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(54) **MAN-MACHINE INTERFACE FOR A VIRTUAL ANNUNCIATOR PANEL DISPLAY**

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Related U.S. Application Data

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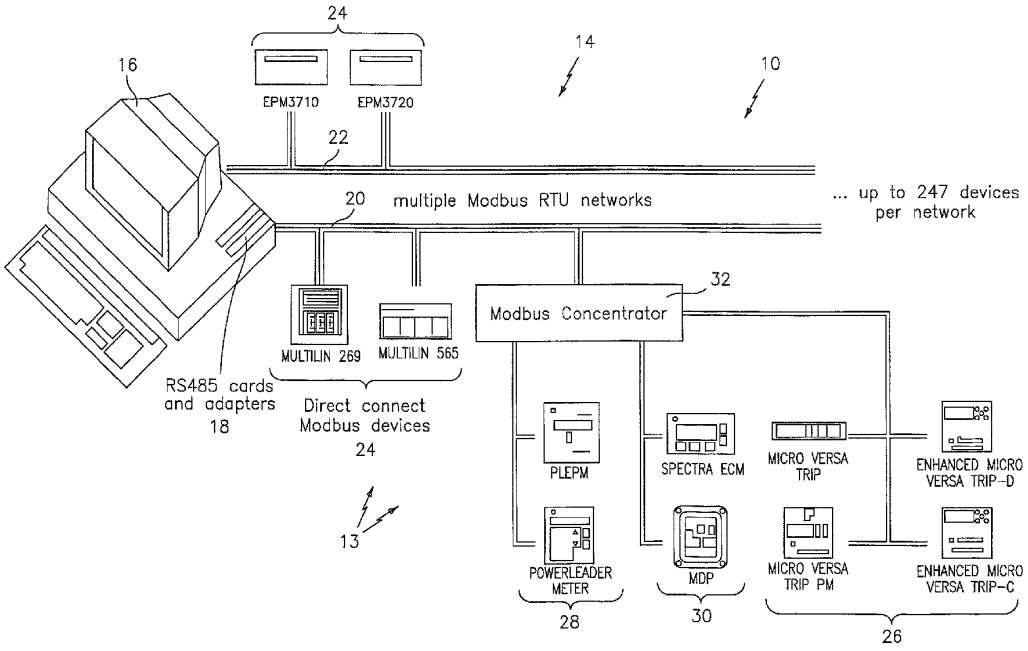
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(52) **U.S. Cl.** **345/771**; 345/772

(57) **ABSTRACT**

A power management control system provides control and graphical representation of a plurality of electrical devices and components of an electrical distribution system. The control system includes a virtual three-dimensional annunciator panel for displaying an indication of the status or condition of a plurality a plurality of electrical devices of an electrical distribution system. The virtual annunciator panel includes an array (6×8) of indicator buttons that represent a particular device, event or group of events of the PMCS. The buttons are displayed in different colors to indicate different alarm systems. The annunciator panel functions to notify the user/operator of an alarm condition of a device, as well as permits the user to acknowledge alarms. The development of the virtual annunciator panel display is automated using software, namely an Annunciator Panel Wizard. The Panel Wizard provides the automated configuration of the annunciator panel graphic as well as a built-in event mapping to the annunciator buttons which is user configurable. The Panel Wizard allows the user to generate the virtual annunciator panel display without any programming skills or detailed device knowledge.



Google Exhibit 1011
Google v. VirtaMove

Oracle Ex. 1011
Oracle v. VirtaMove, IPR2025-00965

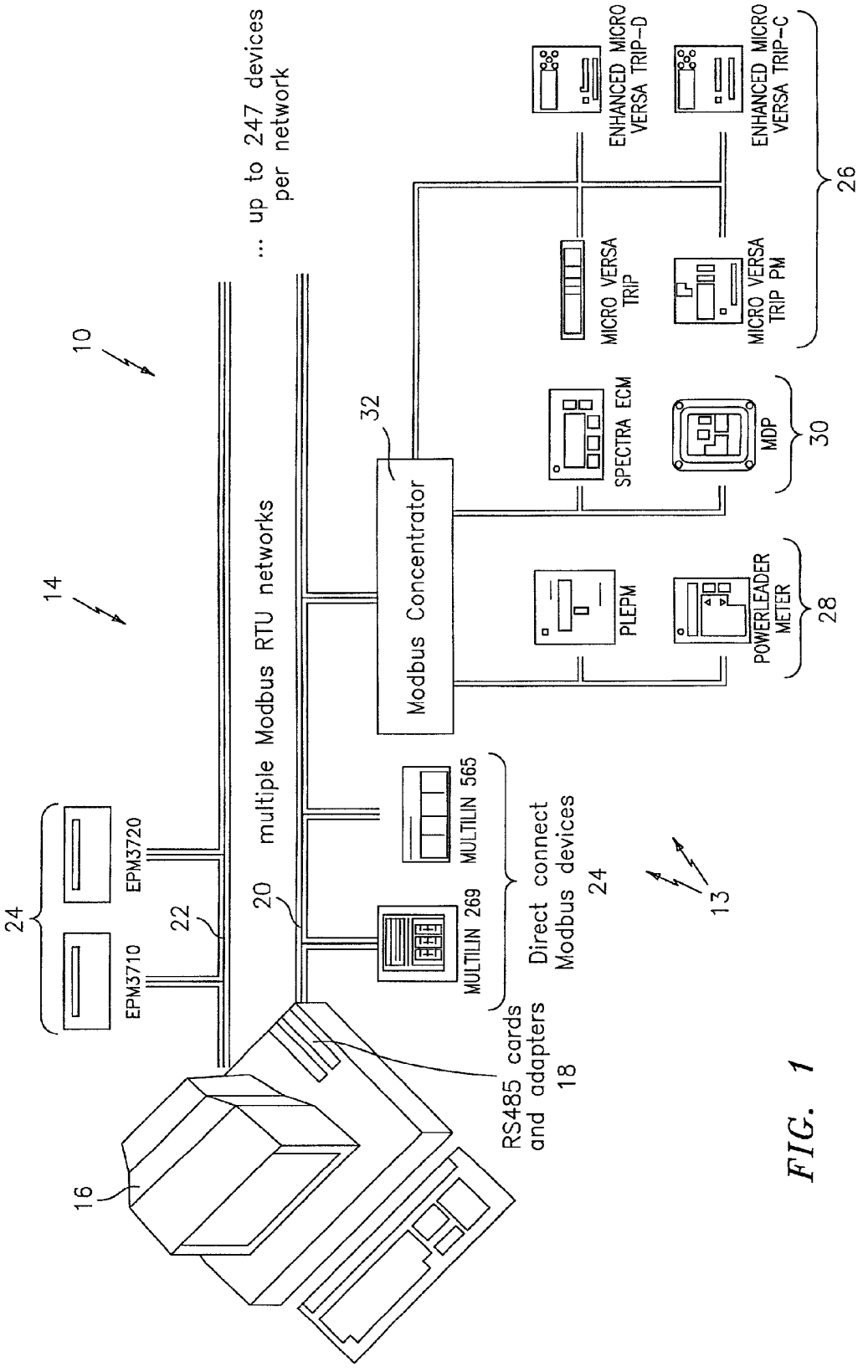

10
14
... up to 247 devices per network
multiple Modbus RTU networks
20
32
Modbus Concentrator
ENHANCED MICRO VERSA TRIP-D
ENHANCED MICRO VERSA TRIP-C
MICRO VERSA TRIP
MICRO VERSA TRIP PM
26
SPECTRA ECM
MDP
30
PLEPM
POWERLEADER METER
28
24
EPM3720
EPM3710
22
MULTILIN 565
MULTILIN 269
Direct connect Modbus devices
24
13
RS485 cards and adapters
18
16

FIG. 1

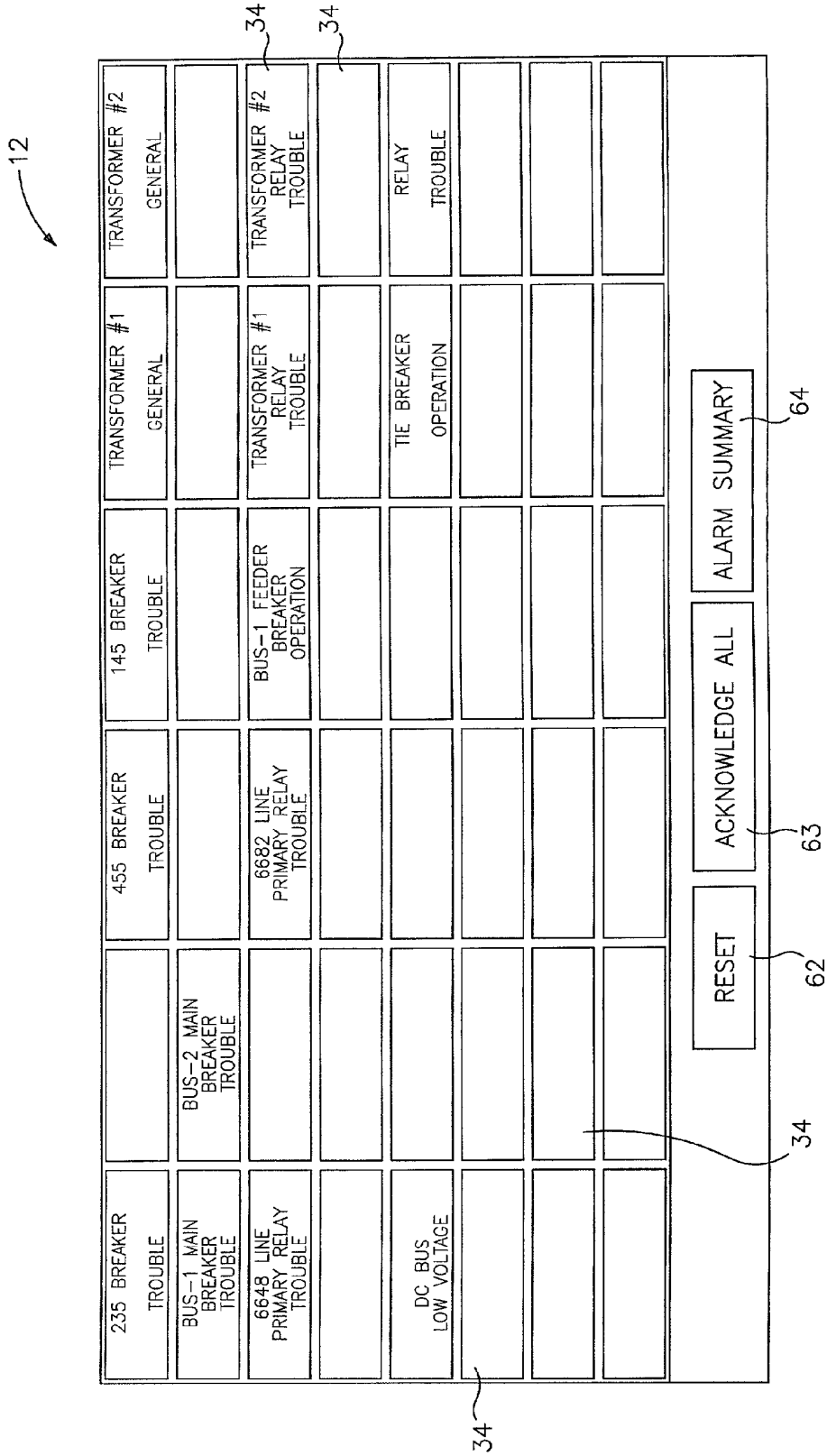

12
34
34
235 BREAKER TROUBLE
BUS-1 MAIN BREAKER TROUBLE
6648 LINE PRIMARY RELAY TROUBLE
DC BUS LOW VOLTAGE
BUS-2 MAIN BREAKER TROUBLE
455 BREAKER TROUBLE
6682 LINE PRIMARY RELAY TROUBLE
145 BREAKER TROUBLE
BUS-1 FEEDER BREAKER OPERATION
TRANSFORMER #1 GENERAL
TRANSFORMER #1 RELAY TROUBLE
TIE BREAKER OPERATION
TRANSFORMER #2 GENERAL
TRANSFORMER #2 RELAY TROUBLE
RELAY TROUBLE
34
34
RESET
62
ACKNOWLEDGE ALL
63
ALARM SUMMARY
64

FIG. 2

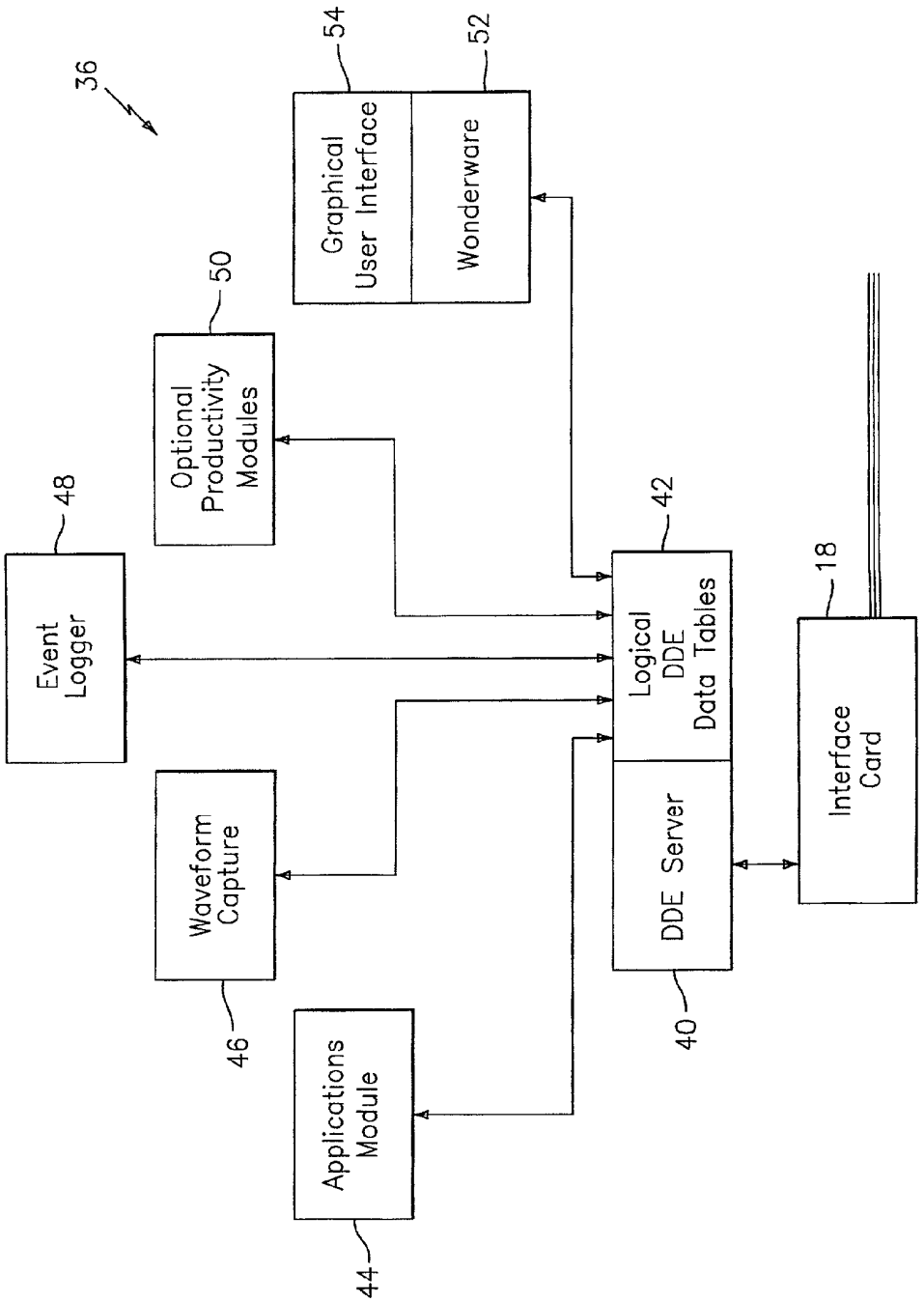

36
54
52
Graphical User Interface
Wonderware
50
Optional Productivity Modules
48
Event Logger
42
Logical DDE Data Tables
18
Interface Card
DDE Server
40
Waveform Capture
46
Applications Module
44

FIG. 3

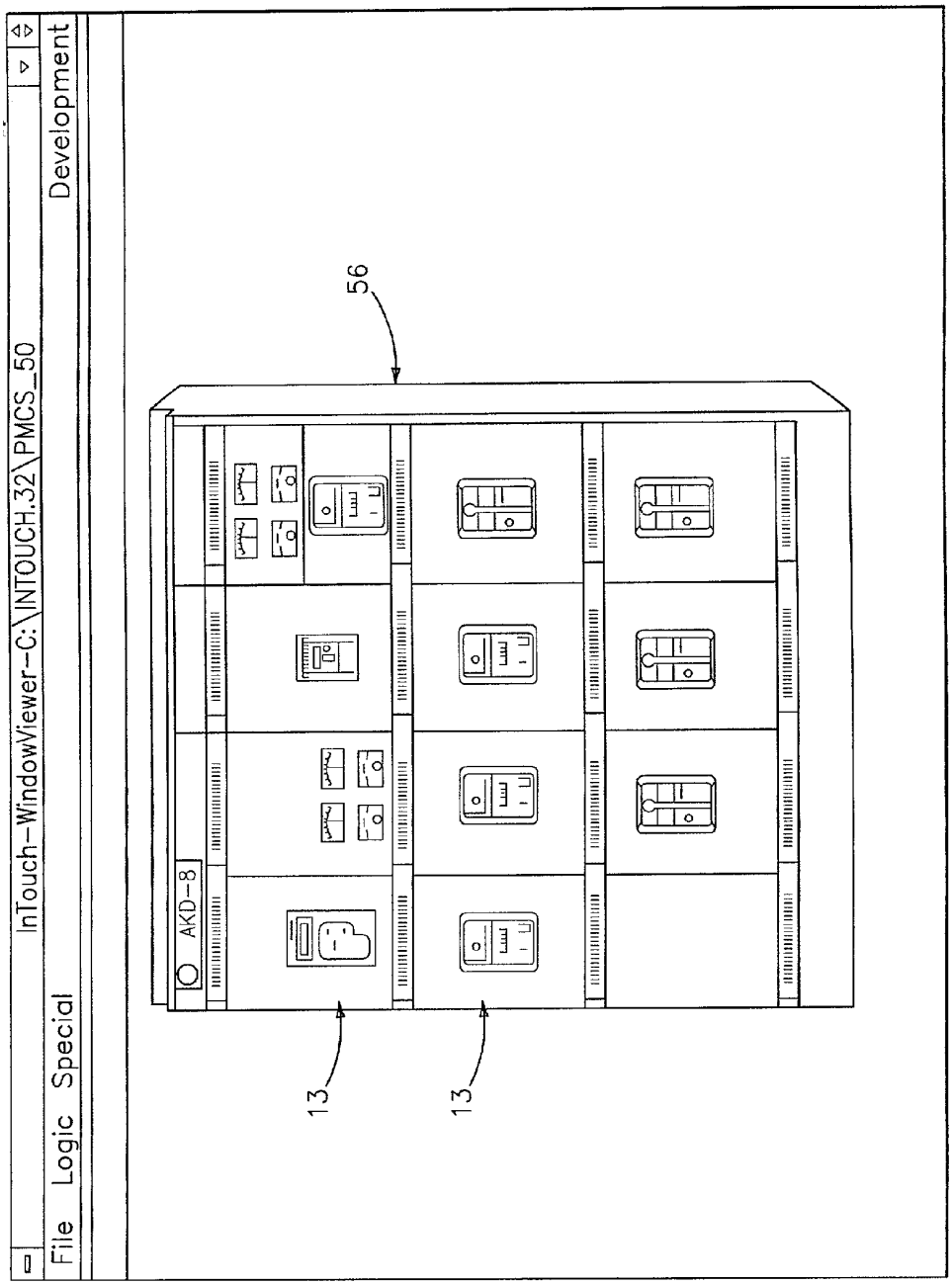

InTouch-WindowViewer-C:\INTOUCH.32\PMCS_50
File Logic Special
Development
AKD-8
56
13
13

FIG. 4

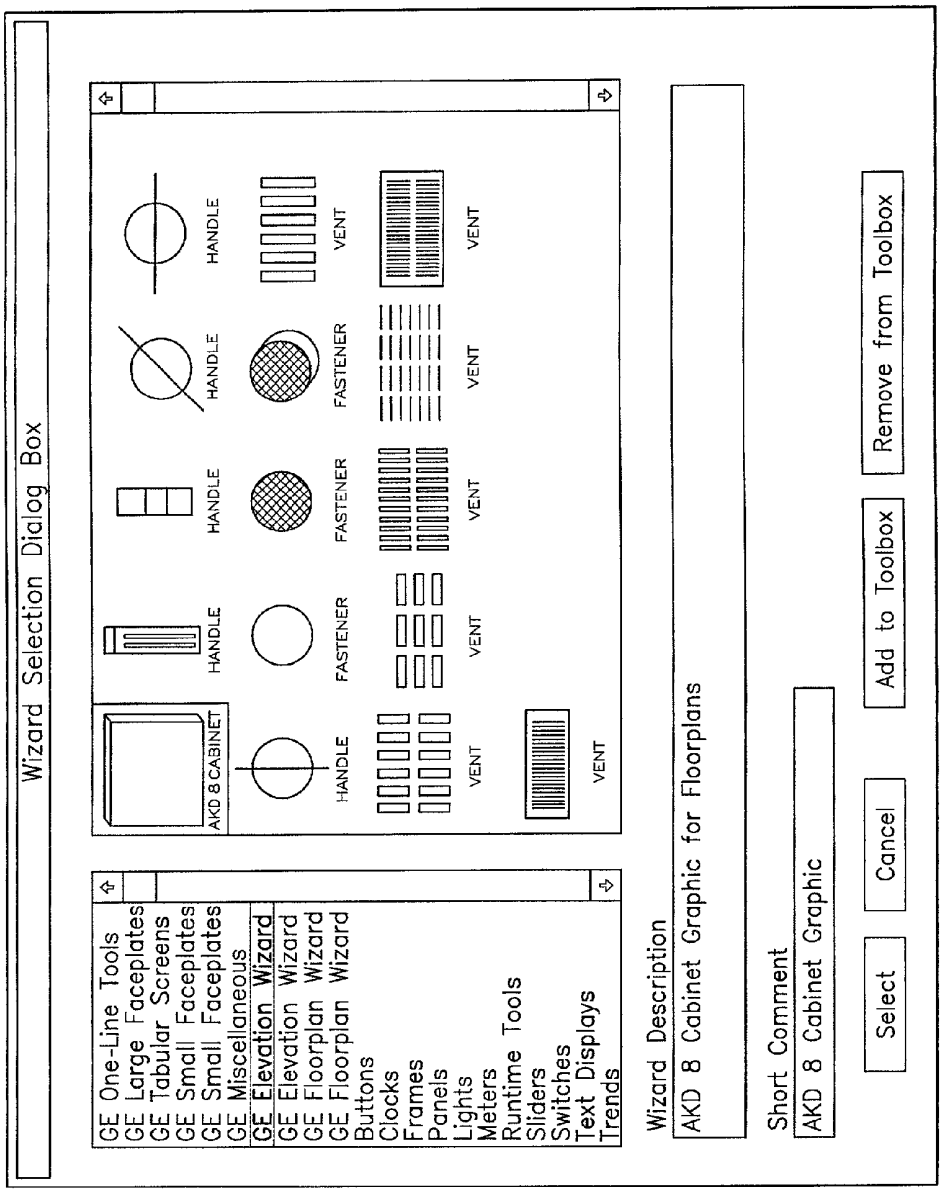

Wizard Selection Dialog Box
GE One-Line Tools
GE Large Faceplates
GE Tabular Screens
GE Small Faceplates
GE Small Faceplates
GE Miscellaneous
GE Elevation Wizard
GE Elevation Wizard
GE Floorplan Wizard
GE Floorplan Wizard
Buttons
Clocks
Frames
Panels
Lights
Meters
Runtime Tools
Sliders
Switches
Text Displays
Trends
AKD 8 CABINET
HANDLE
HANDLE
HANDLE
HANDLE
FASTENER
FASTENER
FASTENER
VENT
VENT
VENT
VENT
VENT
Wizard Description
AKD 8 Cabinet Graphic for Floorplans
Short Comment
AKD 8 Cabinet Graphic
Select
Cancel
Add to Toolbox
Remove from Toolbox

FIG. 5

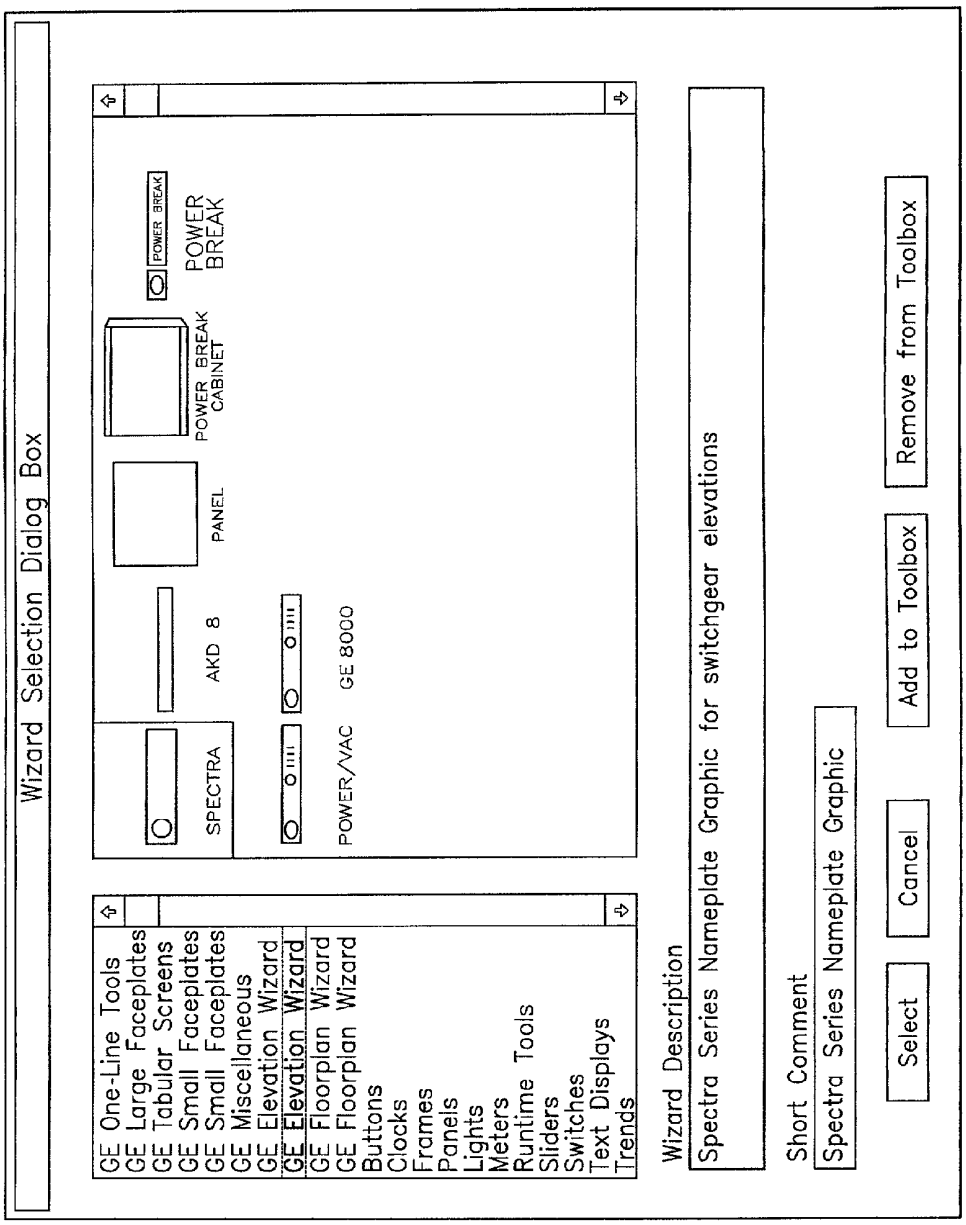

Wizard Selection Dialog Box
GE One-Line Tools
GE Large Faceplates
GE Tabular Screens
GE Small Faceplates
GE Small Faceplates
GE Miscellaneous
GE Elevation Wizard
GE Elevation Wizard
GE Floorplan Wizard
GE Floorplan Wizard
Buttons
Clocks
Frames
Panels
Lights
Meters
Runtime Tools
Sliders
Switches
Text Displays
Trends
SPECTRA
AKD 8
PANEL
POWER BREAK CABINET
POWER BREAK
POWER BREAK
POWER/VAC
GE 8000
Wizard Description
Spectra Series Nameplate Graphic for switchgear elevations
Short Comment
Spectra Series Nameplate Graphic
Select
Cancel
Add to Toolbox
Remove from Toolbox

FIG. 6

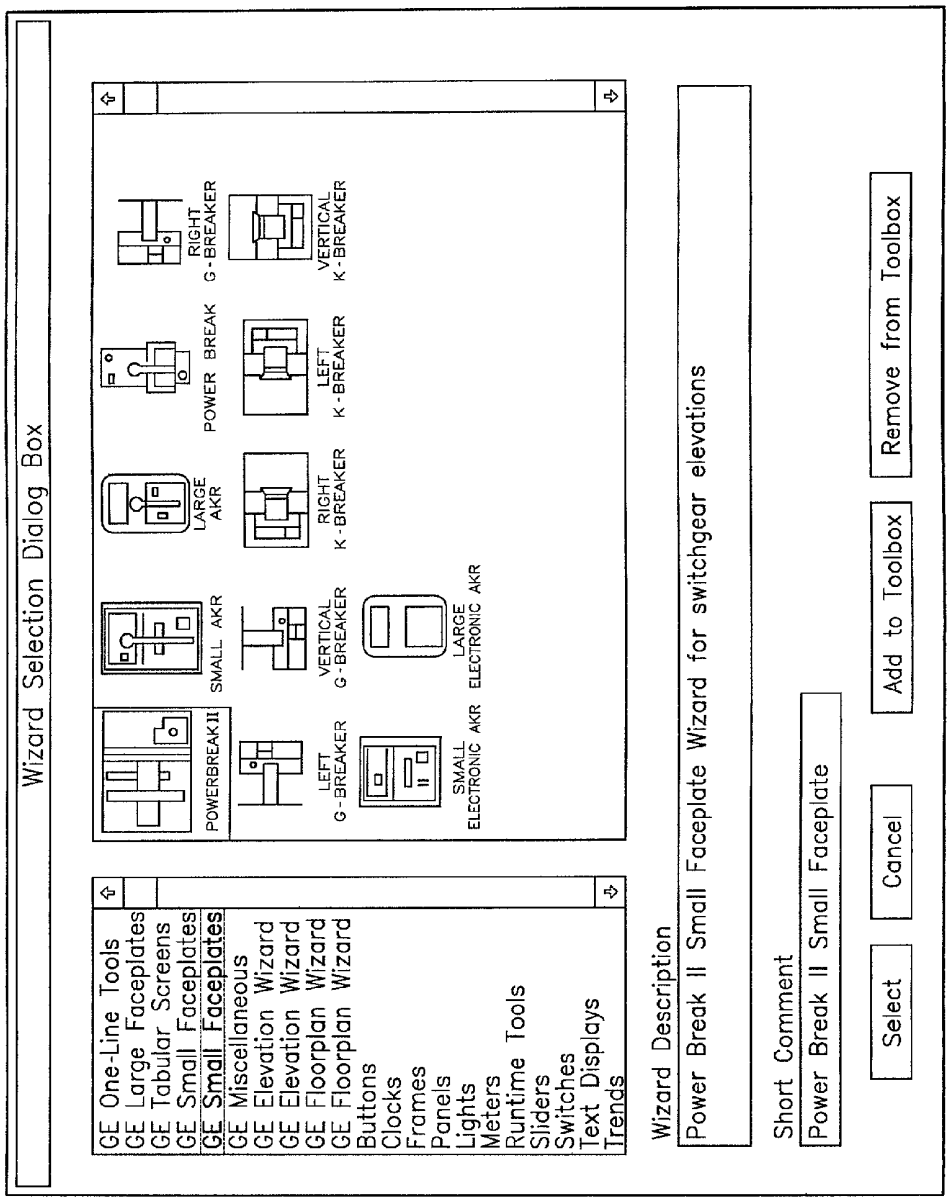

Wizard Selection Dialog Box
GE One-Line Tools
GE Large Faceplates
GE Tabular Screens
GE Small Faceplates
GE Small Faceplates
GE Miscellaneous
GE Elevation Wizard
GE Elevation Wizard
GE Floorplan Wizard
GE Floorplan Wizard
Buttons
Clocks
Frames
Panels
Lights
Meters
Runtime Tools
Sliders
Switches
Text Displays
Trends
POWERBREAK II
SMALL AKR
LARGE AKR
POWER BREAK
RIGHT G-BREAKER
LEFT G-BREAKER
VERTICAL G-BREAKER
RIGHT K-BREAKER
LEFT K-BREAKER
VERTICAL K-BREAKER
SMALL ELECTRONIC AKR
LARGE ELECTRONIC AKR
Wizard Description
Power Break II Small Faceplate Wizard for switchgear elevations
Short Comment
Power Break II Small Faceplate
Select
Cancel
Add to Toolbox
Remove from Toolbox

FIG. 7

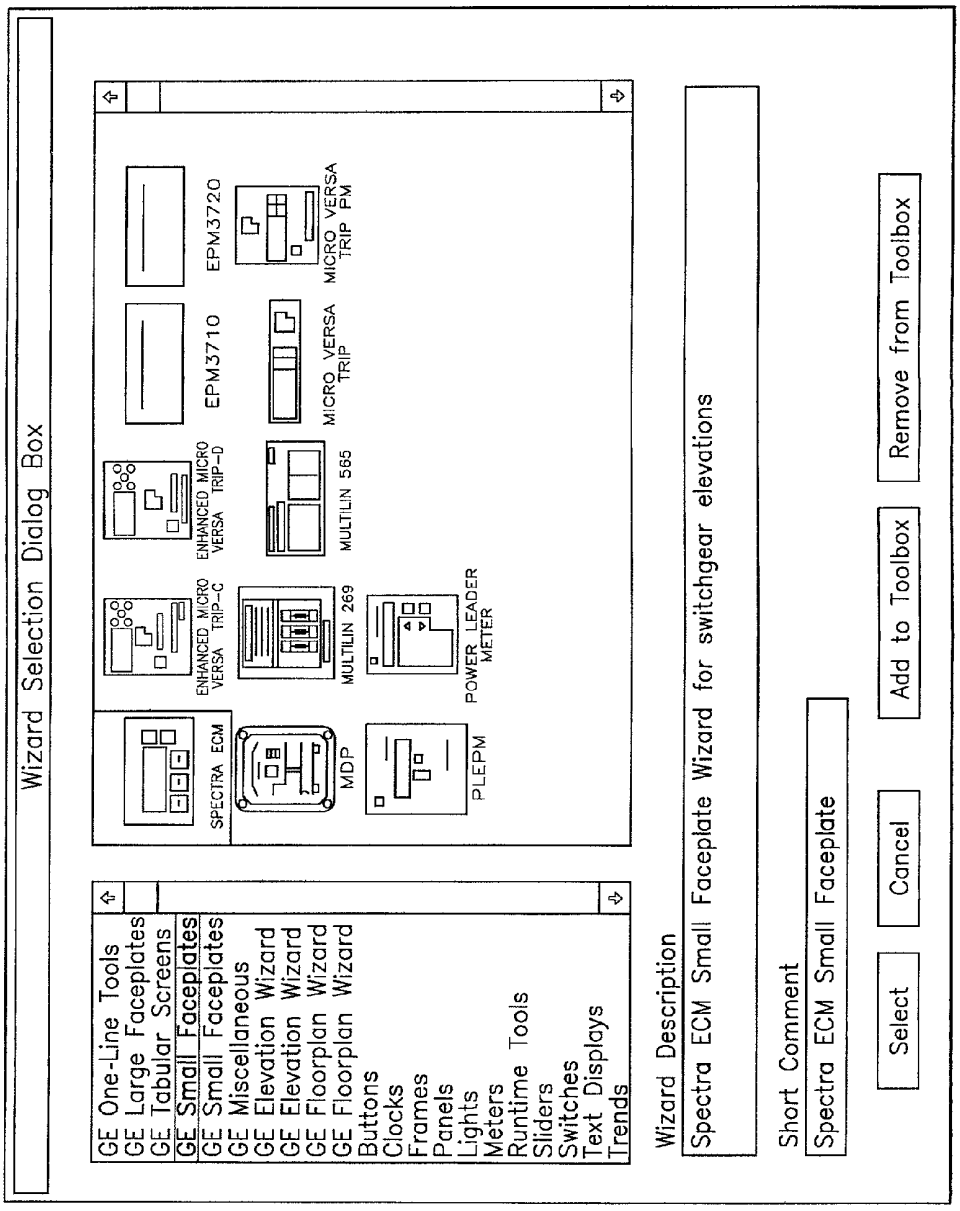

Wizard Selection Dialog Box
GE One-Line Tools
GE Large Faceplates
GE Tabular Screens
GE Small Faceplates
GE Small Faceplates
GE Miscellaneous
GE Elevation Wizard
GE Elevation Wizard
GE Floorplan Wizard
GE Floorplan Wizard
Buttons
Clocks
Frames
Panels
Lights
Meters
Runtime Tools
Sliders
Switches
Text Displays
Trends
SPECTRA ECM
MDP
PLEPM
ENHANCED MICRO VERSA TRIP-C
MULTILIN 269
POWER LEADER METER
ENHANCED MICRO VERSA TRIP-D
MULTILIN 565
EPM3710
MICRO VERSA TRIP
EPM3720
MICRO VERSA TRIP PM
Wizard Description
Spectra ECM Small Faceplate Wizard for switchgear elevations
Short Comment
Spectra ECM Small Faceplate
Select
Cancel
Add to Toolbox
Remove from Toolbox

FIG. 8

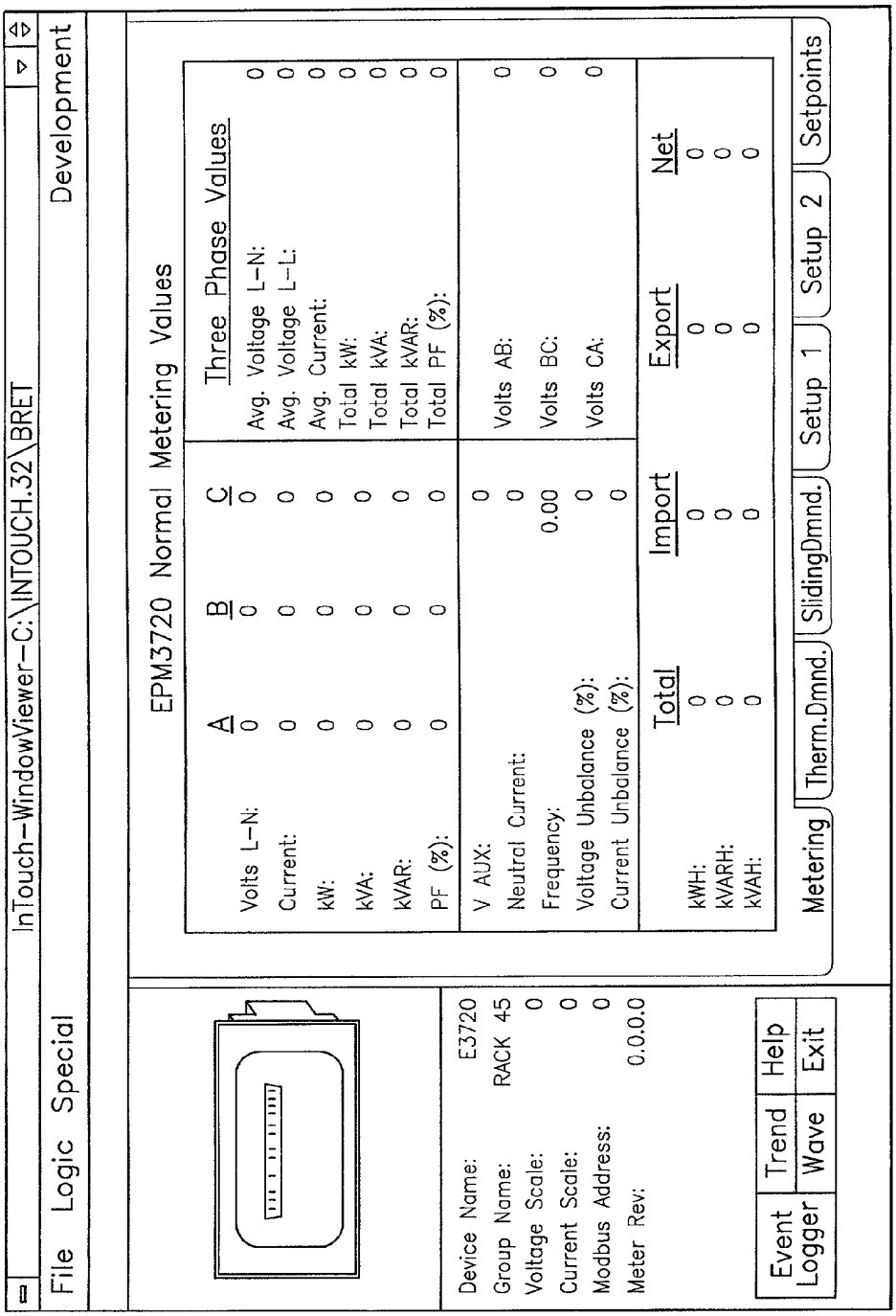

InTouch-WindowViewer-C:\INTOUCH.32\BRET
File Logic Special
Development
EPM3720 Normal Metering Values
Three Phase Values
Avg. Voltage L-N: 0
Avg. Voltage L-L: 0
Avg. Current: 0
Total kW: 0
Total kVA: 0
Total kVAR: 0
Total PF (%): 0
A B C
Volts L-N: 0 0 0
Current: 0 0 0
kW: 0 0 0
kVA: 0 0 0
kVAR: 0 0 0
PF (%): 0 0 0
V AUX: 0
Neutral Current: 0
Frequency: 0.00
Voltage Unbalance (%): 0
Current Unbalance (%): 0
Volts AB: 0
Volts BC: 0
Volts CA: 0
Total Import Export Net
kWH: 0 0 0 0
kVARH: 0 0 0 0
kVAH: 0 0 0 0
Device Name: E3720
Group Name: RACK 45
Voltage Scale: 0
Current Scale: 0
Modbus Address: 0
Meter Rev: 0.0.0.0
Metering
Therm.Dmnd.
SlidingDmnd.
Setup 1
Setup 2
Setpoints
Event Logger
Trend Wave
Help Exit

FIG. 9

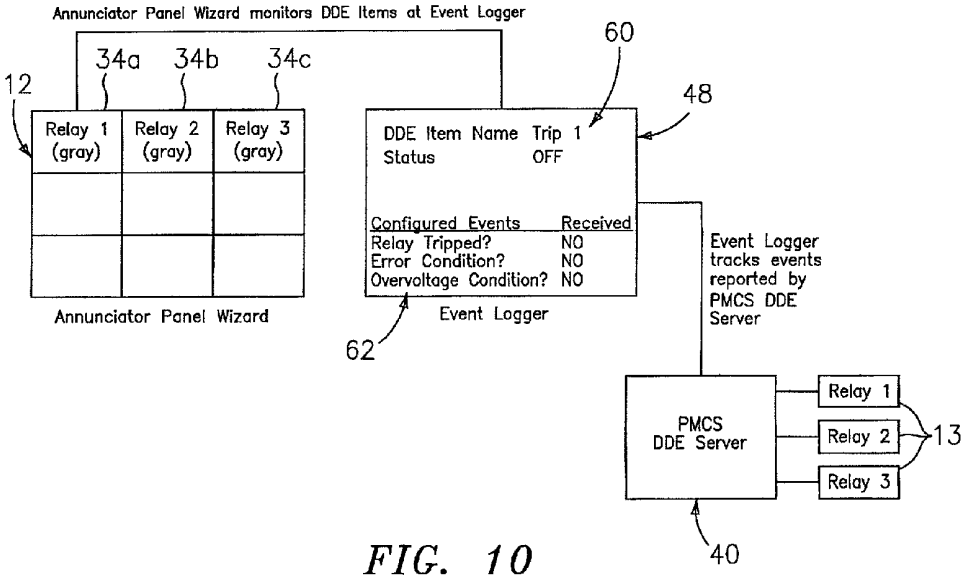

Annunciator Panel Wizard monitors DDE Items at Event Logger
34a
34b
34c
12
60
48
Relay 1 (gray)
Relay 2 (gray)
Relay 3 (gray)
DDE Item Name Trip 1
Status OFF
Configured Events Received
Relay Tripped? NO
Error Condition? NO
Overvoltage Condition? NO
Event Logger tracks events reported by PMCS DDE Server
Annunciator Panel Wizard
Event Logger
62
PMCS DDE Server
Relay 1
Relay 2
Relay 3
13
40

FIG. 10

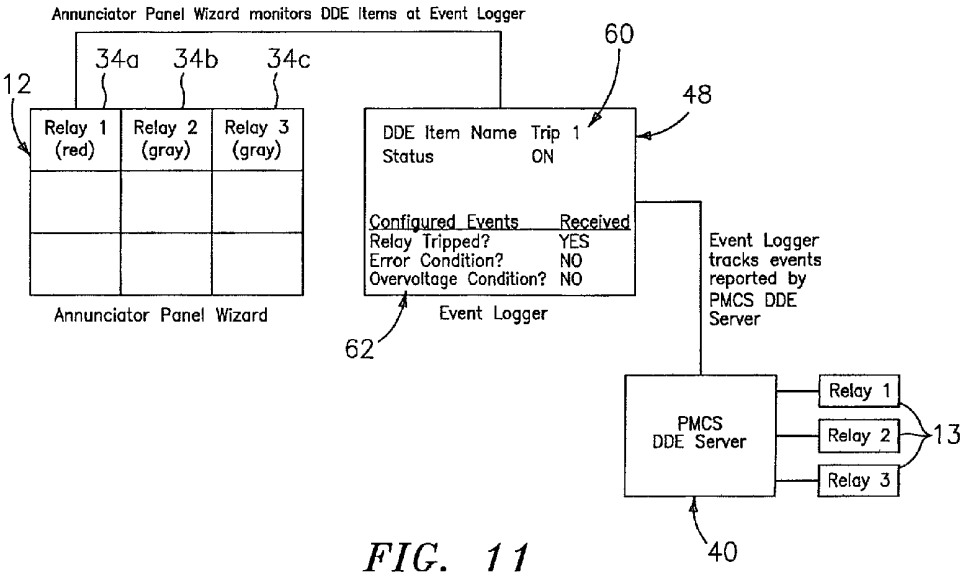

Annunciator Panel Wizard monitors DDE Items at Event Logger
34a
34b
34c
12
60
48
Relay 1 (red)
Relay 2 (gray)
Relay 3 (gray)
DDE Item Name Trip 1
Status ON
Configured Events Received
Relay Tripped? YES
Error Condition? NO
Overvoltage Condition? NO
Event Logger tracks events reported by PMCS DDE Server
Annunciator Panel Wizard
Event Logger
62
PMCS DDE Server
Relay 1
Relay 2
Relay 3
13
40

FIG. 11

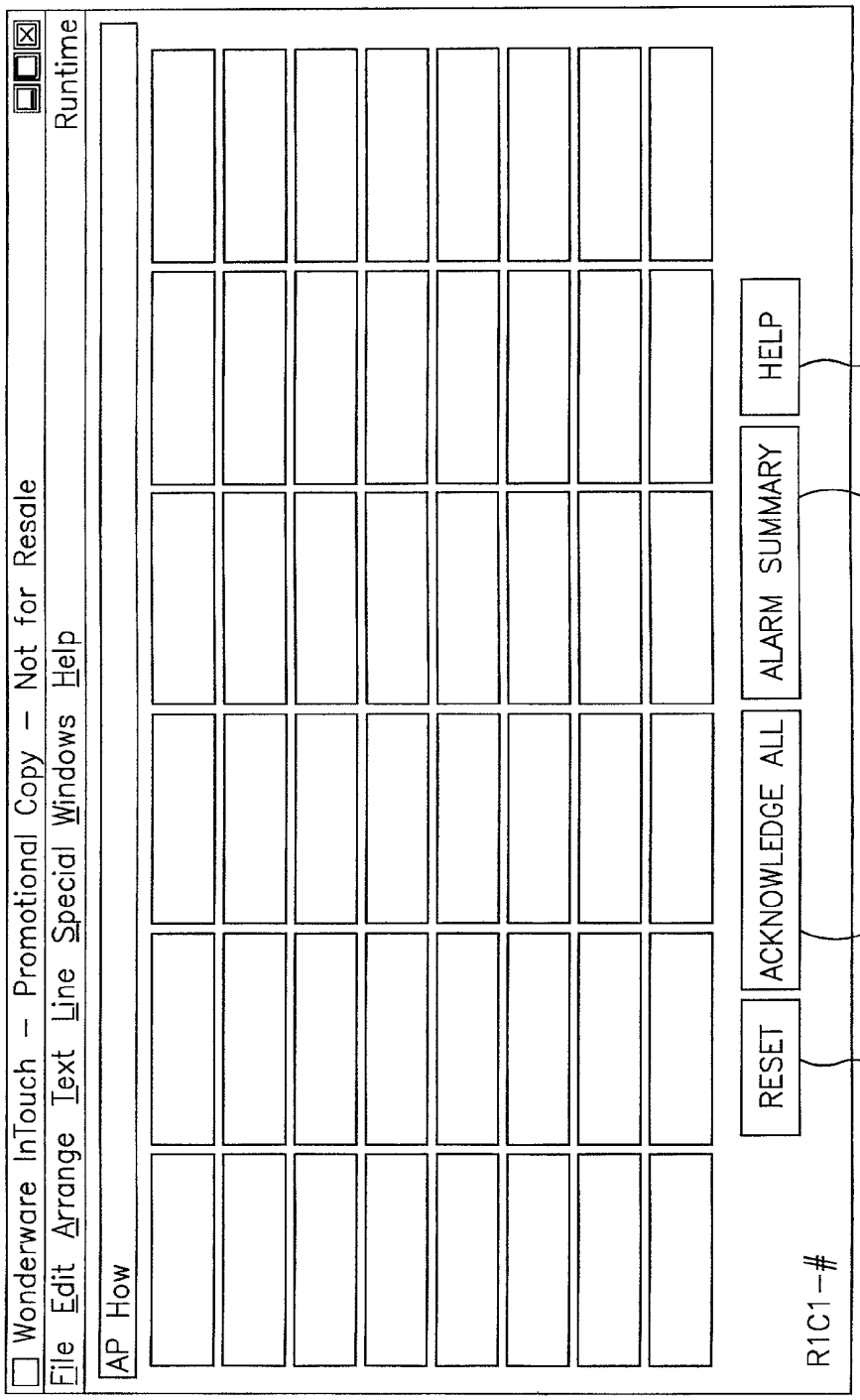

Wonderware InTouch – Promotional Copy – Not for Resale
File Edit Arrange Text Line Special Windows Help
Runtime
AP How
R1C1–#
RESET
ACKNOWLEDGE ALL
ALARM SUMMARY
HELP
62
63
64
65

FIG. 12

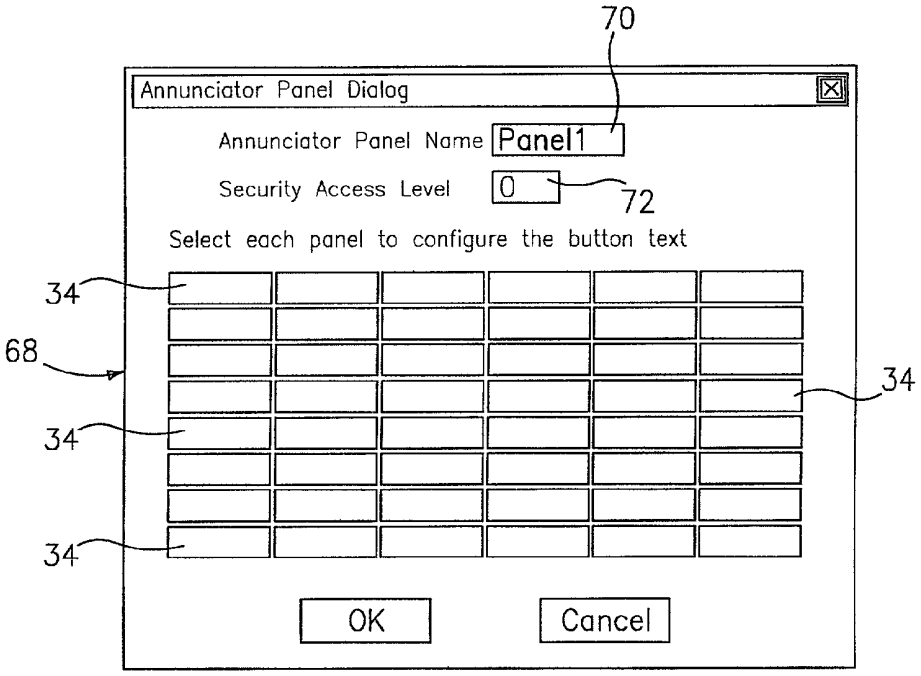

70
Annunciator Panel Dialog
Annunciator Panel Name
Panel1
Security Access Level
0
72
Select each panel to configure the button text
34
68
34
34
34
OK
Cancel

FIG. 13

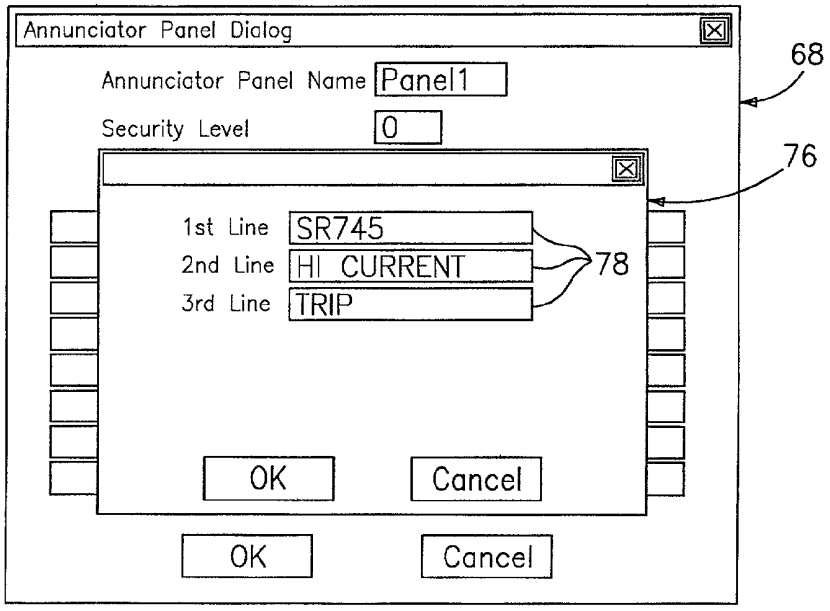

Annunciator Panel Dialog
68
Annunciator Panel Name
Panel1
Security Level
0
76
1st Line
SR745
2nd Line
HI CURRENT
3rd Line
TRIP
78
OK
Cancel
OK
Cancel

FIG. 14

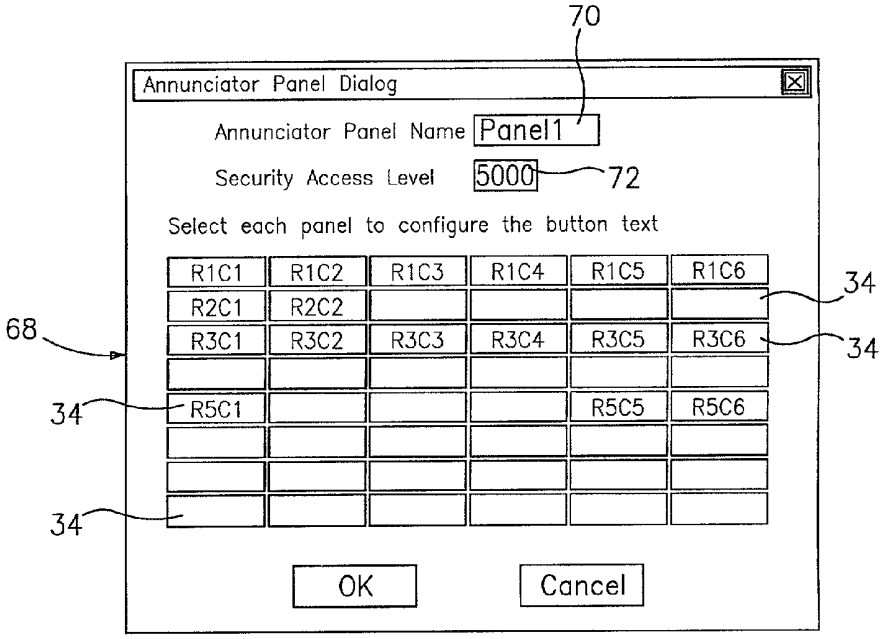

70
Annunciator Panel Dialog
Annunciator Panel Name
Panel1
Security Access Level
5000
72
Select each panel to configure the button text
R1C1
R1C2
R1C3
R1C4
R1C5
R1C6
R2C1
R2C2
R3C1
R3C2
R3C3
R3C4
R3C5
R3C6
R5C1
R5C5
R5C6
34
34
34
34
68
OK
Cancel

FIG. 15

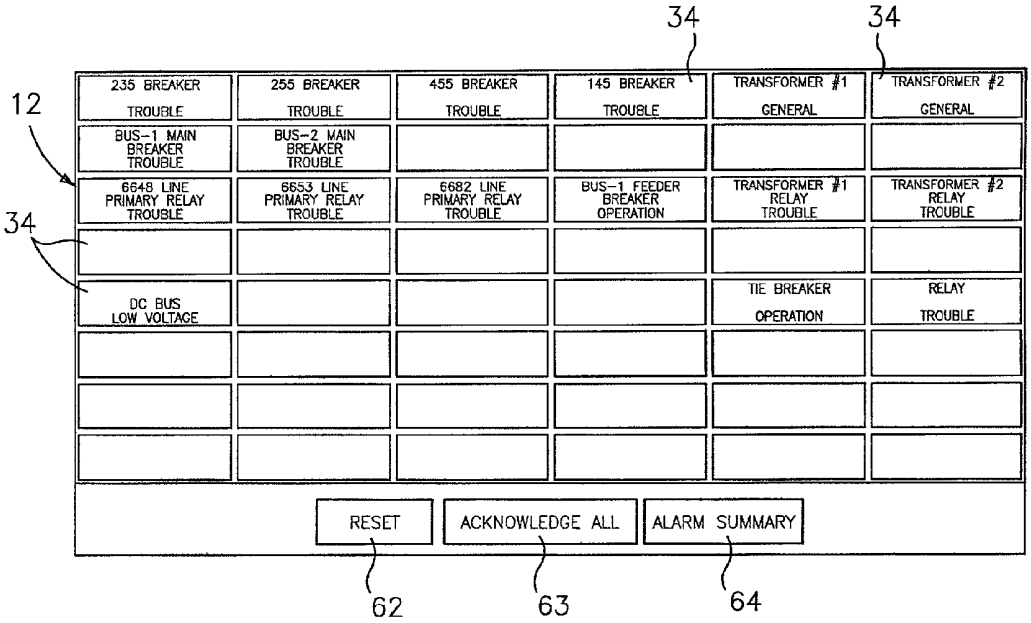

34
34
12
34
235 BREAKER TROUBLE
255 BREAKER TROUBLE
455 BREAKER TROUBLE
145 BREAKER TROUBLE
TRANSFORMER #1 GENERAL
TRANSFORMER #2 GENERAL
BUS-1 MAIN BREAKER TROUBLE
BUS-2 MAIN BREAKER TROUBLE
6648 LINE PRIMARY RELAY TROUBLE
6653 LINE PRIMARY RELAY TROUBLE
6682 LINE PRIMARY RELAY TROUBLE
BUS-1 FEEDER BREAKER OPERATION
TRANSFORMER #1 RELAY TROUBLE
TRANSFORMER #2 RELAY TROUBLE
DC BUS LOW VOLTAGE
TIE BREAKER OPERATION
RELAY TROUBLE
RESET
ACKNOWLEDGE ALL
ALARM SUMMARY
62
63
64

FIG. 16

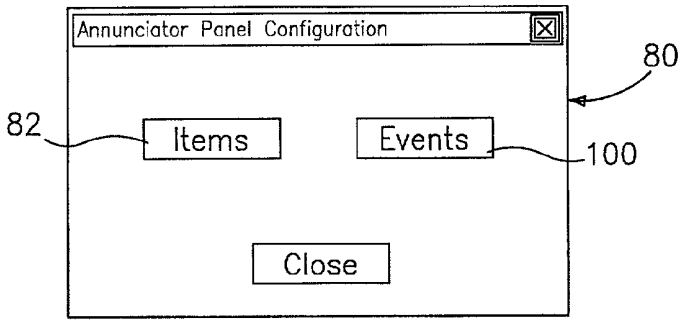


FIG. 17

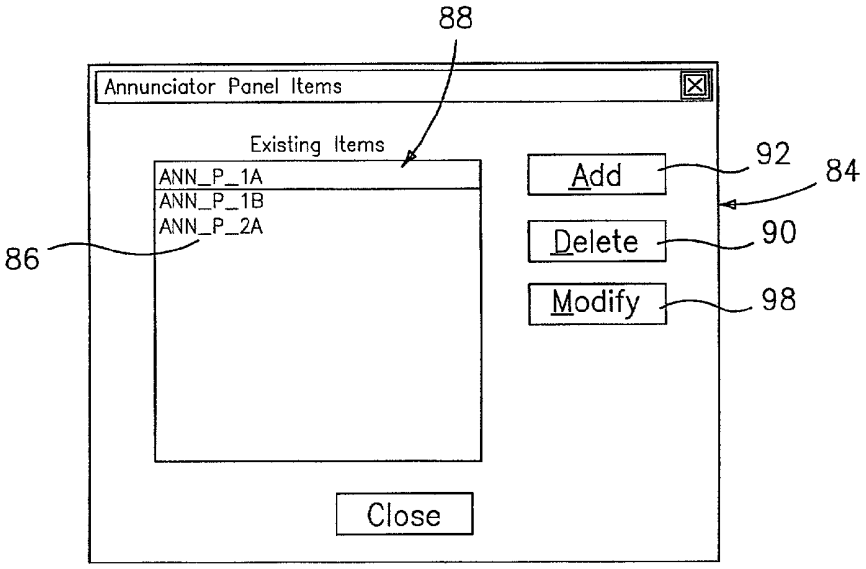


FIG. 18

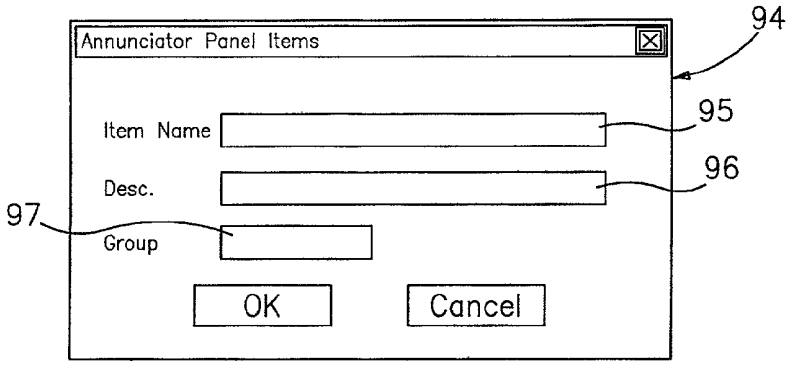


FIG. 19

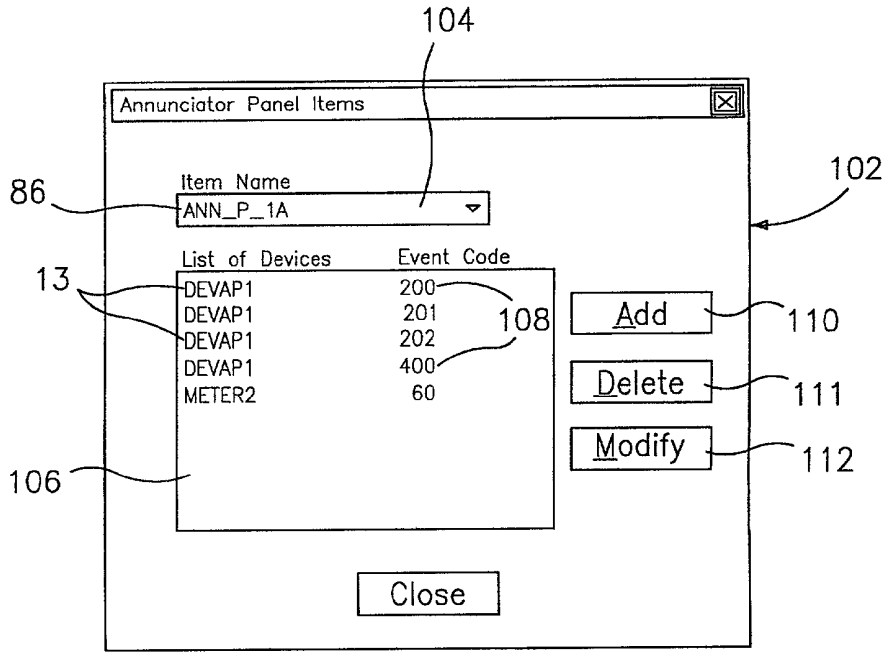

104
Annunciator Panel Items
102
86
Item Name
ANN_P_1A
List of Devices
Event Code
13
DEVAP1
DEVAP1
DEVAP1
DEVAP1
METER2
200
201
202
400
60
108
Add
110
Delete
111
Modify
112
106
Close

FIG. 20

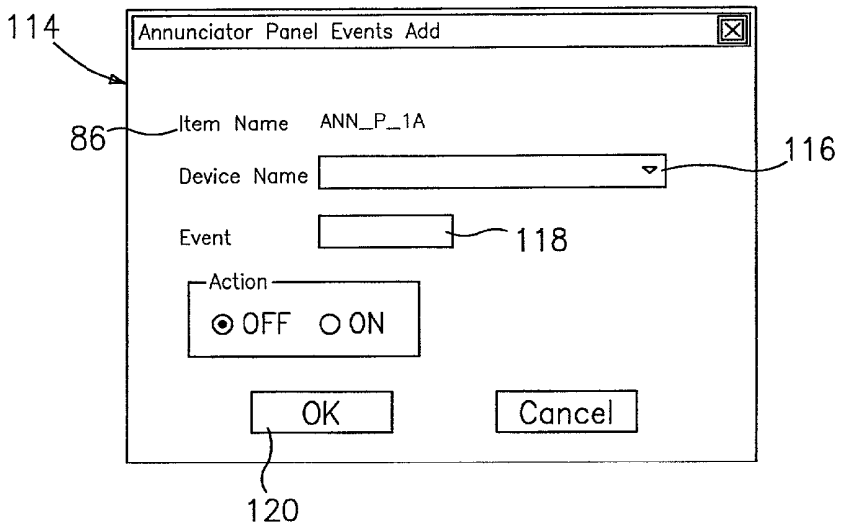

114
Annunciator Panel Events Add
86
Item Name
ANN_P_1A
Device Name
116
Event
118
Action
OFF
ON
OK
Cancel
120

FIG. 21

MAN-MACHINE INTERFACE FOR A VIRTUAL ANNUNCIATOR PANEL DISPLAY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 09/156,203, entitled MAN-MACHINE INTERFACE FOR A VIRTUAL ANNUNCIATOR PANEL DISPLAY, filed on Sep. 17, 1998 and now allowed, which is incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] The present invention relates generally to a power management control system and in particular, to software that implements and automates the development of a virtual 3-D annunciator panel display including built-in event mapping to the annunciator tiles.

[0003] Power management control systems monitor and control a variety of intelligent electronic devices of an electrical distribution system. These control systems, generally, include an annunciator panel or board provided at a console of the operator or user. The annunciator panel includes an array of buttons that provide status information of selected devices of the distribution system. Each button is indicative of the status of a corresponding device of the distribution system. Each of the buttons illuminates with different colors, wherein each color is representative of the status of the selected device. For example, a green button may represent that the corresponding device is operating properly, and a red light may indicate that a fault condition exists. The panel provides an easy method of visually monitoring the condition or status of the electrical system. If a fault occurs that requires acknowledgement by the operator of the system before resetting the fault, the operator may attempt to reset the failure by depressing the button to acknowledge the fault.

[0004] Some power management control systems include a computer connected to a common bus that allows communication between the intelligent monitoring/control devices and a server. The control system provides graphical representations of and links to the devices of the distribution system to enable a user to monitor and operate the distribution system.

[0005] For these computer control management systems, there is a need for an equivalent virtual annunciator panel display that provides the same function of the annunciator panel described hereinbefore. Some power management control systems do offer a virtual three-dimensional annunciator panel displays; however, the system is not easily configurable without having programming knowledge and capability as well as intimate knowledge of each of the devices of the distribution system.

[0006] Current virtual annunciator panel displays also include an array of buttons or tiles that provide the status of selected intelligent devices of the distribution system. In order to functionally link buttons of the virtual annunciator panel to the selected devices, each virtual annunciator panel requires custom programming by a knowledgeable integrator.

BRIEF SUMMARY OF THE INVENTION

[0007] The above discussed and other drawbacks and deficiencies are overcome or alleviated by a power management control system comprising a network, a first control device connected directly to said network and communicable with said network, a user configurable annunciator panel, said panel including an indicator for visually displaying the of status or condition of the first control device, and software defining an annunciator panel wizard, wherein the annunciator panel wizard provides user configuration of the annunciator panel.

[0008] The above discussed and other features and advantages of the present invention will be appreciated and understood by those skilled in the art from the following detailed description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Referring now to the drawings wherein like elements are numbered alike in the several FIGURES:

[0010] **FIG. 1** is a diagrammatic block diagram of a power management and control system in accordance with the present invention;

[0011] **FIG. 2** is a view of a virtual annunciator panel display window generated by computer software embodying the present invention;

[0012] **FIG. 3** is a block diagram of the computer software used in the power management and control system of the present invention;

[0013] **FIG. 4** is view of an InTouch-windowviewer window generated by the computer software of **FIG. 3**;

[0014] FIGS. **5-8** are views of wizard selection dialog box windows generated by the computer software of **FIG. 3**;

[0015] **FIG. 9** is a view of an InTouch-windowviewer window generated by the computer software of **FIG. 3**;

[0016] **FIGS. 10 and 11** are diagrammatic block diagrams of an annunciator panel display, Event Logger and power management and control system in accordance with the present invention;

[0017] **FIG. 12** is a view of an InTouch-windowviewer window generated by the computer software of **FIG. 3** showing a virtual annunciator panel display presented to an integrator for programming;

[0018] **FIG. 13** is a view of a dialog box window generated by the computer software of **FIG. 3** for configuring the buttons of the virtual annunciator panel display;

[0019] **FIG. 14** is a view of a dialog box window generated by the computer software of **FIG. 3** for providing a description of a button of the virtual annunciator panel display;

[0020] **FIG. 15** is a view of a dialog box window generated by the computer software of **FIG. 3** showing the configured virtual annunciator panel Display of **FIG. 12**;

[0021] **FIG. 16** is a view of an InTouch-windowviewer window generated by the computer software of **FIG. 3** showing the configured virtual annunciator panel display of **FIG. 12**; and

[0022] FIGS. **17-21** are views of an InTouch dialog boxes for configuring the Event Logger to enable interface with the annunciator panel display of **FIG. 2**.

DETAILED DESCRIPTION OF THE INVENTION

[0023] Referring now to **FIG. 1, a** power management control system ("PMCS"), generally designated **10**, provides a three-dimensional ("3-D") virtual annunciator panel **12** (see **FIG. 2**) for displaying a visual indication of the status or condition of a plurality of electrical devices and components **13** of an electrical distribution system **14**. The PMCS **10** comprises a computer **16**, e.g., an IBM-PC AT compatible machine which is based on a Pentium processor, having standard RS485 interface cards **18**, or an RS232 to RS485 convertor, and adapters installed in its I/O slots. The computer **16** contains software for monitoring and controlling selected aspects of power usage/consumption, as described in more detail hereinafter. Cards **18** provide I/O ports that define multiple industry standard Modbus RTU networks **20** and **22**. The Modbus RTU protocol is a well-known industry standard. Devices with a Modbus RTU interface can be connected directly to the Modbus, e.g., control devices **24**, such as, Multilin models 269 and 565 and power management EPM 3710 and EPM 3720. Other devices communicate on the Commnnet protocol and include trip units 26, e.g., Trip, Enhanced Trip-D, Trip PM and Enhanced Trip-C Units, which are commercially available from General Electric Co., meters **28**, e.g., Power Leader Meters commercially available from General Electric Co., and relays **30**, e.g., General Electric Co.'s Spectra ECM and Power Leader MDP. A Modbus concentrator **32** provides an interface between the Modbus RTU protocol and the Commnet protocol, whereby these devices can communicate through Modbus concentrator **32** over the Modbus. In this example, up to thirty-two devices (i.e., direct connect devices or Modbus concentrators) can be connected to each Modbus RTU network.

[0024] Referring to **FIG. 2**, the display of the virtual three-dimensional annunciator panel **12** includes an array (6×8) of indicator buttons or tiles **34** that represent a particular device, event or group of events of the PMCS **10**. The buttons **34** are displayed in different colors to indicate different alarm systems. The annunciator panel **12** functions to notify the user/operator of an alarm condition of a device **13**, as well as permits the user to acknowledge alarms, as will be described in greater detail hereinafter.

[0025] The development of a virtual 3-D annunciator panel display **12** is automated using software, namely an Annunciator Panel Wizard. The Panel Wizard provides the automated configuration of the annunciator panel graphic as well as a built-in event mapping to the annunciator buttons **34** which is user configurable. The Panel Wizard provides a rapid and cost effective method by which to develop a virtual annunciator panel display **12**. Previous implementations of annunciator panel displays required custom programming by the integrator developing the system. The Panel Wizard allows the user to generate the virtual annunciator panel display **12** without any programming skills or detailed device knowledge. The invention closely couples the existing event processing in the PMCS **10** with annunciator displays **12** in the user interface, as will be described in greater detail hereinafter.

[0026] Referring now to **FIG. 3, a** block diagram **36** of the software for monitoring and controlling selected aspects of power usage/consumption of the PMCS **10**, discussed above, is generally shown. This software is loaded into the computer **16** and includes a dynamic data exchange (DDE) server **40**. DDE server **40** allows external programs to access power management data in a Microsoft Windows environment. Data interface to DDE server **40** is provided by the system through a Wonderware InTouch utility. A configuration and control interface for the DDE server is provided through server application window menus. Associated with DDE server **40** are logical data tables **42** and related modules, i.e., an Excel or other DDE aware applications module **44**, a waveform capture module **46**, an event logger module **48**, productivity modules **50**, and a Wonderware InTouch module **52**. Module **52** includes a tool kit for building screens and interfaces, and a graphical user interface **54** for monitoring and control of the electrical distribution system. The graphical user interface **54** for the server operates in 32 bit Windows or Windows NT environment and InTouch library functions. Waveform capture module **46** provides for viewing and analysis of waveforms (e.g., Fourier, frequency and/or harmonic analysis) captured by sophisticated metering devices. Event Logger module **48** provides for viewing, organizing and analyzing unusual behavior in a power system. Productivity modules **50** include, for example, a cost allocation module and a load management module. The cost allocation module provides for tracking power consumption to the sub-unit level, developing internal billing methods and reports, thereby reducing cost. The load management module provides for tracking power demand and automatically shedding non-critical loads to prevent peak demand penalties, and provides for timer-based control to reduce power consumption. DDE server **40** communicates though the interface card **18** shown in **FIGS. 1 and 3**.

[0027] The event logger module **48** includes a utility that passes a received message as an un-acknowledgeable or acknowledgeable alarm or as an event based upon the contents of an initialization file. The DDE server **40** ensures that all events are cast in the same format so that the event logger module **48** can interpret each event. Electrical meters **28** and control/protection devices **26** use various codes to describe occurrences to the circuits that are monitored or controlled. A file collates these codes into three categories for analysis. These three categories for any particular device are modifiable for the code received from a device. The three categories are 'ACK/UNACK' for acknowledgeable alarms, '-' for alarms requiring no acknowledgment, and "EVENTS" for merely reporting the device status.

[0028] The waveform capture module **46** includes a utility that provides an interface to configure and display data from a device that transmits waveform data. These devices transmit waveform data with different formats. One uniform display format is desired for these different types of meters. This utility applies header information transmitted by the meter to correctly scale and display the comma separated value data transmitted by the devices as applicable.

[0029] The Wonderware InTouch module **52** includes a software toolkit for rapid development of three-dimensional representations of electrical distribution switchgear **56**, as shown in **FIG. 4**. These switchgear elevations have logical connections to the switchgear devices **13**. Referring to **FIG. 4, a** typical switchgear elevation developed with the so-called Power Wizards illustrated in FIGS. **5-8** is shown. This elevation can be modified to any dimensions with an infinite number of combinations and arrangements of meters and protection devices to quickly and accurately represent a customer's switchgear. The Power Wizards eliminate the necessity to draw each individual component line by line. The user starts by selecting a cabinet wizard such as the AKD-8 or Power Break Cabinet to which handles, panels, and fasteners are added, **FIGS. 5 and 6**. Thereafter, circuit breakers **26 (FIG. 7)**, meters **28** and other protection devices **(FIG. 8)** are located or dropped onto the appropriate panels in the same locations as the customer's actual switchgear. These items have dialog boxes associated with them that are opened by double clicking on one of the Power Wizards once they have been dropped. From this dialog box a navigational link is established to another window that contains another Power Wizard that displays detailed metering, configuration, and control information.

[0030] The Wonderware InTouch module **52** includes predefined tabular representations of metering and setup/set point information that is generated automatically, with the appropriate database server links established. A rapid method is provided to accurately generate a user interface for power distribution metering, protection, and control devices **13** with the capability to repeat this interface repeatedly for many devices of the same type while maintaining the capability to uniquely identify a device. The Power Wizards allows the user to generate a power distribution device interface without programming skills or detailed knowledge of the device.

[0031] Referring to **FIG. 9**, an example of a Power Wizard of a metering device **28**. The Power Wizards instantly develop a standard looking interface for a particular device type. These Power Wizards also create from this standard interface, unique database links that the user defines by selecting a name and entering in this name from a Power Wizard dialog box. In this way the same wizard may be used over and over again but can be logically distinguished from another via the user-defined name for a device entered in the Power Wizard dialog box. All margin for error that may have occurred in manually entering in the data access links to a database server are removed by the Power Wizards capability to set them up automatically using a unique user defined device name.

[0032] Every windows application is registered in a windows kernel with an application name. To uniquely identify a data item for communication between two cooperating (DDE aware) windows applications, the data item is identified by tuple (Application, Topic, Item). Topic name provides a grouping, and item name specifies the actual data point to be accessed under a topic. For the DDE server **40**, the application name is the server's executable name. Topic name can be the device identification name and item name can be the register identification of a field data point. For example, with a General Electric Co. EPM meter, the tuple can be GE32MODB, EPM1, AMP_A where GE32MODB is the Application name for a DDE Server, EPM1 is the meter identification name, and AMP_A is the current for phase A. DDE messages mainly include requests to send data as identified by the Topic and Item name. They may also be for set point download to the data point as identified by the Topic and Item names. Input parameter values are reported by field devices on the communication interface in response to a poll by the server. This value may be a float value, an integer value, a string or discrete status bits.

[0033] Set points registers are to be downloaded based on request from a DDE client, i.e., a program, for example, such as Wonderware InTouch 5.0 or MS-Excel, which request data items from the DDE server **40** and accepts data through DDE. The DDE server acts as a link between a client requesting device data and a field device that can provide the data. The DDE server communicates to the field device through communication ports and to the client via DDE message link. A client sends its requests to the server to read/write some device registers. The server maps each request to suitable device read/write request packets and carries out the necessary transaction with the device. Then it relays the result back to the client after processing and, if necessary, casts the collected device data to the proper format. Apart from reporting contents of normal device registers, the server can also collect special data like waveform capture/recording data from the device and pass it to a client.

[0034] The DDE server **40** maintains current status (DEAD/ACTIVE) of all active topics (devices). This information does not have any direct register associated with the device topic name and hence a pseudo item called 'STATUS' is maintained by the DDE server. If the DDE server **40** does not get a response from any device during 'n' consecutive poll cycles then that particular device is declared DEAD. The value of 'n' is read from an initialization file. The status of any device will be updated to a client only if a pre-defined item called 'STATUS' is made active. DEAD devices would be polled with period equal to a dead device scan interval (available in initialization file) instead of the device scan interval. DEAD devices will become ACTIVE when they respond to a polling request.

[0035] A device type register map must be configured for each of the device topics connected thereto. The system provides for configuration of a starting valid address, a last valid address, and a set of invalid register blocks using this utility. Valid registers, in the present example, are R0XXXX; R1XXXX; R3XXXX; or R4XXXX. Accordingly, DDE server **40** supports the following Modbus register types; R0XXXX—Discrete coils, R1XXXX—Discrete status registers, R3XXXX Input registers, and R4XXXX—Set point registers. With these generic types, a user can configure any number of register types. Each of these types will have poll rate attributes (i.e., Fast Poll, Slow Poll, or Poll Once). Buffered events, read/write date/time registers for time synchronization, waveform capture data and waveform recording data are implemented differently in the devices which support them hence, no common configuration utility is provided for these functions. The DDE server handles each of these functions specifically. Again a mnemonic name is associated with a register address.

[0036] In general, the DDE server **40** uses the Modbus RTU protocol to communicate with a field device **13**. The DDE server provides appropriate return values as specified

for all clients, i.e., periodic polling packets for active topics and items, periodic polling packets for events and status, periodic update of time to all the devices, data value update to clients for acquired items, event/status report to InTouch so that it becomes part of normal alarm log, and status update for active topics (devices). Set point write requests are properly formatted set point download communication packets for the request. Execution and termination of the server are initiated on user request from the DDE server window menu.

[0037] As described hereinbefore, the Annunciator Panel Wizard assists the integrator in the development of the virtual annunciator panel display **12** of the present invention, shown in **FIG. 2**. Specifically, the Annunciator Panel Wizard interconnects specific device events/alarms received by the Event Logger Module **48** through the DDE server **40** to specific buttons **14** of the annunciator panel **12**, and thereby provides the ability to notify the user of Alarm On/Off states of the devices throughout the PMCS **10**. The annunciator panel **12** also allows the user to acknowledge alarms which are either currently on, or have previously been on and have gone to an off state.

[0038] The Annunciator Panel Wizard provides a screen full of indicator buttons **34**, each relating to a particular device **13**, event, or group of events. The Annunciator Panel Wizard monitors selected DDE items in the Event Logger **48** and responds to changes of state in these items by changing the colors of individual indicator buttons **34**. For example, the integrator might configure a relay trip event to be associated with a button in the Annunciator Panel Wizard. The Annunciator Panel Wizard monitors a DDE tag **60** at the Event Logger **48** corresponding to the trip status of the corresponding relay **13** and displays a gray indicator if the relay is operating properly, and a red indicator if the relay has tripped.

[0039] The annunciator panel **12** includes an array of forty-eight (48) buttons **34** (six columns by eight rows). Each button **34** has an animation link, as well as 3 lines of text (definable at design time) that describe the function of each button. For example, referring to **FIG. 2**, the description of the second button down in the first column of buttons is "BUS-1 MAIN BREAKER TROUBLE".

[0040] As shown in **FIG. 12**, four (4) additional buttons **62-65** are disposed below the array of buttons **34** labeled "RESET", "ACKNOWLEDGE ALL", "ALARM SUMMARY" and "HELP", respectively. The RESET button **62** allows a privileged user the ability to reset all Alarm Indicators that are currently in an Alarm Acknowledged state. The ACKNOWLEDGE ALL button **63** cycles through all of the panel buttons **34** and acknowledges all Alarm Indicators which are in an unacknowledged state. The ALARM SUMMARY button **64** brings the local S30 Event Logger program **48** to the foreground. The HELP button **34** invokes a PMCS Help file with a context string of "Annunciator" that provides the user instructions of the features and operation of the annunciator panel **12**.

[0041] The diagrams of **FIGS. 10 and 11** illustrate the relationship of the annunciator panel **12**, the Event Logger **48**, and the DDE Server **40** which monitors the devices **13** (e.g., Relay 1, Relay 2 and Relay 3) of the PMCS **12**. The Event Logger **48** is programmed to selectively track events reported by the DDE server **40**. For example, the Event Logger **48** is programmed to track three events of Relay 1. The monitored events may include the tripping of the relay 13, the occurrence of an error condition and an overvoltage condition. The Event Logger **48** is configured to change the state of the Trip 1 DDE item **60** dependent on the occurrence of any of the three monitored events.

[0042] The Annunciator Panel Wizard monitors the configured DDE items **60** at the Event Logger **48**. As shown in **FIG. 10**, the Relay 1 button **34***a* monitors the DDE item Trip 1. Similarly the Relay 2 button **34***b* and Relay 3 button **34***c* of the annunciator panel **12** monitors other corresponding DDE items **60** that may be named Trip 2 and Trip 3, respectively. The Relay 1 button **34***a* is configured to display a gray indicator button when the status of the DDE Item Trip 1 is OFF and red when the status of the DDE Item Trip 1 is ON. In **FIG. 10** none of the monitored events have occurred and therefore, the status of the DDE Item Trip 1 is OFF and the Relay 1 button **34***a* is gray. In **FIG. 11** Relay 1 tripped and therefore, the status of the DDE Item Trip 1 is ON. In response to the ON status, the Relay 1 button **34***a* changes to display a red indicator button, indicative of the presence of a fault condition of Relay 1. It will be appreciated that each of the other buttons, i.e., Relay 2 button **34***b* and Relay 3 button **34***c*, operate in a similar manner for another DDE Item **60**. The Event Logger Annunciator Panel Logic will also change the state of a DDE Item **60** in response to actions performed at the Annunciator Panel Wizard. The user can both acknowledge and reset individual Annunciator DDE items **60**.

[0043] The wizard functionality is based on the premise that the Event Logger **48** provides new DDE "Alarm Items" which indicate the current "state" of a button of the annunciator panel **12**. In the implementation of the wizard to generate an annunciator panel, the integrator configures the Event Logger Alarms Items (in the Event Logger) that track the status of a device or devices **13** of the PMCS **10**. The DDE Alarm Items, therefore, are controlled by specific device events/alarms received by the event log application.

[0044] The Annunciator Panel Wizard is controlled by indirect analog tags, which the integrator associates a button **34** of the annunciator panel **12** with a corresponding Event Logger DDE Item **60**. The indirect tag is used to control the color changes of each button **34**, and to poke values to these DDE Items **60** (through the indirect analog tags) in order to Acknowledge and reset each Alarm Item.

[0045] The development of the virtual annunciator panel **12** includes three basic steps. First, the integrator use the Annunciator Panel Wizard to generate the annunciator panel **12** and identify each of the buttons **34** as desired. Once the wizard is configured, the integrator performs the remaining steps to complete annunciator Panel functionality in the Wonderware InTouch Application. In the InTouch Application the integrator creates InTouch DDE tags for the DDE Items **60** in the Event Logger **48** which correspond to the buttons of the annunciator panel **12** (up to 48 tags per annunciator panel). The integrator then writes a InTouch script (e.g., application startup script) that associates the InTouch indirect tags (created by the wizard) with the InTouch DDE tags created directly by the integrator.

[0046] Referring to **FIG. 12**, the annunciator panel **12** is shown prior to configuring the Annunciator Panel Wizard. To configure the Annunciator Panel Wizard, the integrator drops in the wizard by selecting the Annunciator Panel Wizard from a pull down menu. Upon selection of the Annunciator Panel Wizard, a dialog box **68** is presented, as shown in **FIG. 13**, to the integrator with the following configuration items. First, the annunciator panel **12** is identified by entering its name in the Annunciator Panel Name field **70** (i.e., "Panel 1"). The integrator can enter up to 25 characters for this name. It is important to note that the Annunciator Panel Name is later used as a prefix for all indirect and direct tags created by the wizard. Next, the Security Access Level is entered into the corresponding field **72** of the dialog box **68**. The default value is zero. The security access value defines the level of access required by the user to reset the buttons **34** (or alarms) displayed on the annunciator panel **12**. The access level of each user is stored in the Wonderware $AccessLevel which enables the wizard to determine the level of access of the current user of the annunciator panel. If the user's access level is below that of the annunciator panel **12**, the reset button **62** (see **FIGS. 2 and 12**) is disabled, prohibiting the user from resetting any of the alarms indicated on the annunciator panel.

[0047] Lastly, one of the 48 buttons **34** is selected to enable the user to configure the text on each individual button of the annunciator panel **12**. Upon selecting a button by pointing and clicking on the button, a second dialog box **76**, titled "Enter Description of Button", appears in the Annunciator Panel Display as shown in **FIG. 14**. The second dialog box **76** permits the integrator to enter three lines of text in three separate fields **78** associated with the selected button **34**. After the integrator has completed entering the text, "OK" is selected to store the text for the selected button. This is repeated for each button **34** to be configured. Referring to **FIG. 15**, each time the integrator closes the second dialog box **76**, the first dialog box **68** appears showing the integrator which panel buttons **34** have been configured via a text string (e.g. "R1C1") appearing on each configured button.

[0048] After configuring the above information (for all panels which are to be used) and selecting the "OK" button on the Annunciator Panel Wizard first dialog box **68**, the wizard creates a plurality of tags, prefixed by the name entered for the annunciator panel (e.g. Panel 1), assuming that they do not already exist. A tag is a storage register that is accessible by a plurality of applications to provide a communication link therebetween. The tags created by the Annunciator Panel Wizard include 48 indirect analog tags, one for each panel button **34**, that are named xxxx.R1C1 through xxxx.R8C6. Further, the Annunciator Panel Wizard includes two memory discrete tags named xxxx_Test, used to enable/disable a Test function, and xxxx_Path, used for wizard internal use. The prefix of each of the names of these tags is the name of the wizard or annunciator panel (e.g. Panel 1).

[0049] The Annunciator Panel Wizard then displays the newly configured annunciator panel **12** as shown in **FIG. 16**, which is representative of the display the user will see. Each configured panel button **34** includes the text entered in the second dialog box **76** of the Annunciator Panel Wizard of **FIG. 14**. Each panel button **34** can have five different colors, based on the state or condition of the DDE Item **60** of the Event Logger **48** for the corresponding device **13** of the PMCS **10**. A fill color animation link controlled by an indirect integer tag will be used to change colors of the buttons. For example, the fill color link of 0-9 is for the color "Dark Gray", 10-19 for "Gray", 20-29 for Gray (also including a flashing Red animation link), 30-39 for "Red" and greater than 40 for "Yellow".

[0050] A blink link or flashing Red animation link provides the Red blinking color for a fill color link of 20-29. This blink link is activated whenever the button **34** is in the Alarm Active state OR a test discrete tag is set (PanelName_Test).

[0051] When the status of a DDE Item **60** is "ON", the Event Logger **48** defines the alarm that appears to the Wonderware InTouch Application as a DDE Integer item. An alarm can be one of the following states or value: Normal (No Alarm) state; Alarm Active—Unacknowledged state; Alarm Active—Acknowledged state, Alarm Reset—Unacknowledged (Alarm occurred and automatically reset) state; and Alarm Disabled (Event Logger disable the Alarm Indicator) state. The Normal state has a DDE alarm value or tag value between 10 and 19 that represents a default color of "Solid Gray". The Alarm Active—Unacknowledged state has a tag value between 20 and 29 that represents a default color of "Blinking Red". The Alarm Active—Acknowledged state has a tag value between 30 and 39 that represents a default color of "Solid Red". The Alarm Reset—Unacknowledged state has a tag value between 40 and 49 that represents a default color of "Solid Yellow". The Alarm Disabled state has a tag value between 0 and 9 that represents a default color of "Dark Gray".

[0052] Each individual panel button **34** includes another animation link having an action script that is used to Acknowledge a button that is in an Unacknowledged state. The script will work as follows:

[0053] IF button_state .EQ. Alarm, Unacknowledged THEN

[0054] button_state=Alarm+Acknowledged

[0055] ELSEIF button_state .EQ. Alarm_Reset, Unacknowledged THEN

[0056] button_state=Alarm_Reset+Acknowledged

[0057] ENDIF

[0058] The actual code of the above script for the button R1C1 is:

[0059] {If Alarm Active+Unack, then Ack}

[0060] IF AP_Test_r1c2=20 THEN

[0061] AP_Test_r1c2=23;

[0062] ELSE

[0063] {If Alarm Reset+Unack, then Ack}

[0064] IF AP_Test_r1c2=40 THEN

[0065] AP_Test_r1c2=43;

[0066] ENDIF;

[0067] ENDIF;

[0068] By changing the button_state, the indirect integer tag associated with the button **34** triggers the corresponding DDE Item **60** with which the indirect analog tag is associated. This will send a DDE Poke to the Event Logger **48** allowing the Event Logger to recognize the change in state of the alarm button or indicator **34**. Each panel button **34** will only be enabled when it's corresponding Alarm is in an unacknowledged state (e.g. value=20 or value=40). After poking the Acknowledge over to the Event Logger **48**, the buttons **34** will not change color until the Event Logger sends a data change value back (via DDE server), changing the button to a new state.

[0069] After the Annunciator Panel Wizard has been configured, the integrator has two steps remaining in order to get the complete annunciator panel functionality in the InTouch application. First, the integrator creates InTouch DDE tags for the DDE Items **60** in the Event Logger **48** that correspond to the Alarm panel buttons **34** of the annunciator panel **12**. Second, a script is created that associates the InTouch indirect tags (created by the wizard) with the InTouch DDE tags created above. An example of this simple script is shown below:

[0070] Panel **1_R**1C1.Name=ALARM_1.Name;

[0071] Panel **1_R**1C2.Name=ALARM_52B.Name;

[0072] Panel **1_R**1C3.Name=XFORMER_**1_ALM.Name;**

. . .

[0073] Panel **1_R**8C4.Name=ALARM_16.Name;

[0074] Panel **1_R**8C5.Name=ALARM_25.Name;

[0075] Panel **1_R**8C6.Name=MAIN_BRKR_ALARM.Name;

[0076] The above two steps can not be automated by the Annunciator Panel Wizard without restricting the functionality of the annunciator panel **12**, and due to the fact that the wizard can not create a script that is run when an application is started. Another benefit of using Indirect tags in the wizard is that one annunciator panel **12** can be used for multiple devices **13** (of the same type), and that one annunciator panel can communicate with multiple Event Loggers **48** at the same time.

[0077] From the Event Logger's perspective, there are two parts to configuring the annunciator panel **12**. First, each DDE item **60** that will be displayed on the Annunciator Panel Wizard must be added at the Event Logger **48** (using the Add items dialog). Each DDE item **60** will connect to an individual button **34** in the Annunciator Panel Wizard.

[0078] The second part includes defining events **62** (see **FIGS. 10 and 11**) which will turn individual DDE Alarm items **60** ON or OFF. Each DDE Alarm item **60** (or annunciator panel button **34**) can be turned on or off by any number of device events **62** defined by the integrator. The events **62** are logically ORed together to determine ON or OFF conditions; i.e., if any of the events occurs, the DDE item **60** in ON; if none of the events **62** have occurred, the DDE item remains OFF.

[0079] To configure the annunciator panel items in the Event Logger **48**, the integrator displays the Annunciator Panel Configuration dialog box **80** as shown in **FIG. 17**. The selection of the ITEMS button **82** opens the Annunciator Panel Item window **84** shown in **FIG. 18** which permits the integrator to configure particular DDE Items **60** to be available to other applications. The Annunciator Panel Items window **84** displays all the existing DDE Items **60** available to the annunciator panel buttons **34**. A Panel Item **86** may be deleted from the Existing Item List **88** by highlighting the Panel Item and selecting the DELETE button **90**. At a confirmation dialog box (not shown), the OK button is selected to delete the Panel Item **86**.

[0080] A Panel Item **86** may be added to the Existing Item List **88** by selecting the ADD button **92** which displays the Annunciator Panel Items Add window **94**, shown in **FIG. 19**. The integrator then enters an Item Name, Description and Group for this item in the respective fields **95-97**. The Item name **95** of these entries are used when writing the script that associates the InTouch indirect tags with the InTouch DDE tags created in the Event Logger **48**, as described hereinabove.

[0081] To modify an existing DDE Item **60**, the DDE Item in the Annunciator Panel Items window **84** of **FIG. 18** is highlighted and the Modify button **98** of is selected which displays the Annunciator Panel items Add window **94** of **FIG. 19**. The integrator then makes any changes to the Item Name, Description or Group fields **95-97** and clicks OK.

[0082] Referring back to the Annunciator Panel Configuration window **80** of **FIG. 17**, the integrator select the Events button **100** to configure or modify the events **62** associated with an existing Annunciator Panel Item **86**. Selecting of the Events button **100** displays the Annunciator Panel Events dialog box **102** of **FIG. 20**. The Panel Item **86** to be configured is selected from the pull down menu in the Item Name field **104**. A second field **106** then displays the list of devices **13** and corresponding event codes **108** for each of the selected devices. The integrator may change the devices and event codes listed for the Panel Item **86** by selecting one of the Add, Delete and Modify buttons **110-112**, respectively. A device may be deleted from the list by highlighting the device **13** and selecting the Delete button **111**. A device **13** may be added by selecting the Add button **110** that displays the Annunciator Panel Events Add dialog box **114** shown in **FIG. 21**. In the Annunciator Panel Events Add dialog box **114**, the Item Name **86** shows the currently selected DDE Item **60**. The integrator selects a device **13** from the Device Name pulldown menu **116** and then enters an event code **108** in the Event field **118** that the Event Logger **48** monitors. In the Action filed, the integrator selects whether this event will cause an "ON" or "OFF" condition of this DDE Item **60**. The "OK" button **120** is selected to close the dialog box **114** and save the Panel Event **86** to the DDE Item **60**.

[0083] As described hereinbefore, if any of the event code **108** of the device selected for a DDE Item **60** is detected, the annunciator panel button **34** associated with the DDE Item, through the indirect tags, changes the color of the panel button **34** in accordance with the type of fault detected.

[0084] While preferred embodiments have been shown and described, various modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.

What is claimed is:

1. A power management control system comprising:

a network;

a first control device connected directly to said network and communicable with said network;

a user configurable annunciator panel, said panel including an indicator for visually displaying the status or condition of said first control device; and,

software defining an annunciator panel wizard, wherein the annunciator panel wizard provides user configuration of the annunciator panel.

2. The power management control system of claim 1 further comprising

a second control device; and,

a concentrator providing an interface between the network and the second control device;

wherein said indicator includes a visual display of the status or condition of said second control device.

3. The power management control system of claim 2 further comprising a computer, said panel and said software being associated with said computer.

4. The power management control system of claim 3 wherein the computer includes RS485 interface cards providing I/O ports that define multiple Modbus RTU networks.

5. The power management control system of claim 3 wherein the computer includes an RS232 to RS485 convertor.

6. The power management control system of claim 3 wherein the network comprises multiple Modbus RTU networks.

7. The power management control system of claim 6 comprising a plurality of first control devices.

8. The power management control system of claim 7 wherein the plurality of first control devices includes direct connect Modbus control devices and direct connect Modbus power management devices.

9. The power management control system of claim 3 comprising a plurality of second control devices.

10. The power management control system of claim 9 wherein the plurality of second control devices includes trip units, meters, and relays.

11. The power management control system of claim 3 wherein the computer contains software which monitors and controls the first and second control devices.

12. The power management control system of claim 3 wherein the software includes a server.

13. The power management control system of claim 12 wherein the software includes logical data tables associated with the server.

14. The power management control system of claim 13 wherein the software includes a module having a tool kit for building screens and interfaces.

15. The power management control system of claim 14 wherein the software includes a graphical user interface.

16. The power management control system of claim 13 wherein the software includes at least one productivity module.

17. The power management control system of claim 16 wherein the at least one productivity module includes a cost allocation module and a load management module.

18. The power management control system of claim 13 wherein the software includes an event logger module.

19. The power management control system of claim 13 wherein the software includes a waveform capture module.

20. The power management control system of claim 13 wherein the software includes an applications module, a waveform capture module, an event logger module, a productivity module, and a module having a tool kit for building screens and interfaces.

21. The power management control system of claim 3 wherein the annunciator panel includes an array of indicator buttons, at least one button in the array of indicator buttons relating to the first control device and at least one button in the array of indicator buttons relating to the second control device.

22. The power management control system of claim 21 wherein the indicator buttons within the array of indicator buttons are changeable in color for indicating an alarm state.

23. The power management control system of claim 21 wherein the indicator buttons within the array of indicator buttons include alphanumeric indicia for describing function of each button.

24. The power management control system of claim 21 further comprising a reset button which resets alarm indicators that are in an alarm state.

25. The power management control system of claim 21 further comprising a first dialog box accessible from the annunciator panel, the first dialog box providing a graphic of the array of indicator buttons for selecting a button to configure text of the button.

26. The power management control system of claim 25 further comprising a second dialog box providing text entry spaces.

27. The power management control system of claim 21 wherein the software includes an event logger module, the system further comprising an annunciator panel configuration dialog box for configuring annunciator panel items in the event logger module.

28. A power management control system comprising:

a computer;

a network associated with the computer;

a first control device connected directly to said network and communicable with said network;

a second control device;

a concentrator providing an interface between the network and the second control device; and,

a user configurable annunciator panel associated with said computer, said panel including an indicator for visually displaying the status or condition of said first control device and said second control device.

29. A power management control system comprising:

a computer including software defining an annunciator panel wizard, the software including an applications module, a waveform capture module, an event logger module, a productivity module, and a module having a tool kit for building screens and interfaces;

a network associated with the computer;

a first control device connected directly to said network and communicable with said network;

a user configurable annunciator panel associated with said computer, the annunciator panel wizard providing user configuration of the annunciator panel, said annunciator panel including an array of indicator buttons having at least one indicator button for visually displaying the status or condition of said first control device; and,

a dialog box accessible from the annunciator panel, the dialog box providing a graphic of the array of indicator buttons for selecting a button to configure text of the button.

30. A method of generating an annunciator panel display having at least one indicator for monitoring a device of a power control system; said method comprising:

selecting an annunciator panel wizard;

selecting an indicator of the annunciator panel;

providing an event logger for monitoring events of a monitored device of the power control system;

providing a navigational link between said selected indicator and said event logger; and

assigning a visual display to said selected indicator indicative of the occurrence of said monitored event.

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