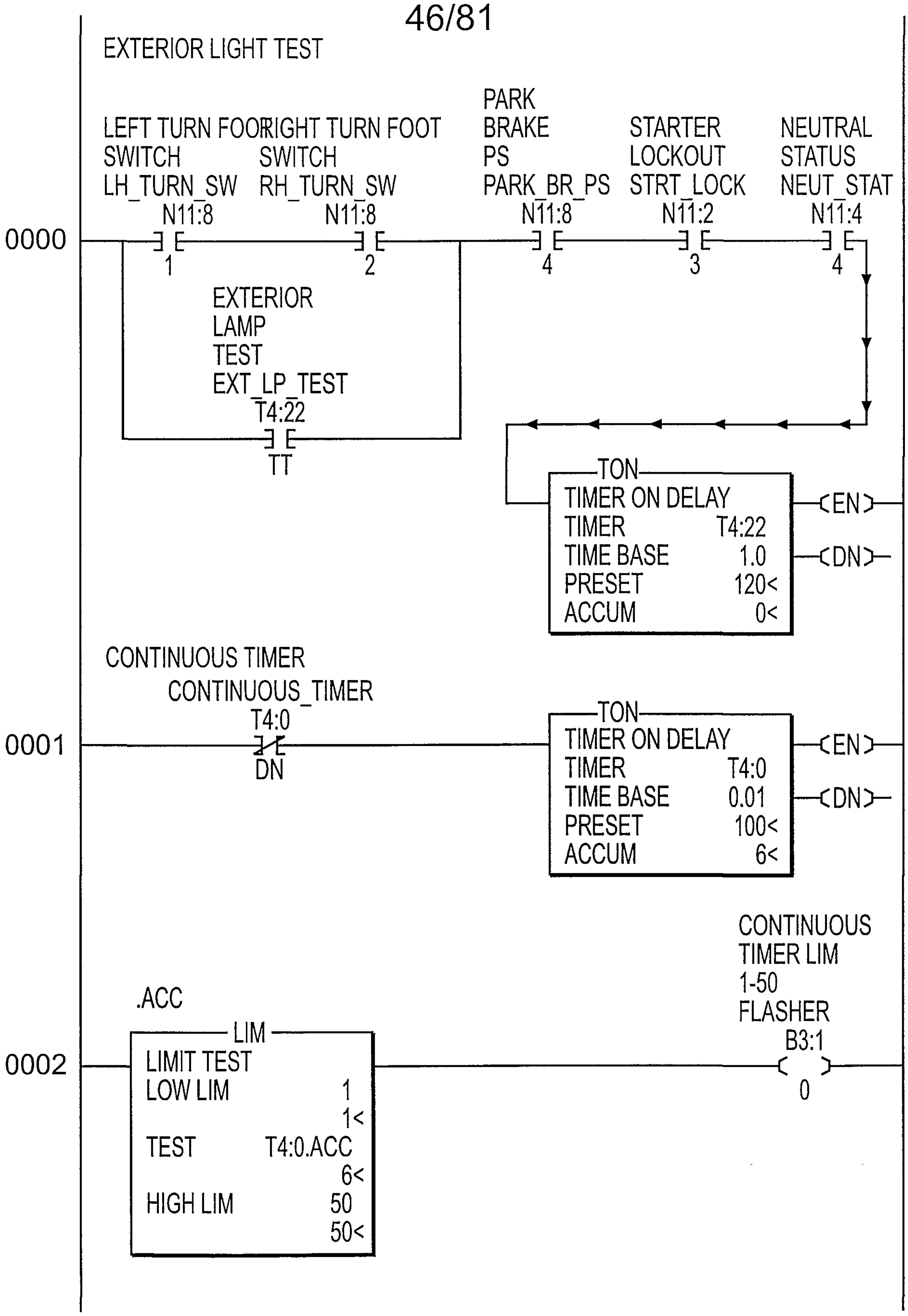

DEFROSTER
BOOSTER
PUMP
REQUEST
DEF_BP_REQ
N11:16
5
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
BOOSTER_PUMP
BOOSTER_PUMP
N10:3
4
0004
TK_BP_REQ
N11:20
4
WEBASTO
ON
WEBASTO_ON
N11:4
6
AUX HEATER
SWITCH
AUX_HEATER_SW
N11:9
9
0005
WEBASTO
IGNITION
WEBASTO
N10:2
5
0006
END

FIG. 35b



EXTERIOR LIGHT TEST
LEFT TURN FOOT SWITCH LH_TURN_SW N11:8 1
RIGHT TURN FOOT SWITCH RH_TURN_SW N11:8 2
PARK BRAKE PS PARK_BR_PS N11:8 4
STARTER LOCKOUT STRT_LOCK N11:2 3
NEUTRAL STATUS NEUT_STAT N11:4 4
0000
EXTERIOR LAMP TEST EXT_LP_TEST T4:22 TT
TON
TIMER ON DELAY
TIMER T4:22
TIME BASE 1.0
PRESET 120<
ACCUM 0<
EN
DN
CONTINUOUS TIMER
CONTINUOUS_TIMER T4:0 DN
0001
TON
TIMER ON DELAY
TIMER T4:0
TIME BASE 0.01
PRESET 100<
ACCUM 6<
EN
DN
.ACC
0002
LIM
LIMIT TEST
LOW LIM 1 1<
TEST T4:0.ACC 6<
HIGH LIM 50 50<
CONTINUOUS TIMER LIM 1-50 FLASHER B3:1 0

FIG. 36a

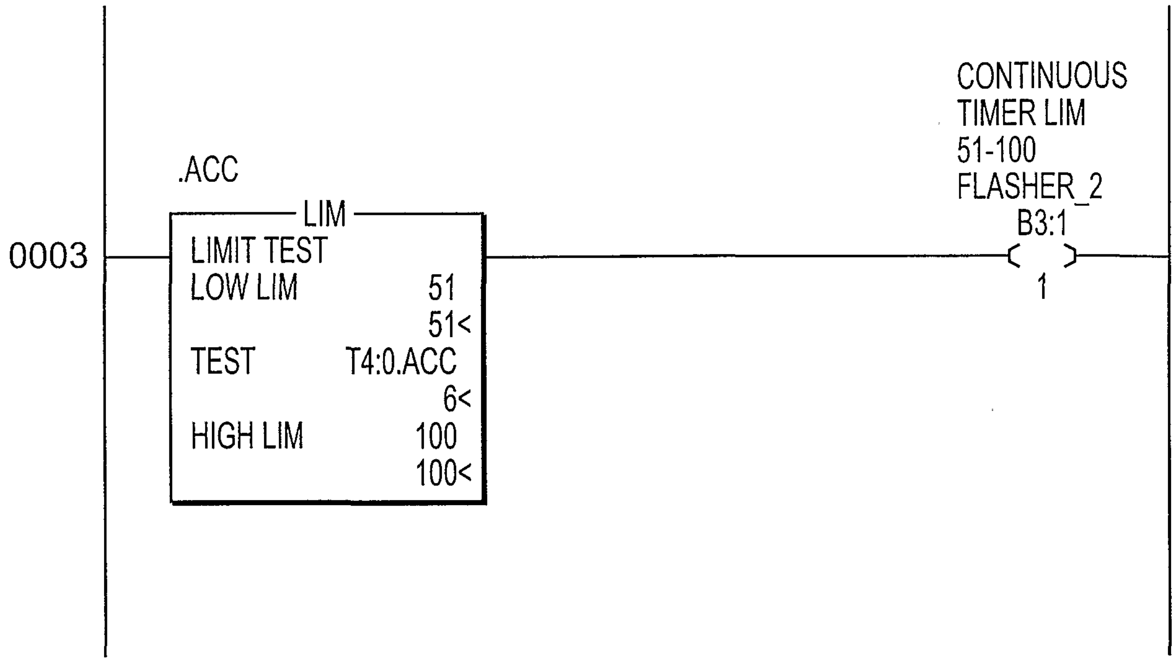

0003
.ACC
LIM
LIMIT TEST
LOW LIM 51
51<
TEST T4:0.ACC
6<
HIGH LIM 100
100<
CONTINUOUS
TIMER LIM
51-100
FLASHER_2
B3:1
1

FIG. 36b

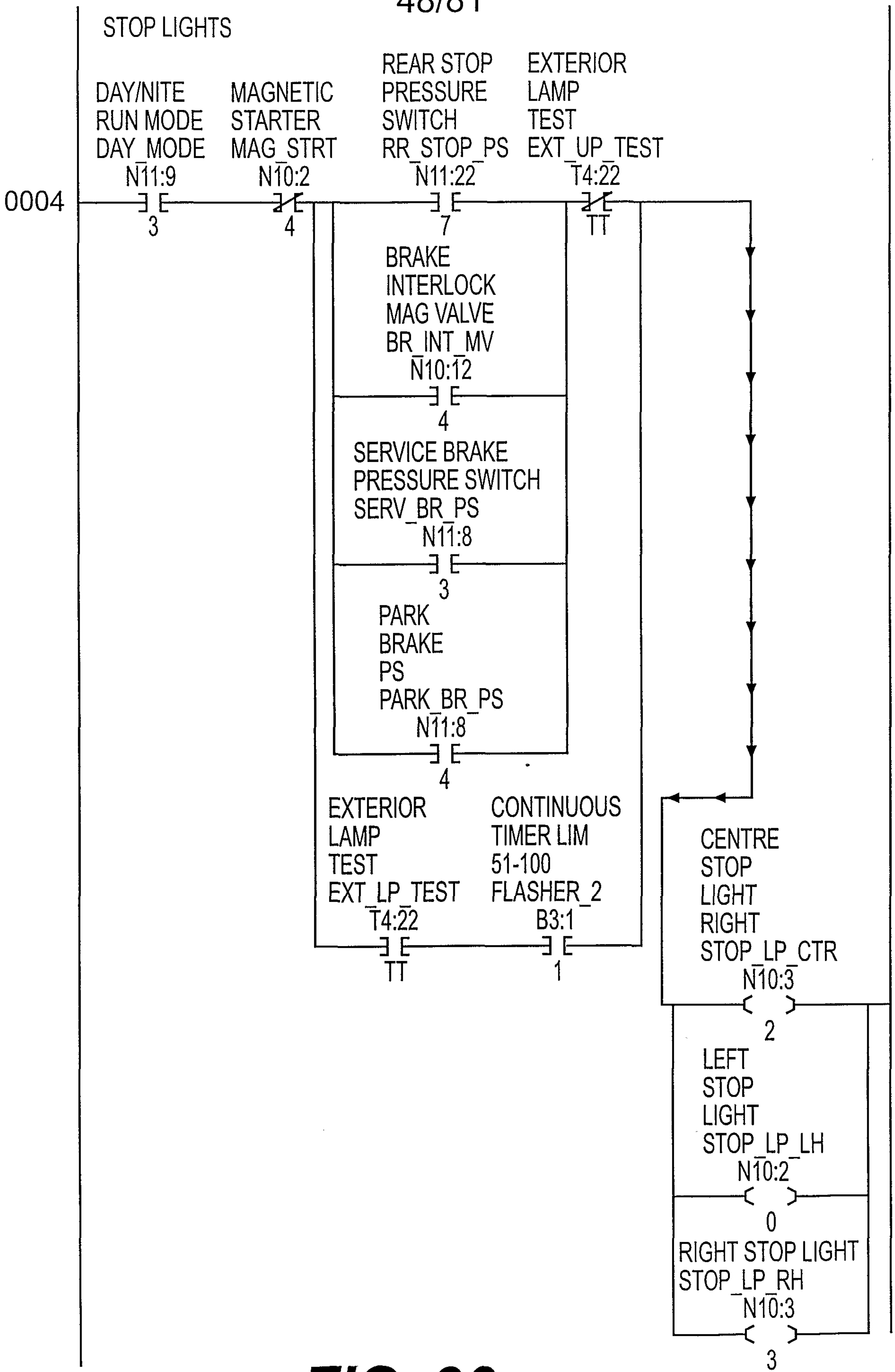

STOP LIGHTS
0004
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
MAGNETIC
STARTER
MAG_STRT
N10:2
4
REAR STOP
PRESSURE
SWITCH
RR_STOP_PS
N11:22
7
EXTERIOR
LAMP
TEST
EXT_UP_TEST
T4:22
TT
BRAKE
INTERLOCK
MAG VALVE
BR_INT_MV
N10:12
4
SERVICE BRAKE
PRESSURE SWITCH
SERV_BR_PS
N11:8
3
PARK
BRAKE
PS
PARK_BR_PS
N11:8
4
EXTERIOR
LAMP
TEST
EXT_LP_TEST
T4:22
TT
CONTINUOUS
TIMER LIM
51-100
FLASHER_2
B3:1
1
CENTRE
STOP
LIGHT
RIGHT
STOP_LP_CTR
N10:3
2
LEFT
STOP
LIGHT
STOP_LP_LH
N10:2
0
RIGHT STOP LIGHT
STOP_LP_RH
N10:3
3

FIG. 36c

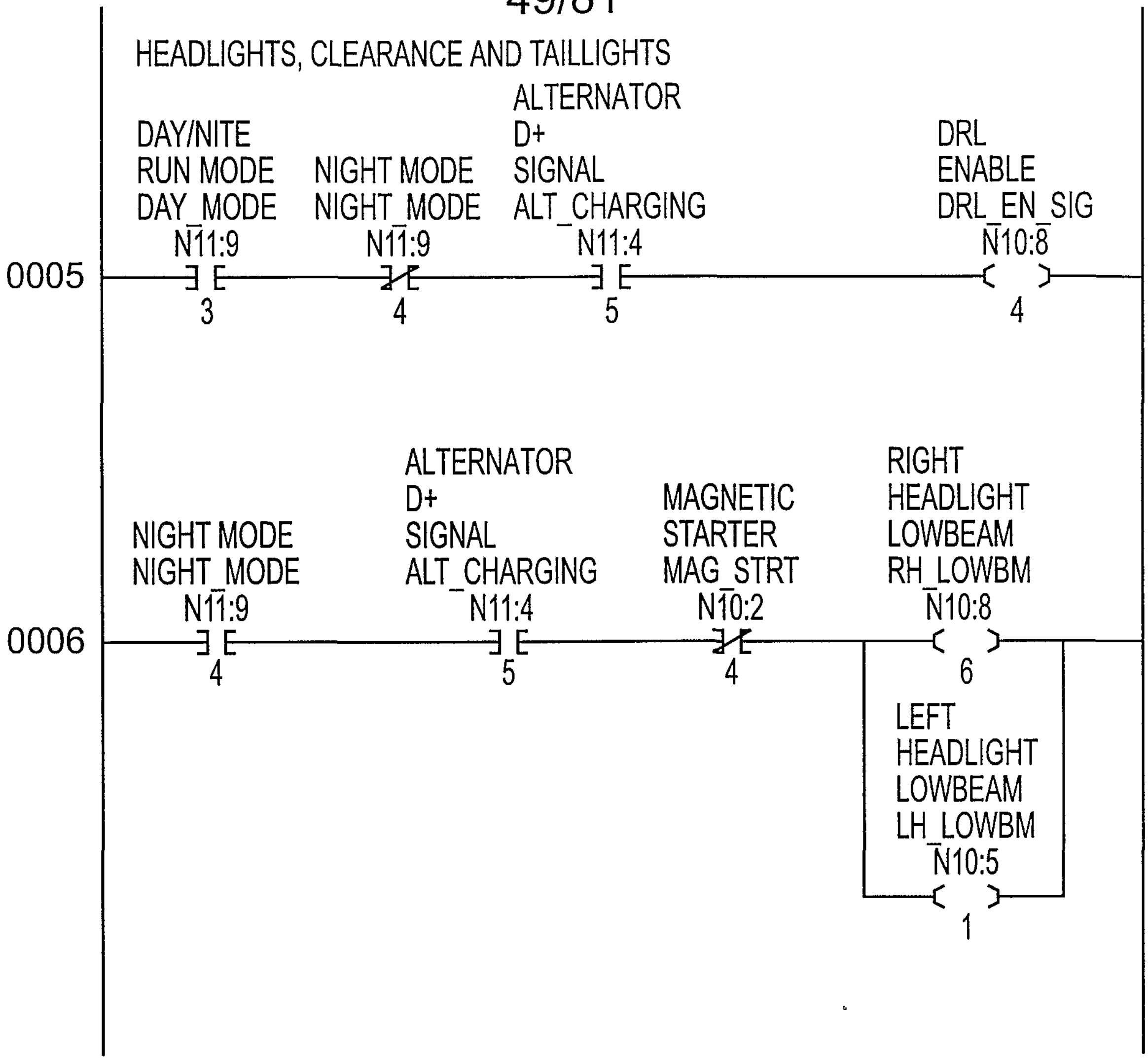

HEADLIGHTS, CLEARANCE AND TAILLIGHTS
0005
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
NIGHT MODE
NIGHT_MODE
N11:9
4
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
DRL
ENABLE
DRL_EN_SIG
N10:8
4
0006
NIGHT MODE
NIGHT_MODE
N11:9
4
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
MAGNETIC
STARTER
MAG_STRT
N10:2
4
RIGHT
HEADLIGHT
LOWBEAM
RH_LOWBM
N10:8
6
LEFT
HEADLIGHT
LOWBEAM
LH_LOWBM
N10:5
1

FIG. 36d

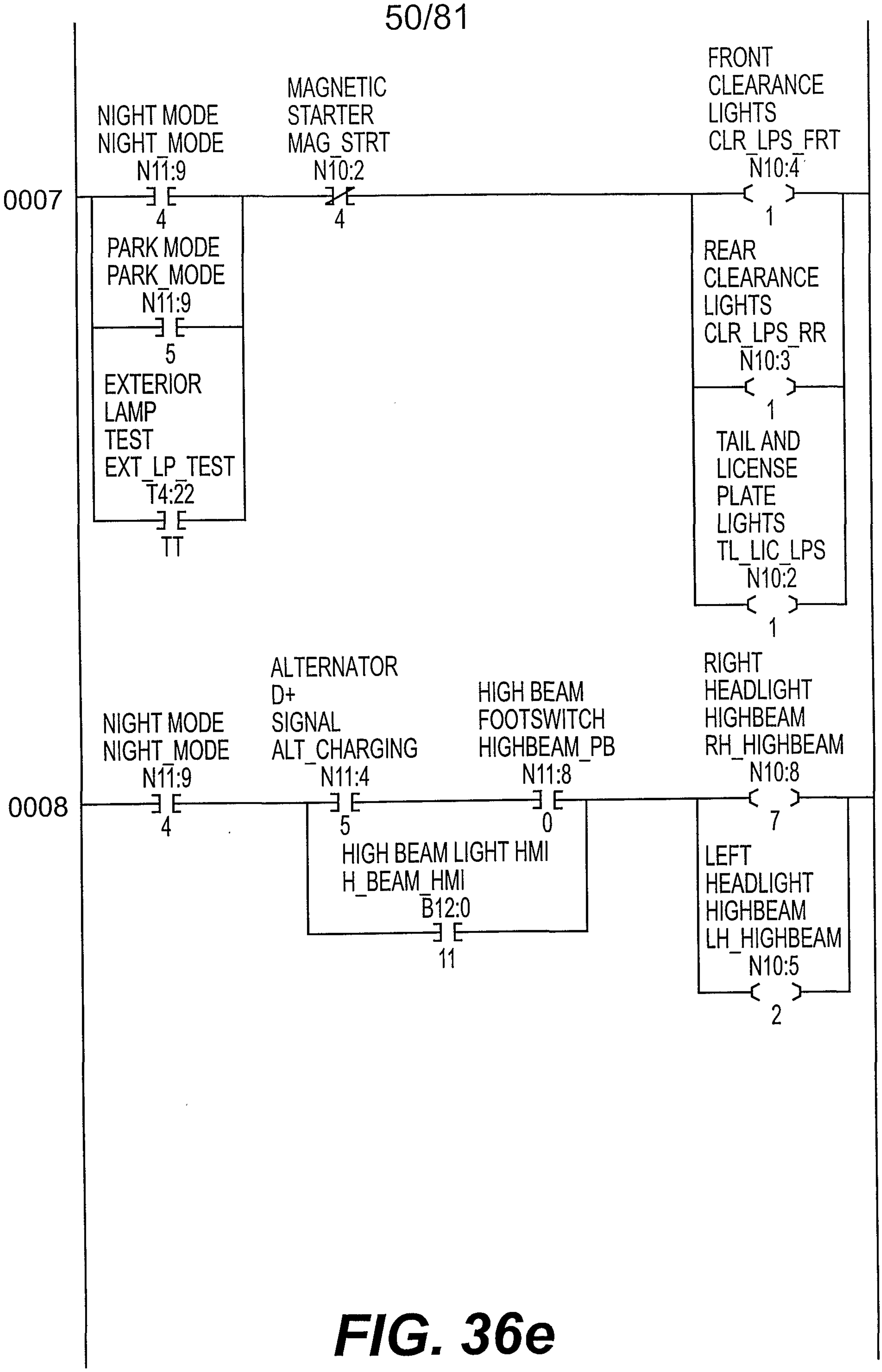

0007
NIGHT MODE
NIGHT_MODE
N11:9
4
PARK MODE
PARK_MODE
N11:9
5
EXTERIOR
LAMP
TEST
EXT_LP_TEST
T4:22
TT
MAGNETIC
STARTER
MAG_STRT
N10:2
4
FRONT
CLEARANCE
LIGHTS
CLR_LPS_FRT
N10:4
1
REAR
CLEARANCE
LIGHTS
CLR_LPS_RR
N10:3
1
TAIL AND
LICENSE
PLATE
LIGHTS
TL_LIC_LPS
N10:2
1
0008
NIGHT MODE
NIGHT_MODE
N11:9
4
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
HIGH BEAM LIGHT HMI
H_BEAM_HMI
B12:0
11
HIGH BEAM
FOOTSWITCH
HIGHBEAM_PB
N11:8
0
RIGHT
HEADLIGHT
HIGHBEAM
RH_HIGHBEAM
N10:8
7
LEFT
HEADLIGHT
HIGHBEAM
LH_HIGHBEAM
N10:5
2

FIG. 36e

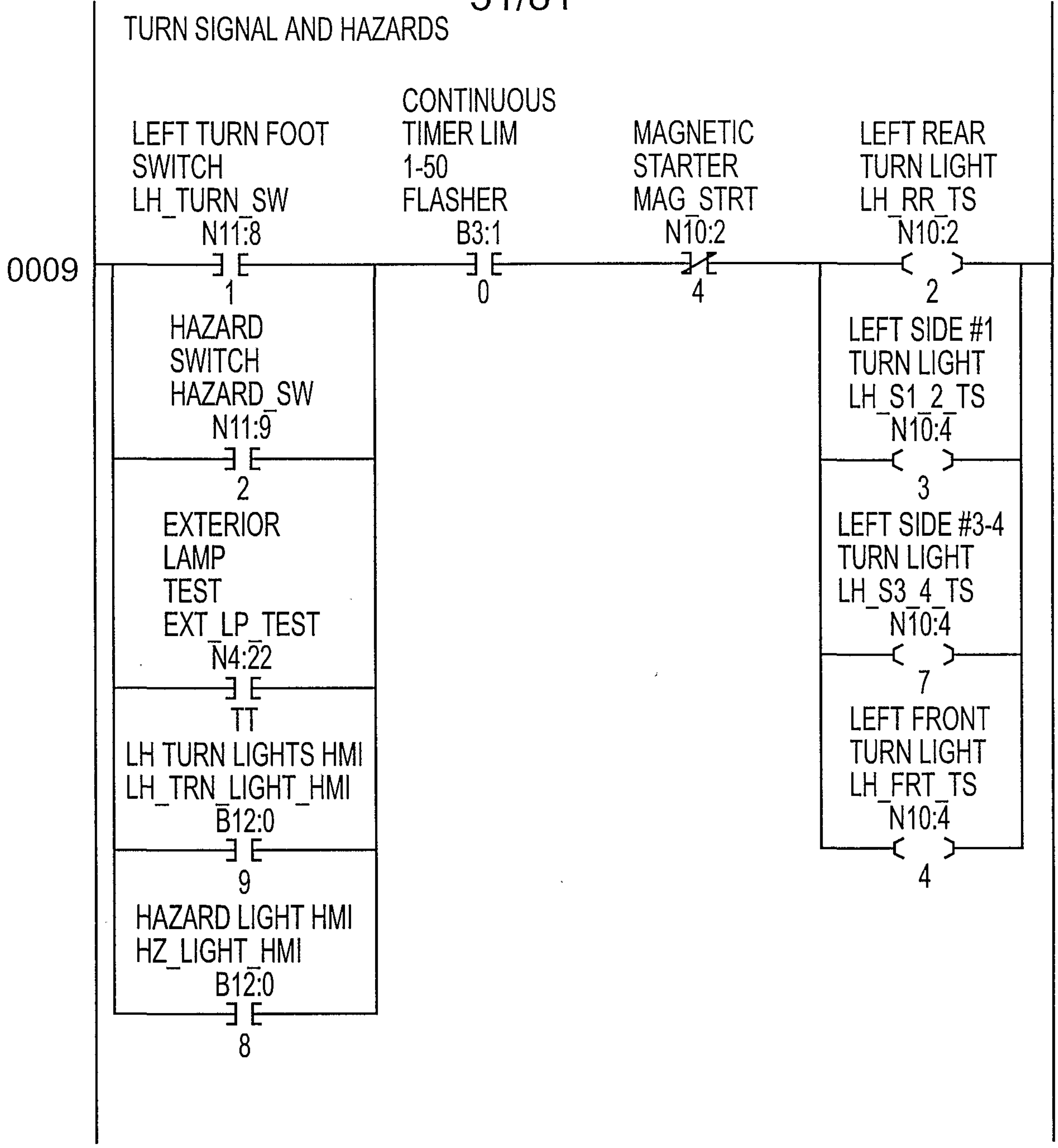

TURN SIGNAL AND HAZARDS
0009
LEFT TURN FOOT SWITCH
LH_TURN_SW
N11:8
1
CONTINUOUS TIMER LIM 1-50 FLASHER
B3:1
0
MAGNETIC STARTER
MAG_STRT
N10:2
4
LEFT REAR TURN LIGHT
LH_RR_TS
N10:2
2
HAZARD SWITCH
HAZARD_SW
N11:9
2
EXTERIOR LAMP TEST
EXT_LP_TEST
N4:22
TT
LH TURN LIGHTS HMI
LH_TRN_LIGHT_HMI
B12:0
9
HAZARD LIGHT HMI
HZ_LIGHT_HMI
B12:0
8
LEFT SIDE #1 TURN LIGHT
LH_S1_2_TS
N10:4
3
LEFT SIDE #3-4 TURN LIGHT
LH_S3_4_TS
N10:4
7
LEFT FRONT TURN LIGHT
LH_FRT_TS
N10:4
4

FIG. 36f

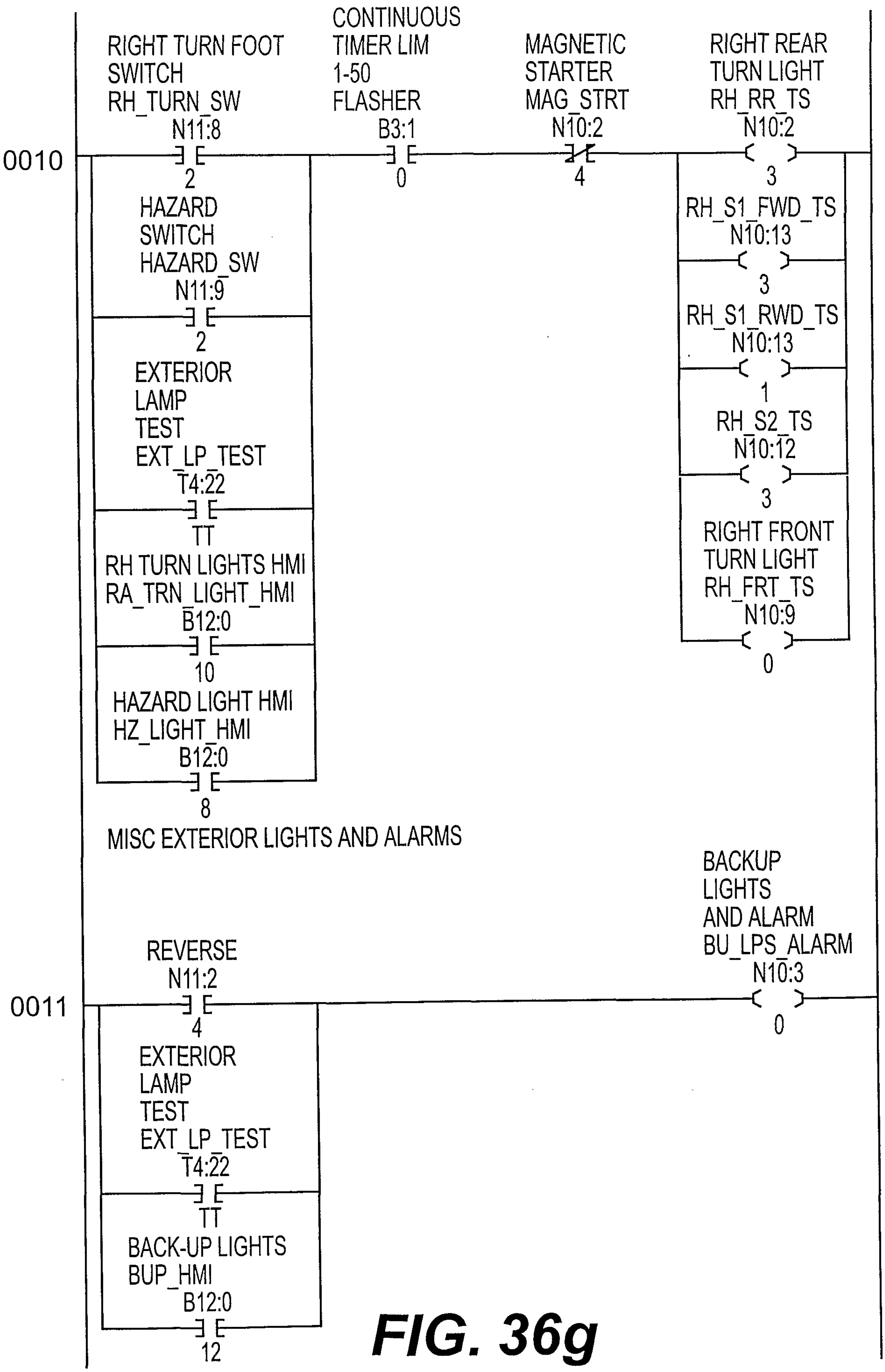

0010
RIGHT TURN FOOT SWITCH
RH_TURN_SW
N11:8
2
CONTINUOUS TIMER LIM 1-50 FLASHER
B3:1
0
MAGNETIC STARTER
MAG_STRT
N10:2
4
RIGHT REAR TURN LIGHT
RH_RR_TS
N10:2
3
RH_S1_FWD_TS
N10:13
3
RH_S1_RWD_TS
N10:13
1
RH_S2_TS
N10:12
3
RIGHT FRONT TURN LIGHT
RH_FRT_TS
N10:9
0
HAZARD SWITCH
HAZARD_SW
N11:9
2
EXTERIOR LAMP TEST
EXT_LP_TEST
T4:22
TT
RH TURN LIGHTS HMI
RA_TRN_LIGHT_HMI
B12:0
10
HAZARD LIGHT HMI
HZ_LIGHT_HMI
B12:0
8
MISC EXTERIOR LIGHTS AND ALARMS
0011
REVERSE
N11:2
4
BACKUP LIGHTS AND ALARM
BU_LPS_ALARM
N10:3
0
EXTERIOR LAMP TEST
EXT_LP_TEST
T4:22
TT
BACK-UP LIGHTS
BUP_HMI
B12:0
12

FIG. 36g

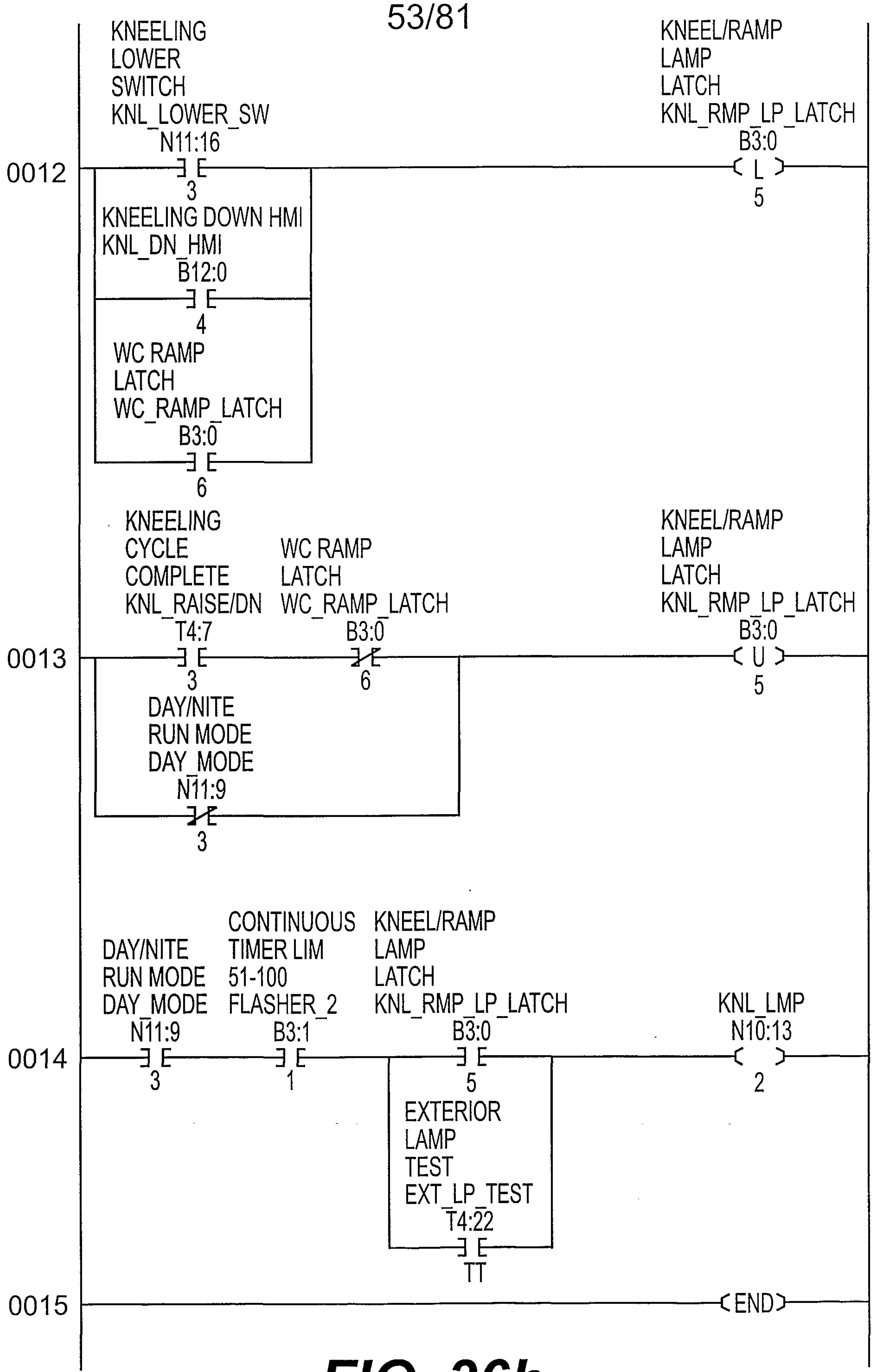

KNEELING
LOWER
SWITCH
KNL_LOWER_SW
N11:16
3
KNEELING DOWN HMI
KNL_DN_HMI
B12:0
4
WC RAMP
LATCH
WC_RAMP_LATCH
B3:0
6
KNEEL/RAMP
LAMP
LATCH
KNL_RMP_LP_LATCH
B3:0
L
5
0012
KNEELING
CYCLE
COMPLETE
KNL_RAISE/DN
T4:7
3
WC RAMP
LATCH
WC_RAMP_LATCH
B3:0
6
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
KNEEL/RAMP
LAMP
LATCH
KNL_RMP_LP_LATCH
B3:0
U
5
0013
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
CONTINUOUS
TIMER LIM
51-100
FLASHER_2
B3:1
1
KNEEL/RAMP
LAMP
LATCH
KNL_RMP_LP_LATCH
B3:0
5
EXTERIOR
LAMP
TEST
EXT_LP_TEST
T4:22
TT
KNL_LMP
N10:13
2
0014
0015
END

FIG. 36h

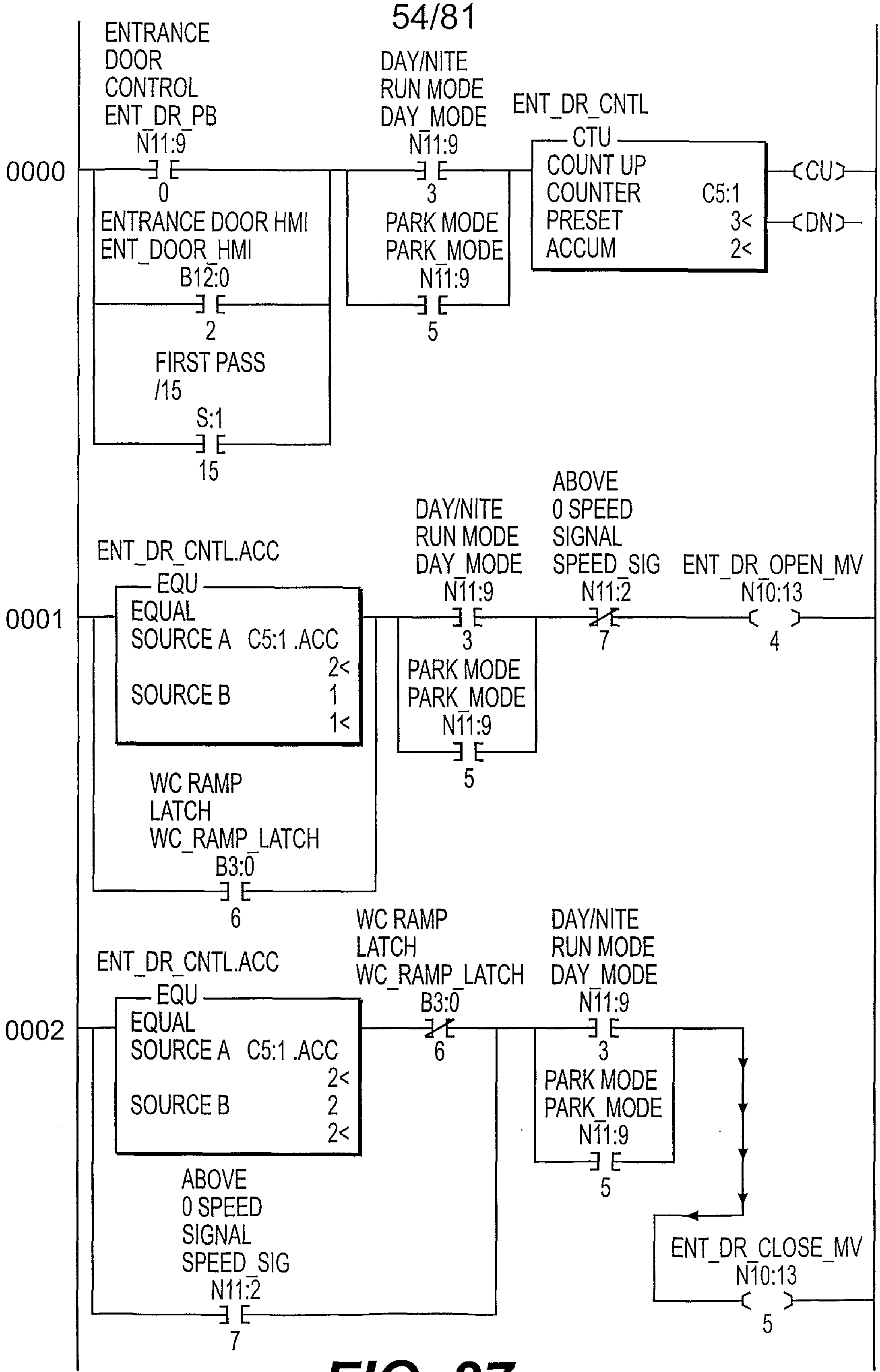

0000
ENTRANCE DOOR CONTROL ENT_DR_PB N11:9
0
ENTRANCE DOOR HMI ENT_DOOR_HMI B12:0
2
FIRST PASS /15 S:1
15
DAY/NITE RUN MODE DAY_MODE N11:9
3
PARK MODE PARK_MODE N11:9
5
ENT_DR_CNTL
CTU
COUNT UP COUNTER C5:1
PRESET 3<
ACCUM 2<
CU
DN
0001
ENT_DR_CNTL.ACC
EQU
EQUAL
SOURCE A C5:1 .ACC
2<
SOURCE B 1
1<
WC RAMP LATCH WC_RAMP_LATCH B3:0
6
DAY/NITE RUN MODE DAY_MODE N11:9
3
PARK MODE PARK_MODE N11:9
5
ABOVE 0 SPEED SIGNAL SPEED_SIG N11:2
7
ENT_DR_OPEN_MV N10:13
4
0002
ENT_DR_CNTL.ACC
EQU
EQUAL
SOURCE A C5:1 .ACC
2<
SOURCE B 2
2<
ABOVE 0 SPEED SIGNAL SPEED_SIG N11:2
7
WC RAMP LATCH WC_RAMP_LATCH B3:0
6
DAY/NITE RUN MODE DAY_MODE N11:9
3
PARK MODE PARK_MODE N11:9
5
ENT_DR_CLOSE_MV N10:13
5

FIG. 37a

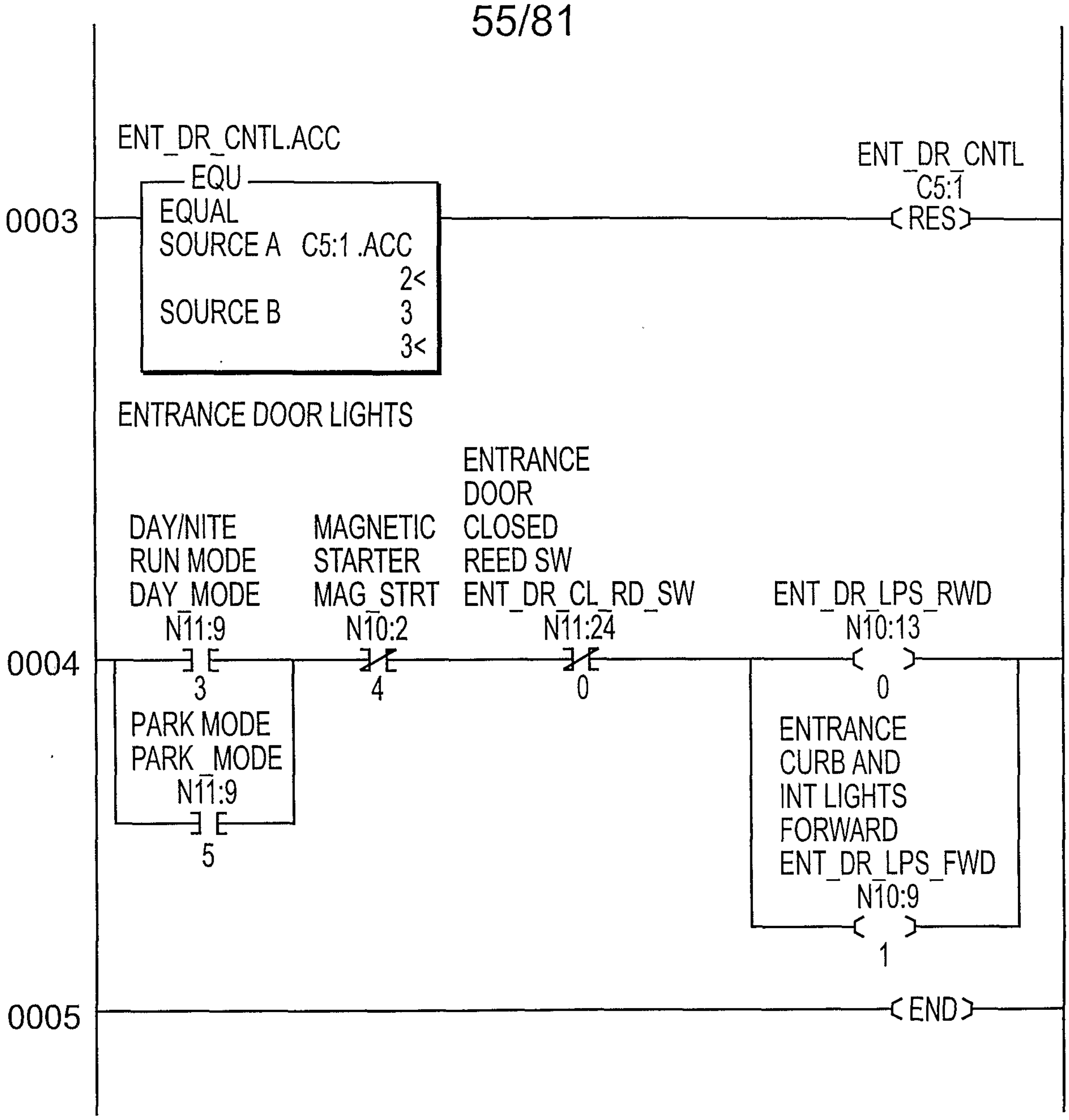
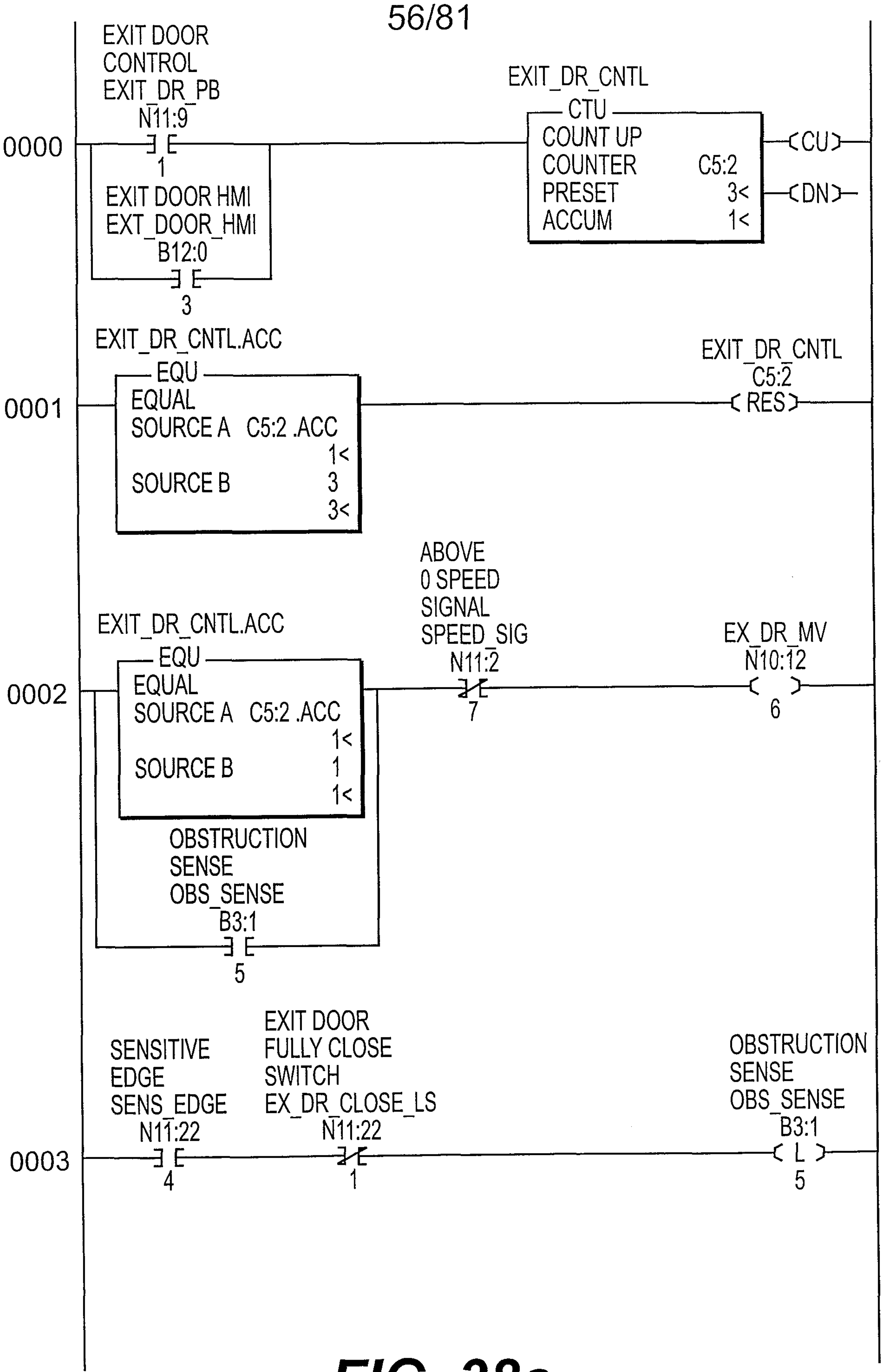

ENT_DR_CNTL.ACC
EQU
EQUAL
SOURCE A C5:1 .ACC
2<
SOURCE B 3
3<
ENT_DR_CNTL
C5:1
RES
0003
ENTRANCE DOOR LIGHTS
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
MAGNETIC
STARTER
MAG_STRT
N10:2
4
ENTRANCE
DOOR
CLOSED
REED SW
ENT_DR_CL_RD_SW
N11:24
0
ENT_DR_LPS_RWD
N10:13
0
0004
PARK MODE
PARK _MODE
N11:9
5
ENTRANCE
CURB AND
INT LIGHTS
FORWARD
ENT_DR_LPS_FWD
N10:9
1
0005
END

FIG. 37b



EXIT DOOR
CONTROL
EXIT_DR_PB
N11:9
1
EXIT DOOR HMI
EXT_DOOR_HMI
B12:0
3
0000
EXIT_DR_CNTL
CTU
COUNT UP
COUNTER C5:2
PRESET 3<
ACCUM 1<
CU
DN
0001
EXIT_DR_CNTL.ACC
EQU
EQUAL
SOURCE A C5:2 .ACC
1<
SOURCE B 3
3<
EXIT_DR_CNTL
C5:2
RES
0002
EXIT_DR_CNTL.ACC
EQU
EQUAL
SOURCE A C5:2 .ACC
1<
SOURCE B 1
1<
ABOVE
0 SPEED
SIGNAL
SPEED_SIG
N11:2
7
EX_DR_MV
N10:12
6
OBSTRUCTION
SENSE
OBS_SENSE
B3:1
5
0003
SENSITIVE
EDGE
SENS_EDGE
N11:22
4
EXIT DOOR
FULLY CLOSE
SWITCH
EX_DR_CLOSE_LS
N11:22
1
OBSTRUCTION
SENSE
OBS_SENSE
B3:1
L
5

FIG. 38a

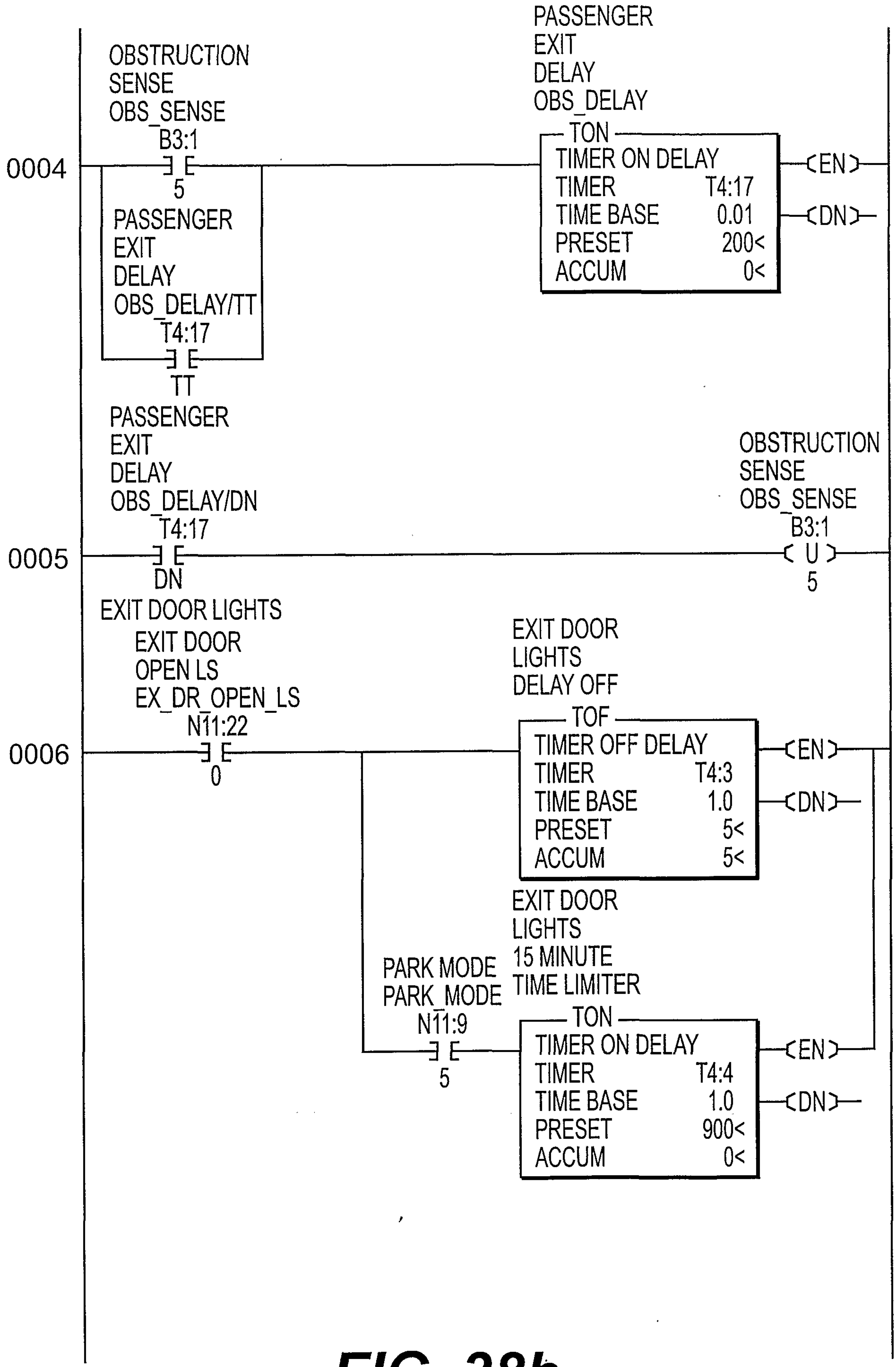

0004
OBSTRUCTION
SENSE
OBS_SENSE
B3:1
5
PASSENGER
EXIT
DELAY
OBS_DELAY/TT
T4:17
TT
PASSENGER
EXIT
DELAY
OBS_DELAY
TON
TIMER ON DELAY
TIMER T4:17
TIME BASE 0.01
PRESET 200<
ACCUM 0<
EN
DN
0005
PASSENGER
EXIT
DELAY
OBS_DELAY/DN
T4:17
DN
OBSTRUCTION
SENSE
OBS_SENSE
B3:1
U
5
0006
EXIT DOOR LIGHTS
EXIT DOOR
OPEN LS
EX_DR_OPEN_LS
N11:22
0
EXIT DOOR
LIGHTS
DELAY OFF
TOF
TIMER OFF DELAY
TIMER T4:3
TIME BASE 1.0
PRESET 5<
ACCUM 5<
EN
DN
PARK MODE
PARK_MODE
N11:9
5
EXIT DOOR
LIGHTS
15 MINUTE
TIME LIMITER
TON
TIMER ON DELAY
TIMER T4:4
TIME BASE 1.0
PRESET 900<
ACCUM 0<
EN
DN

FIG. 38b

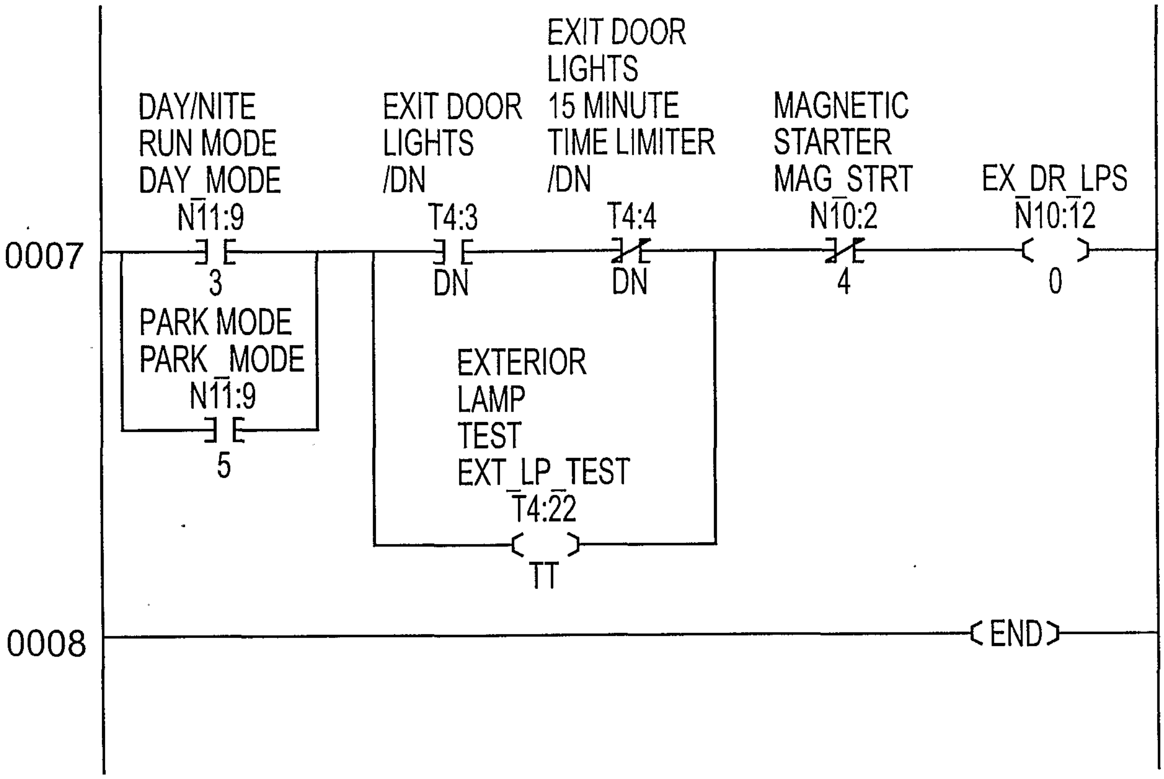
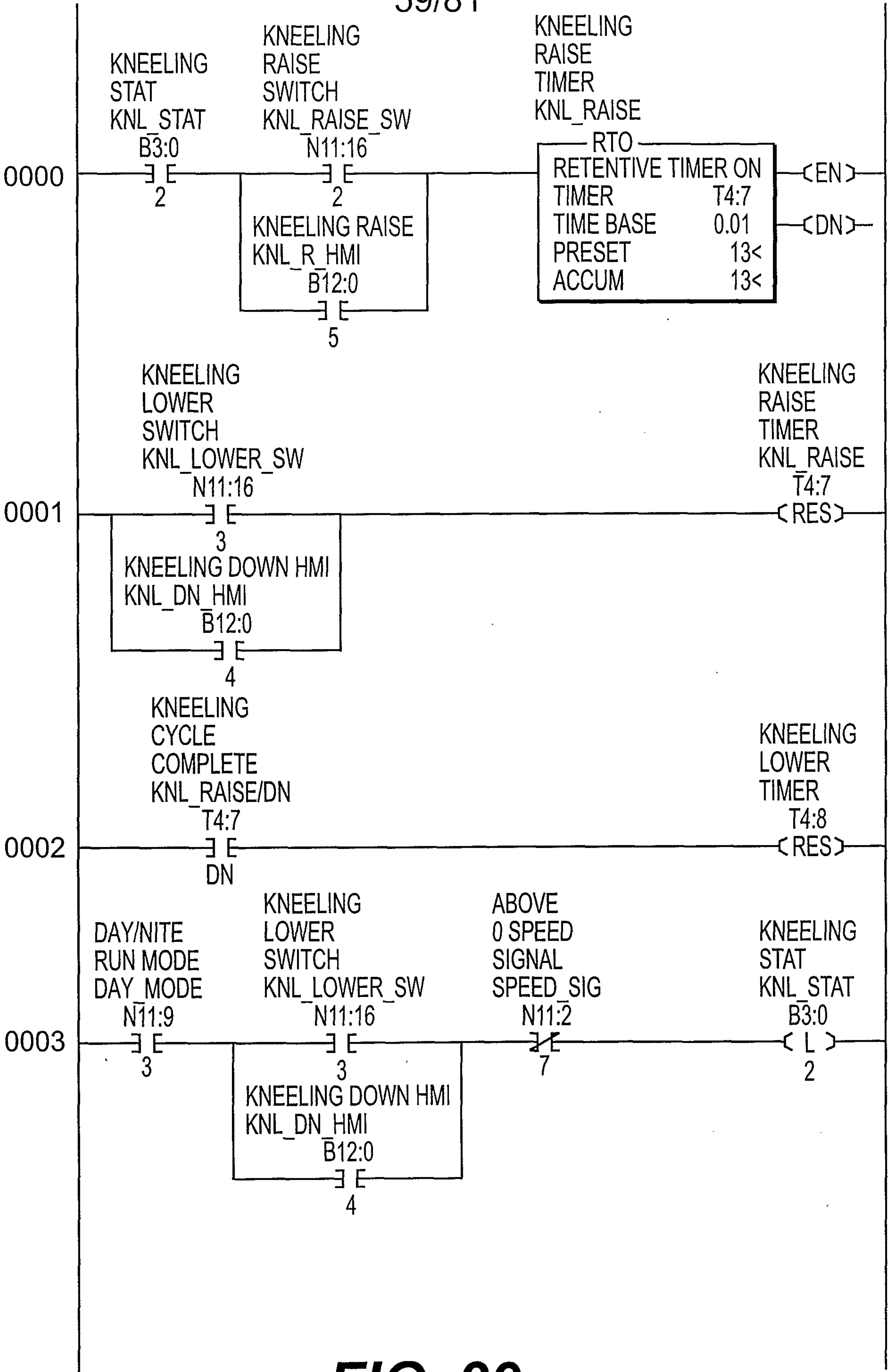

0007
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
PARK MODE
PARK_MODE
N11:9
5
EXIT DOOR
LIGHTS
/DN
T4:3
DN
EXIT DOOR
LIGHTS
15 MINUTE
TIME LIMITER
/DN
T4:4
DN
EXTERIOR
LAMP
TEST
EXT_LP_TEST
T4:22
TT
MAGNETIC
STARTER
MAG_STRT
N10:2
4
EX_DR_LPS
N10:12
0
0008
END

FIG. 38c



KNEELING STAT KNL_STAT B3:0 2
KNEELING RAISE SWITCH KNL_RAISE_SW N11:16 2
KNEELING RAISE KNL_R_HMI B12:0 5
KNEELING RAISE TIMER KNL_RAISE
RTO
RETENTIVE TIMER ON
TIMER T4:7
TIME BASE 0.01
PRESET 13<
ACCUM 13<
EN
DN
0000
0001
KNEELING LOWER SWITCH KNL_LOWER_SW N11:16 3
KNEELING DOWN HMI KNL_DN_HMI B12:0 4
KNEELING RAISE TIMER KNL_RAISE T4:7
RES
0002
KNEELING CYCLE COMPLETE KNL_RAISE/DN T4:7 DN
KNEELING LOWER TIMER T4:8
RES
0003
DAY/NITE RUN MODE DAY_MODE N11:9 3
KNEELING LOWER SWITCH KNL_LOWER_SW N11:16 3
KNEELING DOWN HMI KNL_DN_HMI B12:0 4
ABOVE 0 SPEED SIGNAL SPEED_SIG N11:2 7
KNEELING STAT KNL_STAT B3:0
L
2

FIG. 39a

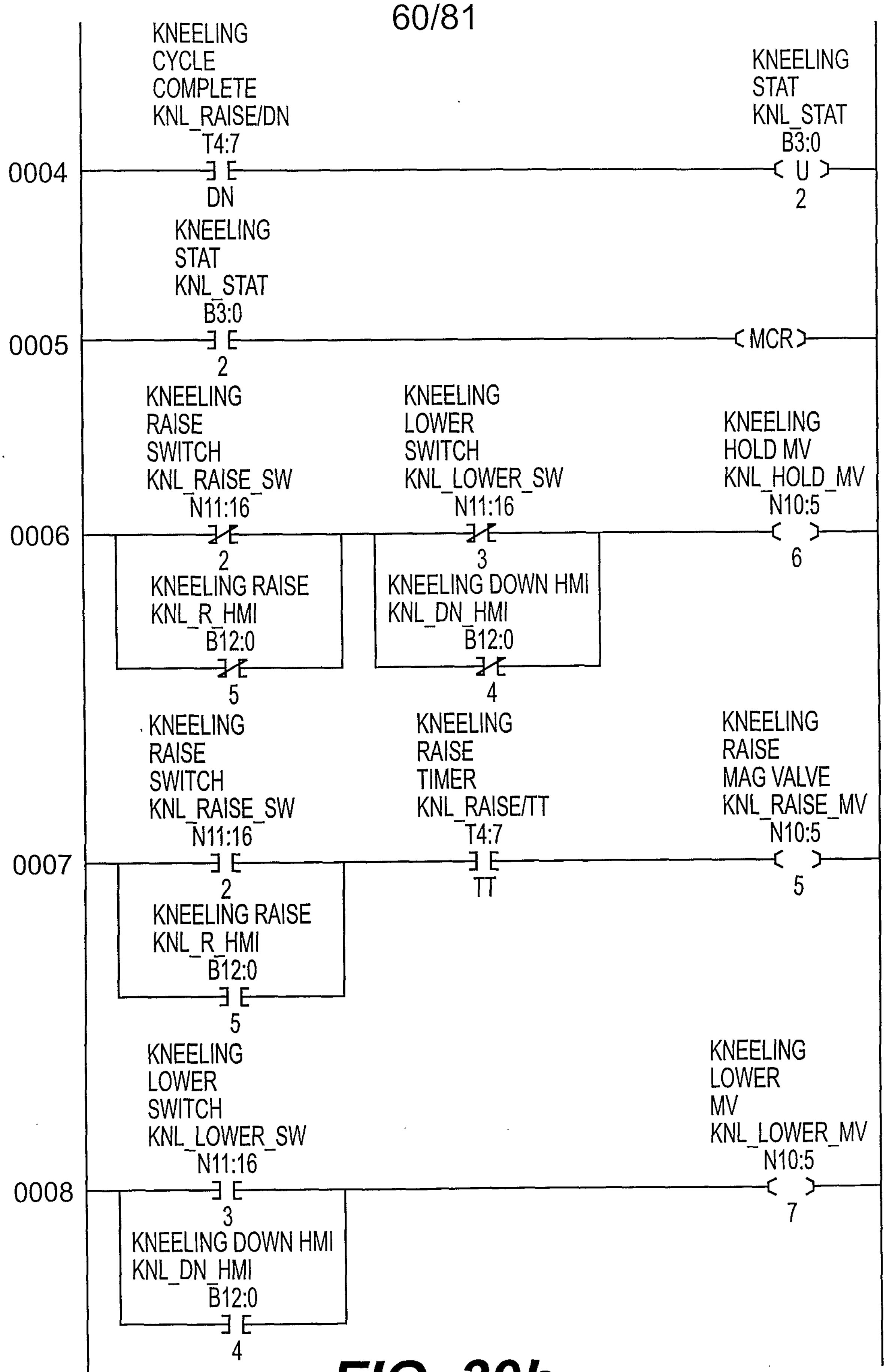

KNEELING CYCLE COMPLETE KNL_RAISE/DN T4:7 DN
KNEELING STAT KNL_STAT B3:0 U 2
0004
KNEELING STAT KNL_STAT B3:0 2
MCR
0005
KNEELING RAISE SWITCH KNL_RAISE_SW N11:16 2
KNEELING LOWER SWITCH KNL_LOWER_SW N11:16 3
KNEELING HOLD MV KNL_HOLD_MV N10:5 6
KNEELING RAISE KNL_R_HMI B12:0 5
KNEELING DOWN HMI KNL_DN_HMI B12:0 4
0006
KNEELING RAISE SWITCH KNL_RAISE_SW N11:16 2
KNEELING RAISE TIMER KNL_RAISE/TT T4:7 TT
KNEELING RAISE MAG VALVE KNL_RAISE_MV N10:5 5
KNEELING RAISE KNL_R_HMI B12:0 5
0007
KNEELING LOWER SWITCH KNL_LOWER_SW N11:16 3
KNEELING LOWER MV KNL_LOWER_MV N10:5 7
KNEELING DOWN HMI KNL_DN_HMI B12:0 4
0008

FIG. 39b

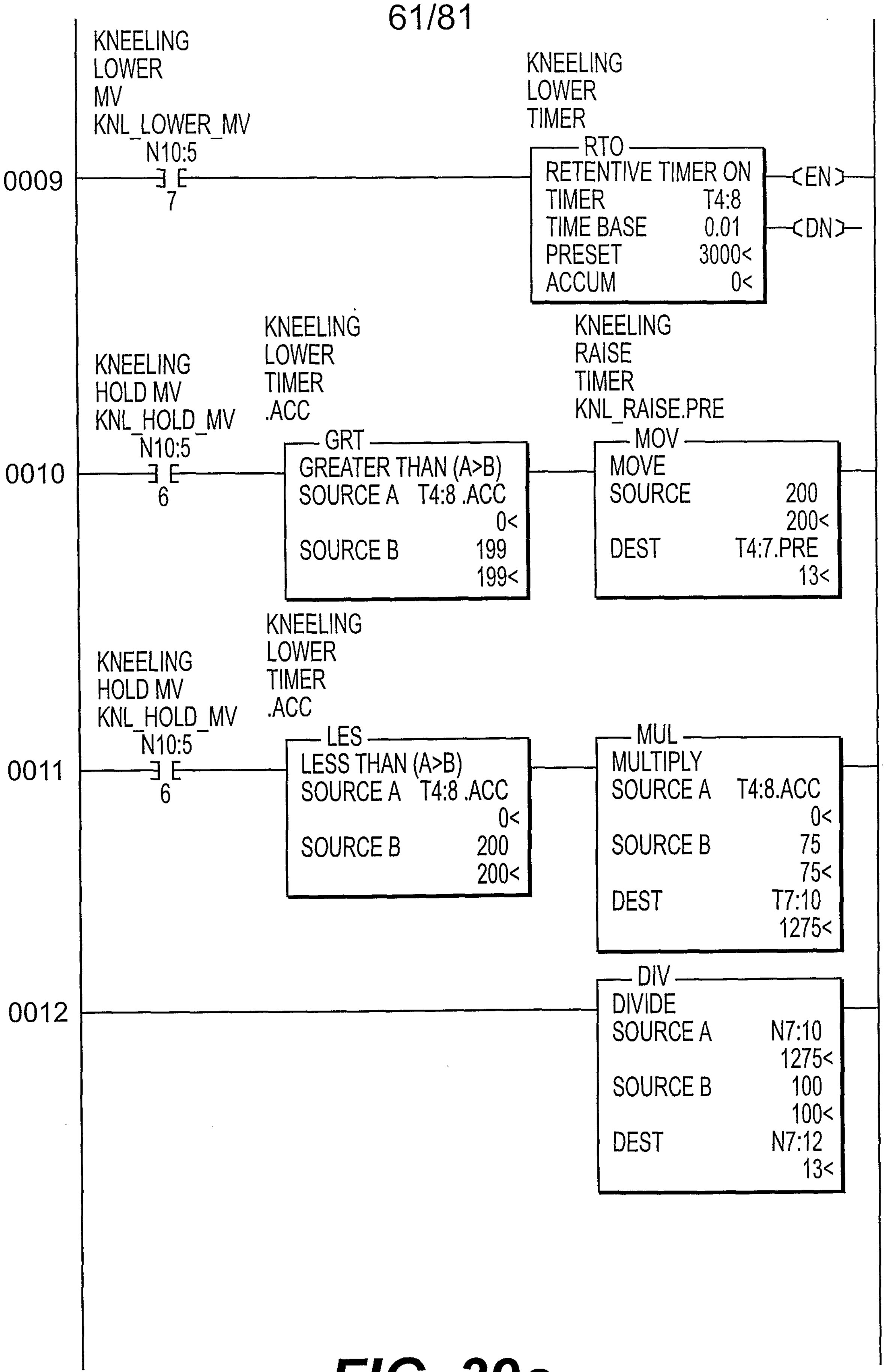

KNEELING
LOWER
MV
KNL_LOWER_MV
N10:5
7
0009
KNEELING
LOWER
TIMER
RTO
RETENTIVE TIMER ON
TIMER T4:8
TIME BASE 0.01
PRESET 3000<
ACCUM 0<
EN
DN
0010
KNEELING
HOLD MV
KNL_HOLD_MV
N10:5
6
KNEELING
LOWER
TIMER
.ACC
GRT
GREATER THAN (A>B)
SOURCE A T4:8 .ACC
0<
SOURCE B 199
199<
KNEELING
RAISE
TIMER
KNL_RAISE.PRE
MOV
MOVE
SOURCE 200
200<
DEST T4:7.PRE
13<
0011
KNEELING
HOLD MV
KNL_HOLD_MV
N10:5
6
KNEELING
LOWER
TIMER
.ACC
LES
LESS THAN (A>B)
SOURCE A T4:8 .ACC
0<
SOURCE B 200
200<
MUL
MULTIPLY
SOURCE A T4:8.ACC
0<
SOURCE B 75
75<
DEST T7:10
1275<
0012
DIV
DIVIDE
SOURCE A N7:10
1275<
SOURCE B 100
100<
DEST N7:12
13<

FIG. 39c

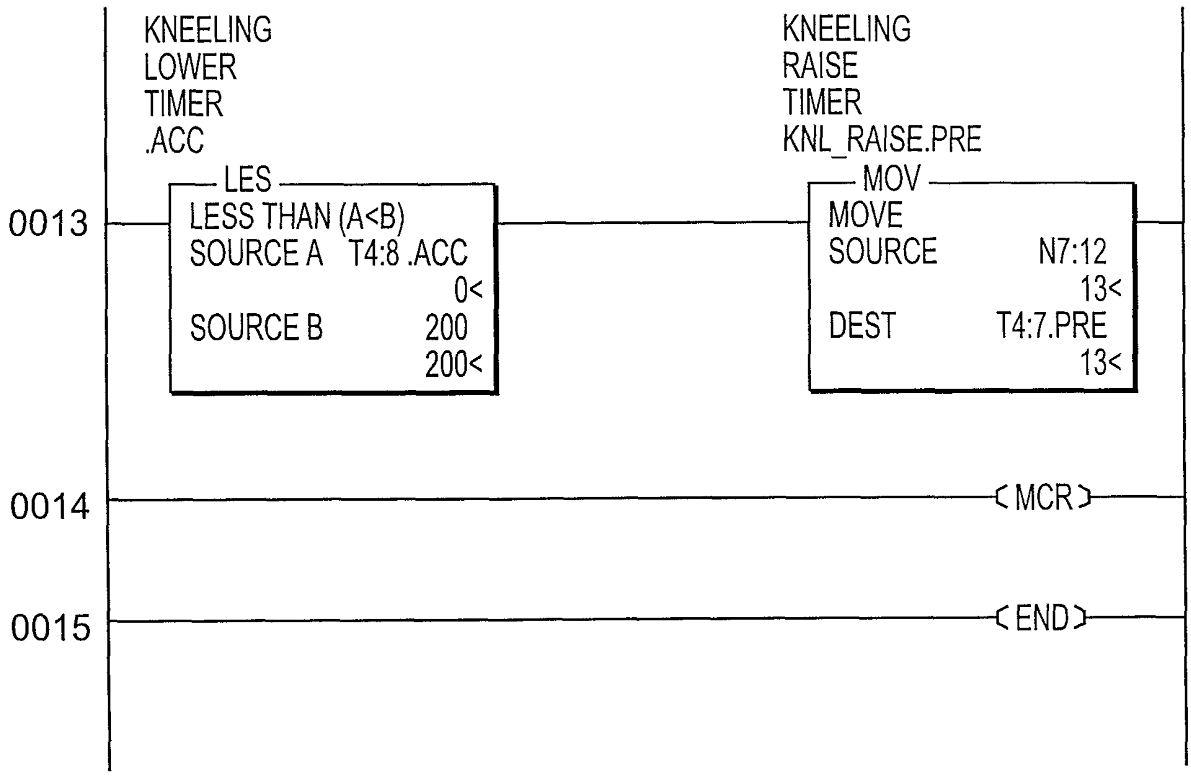

KNEELING
LOWER
TIMER
.ACC
KNEELING
RAISE
TIMER
KNL_RAISE.PRE
0013
LES
LESS THAN (A<B)
SOURCE A T4:8 .ACC
0<
SOURCE B 200
200<
MOV
MOVE
SOURCE N7:12
13<
DEST T4:7.PRE
13<
0014
MCR
0015
END

FIG. 39d

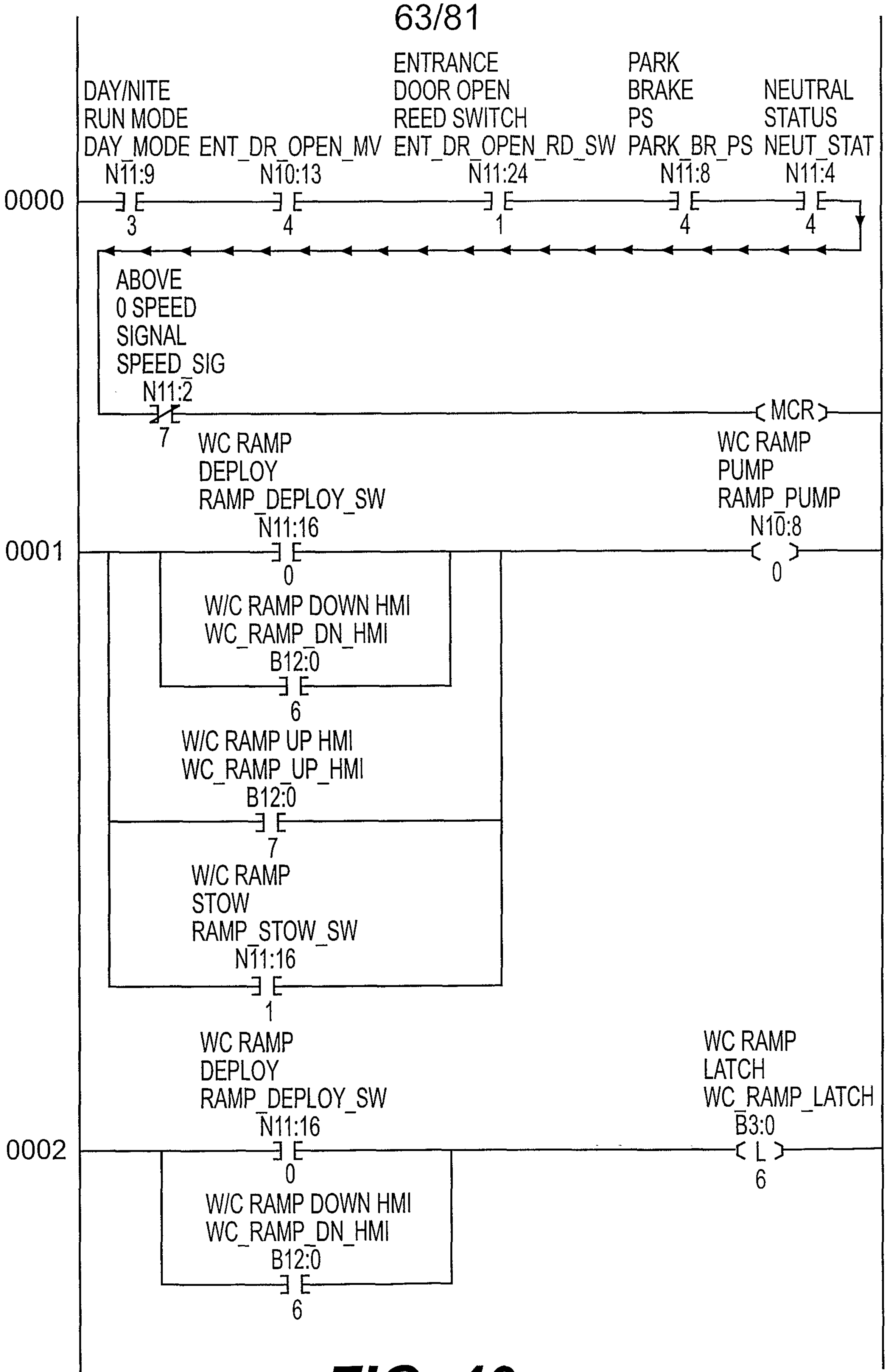
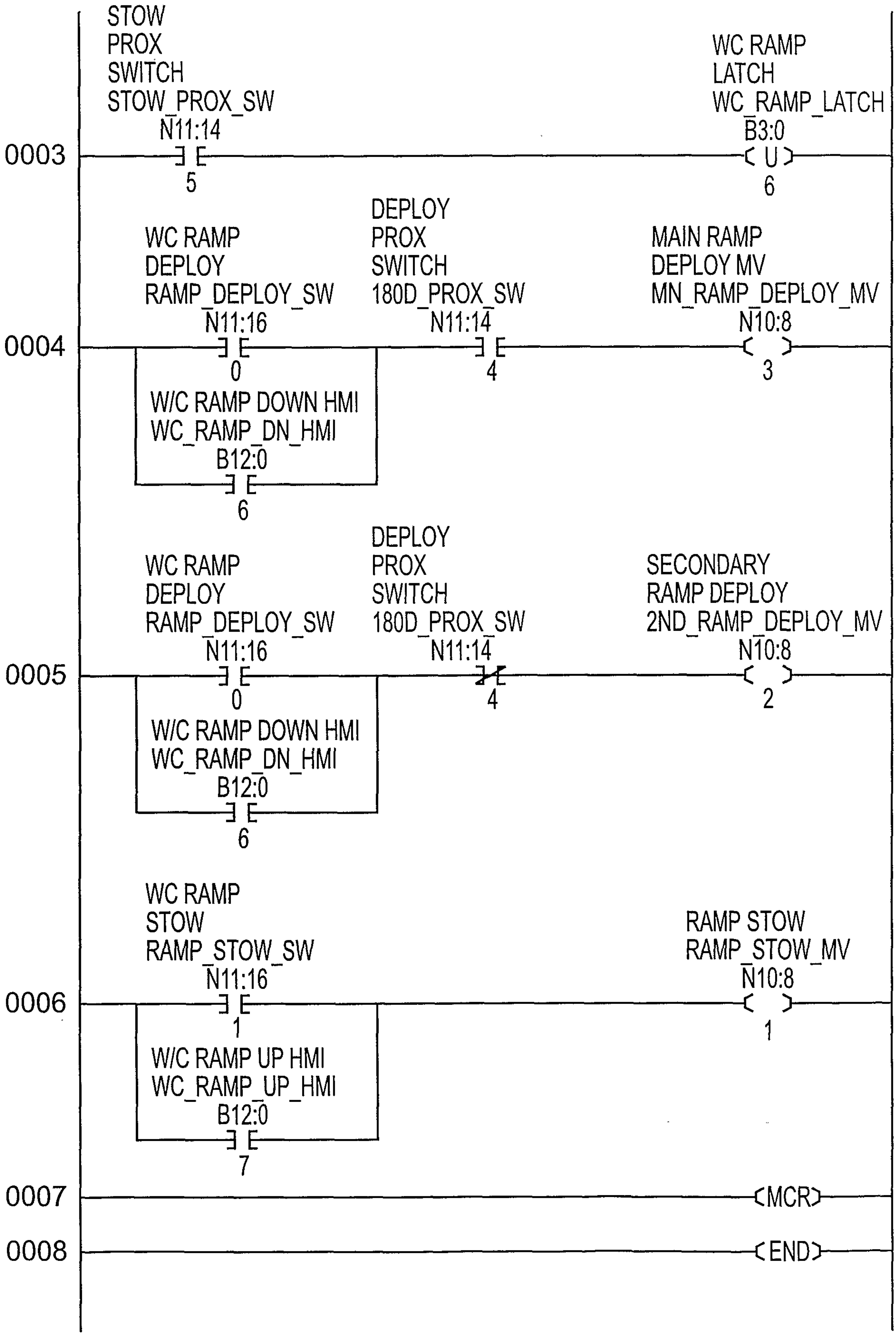

0000
DAY/NITE RUN MODE DAY_MODE N11:9 3
ENT_DR_OPEN_MV N10:13 4
ENTRANCE DOOR OPEN REED SWITCH ENT_DR_OPEN_RD_SW N11:24 1
PARK BRAKE PS PARK_BR_PS N11:8 4
NEUTRAL STATUS NEUT_STAT N11:4 4
ABOVE 0 SPEED SIGNAL SPEED_SIG N11:2 7
MCR
0001
WC RAMP DEPLOY RAMP_DEPLOY_SW N11:16 0
W/C RAMP DOWN HMI WC_RAMP_DN_HMI B12:0 6
W/C RAMP UP HMI WC_RAMP_UP_HMI B12:0 7
W/C RAMP STOW RAMP_STOW_SW N11:16 1
WC RAMP PUMP RAMP_PUMP N10:8 0
0002
WC RAMP DEPLOY RAMP_DEPLOY_SW N11:16 0
W/C RAMP DOWN HMI WC_RAMP_DN_HMI B12:0 6
WC RAMP LATCH WC_RAMP_LATCH B3:0 L 6

FIG. 40a



STOW PROX SWITCH STOW_PROX_SW N11:14 5
WC RAMP LATCH WC_RAMP_LATCH B3:0 U 6
0003
0004
WC RAMP DEPLOY RAMP_DEPLOY_SW N11:16 0
DEPLOY PROX SWITCH 180D_PROX_SW N11:14 4
MAIN RAMP DEPLOY MV MN_RAMP_DEPLOY_MV N10:8 3
W/C RAMP DOWN HMI WC_RAMP_DN_HMI B12:0 6
0005
WC RAMP DEPLOY RAMP_DEPLOY_SW N11:16 0
DEPLOY PROX SWITCH 180D_PROX_SW N11:14 4
SECONDARY RAMP DEPLOY 2ND_RAMP_DEPLOY_MV N10:8 2
W/C RAMP DOWN HMI WC_RAMP_DN_HMI B12:0 6
0006
WC RAMP STOW RAMP_STOW_SW N11:16 1
RAMP STOW RAMP_STOW_MV N10:8 1
W/C RAMP UP HMI WC_RAMP_UP_HMI B12:0 7
0007
MCR
0008
END

FIG. 40b

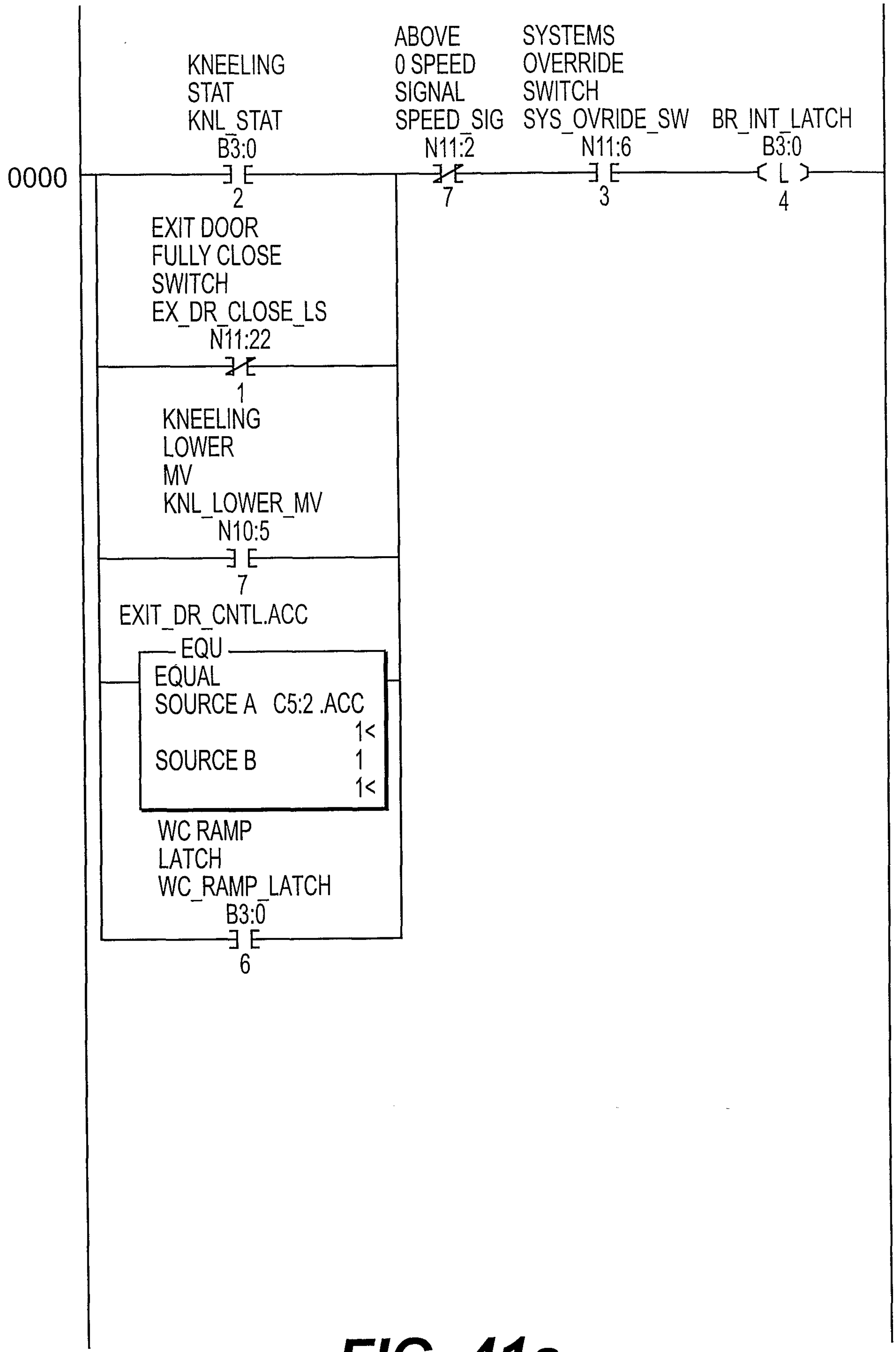

0000
KNEELING
STAT
KNL_STAT
B3:0
2
ABOVE
0 SPEED
SIGNAL
SPEED_SIG
N11:2
7
SYSTEMS
OVERRIDE
SWITCH
SYS_OVRIDE_SW
N11:6
3
BR_INT_LATCH
B3:0
L
4
EXIT DOOR
FULLY CLOSE
SWITCH
EX_DR_CLOSE_LS
N11:22
1
KNEELING
LOWER
MV
KNL_LOWER_MV
N10:5
7
EXIT_DR_CNTL.ACC
EQU
EQUAL
SOURCE A C5:2 .ACC
1<
SOURCE B 1
1<
WC RAMP
LATCH
WC_RAMP_LATCH
B3:0
6

FIG. 41a

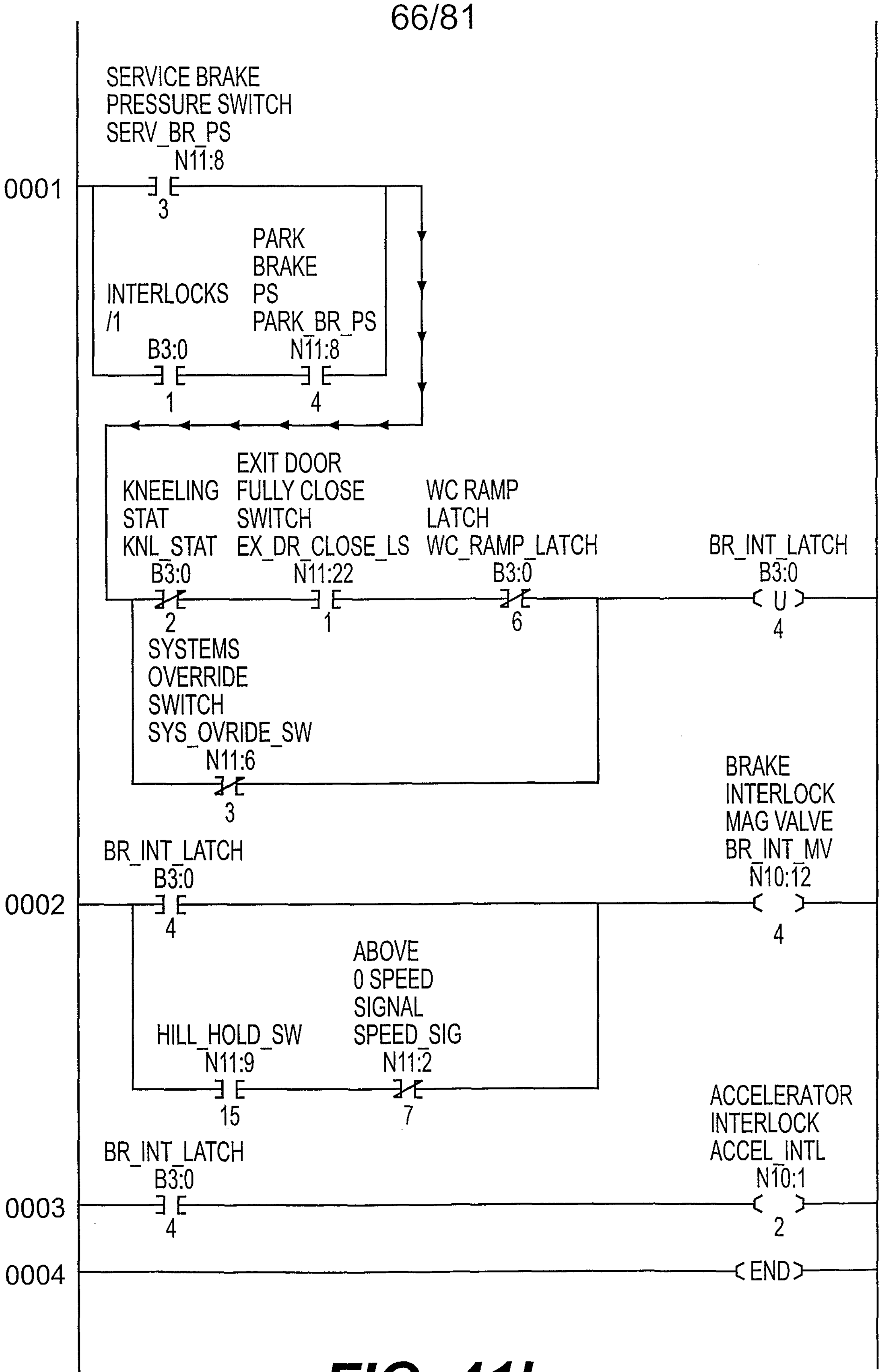

SERVICE BRAKE
PRESSURE SWITCH
SERV_BR_PS
N11:8
0001
3
PARK
BRAKE
PS
PARK_BR_PS
INTERLOCKS
/1
B3:0
N11:8
1
4
KNEELING
STAT
KNL_STAT
B3:0
2
EXIT DOOR
FULLY CLOSE
SWITCH
EX_DR_CLOSE_LS
N11:22
1
WC RAMP
LATCH
WC_RAMP_LATCH
B3:0
6
BR_INT_LATCH
B3:0
U
4
SYSTEMS
OVERRIDE
SWITCH
SYS_OVRIDE_SW
N11:6
3
BR_INT_LATCH
B3:0
0002
4
BRAKE
INTERLOCK
MAG VALVE
BR_INT_MV
N10:12
4
HILL_HOLD_SW
N11:9
15
ABOVE
0 SPEED
SIGNAL
SPEED_SIG
N11:2
7
BR_INT_LATCH
B3:0
0003
4
ACCELERATOR
INTERLOCK
ACCEL_INTL
N10:1
2
0004
END

FIG. 41b

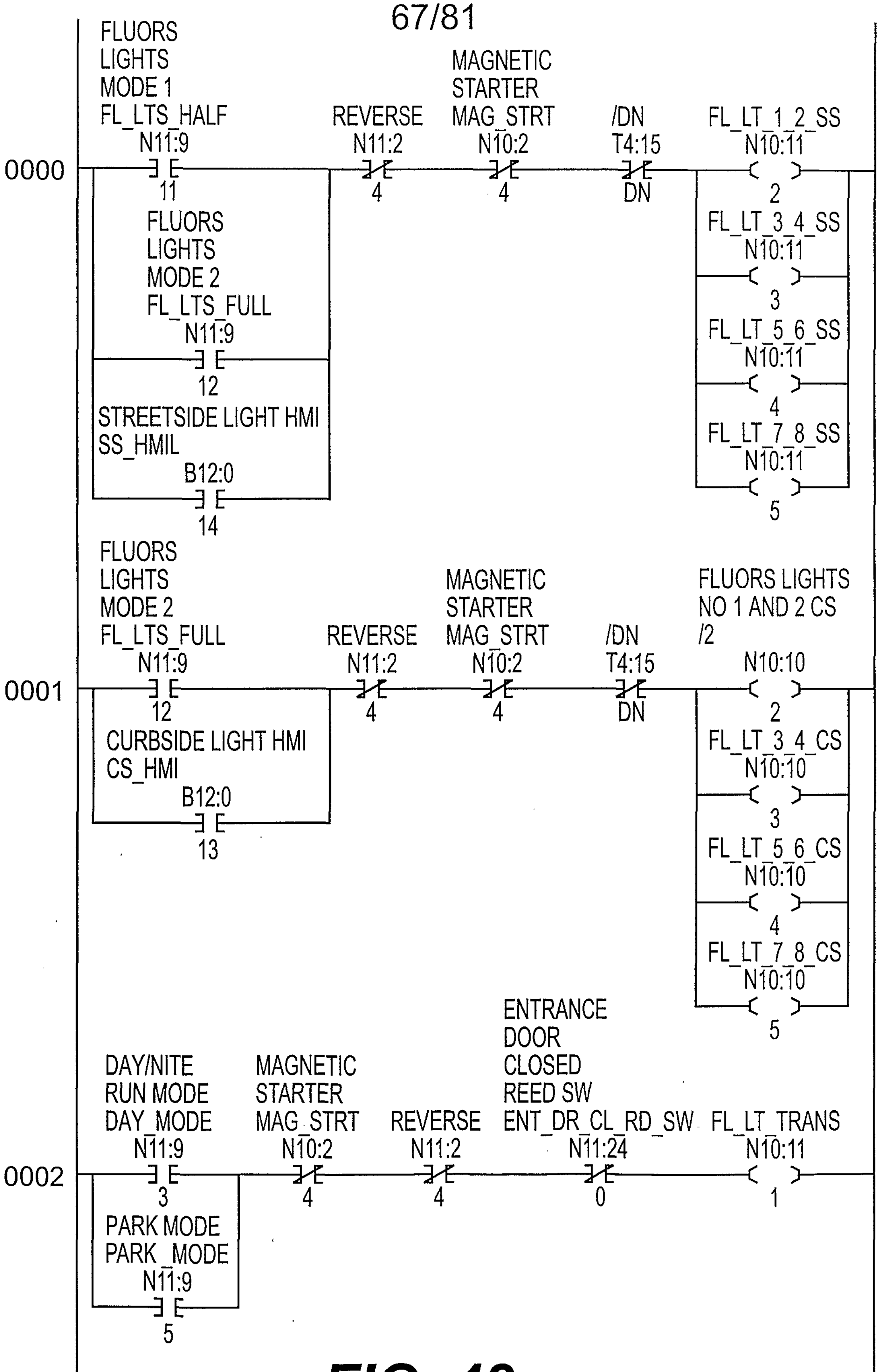

0000
FLUORS LIGHTS MODE 1 FL_LTS_HALF N11:9 11
FLUORS LIGHTS MODE 2 FL_LTS_FULL N11:9 12
STREETSIDE LIGHT HMI SS_HMIL B12:0 14
REVERSE N11:2 4
MAGNETIC STARTER MAG_STRT N10:2 4
/DN T4:15 DN
FL_LT_1_2_SS N10:11 2
FL_LT_3_4_SS N10:11 3
FL_LT_5_6_SS N10:11 4
FL_LT_7_8_SS N10:11 5
0001
FLUORS LIGHTS MODE 2 FL_LTS_FULL N11:9 12
CURBSIDE LIGHT HMI CS_HMI B12:0 13
REVERSE N11:2 4
MAGNETIC STARTER MAG_STRT N10:2 4
/DN T4:15 DN
FLUORS LIGHTS NO 1 AND 2 CS /2 N10:10 2
FL_LT_3_4_CS N10:10 3
FL_LT_5_6_CS N10:10 4
FL_LT_7_8_CS N10:10 5
0002
DAY/NITE RUN MODE DAY_MODE N11:9 3
PARK MODE PARK_MODE N11:9 5
MAGNETIC STARTER MAG_STRT N10:2 4
REVERSE N11:2 4
ENTRANCE DOOR CLOSED REED SW ENT_DR_CL_RD_SW N11:24 0
FL_LT_TRANS N10:11 1

FIG. 42a

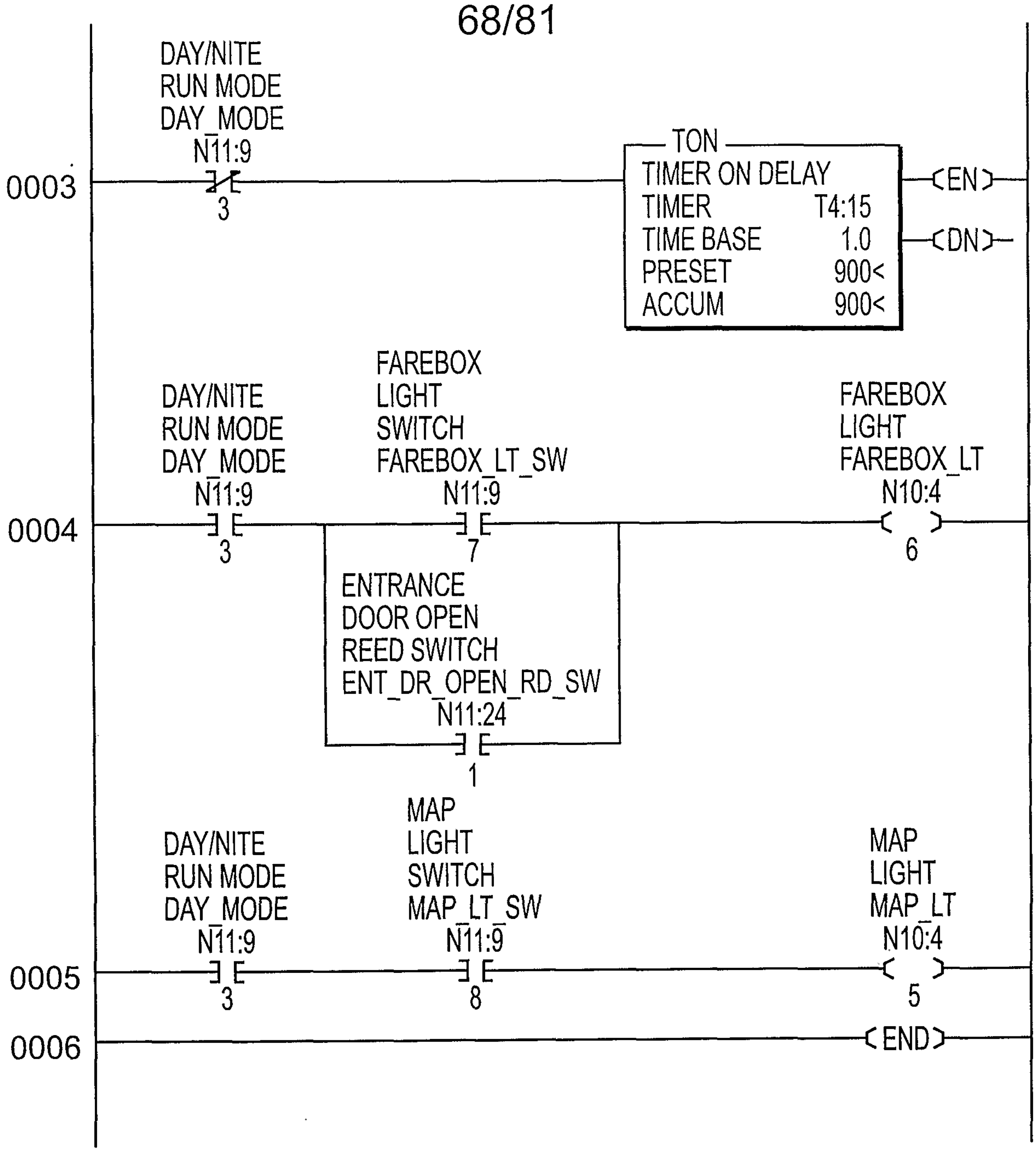
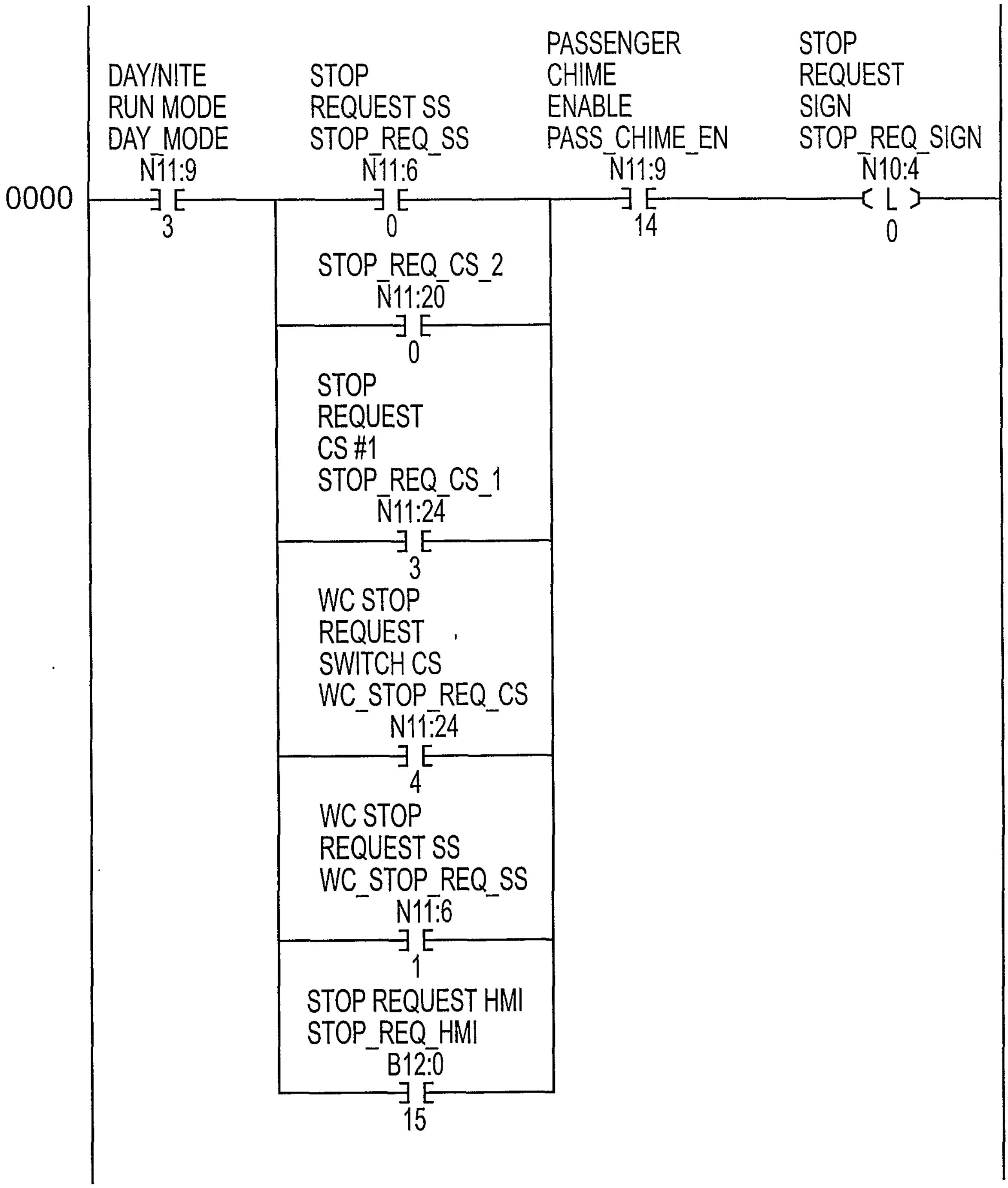

0003
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
TON
TIMER ON DELAY
TIMER T4:15
TIME BASE 1.0
PRESET 900<
ACCUM 900<
EN
DN
0004
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
FAREBOX
LIGHT
SWITCH
FAREBOX_LT_SW
N11:9
7
ENTRANCE
DOOR OPEN
REED SWITCH
ENT_DR_OPEN_RD_SW
N11:24
1
FAREBOX
LIGHT
FAREBOX_LT
N10:4
6
0005
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
MAP
LIGHT
SWITCH
MAP_LT_SW
N11:9
8
MAP
LIGHT
MAP_LT
N10:4
5
0006
END

FIG. 42b



0000
DAY/NITE RUN MODE DAY_MODE
N11:9
3
STOP REQUEST SS STOP_REQ_SS
N11:6
0
PASSENGER CHIME ENABLE PASS_CHIME_EN
N11:9
14
STOP REQUEST SIGN STOP_REQ_SIGN
N10:4
L
0
STOP_REQ_CS_2
N11:20
0
STOP REQUEST CS #1 STOP_REQ_CS_1
N11:24
3
WC STOP REQUEST SWITCH CS WC_STOP_REQ_CS
N11:24
4
WC STOP REQUEST SS WC_STOP_REQ_SS
N11:6
1
STOP REQUEST HMI STOP_REQ_HMI
B12:0
15

FIG. 43a

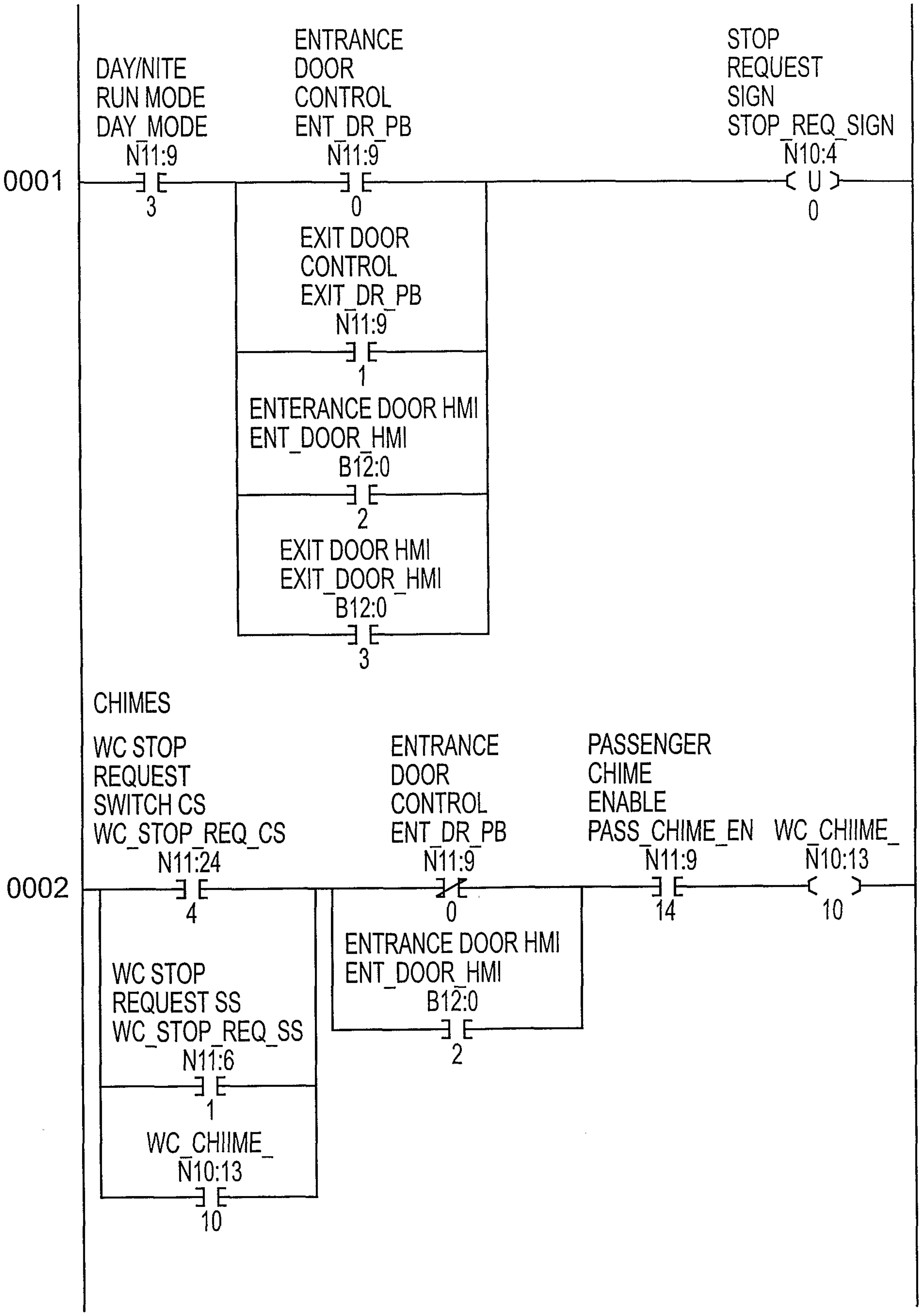

DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
ENTRANCE
DOOR
CONTROL
ENT_DR_PB
N11:9
0
STOP
REQUEST
SIGN
STOP_REQ_SIGN
N10:4
U
0
0001
EXIT DOOR
CONTROL
EXIT_DR_PB
N11:9
1
ENTERANCE DOOR HMI
ENT_DOOR_HMI
B12:0
2
EXIT DOOR HMI
EXIT_DOOR_HMI
B12:0
3
CHIMES
WC STOP
REQUEST
SWITCH CS
WC_STOP_REQ_CS
N11:24
4
ENTRANCE
DOOR
CONTROL
ENT_DR_PB
N11:9
0
PASSENGER
CHIME
ENABLE
PASS_CHIME_EN
N11:9
14
WC_CHIIME_
N10:13
10
0002
WC STOP
REQUEST SS
WC_STOP_REQ_SS
N11:6
1
ENTRANCE DOOR HMI
ENT_DOOR_HMI
B12:0
2
WC_CHIIME_
N10:13
10

FIG. 43b

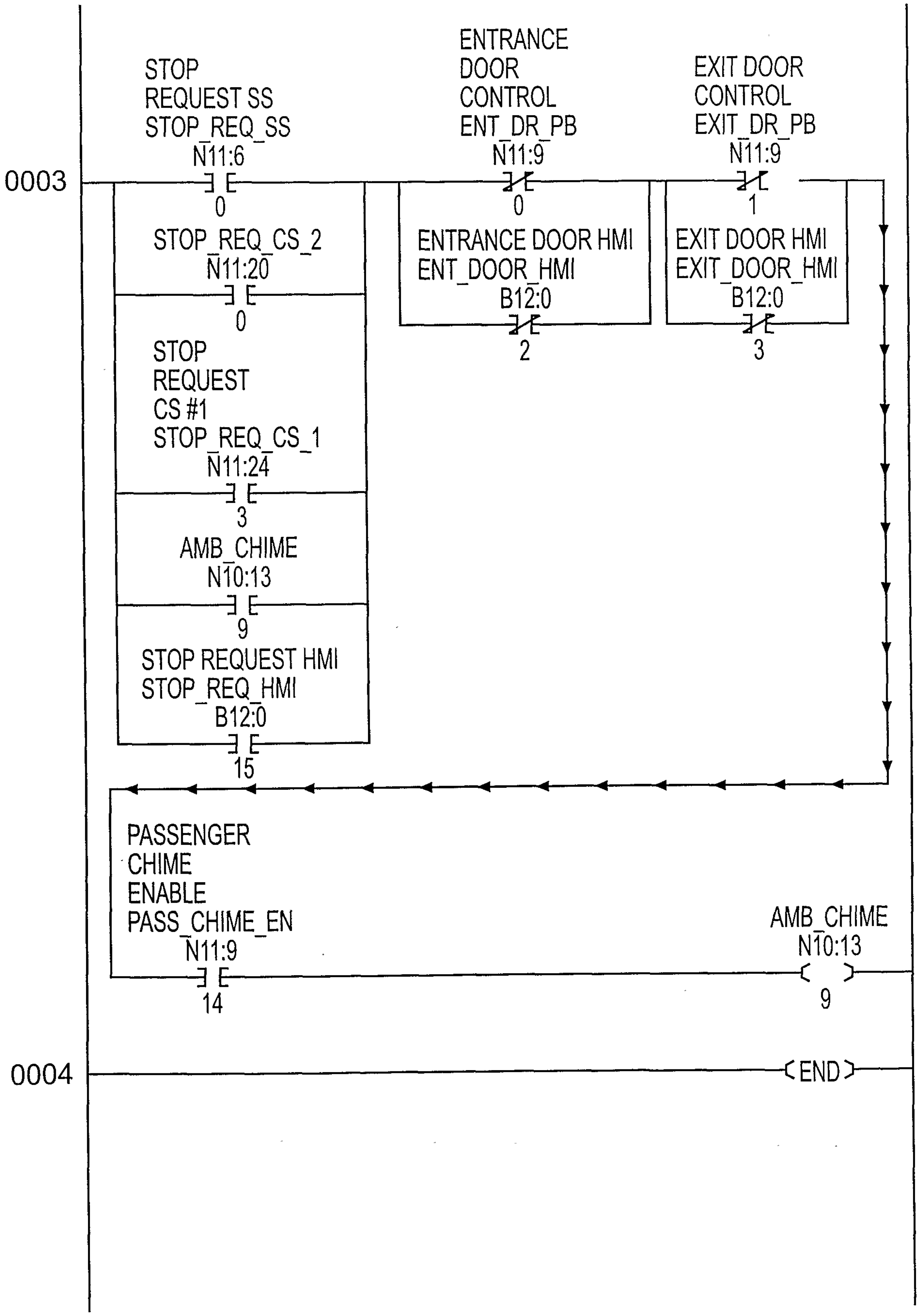

0003
STOP
REQUEST SS
STOP_REQ_SS
N11:6
0
ENTRANCE
DOOR
CONTROL
ENT_DR_PB
N11:9
0
EXIT DOOR
CONTROL
EXIT_DR_PB
N11:9
1
STOP_REQ_CS_2
N11:20
0
ENTRANCE DOOR HMI
ENT_DOOR_HMI
B12:0
2
EXIT DOOR HMI
EXIT_DOOR_HMI
B12:0
3
STOP
REQUEST
CS #1
STOP_REQ_CS_1
N11:24
3
AMB_CHIME
N10:13
9
STOP REQUEST HMI
STOP_REQ_HMI
B12:0
15
PASSENGER
CHIME
ENABLE
PASS_CHIME_EN
N11:9
14
AMB_CHIME
N10:13
9
0004
END

FIG. 43c

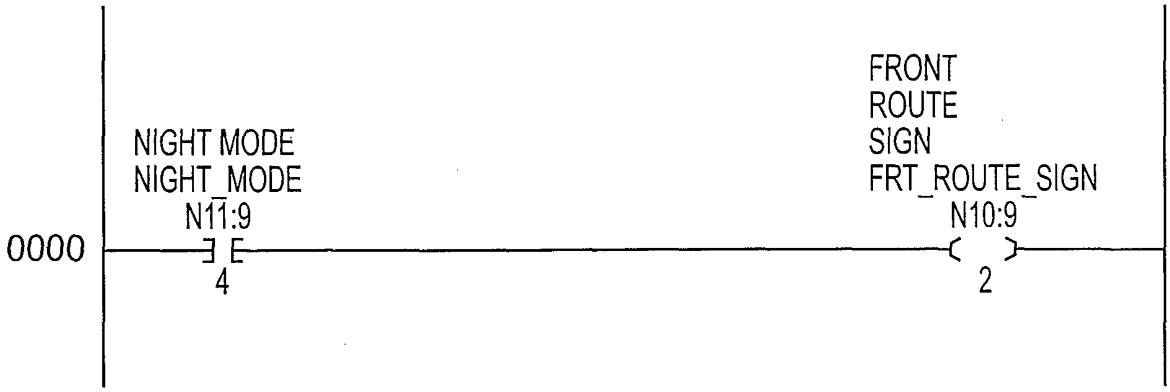

NIGHT MODE
NIGHT_MODE
N11:9
4
FRONT
ROUTE
SIGN
FRT_ROUTE_SIGN
N10:9
2
0000

FIG. 44a

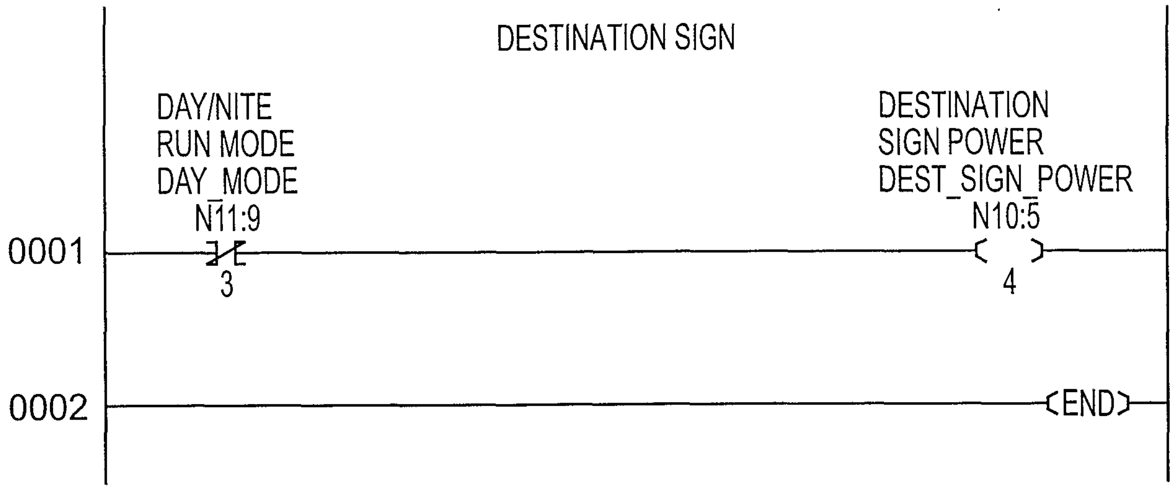
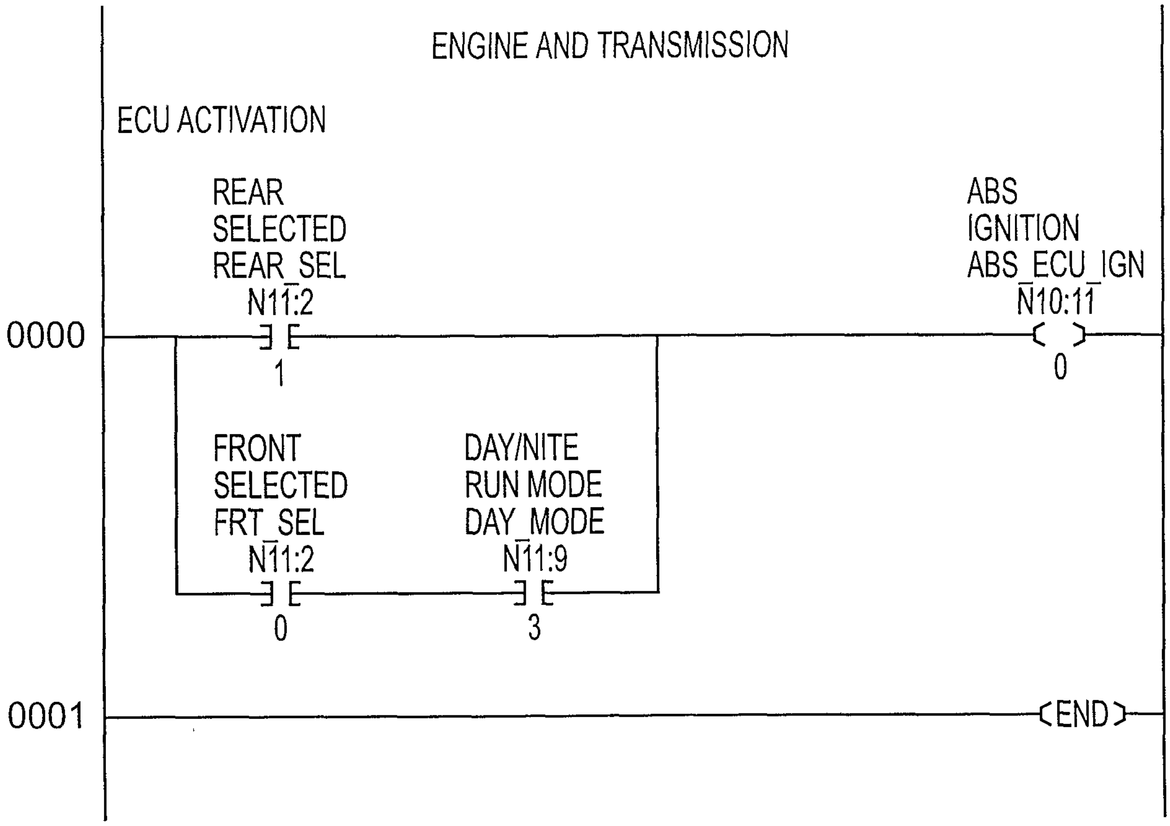

DESTINATION SIGN
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
DESTINATION
SIGN POWER
DEST_SIGN_POWER
N10:5
4
0001
0002
END

FIG. 44b



ENGINE AND TRANSMISSION
ECU ACTIVATION
REAR
SELECTED
REAR_SEL
N11:2
1
ABS
IGNITION
ABS_ECU_IGN
N10:11
0
0000
FRONT
SELECTED
FRT_SEL
N11:2
0
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
0001
END

FIG. 45

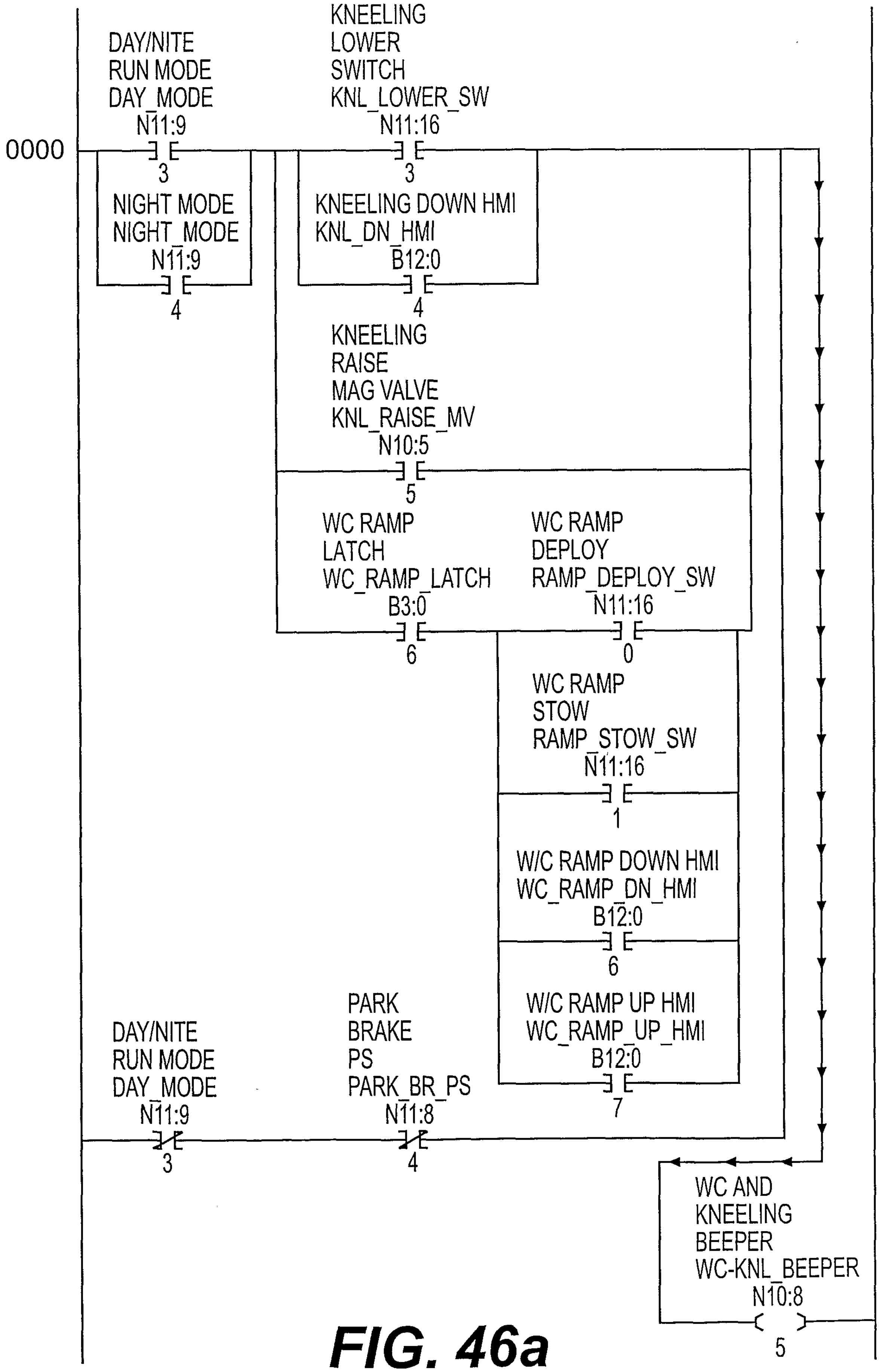
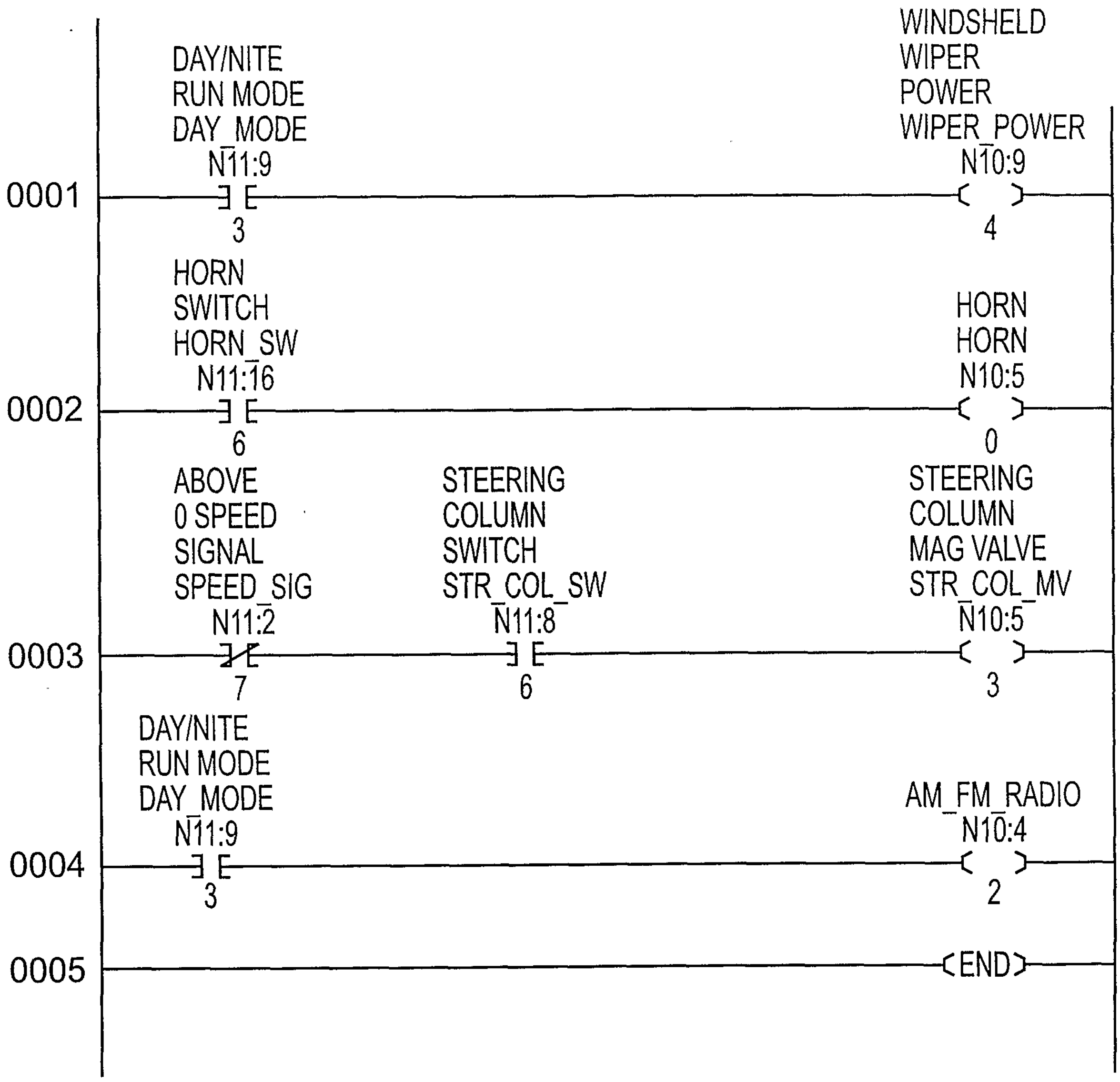
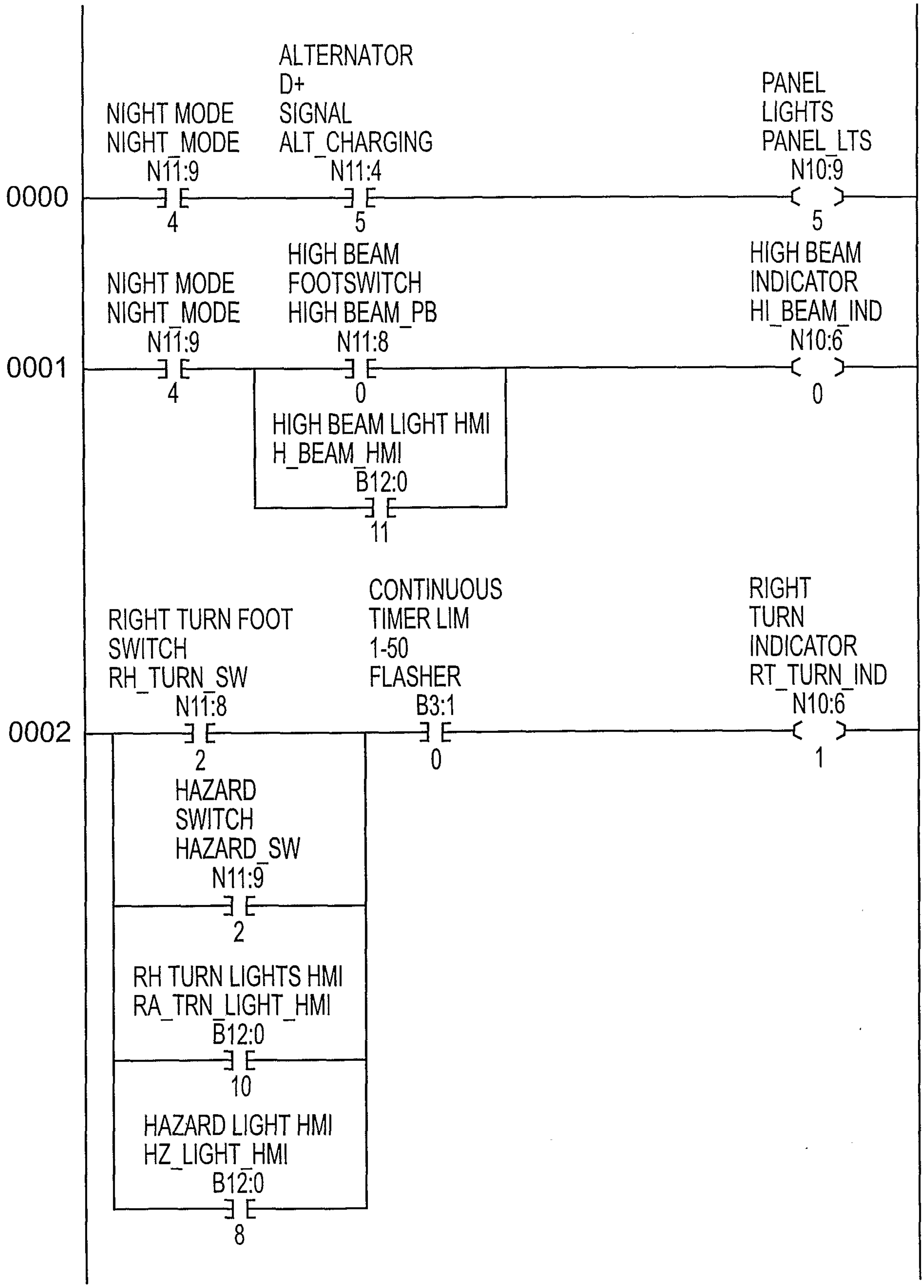

0000
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
NIGHT MODE
NIGHT_MODE
N11:9
4
KNEELING
LOWER
SWITCH
KNL_LOWER_SW
N11:16
3
KNEELING DOWN HMI
KNL_DN_HMI
B12:0
4
KNEELING
RAISE
MAG VALVE
KNL_RAISE_MV
N10:5
5
WC RAMP
LATCH
WC_RAMP_LATCH
B3:0
6
WC RAMP
DEPLOY
RAMP_DEPLOY_SW
N11:16
0
WC RAMP
STOW
RAMP_STOW_SW
N11:16
1
W/C RAMP DOWN HMI
WC_RAMP_DN_HMI
B12:0
6
W/C RAMP UP HMI
WC_RAMP_UP_HMI
B12:0
7
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
PARK
BRAKE
PS
PARK_BR_PS
N11:8
4
WC AND
KNEELING
BEEPER
WC-KNL_BEEPER
N10:8
5

FIG. 46a



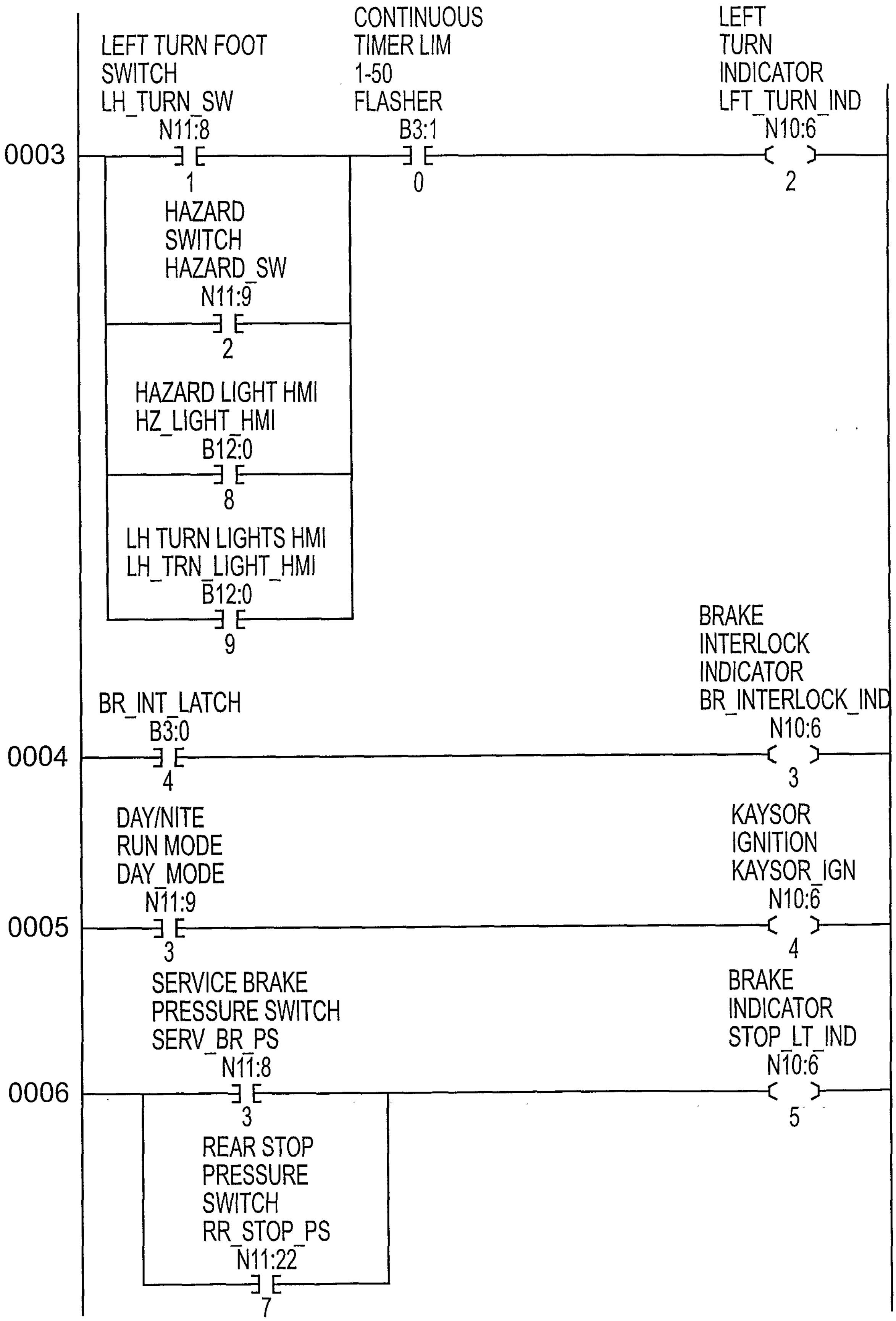
0001
DAY/NITE RUN MODE DAY_MODE N11:9 3
WINDSHELD WIPER POWER WIPER_POWER N10:9 4
0002
HORN SWITCH HORN_SW N11:16 6
HORN HORN N10:5 0
0003
ABOVE 0 SPEED SIGNAL SPEED_SIG N11:2 7
STEERING COLUMN SWITCH STR_COL_SW N11:8 6
STEERING COLUMN MAG VALVE STR_COL_MV N10:5 3
0004
DAY/NITE RUN MODE DAY_MODE N11:9 3
AM_FM_RADIO N10:4 2
0005
END

FIG. 46b



ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
NIGHT MODE
NIGHT_MODE
N11:9
4
0000
PANEL
LIGHTS
PANEL_LTS
N10:9
5
0001
NIGHT MODE
NIGHT_MODE
N11:9
4
HIGH BEAM
FOOTSWITCH
HIGH BEAM_PB
N11:8
0
HIGH BEAM LIGHT HMI
H_BEAM_HMI
B12:0
11
HIGH BEAM
INDICATOR
HI_BEAM_IND
N10:6
0
0002
RIGHT TURN FOOT
SWITCH
RH_TURN_SW
N11:8
2
CONTINUOUS
TIMER LIM
1-50
FLASHER
B3:1
0
RIGHT
TURN
INDICATOR
RT_TURN_IND
N10:6
1
HAZARD
SWITCH
HAZARD_SW
N11:9
2
RH TURN LIGHTS HMI
RA_TRN_LIGHT_HMI
B12:0
10
HAZARD LIGHT HMI
HZ_LIGHT_HMI
B12:0
8

FIG. 47a



0003
LEFT TURN FOOT SWITCH
LH_TURN_SW
N11:8
1
CONTINUOUS TIMER LIM 1-50 FLASHER
B3:1
0
LEFT TURN INDICATOR
LFT_TURN_IND
N10:6
2
HAZARD SWITCH
HAZARD_SW
N11:9
2
HAZARD LIGHT HMI
HZ_LIGHT_HMI
B12:0
8
LH TURN LIGHTS HMI
LH_TRN_LIGHT_HMI
B12:0
9
0004
BR_INT_LATCH
B3:0
4
BRAKE INTERLOCK INDICATOR
BR_INTERLOCK_IND
N10:6
3
0005
DAY/NITE RUN MODE
DAY_MODE
N11:9
3
KAYSOR IGNITION
KAYSOR_IGN
N10:6
4
0006
SERVICE BRAKE PRESSURE SWITCH
SERV_BR_PS
N11:8
3
BRAKE INDICATOR
STOP_LT_IND
N10:6
5
REAR STOP PRESSURE SWITCH
RR_STOP_PS
N11:22
7

FIG. 47b

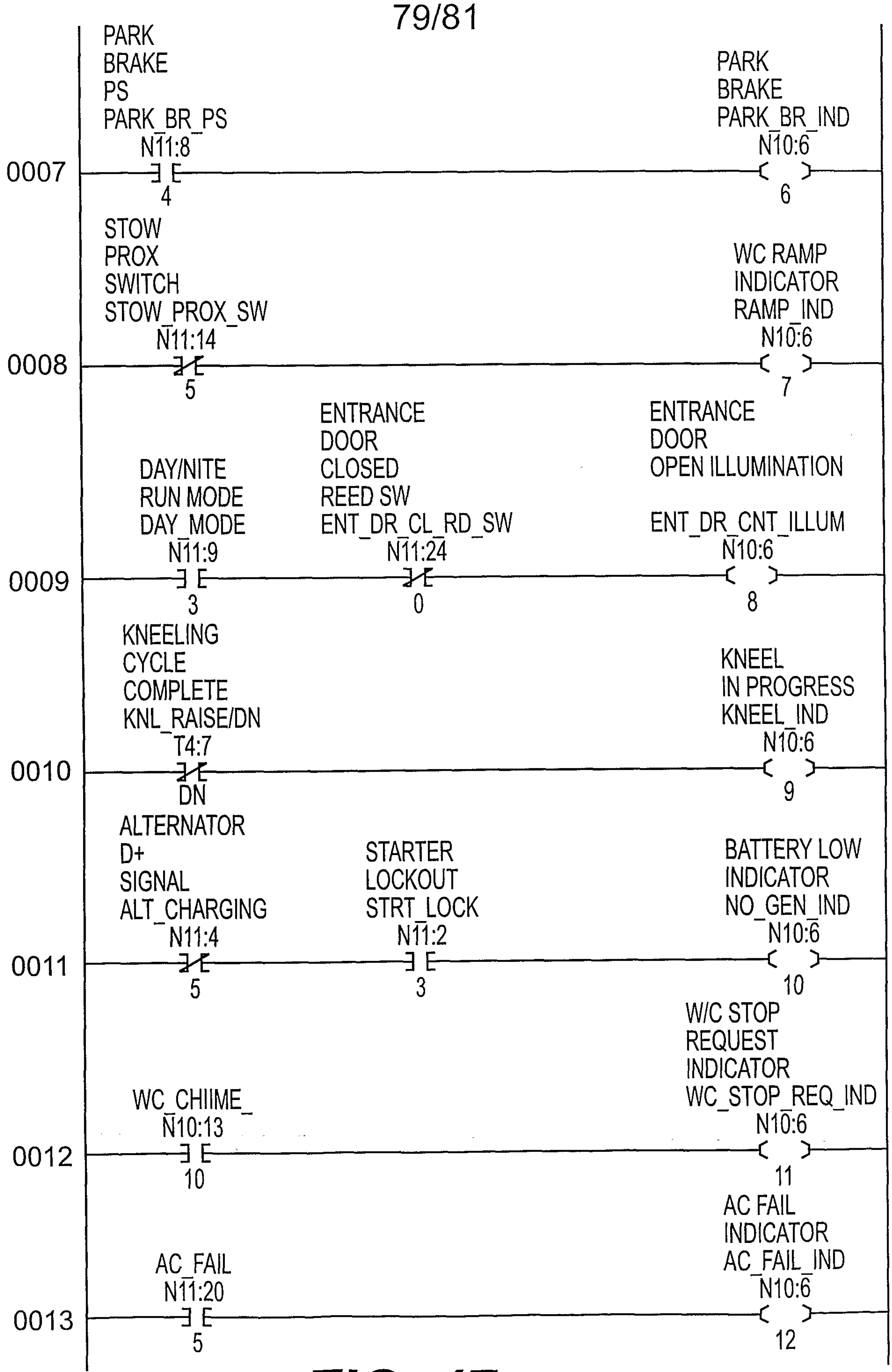

PARK
BRAKE
PS
PARK_BR_PS
N11:8
4
PARK
BRAKE
PARK_BR_IND
N10:6
6
0007
STOW
PROX
SWITCH
STOW_PROX_SW
N11:14
5
WC RAMP
INDICATOR
RAMP_IND
N10:6
7
0008
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
ENTRANCE
DOOR
CLOSED
REED SW
ENT_DR_CL_RD_SW
N11:24
0
ENTRANCE
DOOR
OPEN ILLUMINATION
ENT_DR_CNT_ILLUM
N10:6
8
0009
KNEELING
CYCLE
COMPLETE
KNL_RAISE/DN
T4:7
DN
KNEEL
IN PROGRESS
KNEEL_IND
N10:6
9
0010
ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
STARTER
LOCKOUT
STRT_LOCK
N11:2
3
BATTERY LOW
INDICATOR
NO_GEN_IND
N10:6
10
0011
WC_CHIIME_
N10:13
10
W/C STOP
REQUEST
INDICATOR
WC_STOP_REQ_IND
N10:6
11
0012
AC_FAIL
N11:20
5
AC FAIL
INDICATOR
AC_FAIL_IND
N10:6
12
0013

FIG. 47c

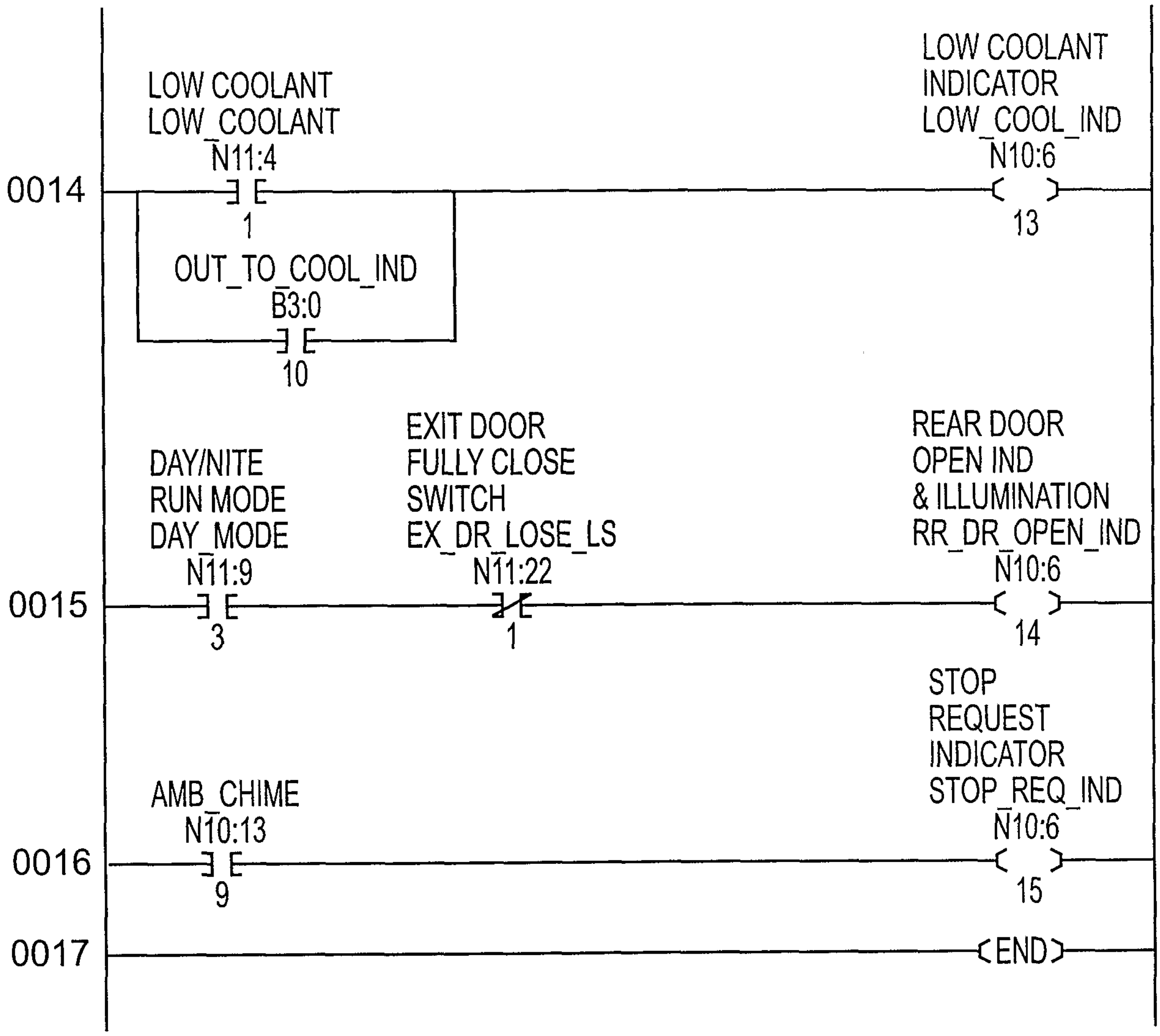

0014
LOW COOLANT
LOW_COOLANT
N11:4
1
OUT_TO_COOL_IND
B3:0
10
LOW COOLANT
INDICATOR
LOW_COOL_IND
N10:6
13
0015
DAY/NITE
RUN MODE
DAY_MODE
N11:9
3
EXIT DOOR
FULLY CLOSE
SWITCH
EX_DR_LOSE_LS
N11:22
1
REAR DOOR
OPEN IND
& ILLUMINATION
RR_DR_OPEN_IND
N10:6
14
0016
AMB_CHIME
N10:13
9
STOP
REQUEST
INDICATOR
STOP_REQ_IND
N10:6
15
0017
END

FIG. 47d

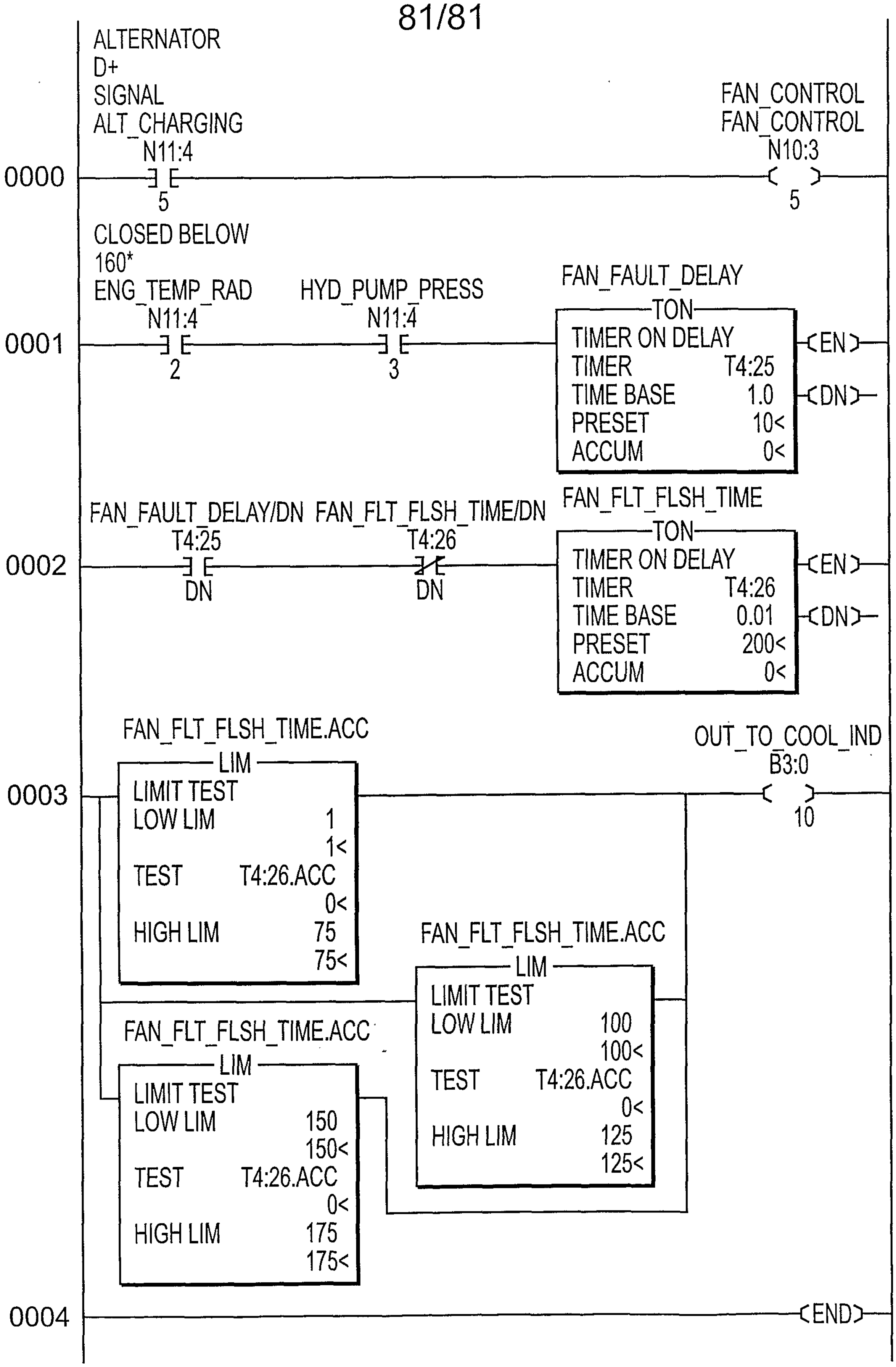

ALTERNATOR
D+
SIGNAL
ALT_CHARGING
N11:4
5
FAN_CONTROL
FAN_CONTROL
N10:3
5
0000
CLOSED BELOW
160*
ENG_TEMP_RAD
N11:4
2
HYD_PUMP_PRESS
N11:4
3
FAN_FAULT_DELAY
TON
TIMER ON DELAY
TIMER T4:25
TIME BASE 1.0
PRESET 10<
ACCUM 0<
EN
DN
0001
FAN_FAULT_DELAY/DN
T4:25
DN
FAN_FLT_FLSH_TIME/DN
T4:26
DN
FAN_FLT_FLSH_TIME
TON
TIMER ON DELAY
TIMER T4:26
TIME BASE 0.01
PRESET 200<
ACCUM 0<
EN
DN
0002
FAN_FLT_FLSH_TIME.ACC
LIM
LIMIT TEST
LOW LIM 1
1<
TEST T4:26.ACC
0<
HIGH LIM 75
75<
OUT_TO_COOL_IND
B3:0
10
0003
FAN_FLT_FLSH_TIME.ACC
LIM
LIMIT TEST
LOW LIM 100
100<
TEST T4:26.ACC
0<
HIGH LIM 125
125<
FAN_FLT_FLSH_TIME.ACC
LIM
LIMIT TEST
LOW LIM 150
150<
TEST T4:26.ACC
0<
HIGH LIM 175
175<
0004
END

FIG. 48

INTERNATIONAL SEARCH REPORT

Int onal Application No
PCT/CA 01/00720

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G08G1/123

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6 023 232 A (EITZENBERGER KLAUS) 8 February 2000 (2000-02-08) column 3, line 60 - line 65 column 6, line 66 -column 7, line 32; figure 1	1-6
Y	EP 1 001 385 A (MERITOR HEAVY VEHICLE SYS LTD) 17 May 2000 (2000-05-17) column 2, line 39 -column 3, line 27	1-6
Y	GB 2 281 141 A (MOTOROLA GMBH) 22 February 1995 (1995-02-22) page 4, line 22 -page 5, line 11	1-6
A	US 4 799 162 A (SHINKAWA KIYOSHI ET AL) 17 January 1989 (1989-01-17) column 4, line 39 - line 57; figure 10	1-10

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 November 2001	19/12/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Créchet, P

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INTERNATIONAL SEARCH REPORT

Information on patent family members

In[illegible]nal Application No
PCT/CA 01/00720

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			JP	1795125 C	28-10-1993
			JP	4077958 B	09-12-1992
			JP	62108399 A	19-05-1987
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			DE	3689139 T2	07-04-1994
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