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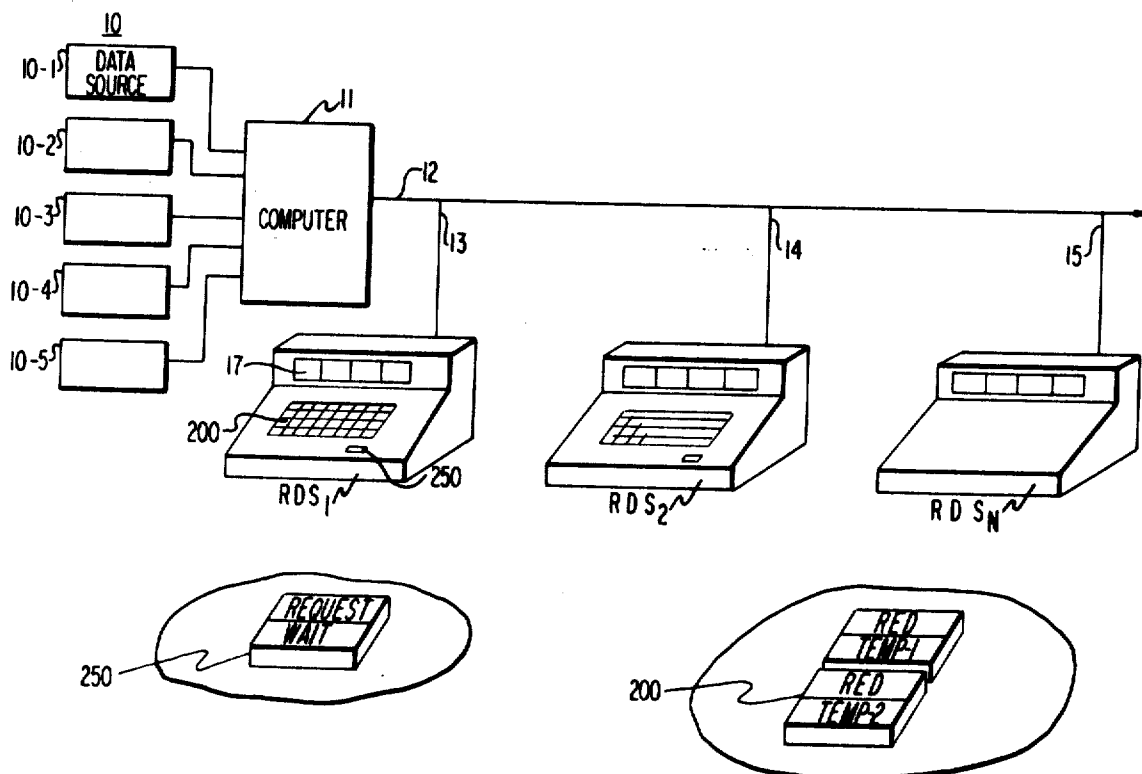
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**[54] DISPLAY TERMINAL FOR COMPUTER
MONITORED PLANT VARIABLES**
13 Claims, 10 Drawing Figs.

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ABSTRACT: Input variables are sensed by sensors at various locations in a manufacturing facility and supplied as raw data to a computer which may or may not perform calculations on the data supplied thereto. Data from the computer is presented on a time sharing basis to a plurality of remotely located data display terminals. Each data display terminal is equipped with a plurality of manually actuated data selection units having identifying indicia and a numerical display displaying data from the computer corresponding to the requested indicia of an actuated data selection unit along with data indicating trend of the variable relative to a standard or reference value. The communication link between the computer and the display terminals may be conventional wiring with data lines common to each display terminal and individual lines for achieving connection to the computer and the display terminal being individual to the display terminals. Consult the specification for further features and details.



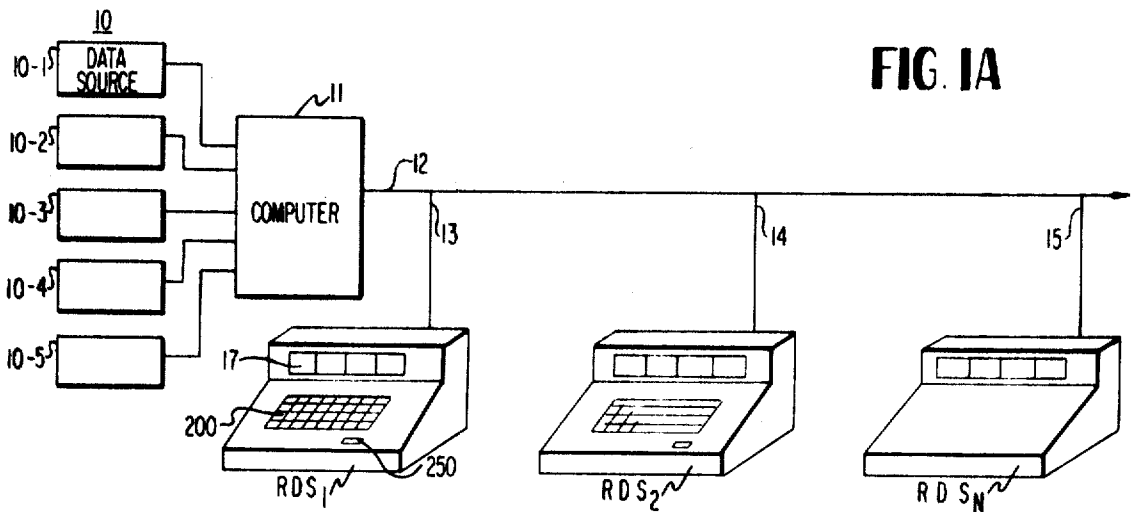


FIG. 1B

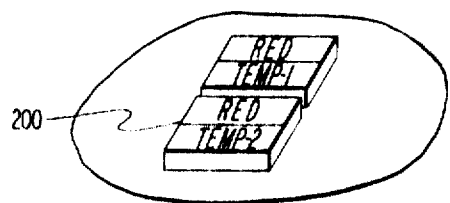
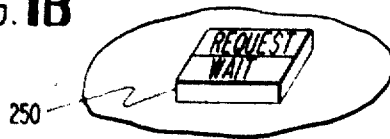


FIG. 1C

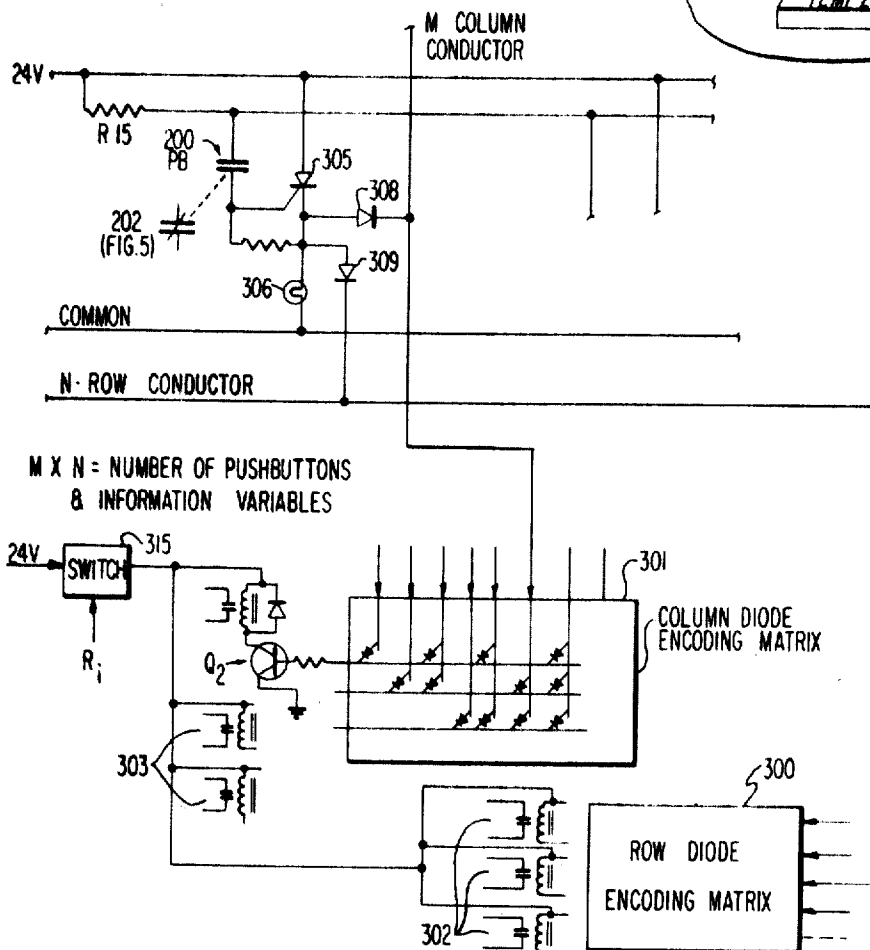


FIG. 4

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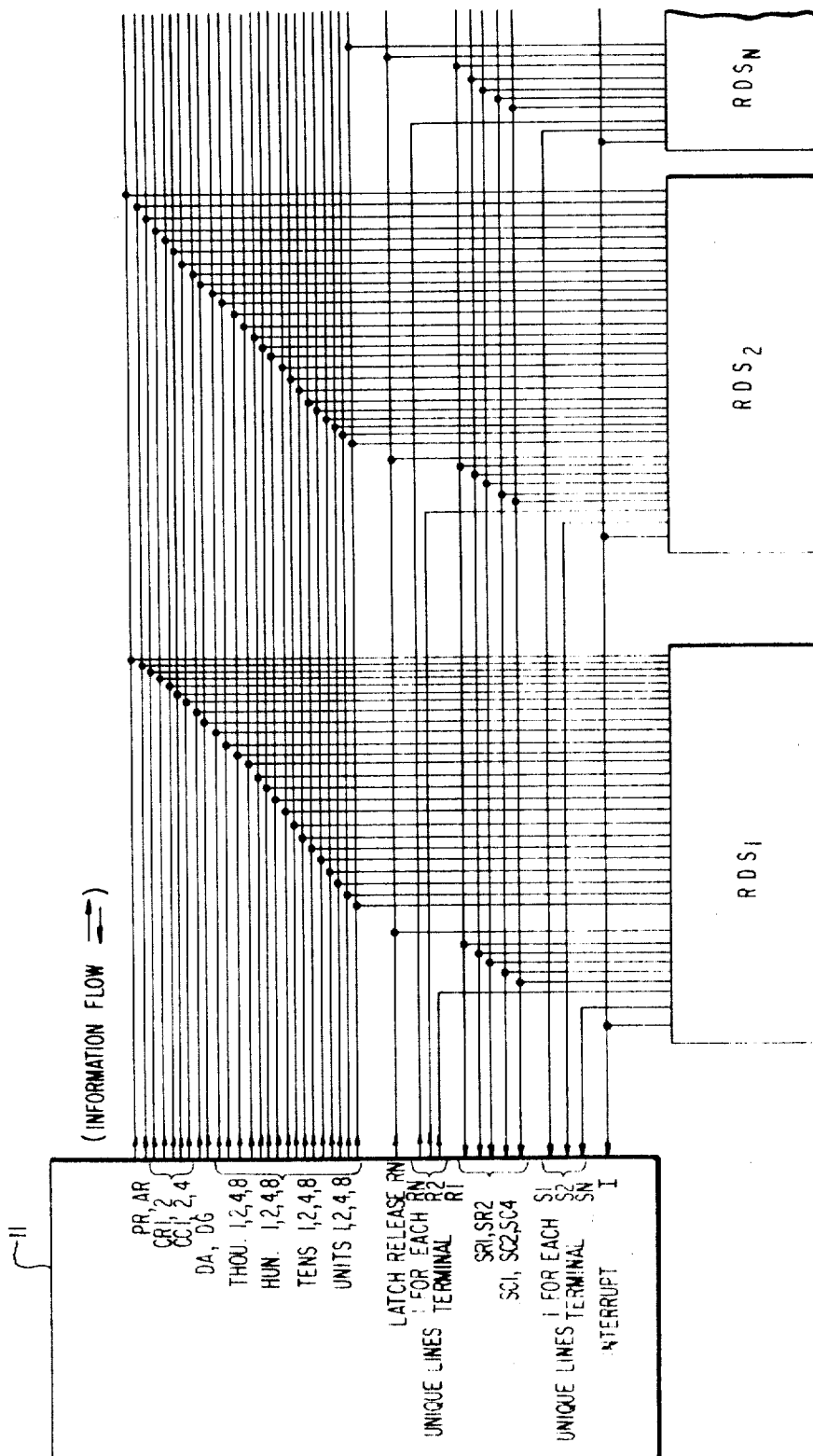


FIG 2

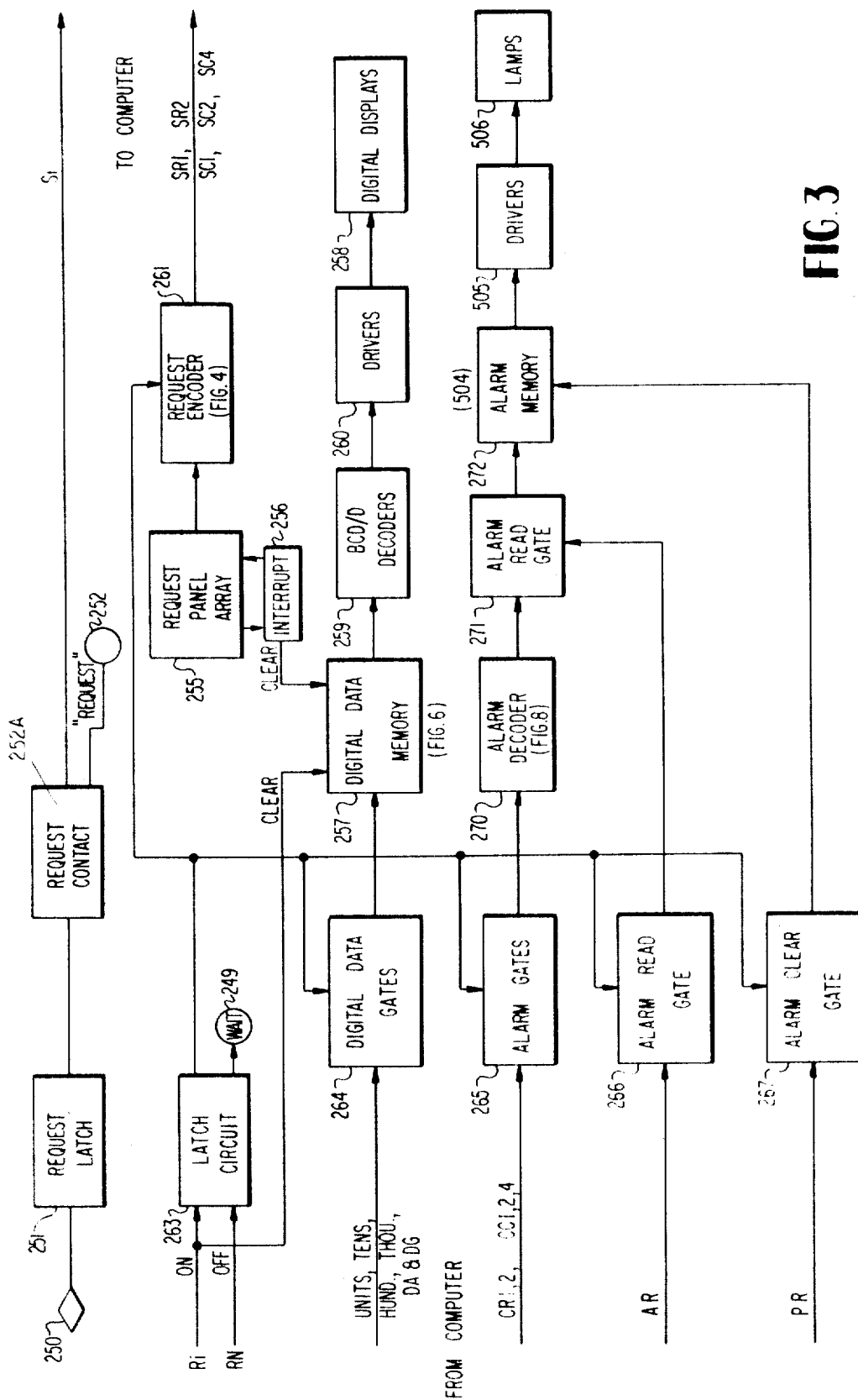


FIG. 3

FIG. 5

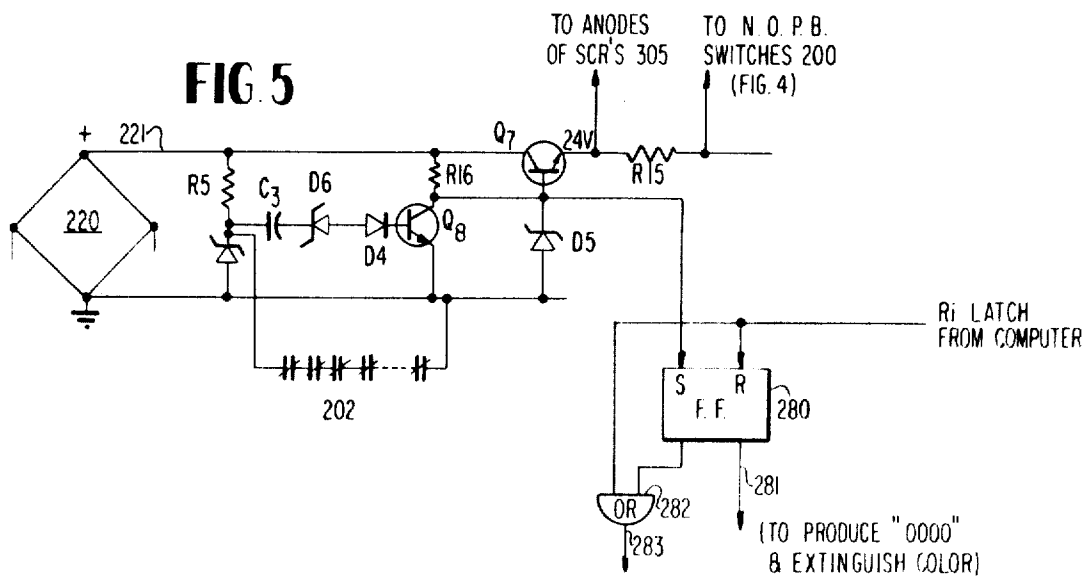
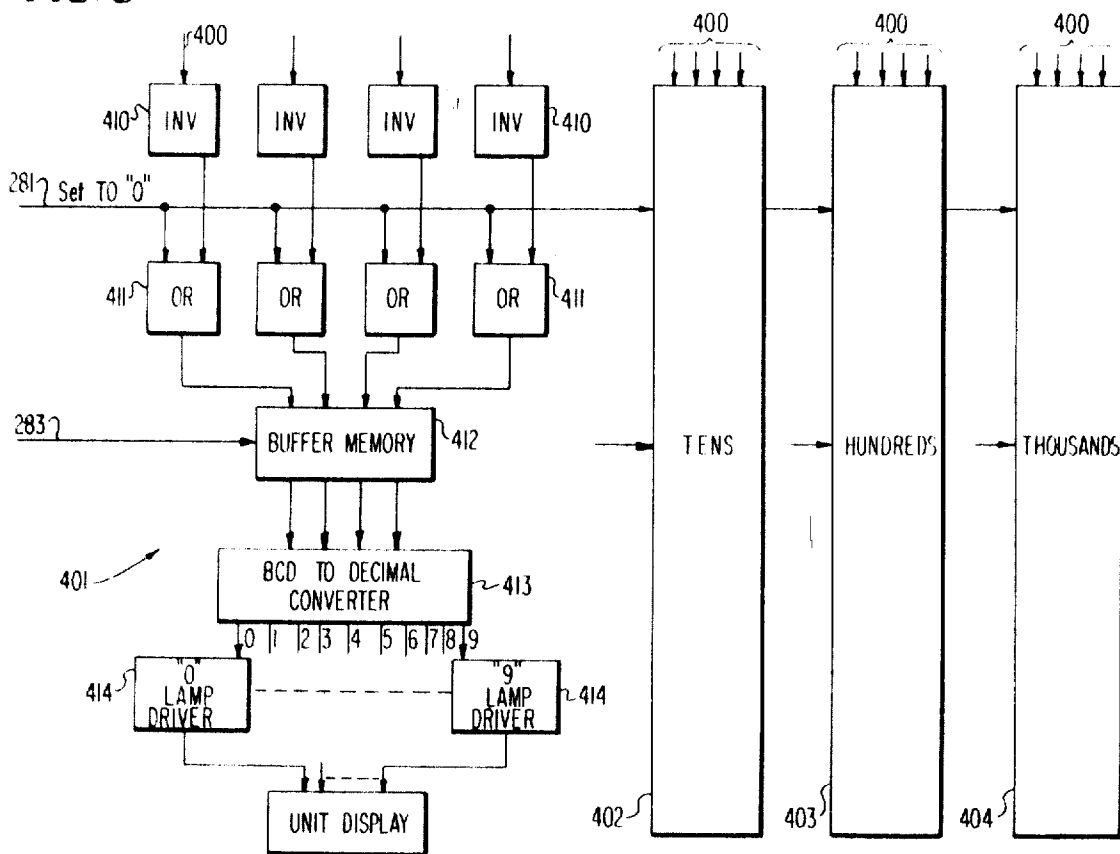
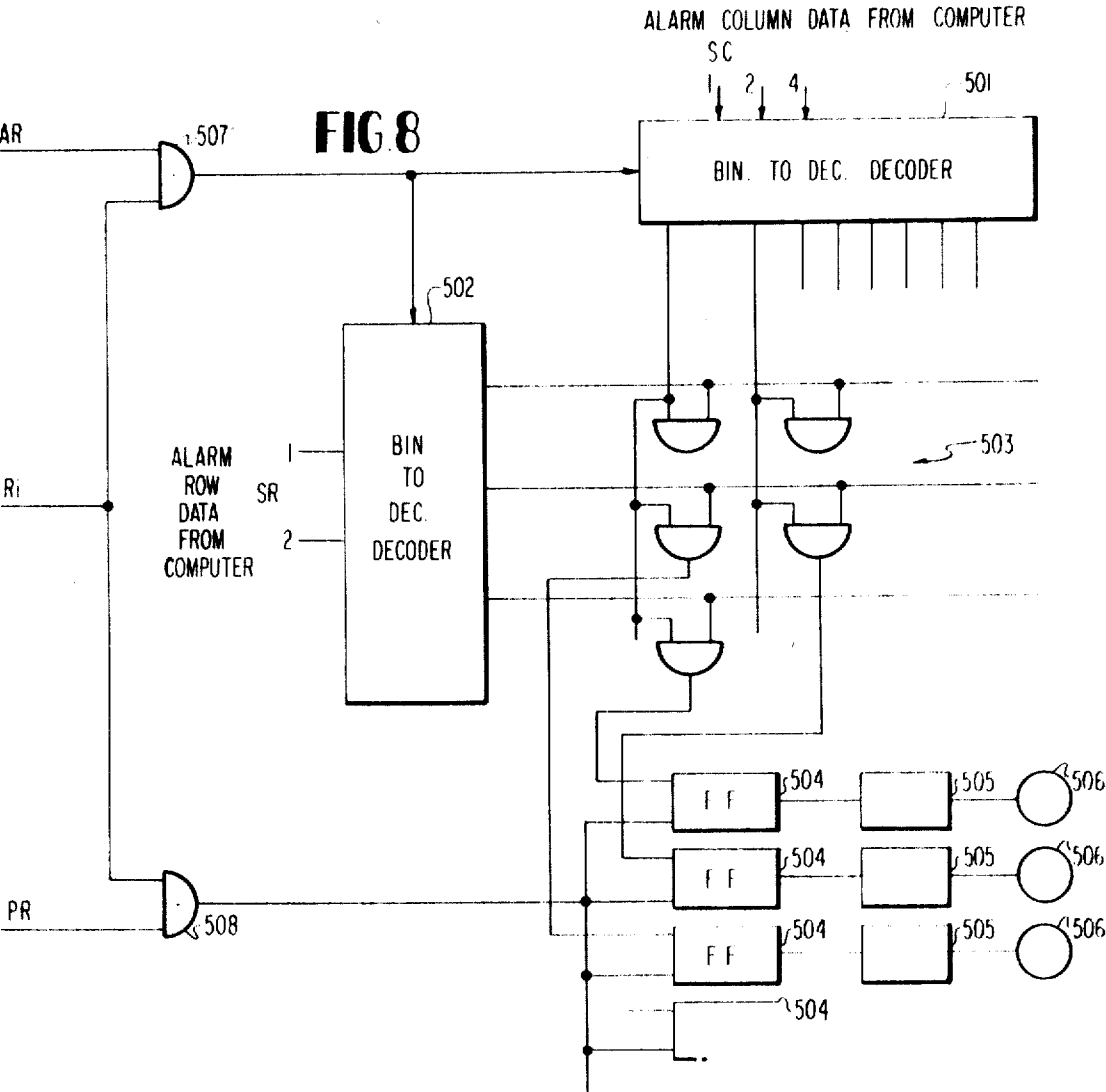
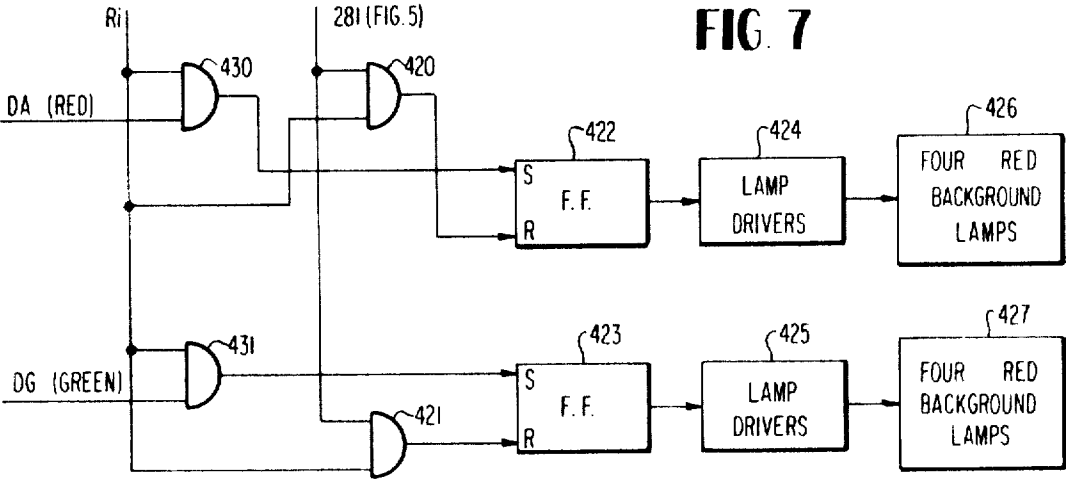


FIG. 6





DISPLAY TERMINAL FOR COMPUTER MONITORED PLANT VARIABLES

This invention relates in general to improvements in remote data display terminals for displaying data from a computer monitoring a manufacturing facility.

Proper control of modern industrial plants requires that production variables be presented to plant operators and management personnel requesting same in as expeditious and economical a manner as possible. There are presently available numerous forms and systems for accomplishing this objective. The present invention is directed to a unique data display terminal to allow operators and management personnel at various near and distant stations to quickly and simply obtain information that is available in a central computer to which information, raw data, etc., is supplied from sensors and other monitoring devices located at various stations and machines in the manufacturing facility. (Of course, the data may be entered into the computer manually.) For example, in a bottle manufacturing assembly line, the operation of the numerous bottle forming machines, glass furnace temperatures, bottle flow rates, and the like, are supplied to the computer which may or may not perform a computation. For example, the computer may simply store the data for display to interested personnel. If a particular bottle forming machine or plant or portion thereof is for some reason operating below standard or normal production rates, which may be stored in the computer, the actual production rate may be measured and compared with the standard by the computer to produce a signal indicating that the production is normal or that it is below normal in trend. The present invention combines the function of simplified instruction with a numerical readout and alarm display on a data display terminal which time shares common data lines with a number of other such data display terminals.

In general, the system comprises one or more remote data display terminals, a set of data lines and a set of digital inputs at the computer. The data display terminal contains a decimal display (one or more units), an array of data selection units such as pushbuttons with two lamps (red and white) behind each pushbutton, and a "request" pushbutton (with lamp), and a separate indicator lamp. Each of the buttons in the array (one for each terminal panel) represents an instruction to the computer; e.g., "obtain and display the current value of a certain variable." When one of these buttons is pressed, its internal white lamp is lit (and any other white lamp on the panel which was previously lit goes out), and a memory unit associated with the pushbutton is actuated. A communication to the computer is initiated by pressing the request button to light its lamp and signals the computer that:

1. a request for service has been made (a priority level is inherent in the request so that the computer may decide whether to service it or defer servicing until an activity of high priority is completed), and
2. the request comes from this particular panel; e.g., the computer identifies the remote terminal requesting information. The computer then signals the particular terminal to "latch on" to the data lines so that it can respond to the information on the data lines from the computer whereby the terminal's instruction will appear on the data lines to the computer. At this time, the lamp in the isolated button goes out and the indicator lamp is lit.

The computer then reads the instruction from the terminal, and its response will place instructions on the data lines from the computer that will place its number (or other message) in the decimal display and turn on any or all of the red lamps in the pushbutton array. The decimal message may be the value of the variable and the red lamp can be used as warning for alarm signals associated with each of several conditions or variables. For example, in the event the particular variable being monitored is the temperature of a glass furnace and the temperature is abnormal, the red lamp behind the decimal display will be lighted, and the decimal display would be presented with a red background to indicate the abnormal condition.

The computer unlatches the terminal (and the indicator lamp goes out) and proceeds to service other data terminals in the same way while the numbers and signals that were posted at the previously served data display terminal are continuously displayed. It will be apparent that the apparatus and system disclosed herein permits as many points per terminal as required;

that each terminal provides its own memory;

that each terminal time shares a main cable or communication link to the computer;

that each terminal utilizes binary code to decimal conversions to conserve wires;

that each terminal incorporates an alarm indication; and

that each unit is simple to operate and understand by operating personnel.

If desired, the computer may be programmed to simultaneously, selectively, or sequentially control the remote terminals to update variable data, trends (alarms), etc. The variables displayed at one terminal need not be the same as those displayed at other terminals.

Objects of the present invention are to provide: remote data display terminals for displaying computer information which have an internal memory and which provide a sustained display by virtue of its own memory system; and combinations of functions of simplified instruction, numerical readout and alarm display on one remote data terminal which time shares common data lines from the computer with other remote data terminals.

These and other advantages and features of the invention will become more apparent and better understood from the following description when read in conjunction with the accompanying drawings wherein:

FIG. 1A is a block diagram illustrating the overall system; and FIGS. 1B and 1C illustrate the request unit and one of the data selection pushbuttons at a remote data display terminal;

FIG. 2 is a wiring diagram illustrating the sharing of common data lines and the control and information flow lines;

FIG. 3 is a block diagram of circuitry at each remote data display unit;

FIG. 4 is a partial circuit schematic illustrating the memory and encoding circuit at each remote data display terminal;

FIG. 5 is a partial circuit schematic illustrating the manner in which actuation of any data selection unit clears the memory units of all data selection units and produces a control pulse for clearing the display for the newly requested information;

FIG. 6 is a partial block diagram illustrating the manner in which input data from the computer is decoded to produce the digital display of data at the remote data display terminals;

FIG. 7 is a block diagram of the circuit for driving the trend indicating lamps (red and green) forming the background for the digital data display; and

FIG. 8 is a block diagram illustrating the decoding circuit for the alarm lamps at each data selection unit pushbutton.

With reference to FIG. 1 of the drawings, data sources 10 constituted by data sensors or monitors 10-1, 10-2, ..., 10-11, at various locations in the plant feed raw data to computer 11, which may be a general purpose digital computer programmed to receive and perform calculations on the raw data or store the data for transmission to a remote station on request. A distribution bus 12 contains data lines (FIG. 2) that are shared by a plurality of remote data display terminals RDS₁, RDS₂, ..., RDS_n connected to the distribution bus by lines 13, 14 and 15 respectively. An operator selects one of the variables for display on digital display screen 17 by actuating one of the data selection units, e.g., pushbuttons 200 at his display terminal. Actuation of the one selection unit returns all the digital display on the screen to an initial or zero display, restores all memory units to an initial nonactuated state and then sets a memory unit for storing the request information for transmission to computer 11. The operator then actuates a request unit 250 (see FIG. 1B) which transmits a signal to the computer from his terminal. Computer 11 determines which

of remote data display stations RDS has signaled and, as described later herein, latches that station onto the data lines in distribution bus 12. Any alarm signals for lighting a red lamp at each data selection unit 200 (FIG. 1C) and the current value of the variable requested are transmitted to the station which is latched onto the data lines of the distribution bus 12. The computer 11 may be programmed to automatically update numerical display and alarms on each terminal RDS₁...RDS_n on a periodic basis.

FIG. 2 shows the actual wiring connections from computer 11 to the various remote data display terminals (the arrows indicating direction of data flow). The upper lines (pairs) are used to transmit variable data to the remote data display units while the lower lines are used to transmit request data from the stations to the computer. Except for the lines labeled R_i , R_2 ... R_n and S_i , S_2 ... S_n . All lines are common to all terminals. Lines S_i , S_2 ... are unique to each station and serve to identify the terminal requesting service to the computer and the lines R_i , R_2 ... R_n are likewise unique to each station and serve to cause the latching on of a remote data terminal to the common data lines.

FIG. 3 is a block diagram of the circuitry at each remote data display unit RDS wherein the data and signalling lines have been labeled to correspond to those shown in FIG. 2. When request button 250 is actuated a latch circuit 251 is energized which sends a signal S_i to the computer 11 which receives the signal and at the same time a lamp 252 behind the "request" unit is energized by way of a request contact circuit 252A. In addition, a second lamp 249, labeled "wait," is energized by latch circuit 263 until the computer sends a latch signal R_i to the terminal on its unique line. The computer is programmed to transmit this signal if it is not servicing another terminal or signal after it has completed servicing the other terminal.

Prior to actuating the request signal, the operator will have actuated one of data selection pushbuttons 200 in request panel array 255 each of which has its own unique memory. Actuation of any data selection pushbutton, produces a signal at interrupt pulse circuit 256 which is applied as a "clear" signal to digital data memory 257 which serves to cause the digital display 258 to exhibit a series of zeros via BCD/D decoder 259 the output of which is applied to the digital display lamps in display unit 258 by driver circuits 260. The specific location of an actuated pushbutton in panel array 255 is encoded by a request encoder 261. However, this coded request data is not applied to the distribution bus for transmission to the computer until the computer sends a signal R_i on the stations unique line which serves to actuate latch circuit 263 causing "wait" lamp 249 to go out. The signal from latch circuit 263 is applied to request encoder 261 to permit the request information code (e.g., the column and row position of an actuated data request unit 200) to be transmitted to computer 11.

Computer 11 receives the request information, formulates a response and applies same to its output data lines. Since only the remote data terminal receiving a signal R_i on its unique lines is latched to the data lines, by way of gate 264, alarm gates 265, 266 and 267, only that station will display the information. The digital information concerning the variables and their trend is stored in digital data memory 257 which applies same to BCD/D decoder 259 which, in turn supplies signals to lamp drivers 260 for the digital display 258. If the DA signal is present the background color will be red and if the DG signal is present the background color will be green to signify a safe or normal value.

In addition, red alarm lamps behind each data request unit may be selectively energized to indicate an alarm condition. Thus the location of the alarm lamp to be energized is received by alarm gate 265 which, if signal R_i is present, passes these signals to an alarm decoder 270, the output of which is passed by gate 271 upon coincidence thereof of the alarm read signal AR from alarm read gate 266. Hence the alarm location, the latch signal R_i and the alarm read signal

from the computer are necessary in order to display an alarm at a specific data selection pushbutton 200. Following the alarm gate 271 is an alarm memory 272 which serves to supply signals to alarm lamp drivers 273, one for each data selection pushbutton (if alarm conditions are to be given for all data variables). One or more alarm lamps may be energized by the computer to advise operators that it has detected an alarm condition.

DATA SELECTION MATRIX

Data selection devices, such as 200 at each remote data station RDS, are arrayed in horizontal rows and vertical columns, and the specific position of a pushbutton is located by its respective row conductor and respective column conductor (cartesian coordinates), and each device has its own internal SCR memory for energizing, when actuated, a respective row conductor and a respective column conductor. However, it will be appreciated that the data selection units need not be physically arrayed in horizontal rows and columns. In FIG. 4, one row conductor (there being a row conductor for each pushbutton row) is identified by the letter N, and a column conductor (there being a column conductor for each column) is identified by the letter M, so that the product $M \times N$ equals the number of information variables displayable at a remote data station. The energized row conductor and the energized column conductor are connected to a row diode encoding matrix 300 and a column diode encoding matrix 301, respectively, which actuate, permutatively, row encoding relay switches 302 and column encoding relay switches 303, respectively; the permutated closings (or openings) of these switches identifying the particular pushbutton which has been actuated by its cartesian coordinates. As described later herein, this information is transmitted to the computer 11 where it is decoded and the information requested produced and transmitted by computer 11 to the remote station. However, as noted earlier this information is not transmitted to computer 11 until computer 11 has signaled the remote station that it is free or able to accommodate the request by transmission of latch signal R_i on the station's unique line. Accordingly, the actuation of the pushbutton at a selected position in the pushbutton array energizes a memory circuit unique with respect to each pushbutton. In FIG. 4, the memory includes a silicon controlled rectifier (SCR) 305 which has its gate electrode G connected to the normally open pushbutton switch element 200 PB through a dropping resistor R-15 to the 24 volt line. The cathode-anode circuit of SCR 305 is connected with a "white" indicating lamp 306 across the 24 volt line and common.

Diagrammatically illustrated in association with the normally open pushbutton switch 200 PB is a normally closed pushbutton switch 202 PB. As shown in FIG. 5, all of the data selection pushbuttons have associated therewith a normally closed pushbutton switch 202 with all of the normally open pushbutton switches being connected in series.

In the circuit of FIG. 5, the direct current power supply, diagrammatically illustrated as rectifier 220, supplies a positive potential on line 221 and the output is regulated by regulating transistor Q-7. Two output voltages are produced, the first, a clean 24 volts taken from the emitter of regulating transistor Q-7, and the second through dropping resistor R-15 to form the gate voltage source for all of the SCR's 305.

Regulating transistor Q-7 has a Zener diode D-5 connected to the base circuit thereof which serves to maintain the current through transistor Q-7 constant. Also shown in FIG. 5 is a voltage divider consisting of resistor R-5 and Zener diode D-7 having connected to the intermediate point thereof capacitor C-3, Zener diode D-6, and reverse current diode D-4. This circuit is connected to the base of a switching transistor Q-8 which has resistor R-16 in the collector circuit thereof, and the collector of transistor Q-8 is connected directly to the base of transistor Q-7. It will be noted that the switching transistor Q-8 is connected in shunt with Diode D-5.

As described thus far, the circuit shown in FIG. 5 operates as follows: When a normally closed contact 202 is opened, the voltage at the junction of Zener diode D-7 and resistor D-5 rises rapidly to the 12 volts determined by the Zener in the voltage divider circuit to produce a pulse (a few milliseconds wide). This pulse is coupled through capacitor C-3, Zener diode D-6, and diode D-4 to the base of transistor Q-8 which is normally nonconductive. This pulse causes transistor Q-8 to conduct to thereby bypass regulating Zener diode D-5 and place the base of series current regulating transistor Q-7 at ground or common, and transistor Q-7 is thus rendered open or nonconductive. Further, the 24 volts normally at the emitter of transistor Q-5 goes to zero, and thus the 24 volt supply to the arrays of SCR 305 (FIG. 4) is removed so that all SCR's are returned to the blocking state to extinguish all white lamps at all data selection and memory units. After this pulse has passed, the 24 volts reappears, and the normally open contact (now closed) of an actuated pushbutton supplies a signal to the gate electrode G of its corresponding SCR 305 to thus energize the white lamp 306 and supply a signal via isolating diode 308 to column conductor M corresponding to a column in which the pushbutton switch is located and a row conductor via diode 309 corresponding to the row in which an actuated pushbutton switch is located.

As described earlier, the column conductors are connected to a column diode encoding matrix 301, and the row conductors are connected to a row diode encoding matrix 300 which, respectively, encode the row and column information into a BCD code by way of the reed relay switches 302 and 303. The respective matrixes drive the reed relays, the contacts 302 and 303 of which are selectively or permutatively closed according to the path formed by the diode matrix. (There is no column matrix for the first column so the BCD code for column one is 000; likewise, there is no row conductor for row one so the BCD code for row one is 000.)

The data thus produced, being the encoded location of the actuated pushbutton, is maintained by the continued energization or actuation of SCR 305 even though the data locating the actuated pushbutton is not transmitted until the computer 11 requests that it be transmitted and after the computer has answered the request and transmitted the requested data. As described earlier, this memory action remains until another data selection pushbutton switch is actuated elsewhere in the pushbutton array.

The signal produced at the base of transistor Q₇ is used to set flip-flop 280, which had been set in a first stable state by the latch signal R_i from computer 11 during a previous interrogation of the computer. When a signal at the set terminal S of flip-flop 280 appears, the flip-flop changes states and a signal is transmitted on line 281 to the data decoder (FIG. 6) and trend data decoder (FIG. 7) to cause the display unit to exhibit the character "0000" and to extinguish the trend color background lamps.

When the latch signal R_i from computer 11 arrives on reset terminal "R" of flip-flop 280, this circuit is reset to its initial state and a signal is applied to OR gate 282 along with latch signal R_i the output of which is supplied on line 283 to the buffer memory (FIG. 6) to permit new incoming data to be fed to this memory.

With further reference to FIG. 4, it will be noted that each reed relay 302 and 303 of the respective encoding matrices 300 and 301 is driven by a transistor Q₂, there being one for each reed relay. All such transistors receive operating potential from the 24 volt supply through a switch 315 which is actuated or energized by the latch signal R_i. With respect to FIG. 3, this is constituted by the R_i signal from latch circuit 263 to request encoder 261. Hence, while transistors Q₂ are permutatively conditioned for energization by the diode encoding matrices 300 and 301, they are not effectively energized until the R_i signal actuates switch 315.

DIGITAL DISPLAY CIRCUITRY (DIGITS)

FIG. 6 is a block diagram of the circuit for decoding incoming data and producing the display. Sixteen data lines 400 in groups of 4, (units, (4) tens (4), hundred (4) and thousands (4) carry data on common lines from the computer to the display terminals. The units decoder and display system 401 will be described, tens 402, hundred 403 and thousands 404 systems being identical. It will be understood that selected letters of the alphabet may be displayed as well as numerals and other characters and it is obvious that the display sequence will be thousands, hundred, tens and units.

It will be recalled that when a data selection unit was actuated a signal had been applied on line 281 to set all display units to "0" as well as turning off any background lights so the system is conditioned for receiving the new data on data lines 400. Binary bits applied to units system 401 are inverted by inverters 410 and passed by OR gates 411 to buffer memory 412, which has been conditioned by the latch signal R_i (FIG. 5) for transferring BCD data bits (the code used in this system) to BCD to decimal converter 413 which, in turn produces an output on one of its 10 output leads (0, 1, ..., 9). Whichever lead is energized, supplies a signal to one of lamp drivers 414. For example if the "2" lead is energized the lamp behind the character "2" to thus project the character "2" on the display screen.

The tens 402, hundreds 403 and thousands 404 systems operate in a similar fashion to thus display the transmitted character or number.

TREND COLOR DISPLAY

FIG. 7 shows the circuit for trend color display. Again, it will be recalled that the signal on line 281 which set the digit display systems to "0000" also removed the background colors. This is done by passing such signal through OR gate 420 in the red channel and OR gate 421 in the green channel. Such signals are applied to the reset terminals of flip-flops 422 and 423 respectively, which remove signals from lamp drivers 424 and 425 respectively to extinguish either the red or green lamps 426 and 427, respectively.

One or the other of trend data signals DA (red) or DG (green) will be transmitted from computer 11. If the DA signal is received, it is applied as one logical input to AND gate 430 with the latch signal R_i constituting a second logical input to this gate the output of AND gate 430 is applied as the set input to flip-flop 422 which produces an output signal to be applied to lamp drivers 424 to cause the four red background lamps 426 to be energized. Similarly, if the DG signal is received, it is applied to AND gate 431 with latch signal R_i to cause the four green background lamps to be energized and provide a green background for the display.

DATA SELECTION ALARM CIRCUIT

Each data selection pushbutton is divided into two portions, the white lamps described earlier being behind a portion labeled with an indicator of the information available when it is actuated. The second portion is used to provide an alarm condition signal from the computer relative to the information available. Thus each data selection unit is provided with a lamp behind a red shield. FIG. 8 is a block diagram illustrating decoding of such alarm information from the computer to cause one red alarm at a desired location in the data selection matrix to be energized.

As illustrated, alarm column data (SC₁, SC₂, SC₄) from the computer is applied to a binary to decimal decoder 501 and alarm row data (SR₁, SR₂) is applied to binary to decimal decoder 502. The system shown is for a 32 data selection pushbutton array of four rows and eight columns, but may obviously be expanded or decreased to accommodate as many variables for display and alarm indication as is desired. The

outputs of decoders 501 and 502 are applied to an AND gate matrix 503, there being an AND gate at each matrix cross-point and 32 AND gates for a 32 pushbutton array. The coincidence of a signal from decoder 501 with a signal from decoder 502 at any matrix cross-point locates the pushbutton in the array at which an alarm is to be posted. The output of each AND gate is applied as the set input to flip-flop memory circuits 504, there being one such flip-flop memory circuit 504 for each AND gate, respectively. The output of flip-flop memory circuits 504 are applied to lamp drivers 505 which, when actuated energize alarm lamps 506 which respectively are located at the pushbutton in the data selection array as described earlier.

In order to post an alarm, in addition to transmitting the location of same, the computer 11 also transmits an alarm signal AR which is applied as one input to AND gate 507 along with latch signal Ri. The output signal from gate 507 is applied to decoders 501 and 502 and is necessary in order to permit decoders 501 and 502 to decode information on the alarm data lines.

In order to clear a posted alarm, e.g., deenergize any of lamps 506 which have been energized, the computer 11 transmits an alarm clear signal PR which signal is applied as one input to AND gate 508 along with latch signal Ri as the second input. The output of AND gate 508 is applied as the reset input to all flip-flop memories 504 so as to deenergize all alarm lamps 506 simultaneously.

It will be appreciated that since the alarm signalling system is to a certain extent separate from the digital display system described earlier, the computer may be programmed to scan the unique lines to each remote data display terminal and post one or more alarms to call the operator's attention to this condition and take appropriate corrective action.

While a specific embodiment of the invention has been described in detail it will be appreciated that many variations thereof will readily suggest themselves to those skilled in the art so the invention is not limited to the specific embodiment disclosed but includes those variations which come within the spirit and scope of the claims appended hereto.

We claim:

1. In combination, apparatus for displaying to a plurality of remote data display stations plant operating data as produced by a computer connected to monitor a plurality of variable data inputs from a plurality of data monitors located in the plant

a plurality of manually actuated data pushbutton selection means arrayed in a logical matrix, each pushbutton selection means having indicia thereon corresponding to a variable data input to the computer and first lamp means behind each indicia for lighting same,

memory-switch means associated with each selection means for deenergizing all lamps behind the indicia in the push-buttons in the array and then energizing the lamp behind an indicia on a pushbutton which has been manually actuated,

encoding matrix means connected to said plurality of pushbutton selection means for encoding the column and row position of said pushbutton selection means which has been actuated,

request means at each remote terminal for interrogating the computer for service,

a communication link for conveying signals produced at each remote station to said computer,

means at the computer for transmitting a signal to the remote data terminal at which said pushbutton has been depressed to cause the data signal from said encoding matrix to be transmitted to the computer,

means at the computer for receiving said transmitted data and delivering signals corresponding to the requested data via said communication link to said remote data terminal in code,

means at said remote data terminal for decoding the received data signals and producing display data corresponding thereto, and

means at the remote data terminal for displaying the decoded display data received from the computer.

2. The invention defined in claim 1 wherein the data transmitted from the computer to the remote data terminal includes

a signal indicating the directional trend of the data transmitted, and

second lamp means at the remote data terminal for displaying the directional trend of the data.

3. The invention defined in claim 1 wherein said request means at each remote terminal includes visible signal means operated by signals from the computer to indicate that the data terminal at which a request has been initiated is connected to receive data from the computer.

4. In combination, a system for displaying to a plurality of remote data display stations plant operating data produced by a computer connected to monitor a plurality of data inputs, a plurality of data monitors located in the plant and connected to said computer, a communication link common to said data display stations and in which data from the computer is individually displayed by data display means at the station requesting same, means at all remote data display stations for preventing the data display means thereof from responding to data on said communication link destined for another remote data display station, and means preventing transmission of signals corresponding to information signals to said computer until the computer has completed transmission of data destined for another remote station.

5. In combination with a data display terminal for interrogating a plant monitoring computer and displaying plant operating data received from the computer, said display terminal including a plurality of pushbutton data selection means arrayed in horizontal rows and vertical columns, each pushbutton having unique indicia thereon corresponding to variable plant operating data available from the computer, the improvement comprising

memory-switch means operatively associated with each pushbutton,

each said memory-switch means including a normally open solid state switch and means supplying operating potentials thereto which is common to normally open solid-state switch means of all memory-switch means, and means operated on actuation of one pushbutton in the array for momentarily removing the operating potentials supplied to all said normally open solid state

6. The invention defined in claim 5 wherein said memory-switch includes

a silicon controlled rectifier, and

a normally open switch connected between the gate electrode of said silicon controlled rectifier and said supply of operating potential.

7. The invention defined in claim 5 wherein said means operated on actuation of one pushbutton in the array for momentarily removing the operating potential supplied to all said normally open solid state switch means to actuate same includes

a normally closed switch, there being one normally closed switch for each pushbutton in the array,

means connecting all of said normally closed switches in series,

a pulse forming circuit,

means connecting said series connected normally closed switches to said pulse forming circuit to cause said pulse forming circuit to produce a pulse upon any one of said normally closed switches being open, and

switch means operated by any pulse so produced for removing the operating potential from said memory-switch means.

8. The invention defined in claim 5 wherein said pulse operated switch is constituted by a current regulating transistor in said means supplying operating potential.

9. The invention defined in claim 5 wherein each said pushbutton includes a lamp for lighting said indicia and wherein each such lamp is supplied with operating current through said

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memory-switch means associated with its respective pushbutton.

10. The invention defined in claim 7 wherein the data display for said data display terminal is constituted by a plurality of decimal readout devices, and further including means responsive to a pulse produced by said pulse forming circuit to cause all said decimal readout devices to exhibit the digit "0."

11. The invention defined in claim 10 wherein said plurality of decimal readout devices exhibit data on a common screen and wherein signals received from said computer include a signal corresponding to the trend of the variable data to be dis-

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played, and further including means for providing a background color on said screen indicative of said trend.

12. The invention defined in claim 9 wherein each pushbutton includes a second lamp, and means responsive to signals from said computer for energizing a selected second lamp independently of the energization of said first lamp.

13. The invention defined in claim 12 including means responsive to signals from said computer for deenergizing any selected second lamp.

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