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Smith

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[54] **SOLID STATE CONTROL AND DISPLAY BOARD**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy,** Washington, D.C.

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[52] **U.S. Cl.** **340/225;** 340/378; 340/381

[51] **Int. Cl.**[2].. **G08B 5/22;** H04N 3/14; H04Q 1/00; G09F 9/14

[58] **Field of Search**..... 340/150, 151, 147 R, 409, 340/225, 147 P, 225, 324, 378, 381, 149 R

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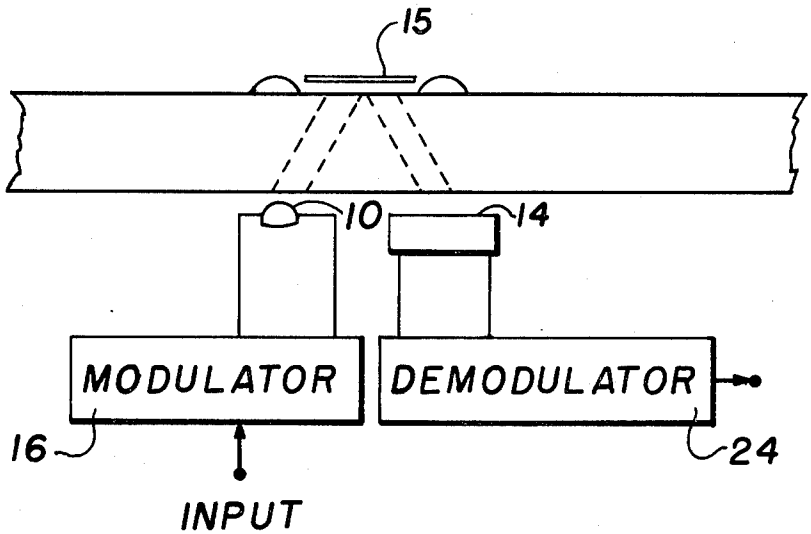
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[57] **ABSTRACT**

A solid state control and display board wherein a total configuration of connected elements is shown together with switchable connections with semiconductor light emitting elements used to generate switching command signals, display opened and closed circuits and provide output signals.

1 Claim, 4 Drawing Figures



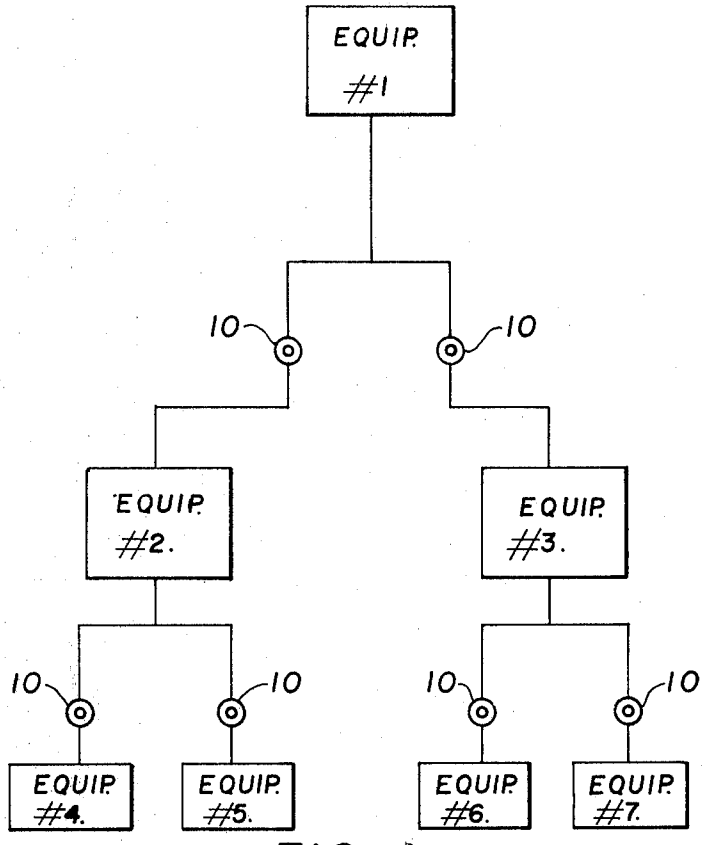

EQUIP. #1
10
10
EQUIP. #2.
EQUIP. #3.
10
10
10
10
EQUIP. #4.
EQUIP. #5.
EQUIP. #6.
EQUIP. #7.

FIG. 1

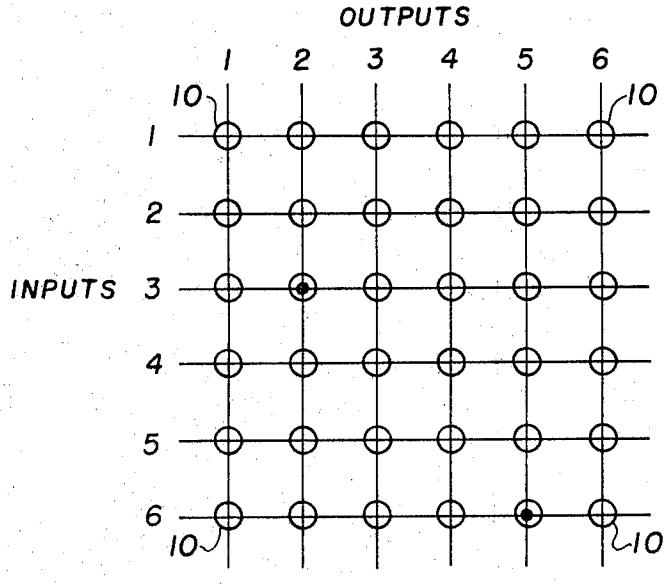

OUTPUTS
1 2 3 4 5 6
10
10
INPUTS
1
2
3
4
5
6
10
10

FIG. 2

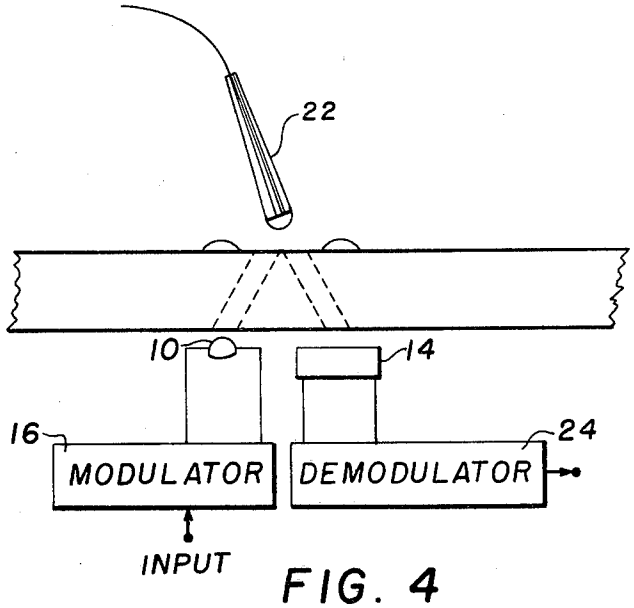

22
10
14
16
24
MODULATOR
DEMODULATOR
INPUT

FIG. 4

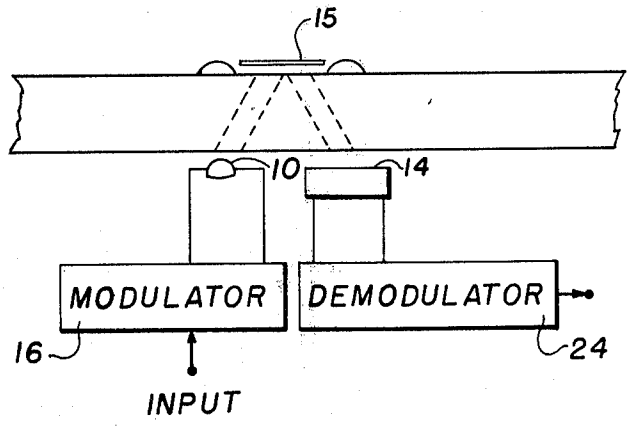

15
10
14
MODULATOR
DEMODULATOR
16
24
INPUT

FIG. 3

SOLID STATE CONTROL AND DISPLAY BOARD

BACKGROUND OF THE INVENTION

Many systems currently in use for control and monitoring of communications networks and data switching employ a cathode ray tube display, either of alpha numeric or alpha graphic, along with fairly complicated computer, memory and peripheral systems. In addition, frequently there is a requirement for investments in complex computer programs. There are drawbacks of cost, equipment complexity, problems of maintenance, and need for operator training in order to use this type of system effectively. In addition to the problems of complexity and associated cost, where the cathode ray tube type system is used, there are other shortcomings related to operator usage. For example, in configuring connections of equipments and connections of data, communications and monitoring channels, the physical size of the cathode ray tube display surface often restricts the view of the user to only a portion of the system he is concerned with. From the standpoint of human interface it is desirable that his view of the switching and configuration options and those already exercised not be so limited. It is also desirable that monitoring and control functions be closely related for convenient and efficient use by the operator. A typical operation employing a cathode ray tube system involves action by the user through keyset action to call up and exercise control action, with related display, of a comparatively small number of items, which along with many others form the total configuration or system, with which he must deal. In many instances it is difficult for the operator to maintain perspective on the total system while working with only a portion.

SUMMARY OF THE INVENTION

The present invention provides a highly reliable and versatile control and display board for control and display of communications switching, data transfer switching, and data sampling for monitor and test of operating systems. The present invention also provides for a continuous display of a total configuration with closely related control capabilities for convenient use by an operator. The present invention makes use of light-emitting diodes or devices with similar performance characteristics, with a suitably matched light detector, which provides the means for controlling and monitoring the configured system. Advantages and new features of the invention are those of providing a continuous display of a total system configuration along with a simplified means of providing control for switching options by use of the same indicator mechanisms as are employed for indicating status of the switch options. One of the advantages is the elimination of the cathode ray tube display and associated complexities of equipment and operation as a requirement for providing the display in associated control. In the present invention the user sees before him a total graphic display showing switch positions and monitor test points. By actuating these indicators the user is able to make and exercise his decisions regarding operation of the system directly in terms of the total system picture and status indicators he sees before him. In addition, another feature of the invention permits transfer of information by one or more users of the graphic display, utilizing either voice or data communications transfered without addition of wires or switches from the indicators themselves

on the display. This results in efficiency and simplicity of the operation, economy of fabrication, freedom from the unreliability of a large number of switches of usual type and improved ability on the part of the human user to formulate and exercise his decisions relating to a part of a system while maintaining perspective regarding the entire system. This capability to display an entire system permits exercise of decisions and readout of information keyed to these decision points, without the complexities or size limitations of alternative systems is an important feature of the invention. The reliability attendant to the absence of multicontact control buttons and switches is another important feature of the invention.

OBJECTS OF THE INVENTION

Accordingly an object of the invention is the provision of a system and supporting sub-system to provide a total configuration and switch connection display along with the related means of controlling and monitoring that configuration.

Another object of the invention is a provision of a total configuration of switch connection display wherein control and monitoring is provided by means of solid state light emitting means and matched light detectors.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing a typical representation of two system blocks which provide for operator choice of various switching options.

FIG. **2** shows a combination display and control panel with light emitting diodes to indicate closed or open switch connections or data sampling points.

FIG. **3** is a section of panel showing the wire-free switching arrangement.

FIG. **4** shows a section of the panel using a non-reflective light sensitive probe for information signal pickup.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is assumed that this invention will be used in conjunction with suitable logic circuitry or a minicomputer with appropriate programming and interfaces to accomplish the types of electronic action described in the description which follows. All of these control, driving, and logic decision actions are typical of those in use in logic and computer-type systems.

Referring now to FIG. **1** wherein there is shown a number of equipments that can be optionally connected or disconnected. Equipment No. **1** may be connected to equipment No. **2** or equipment No. **3.** Light emitting diode indicators **10** indicate the closure or non-closure of the interconnection between the various equipments.

The embodiment of FIG. **2** shows by way of example, an arrangement where diodes **10** are positioned in a grid or switch matrix.

There are three modes of interrelated capabilities in practicing the invention. These are interrogation, control and readout. When it is desired to ascertain or con-

trol the status of the system in the interrogation mode, light emitting diodes **10** are scanned in sequence and pulsed with short pulses from a source not shown. In this mode the diode indicators **10** are caused to light, but with pulses so short and infrequent that to the human observer they do not appear illuminated. There are short bursts of light emitted from each in turn, however in predetermined slots of time, which if detected by a photo transistor or similar device and associated circuitry, can produce an initiating trigger signal identifying the particular switch or signal sampling point on the graphic display (FIGS. **1** and **3**) with which the time period is associated.

A light pen incorporating a light sensitive device pointed at the switch indicator can be used to initiate a trigger for this purpose. An alternative device to the light pen with its associated light sensitive device and attendant electrical connection is shown in FIG. **3**. The light from the light emitting diode **10** is reflected back to a light sensitive detector **14** such as a photocell. Diode **10** and detector **14** should be mounted in the panel in such a manner that light cannot go directly from light source **10** as shown in FIG. **3** to the light detector **14** but can be reflected by a reflective probe or the finger **15** of an operator without the need for active circuitry in the designating device. An advantage of this approach is that no electrical contacts or moving mechanical parts are required for designation. When used in conjunction with a function keyset, the operator would tell the system what function is to be performed relating to the switch point or test point designated. For example, closed circuit, open circuit, inject stimulus, read stimulus etc.

In the second mode of the invention following designation of a switch closing by the operator, light emitting diodes **10** (or devices with similar light emitting response and fast operating characteristics) corresponding to circuits closed in the graphic display will be pulsed or turned on by means of modular **16** or other suitable means during the period or periods when the light-emitting diodes are not being pulsed selectively. To accomplish these two modes of operation optionally it is important to note that the light emitting devices used must have pulsed characteristics such that the following conditions hold: (1) short pulses at relatively infrequent intervals will not be visible to the observer during times when the light emitters are used only for interrogation and designation purposes; for example, short pulses of relatively low intensity of a few microseconds duration occurring every second will not be visible, (2) pulsing of the light emitter indicating a circuit closure or sampling point, at a sufficiently high frequency with sufficient intensity, by turning on the light emitter during the portion of a complete cycle not used for interrogation or designating purposes.

In other words a basic concept of the invention is that the light emitters are pulsed suitably for non-visibility during interrogation period and pulsed or turned on suitably for visibility as appropriate in the information period during the non-interrogation portion of the cycle.

It is important to note that in addition to their desirable response characteristics there is another characteristic of the light-emitting diode which causes them to be particularly useful in the invention. This is the diode nature of the device, which permits prevention of "sneak" circuits without use of additional diodes specifically added for this purpose; in other words, both the light source and the diode isolation are available in the same device.

The present invention also makes use of an additional third mode of operation permitting readout of information fed to respective light emitting diodes during a time shared period, shared with mode one and with mode two described above but independent of the mode one and mode two pulses. If during periods when a light emitter is not pulsed with mode **1** or mode **2** pulses it is pulsed or modulated with information-related signals (either digital or voice, for example) this mode of operation shown in FIG. **4** permits recovery of this information by use of a suitable light sensitive detector, related circuitry and readout equipment. For example, if light emitter **20** is modulated with voice type signals by means of modulator **16** during this time sharing mode, light detector probe **22** and demodulator circuitry (not shown) in conjunction with headset or loudspeaker will permit the operator to monitor traffic flowing at a given point in the graphic display. Light detector probe **22** would be placed over the light emitter as shown in FIG. **4**.

Similarly a small digital or alpha numeric readout probe can be employed if the light emitter **10** is fed with appropriate digital type information. It is required, of course, that the demodulator be properly triggered or synchronized to respond to the information coded modulation or pulses. This feature of the invention, assuming that the desired information is fed to the appropriate light emitter, permits one or several operators to retrieve information from a large control and display board without use of pushbuttons or mutual interference between users. Thus overall status display of the large system along with control of switching or other options is provided together with switch-free monitoring and readout of activity or data associated with any display point. In terms of state of the art devices available a response time of 1 microsecond for matched light source and light detector is feasible.

If an interrogation response time is assumed as 1 second to avoid response-delay annoyance to the user this assumption will establish the basic cycle time as 1 second, composed of 1,000,000 possible time slots which can be used for purposes related to mode **1**, mode **2**, or mode **3** operation. For interrogation purposes, if 1,000 items as a maximum are to be identified, 1,000 microseconds must be allotted for this purpose. For display of the light source to be sufficiently bright and free from flicker as viewed by the human observer the source must be pulsed at least 60 times a second (assuming the pulses are distributed throughout the time period). Because of practical peak current considerations affecting the apparent brightness, it is likely that more than 60 pulses per second (of 1 microsecond duration) should be allotted for this purpose. If arbitrarily one-half second total time per cycle is allocated for interrogation and the apparent steady-state light-on indication, this will leave 500,000 pulse slots per second for information purposes. This is a sufficiently high frequency if the pulses are distributed throughout the 1 second cycle time to permit either voice or data coding and demodulation by a number of conventional methods.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within

the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. In a control and display board for the control and display of communication switching, data transfer switching, data sampling for monitor test of operating systems and the like; the combination comprising:

a. a plurality of display points,

b. light emitting diode means associated with each of said display points for indicating the status of switch, connections associated, respectively, with each of said display points,

c. modulator means coupled to said each of said light emitting diodes for modulating said diode with an input signal,

d. light sensitive detector means associated with said light emitting diode means for sensing the modulated light signal emitted by said light emitting diode means,

e. movable light reflecting means associated with said display points for reflecting light emitted by said light emitting diode means to said light sensitive means when positioned to cover one of said display points,

f. demodulator means connected to said light sensitive detector means for providing an output signal when said display point is covered by said reflecting means.

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