

[54] **ALARM SCANNER APPARATUS AND METHOD**

[75] Inventors: **Randie M. Houston**, Fairfax; **Harold G. Wilson, Jr.**, Woodbridge, both of Va.

[73] Assignee: **Computer Sciences Corporation**, El Segundo, Calif.

[22] Filed: **May 16, 1974**

[21] Appl. No.: **470,681**

[52] U.S. Cl. **340/166 R; 340/163**

[51] Int. Cl.² **H04Q 9/00**

[58] Field of Search..... **340/166 R, 163, 409, 413, 340/151**

[56] **References Cited**

UNITED STATES PATENTS

3,435,416	3/1969	Kretsch.....	340/163
3,465,293	9/1969	Weckler.....	340/166 R
3,576,569	4/1971	Watson	340/166 R

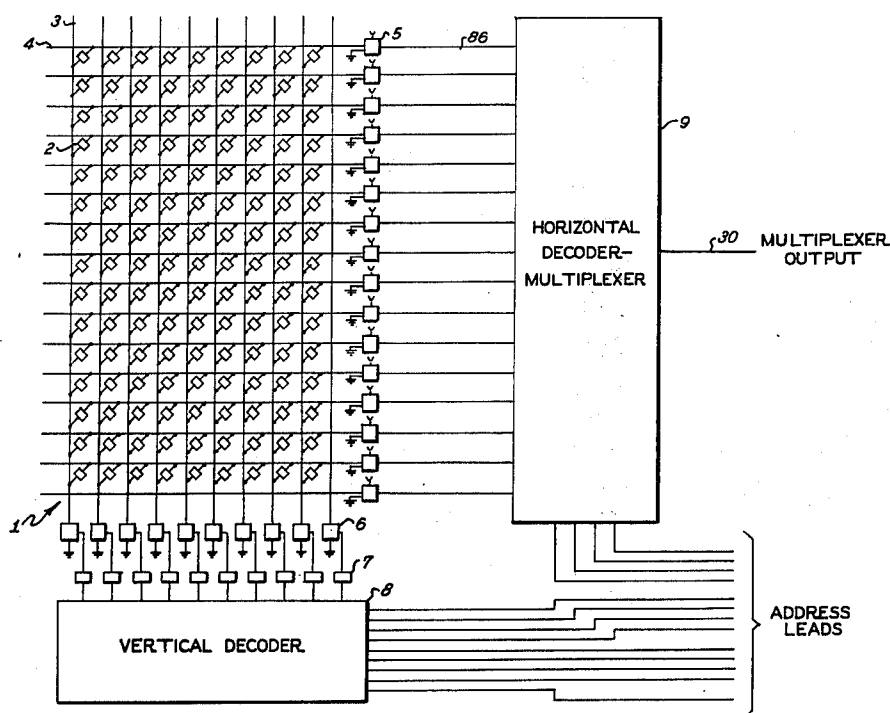
3,651,463 3/1972 Rawson..... 340/166 R

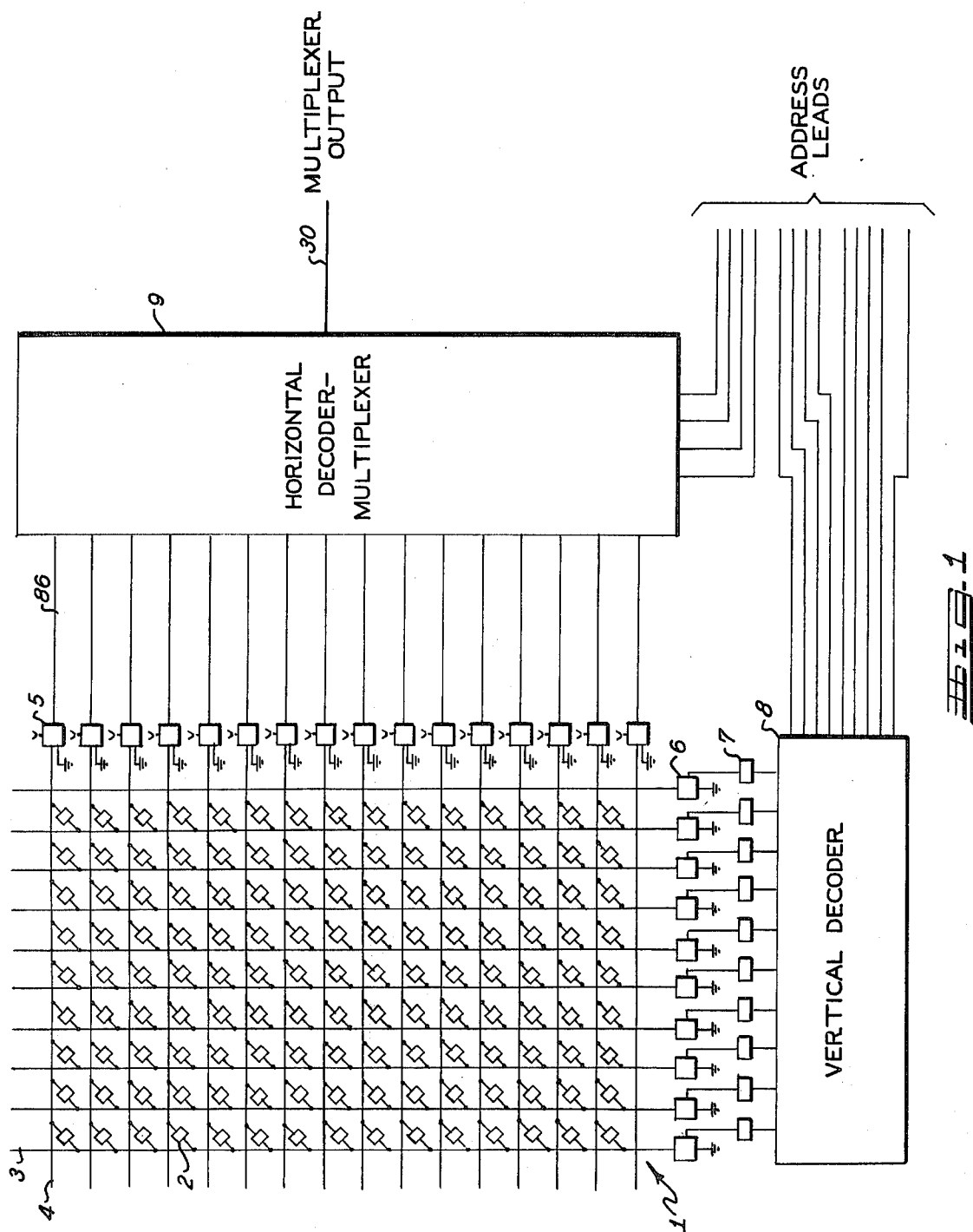
Primary Examiner—Harold I. Pitts
Attorney, Agent, or Firm—Jim Zegeer

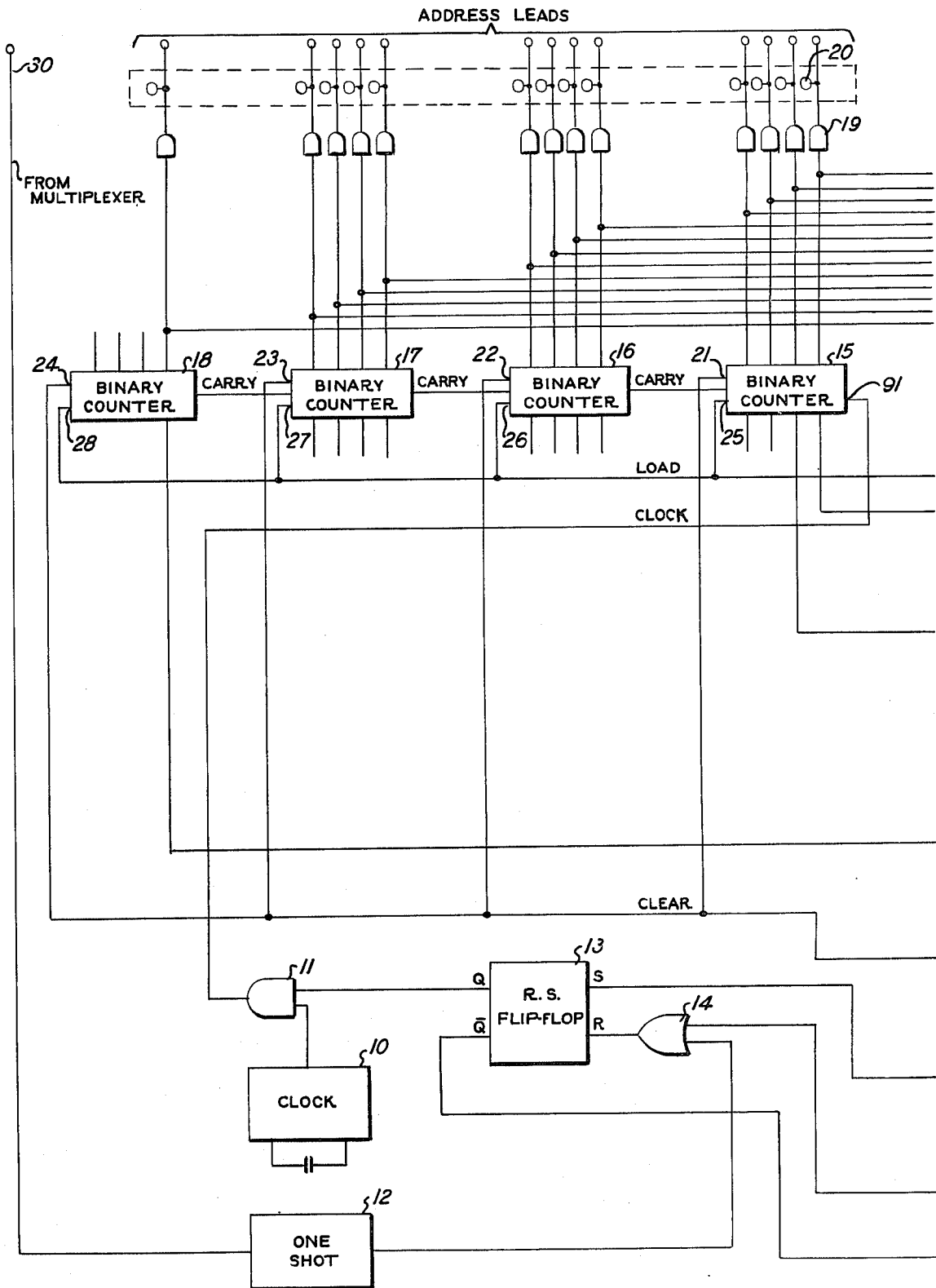
[57] **ABSTRACT**

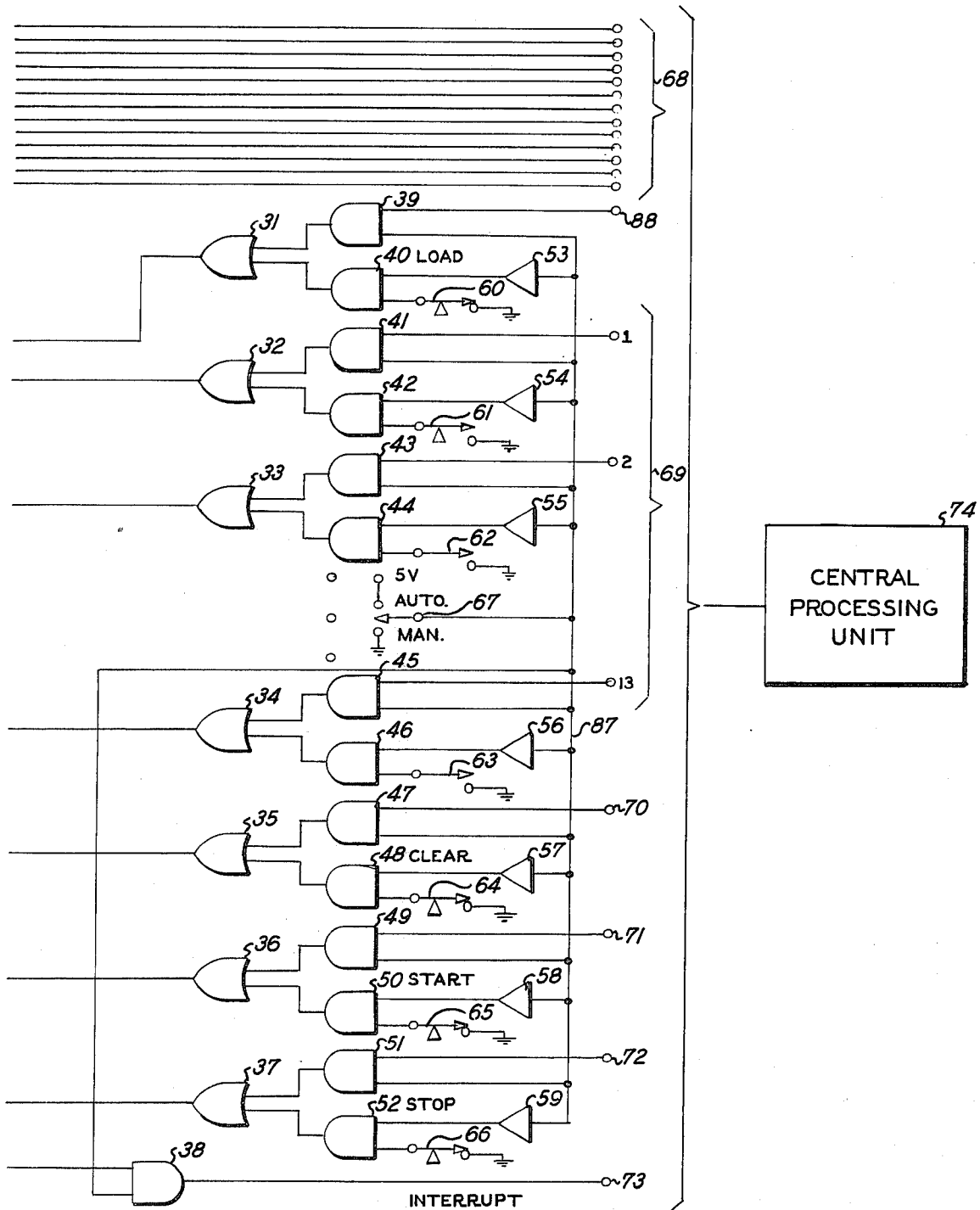
A high speed scanning system and method for scanning a matrix of alarm condition sensing means. A clock-fed counter means and decoder means automatically scan the matrix line by line. When a sensing means which has turned on due to the detection of an alarm condition is sensed the scanning means automatically stops scanning and a readout of the matrix position of the triggered alarm sensing means is provided. The scanning operation may be controlled in either an automatic mode by a central processing unit or in a manual mode by switches located on a control panel. The scanning operation may be stopped or started, the counters may be cleared or loaded and the current scanned matrix position may be read out.

10 Claims, 3 Drawing Figures









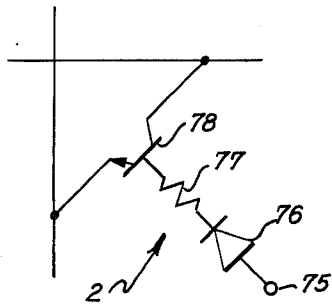


FIG. 3

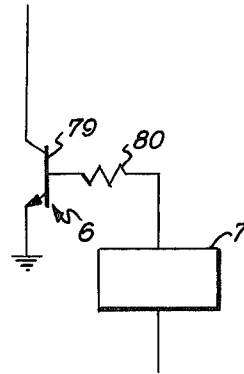


FIG. 4

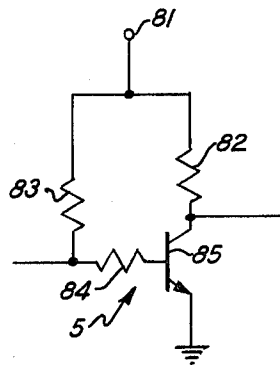


FIG. 5

ALARM SCANNER APPARATUS AND METHOD

BRIEF DESCRIPTION OF THE INVENTION

This invention relates to an improved selectable speed matrix scanning system and method.

The scanning system of the invention finds special application in the high speed scanning of alarm sensors which is necessary in modern alarm monitoring installations. Such installations are frequently called upon to continuously monitor large numbers of remotely located alarm sensors. For instance in a large complex of buildings or in a subway system there may be a large number of alarm sensors for sensing different alarm conditions located remotely from each other. According to the invention a high speed scanning system for providing a continuous indication of the states of all of the alarm sensors is provided.

It is thus an object of the invention to provide a selectable speed, high speed matrix scanning system and method.

It is a further object of the invention to provide a system for the continuous monitoring of the states of a large number of remotely located alarm sensors.

According to the invention a matrix of alarm sensing means is provided which means change state when an alarm condition is detected. Counting and decoding means are provided to sequentially scan the matrix in line by line fashion and a means for automatically stopping the scanning when an alarm condition is sensed and for reading out the address of the triggered sensing means is provided. An adjustable clock feeds clock pulses to the counting means and the scanning speed may be controlled by adjusting the frequency of the clock.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention may be had by referring to the following drawings in which:

FIG. 1 is a drawing of the scanner matrix and the horizontal and vertical decoders.

FIGS. 2 and 2A comprise a diagram of the control logic for controlling the scanning of the matrix.

FIG. 3 is one embodiment of block 2 of FIG. 1.

FIG. 4 is a schematic diagram of block 6 of FIG. 1.

FIG. 5 is a schematic diagram of block 5 of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

A matrix 1 shown in FIG. 1 is comprised of vertical busses 3 and horizontal busses 4 and plurality of alarm sensing means 2 the number of which corresponds to the number of cross-over points of the matrix.

One embodiment of the alarm sensing means 2 is shown in greater detail in FIG. 3 and are seen to comprise base-driven transistor switches. Thus, referring to FIG. 3, the emitter of transistor 78 is connected to a vertical while the collector of the transistor is connected to a horizontal. The base of the transistor is connected to terminal 75 through diode 76 and resistor 77. Each terminal 75 of the matrix is connected to a source of voltage which is switched on when an alarm condition is detected. Thus each terminal 75 would be connected to an alarm sensor which for instance could be a thermistor, photocell, etc. and the plurality of alarm sensors could for instance all be at remote locations. The alarm sensors would be connected in known circuit arrangements so that when an alarm condition was detected a voltage would appear at terminal 75 thereby

turning transistor 78 on and connecting together the horizontal and vertical between which the transistor is connected.

In an alternative embodiment block 2 may comprise a phototransistor/light emitting diode combination wherein the emitter and collector of the phototransistor would be connected as shown in FIG. 3. The base of the phototransistor would be driven by a light emitting diode which would be connected in known circuit arrangement with an alarm sensor so that the light emitting diode is energized when an alarm condition is present which is effective to turn the phototransistor on thereby connecting together the horizontal and vertical to which it is connected. The advantage of this embodiment is that superior electrical isolation is achieved between the alarm sensor and the phototransistor.

SCANNING THE MATRIX

The matrix is scanned to determine the conditions of the various alarm sensing means by selecting each vertical element of the matrix in turn and for each vertical element sequentially stepping through each of the horizontal elements before the next vertical element is selected. Of course in the alternative the vertical elements could be stepped through while each horizontal element is selected and scanning can proceed either in the right-left, left-right, down-up or up-down directions. Each vertical element is connected to an isolation transistor unit 6 shown in schematic diagram form in FIG. 4. In FIG. 4 it is seen that the collector of transistor 79 is connected to the vertical element while the emitter thereof is connected to ground. A particular vertical element is selected by driving the base of transistor 79 through buffer 7 and resistor 80 thereby turning the transistor on and connecting the vertical element to ground. The horizontal elements are selected through horizontal isolation transistor unit 5 shown in greater detail in FIG. 5. Isolation transistor unit 5 is comprised of transistor 85 the emitter of which is connected to ground and the base of which is connected to resistors 83 and 84, the collector being connected to resistor 82. Terminal 81 is connected to a source of positive voltage as shown in FIG. 1.

The horizontal elements are selected by multiplexer 9 which in turn connects each of the conductors 86 to multiplexer output line 30. A change in voltage on line 30 will occur when a row-column cross-over point is scanned having a turned on alarm condition sensing transistor connected therebetween. This is because the selected column of the selected row-column combination will be connected to ground through isolation transistor unit 6. Further the selected column element will be connected to the selected row element through switch means 2 meaning that base resistor 84 of the selected row will be connected to ground thereby changing the voltage at the collector of transistor 85 which change in voltage is fed to multiplexer output line 30. Hence, each time a scanned alarm sensing means is in the on condition a change in voltage will occur on output line 30. While in the embodiment shown the change is an increase in voltage which causes the reset input of flip flop 13 to go high the system would also be designed so that the change in voltage on line 30 indicating an alarm condition is a fall in voltage.

In a preferred embodiment of the invention 16 horizontals are used and up to 512 verticals, resulting in 8,192 scanning points. Preferably, the busses are ar-

ranged on matrix cards and the matrix is expanded by adding cards. As is apparent to those skilled in the art, any number of horizontal or vertical elements may be used and the invention is not limited to the numbers mentioned above.

THE CLOCK AND ADDRESSING SYSTEM

Referring to FIGS. 2 and 2A., clock 10 is employed which may be an astable multivibrator or other free-running clock as known to those skilled in the art. The clock rate of clock 10 will determine the scanning speed of the system and the rate may be adjusted as appropriate for a given system. The output of clock 10 is fed to AND gate 11 the other input of which is the set output of set-reset flip flop 13. When the scanning operation is in progress the set output of flip flop 13 is high and gate 11 will gate the clock output pulses of clock 10 through to the input 91 of binary counter 15. Binary counters 15, 16, 17, and 18 are arranged in a cascade as shown to provide the address counts for vertical and horizontal decoders 8 and 9. The address signals are connected through buffer 19 to the decoders and the rightmost group of address leads in FIG. 2 corresponds to the topmost group of leads shown in FIG. 1 and so on for the other groups of leads. Each address lead is connected to an illumination device 20 such as for instance a light-emitting diode which would be located on a maintenance panel. The four bits fed to horizontal decoder 9 can carry 16 counters to the decoder corresponding to the 16 horizontal elements 4 shown in FIG. 1 while the 9 bits fed to vertical decoder 8 can carry 512 counts. Thus if all counts are utilized the illustrated system can scan a matrix of 512 X 16 or 8,192 scanning points.

The horizontal decoder 9 decodes the 16 counts on the 4 lines fed to it and for each of the counts connects one of 16 lines 86 to multiplexer output line 30. For instance unit 9 may comprise a decoder having sixteen output lines in combination with a multiplexer which may be comprised of sixteen normally closed transistor switches connecting each of the lines 86 to line 30. Each of the decoder outputs would be connected to switch on a different of the transistors in succession so that each of lines 86 would be successively connected to output line 30. The vertical decoder 8 can have up to 512 output lines and decodes the signals appearing on the 9 lines inputted thereto to sequentially activate a new vertical element every 16 counts. Each vertical column is thus selected in succession and held for 16 counts during which time the 16 horizontals are scanned. The count rate is determined by the output frequency of clock 10 and scanning system is free running.

The scanner will continue to automatically scan the matrix column by column in a free running fashion until an alarm sensing means 2 in the on state is detected at which time a signal will appear on multiplexer output line 30 which signal is fed through one-shot multivibrator 12 on OR gate 14 to the reset input of flip flop 13. This will cause the reset output of flip flop 13 to go high and the set output to go low thus causing gate 11 to inhibit the clock signals applied thereto from clock 10 and causing the scanning operation to stop at the matrix position of the turned on alarm sensing means.

AUTOMATIC OR MANUAL MODE

The scanning system of the invention may be operated in either an automatic mode or in a manual mode, which would customarily be used for testing or maintenance. The switches 60 to 66 and the illumination means 20 are located on a control panel and would be utilized in the manual mode. In the automatic mode a central processing unit 74 which may comprise a mini-computer would be used. The central processing unit provides routine stop, start, sample, etc. commands to the scanning system and the programming of these commands is within the skill of one in the art. In FIG. 2A terminals 68, 69, 70 to 73 and 88 are interfaced with central processing unit 74.

When the processing unit 74 is controlling operation of the system, switch 67 is switched to the automatic position which is tied to a voltage of 5 volts. This voltage is connected by line 87 as one of the inputs to AND gates 39, 41, 43, 45, 47, 49, 51, and also 38. Hence when the reset output of flip flop 13 goes high in response to the detection of an alarm condition the signal is gated through gate 38 and is applied at terminal 73 to the interrupt input of central processing unit 74. Processing unit 74 then issues a command to sample lines 68 which is connected to the output of binary counters 15, 16, 17 and 18 to determine the matrix position of the turned on alarm sensing means. Thus when the processing unit is interrupted it reads the 13 bit address which is frozen on lines 68, stores the address and sends back a start command at terminal 71, which command is fed through OR gate 36 to set flip flop 13 once again and again allow the clock pulses to pass through gate 11 to resume the counting and the scanning of the matrix where it left off.

The free-running scan continues until another alarm condition is found or until the end of the matrix is encountered. The decoder address for the last column is set as an alarm condition by applying a positive voltage to the highest horizontal level on the last vertical row, assuming a down to up direction of scanning. When the end of scan alarm point is noted by the central processing unit it provides a clear command signal at terminal 70 which is fed to clear inputs 21, 22, 23, and 24 of counters 15, 16, 17, and 18 respectively to clear the counters and return the scanner to its initial position, the alarm sensing means of which is wired permanently off so the position serves as a rest position. The processor may then perform an independent check to determine if any alarms have cleared during the previous scan. When the check is complete the processor provides a start command at input terminal 71 which is applied through OR gate 36 to set flip flop 13 and begin the clock running and the counters counting again. When the central processing unit requests the condition of a particular point in the matrix a command signal is inputted at terminal 72 to reset flip flop 13 and stop the scanner, the current address is read at terminals 68 and the address to be selected is transferred to the counter by inputting a command signal to terminal 88 which is fed to load inputs 25, 26, 27, and 28 of counters 15, 16, 17, and 18 respectively to allow the counters to be parallel loaded. The proper number to be loaded into the counters is determined on the basis of the desired address and the current address read from terminals 68 and this number is loaded into the 13 parallel load input of the counter by appropriate activa-

tion of input terminals 1 through 13 of terminal group 69 which performs a parallel load of the 13 bit counter causing selection of the desired scanning point.

Manual operation of the scanning system is effected by switching switch 67 to the manual position which ties the switch to ground. The other end of the switch is connected to line 87, which is connected to AND gates 40, 42, 44, 46, 48, 50, and 52 through invertors 53 to 59 respectively. Hence appropriate manual closure of switches 60 to 66 is effective to start, stop, clear or load the system in the same manner as described in conjunction with automatic operation and illumination means 20 at all times visually indicate the matrix point being scanned.

While we have disclosed and described the preferred embodiments of our invention, we wish it understood that we do not intend to be restricted solely thereto, but that we do intend to include all embodiments thereof which would be apparent to one skilled in the art and which come within the spirit and scope of our invention.

We claim:

1. Apparatus for detecting the presence of alarm conditions comprising a matrix of alarm sensing means which change state when an alarm condition is sensed, said matrix comprising a set of horizontal conducting elements and a set of vertical conducting elements, said alarm sensing means corresponding to each cross-over point of said elements, each of said sensing means corresponding to a matrix crosspoint including switch means connected between the horizontal and vertical elements which define matrix crosspoints, means, including counting means, for sequentially scanning said sensing means at each of said matrix crosspoints, means responsive to a scanned sensing means being in said changed state for stopping said scanning at the matrix crosspoint at which a change state occurs and providing a readout of the position in said matrix of said changed state sensing means, and means for starting said scanning again after said readout has occurred.

2. The apparatus of claim 1 further including means for stopping said scanning independently of the state of said sensing means and means for loading said counting means to cause the state of a desired sensing means to be detected.

3. The apparatus of claim 2 further including means for clearing said counting means.

4. The apparatus of claim 1 wherein said scanning means includes a multiplexer means connected to one of said sets of conducting elements for sequentially outputting signals indicative of the state of said sensing means, said means responsive to a scanned sensing means being in said changed state being responsive to the output of said multiplexer means, said means for scanning further including a clock means which is connected to activate said counter means, and said means for stopping including a switch means responsive to the output of said multiplexer means for stopping said clock means.

5. The apparatus of claim 1 further including a plurality of illumination means being connected to the outputs of said counting means to visually indicate the position of the sensing means being scanned.

6. The apparatus of claim 1 wherein said means for

scanning further includes horizontal and vertical decoder means, the inputs of which are connected to the outputs of said counting means, and the outputs of which are connected to said horizontal and vertical conducting elements respectively for effecting line by line scanning.

7. The apparatus of claim 5 wherein said readout is accomplished by sampling the outputs of said counting means.

8. A method of detecting which of the alarm condition sensing means of a row-column conductor matrix of said sensing means is in the alarm indicating state wherein said alarm condition sensing means are connected at row-column crosspoints of the matrix, there being one alarm condition sensing means at each crosspoint, comprising the steps of

sequentially scanning said sensing means in column by column fashion, each crosspoint of a given row being scanned in sequence,

stopping said sequential scanning when a sensing means in the alarm indicating state is detected, providing an indication of matrix crosspoint position when said sequential scanning is stopped, and starting said scanning again after said indication has been provided.

9. In a cross-point matrix system, apparatus for sampling individual cross point conditions of a plurality of cross points in a row-column matrix comprising,

1. a sensed condition output means,

2. automatic scanning means connected to said row-column matrix array for sequentially scanning said cross points and the conditions thereat from a starting cross point to an end cross point and terminating said scanning at any cross point at which a change signal condition from a given condition is present and connecting said any cross point to said sensed condition output means said automatic scanning means, including a multiplexer connected to receive signals from all conductors of one of the conductor axes of said row-column matrix and means for sequentially energizing the conductors in the other axes,

3. a manually actuated matrix cross point selection signalling means connected to said row-column matrix for

a. terminating the automatic scanning of said row-column matrix, and

b. generating a signal representing the manually selected cross point of said row-column matrix and connecting said cross point manually selected to said sensed condition change output means, and

4. a remotely actuated automatic matrix cross point selection signalling means connected to said row-column matrix for

a. terminating the automatic scanning of said row-column matrix, and

b. generating a signal representing the remotely selected cross point of said row-column matrix and connecting said remotely selected cross point to said sensed condition change output means.

10. The apparatus of claim 1 wherein said solid-state switch means comprises a phototransistor.

* * * * *