United States Patent [19]

Clark

[11] **3,774,158**

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[54] **MULTIPLE TERMINAL DISPLAY SYSTEM**

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[73] Assignee: **RCA Corporation**, New York, N.Y.

[22] Filed: **Jan. 6, 1972**

[21] Appl. No.: **215,817**

[52] **U.S. Cl.** ..... **340/172.5**, 340/324 A

[51] **Int. Cl.** **G06f 3/00**

[58] **Field of Search** ..... 340/172.5, 324 A

[56] **References Cited**

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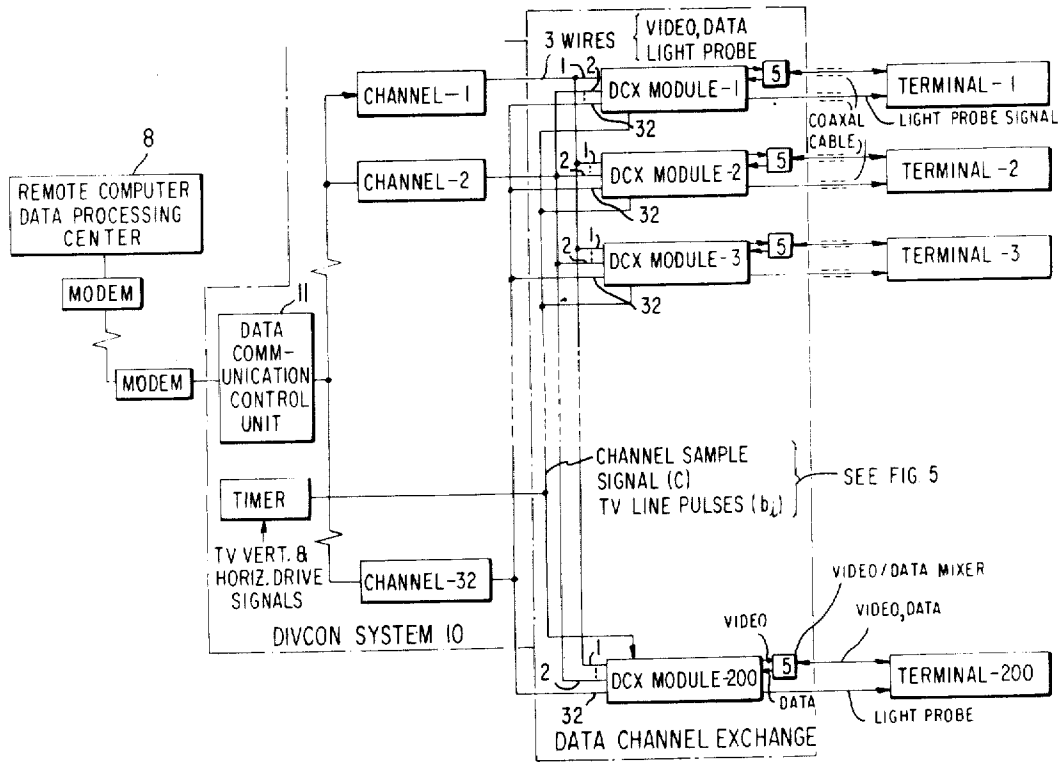
3,426,344	2/1969	Clark	340/324 A
3,544,965	1/1970	Packard	340/172.5
3,639,909	2/1972	Hauck et al.	340/172.5
3,618,035	11/1971	Simms, Jr.	340/172.5
3,641,558	2/1972	Cook et al.	340/172.5

Primary Examiner—Paul J. Henon
Assistant Examiner—John P. Vandenburg
Attorney—Edward J. Norton et al.

[57] **ABSTRACT**

Blocks of digital data representing different pictures are available at a remote data processing center for supply to the control channels of a DIVCON system. Each channel includes a refresh memory for storing a block of digital data and circuits for translating the stored data to a frame of video signals but there are substantially fewer channels than display terminals. In response to a request for service by a terminal, a data channel exchange hunts for a "not busy" control channel and when it finds one, connects the channel to the terminal. The terminal may then communicate with the remote data processing center both for receiving data via the channel's refresh memory for display on the terminal and for sending data to the remote data processing center also via the channel's refresh memory.

7 Claims, 7 Drawing Figures



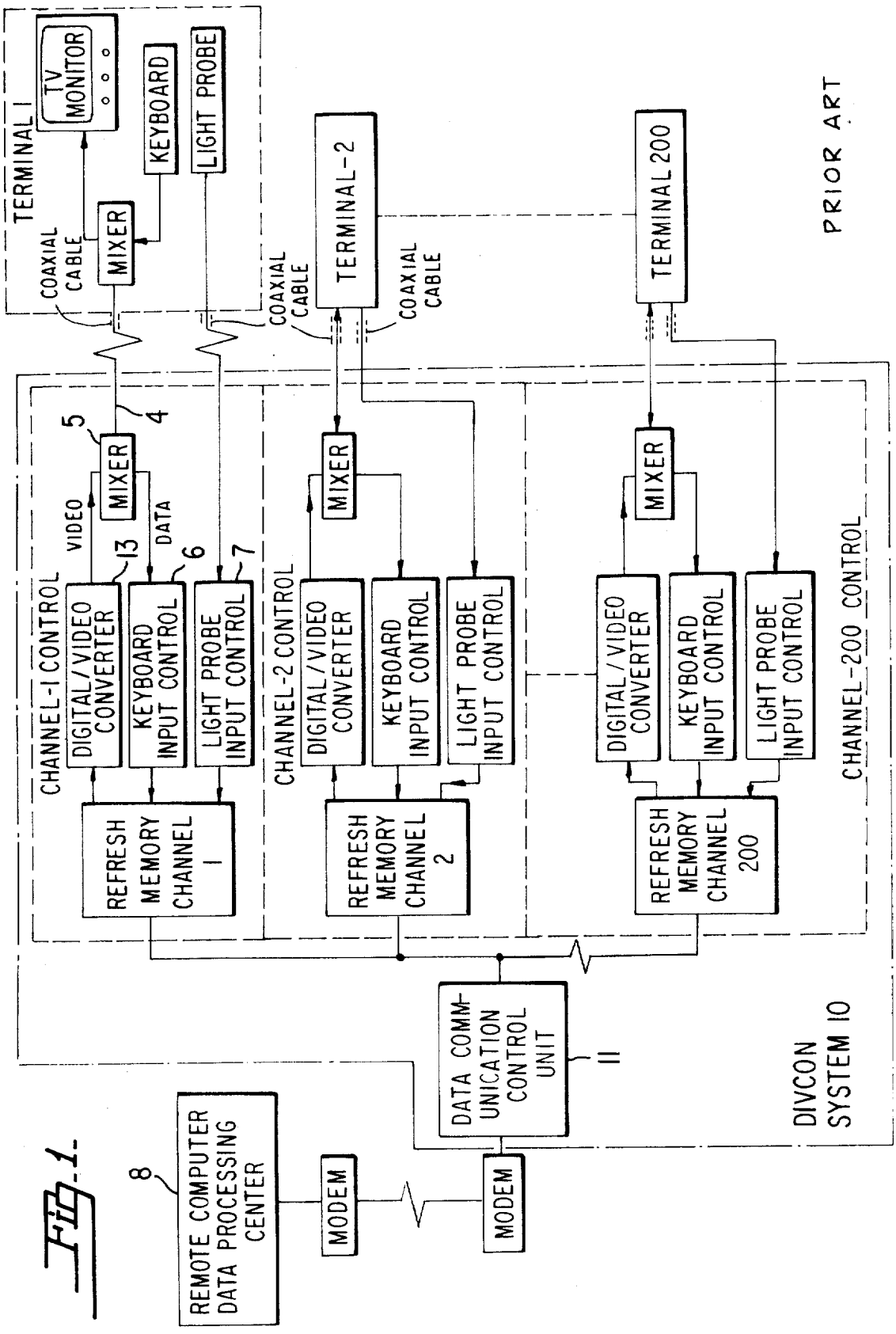

TERMINAL 1
TV MONITOR
KEYBOARD
LIGHT PROBE
MIXER
COAXIAL CABLE
TERMINAL-2
TERMINAL 200
PRIOR ART
CHANNEL-1 CONTROL
CHANNEL-2 CONTROL
CHANNEL-200 CONTROL
DIGITAL/VIDEO CONVERTER
KEYBOARD INPUT CONTROL
LIGHT PROBE INPUT CONTROL
VIDEO
DATA
REFRESH MEMORY CHANNEL 1
REFRESH MEMORY CHANNEL 2
REFRESH MEMORY CHANNEL 200
DATA COMMUNICATION CONTROL UNIT
DIVCON SYSTEM 10
REMOTE COMPUTER DATA PROCESSING CENTER
MODEM
4
5
6
7
8
11
13

Fig. 1.

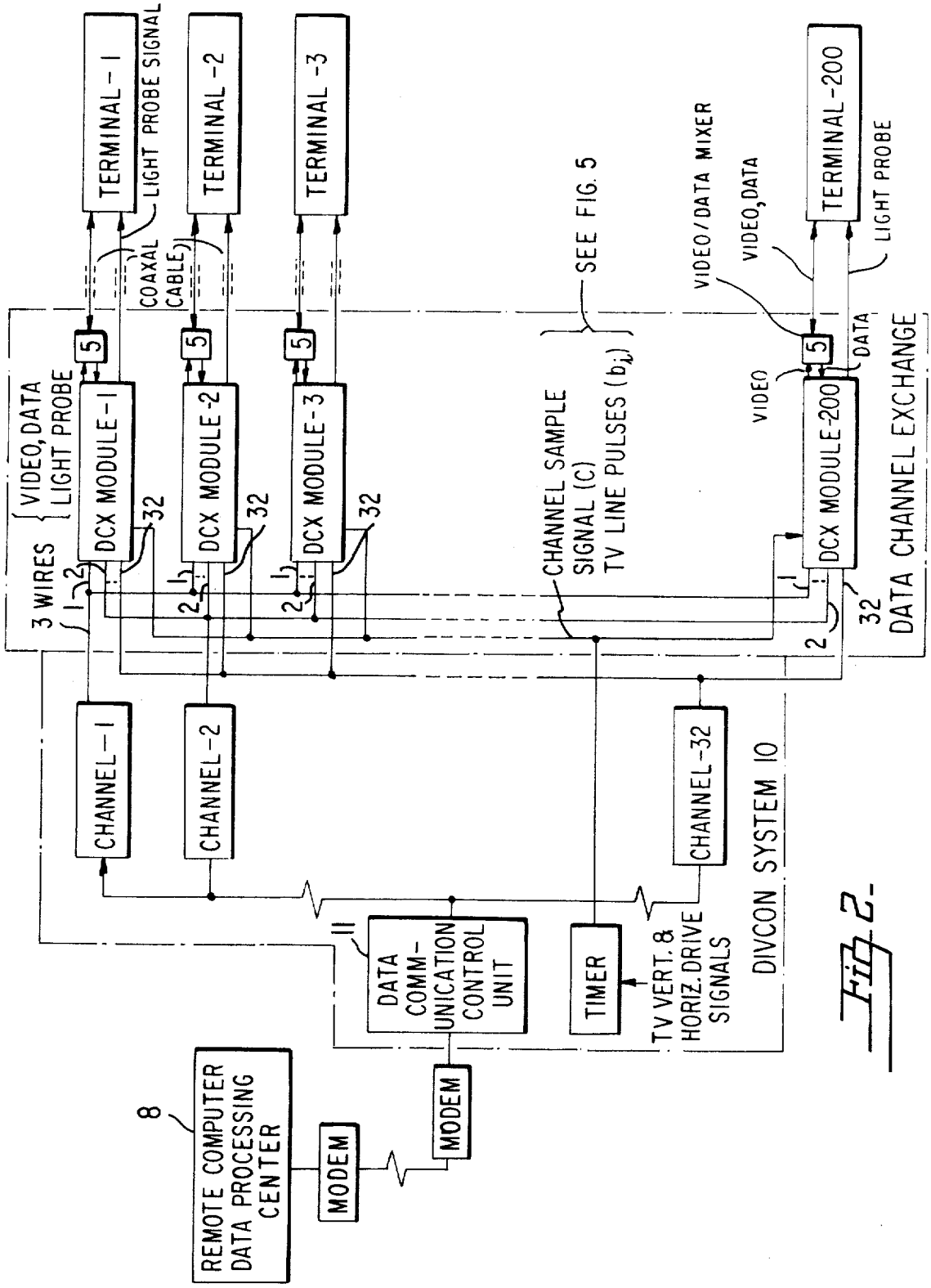

TERMINAL-1
TERMINAL-2
TERMINAL-3
TERMINAL-200
LIGHT PROBE SIGNAL
COAXAL CABLE
VIDEO, DATA
LIGHT PROBE
3 WIRES
DCX MODULE-1
DCX MODULE-2
DCX MODULE-3
DCX MODULE-200
32
SEE FIG. 5
CHANNEL SAMPLE SIGNAL (C)
TV LINE PULSES (b_i)
VIDEO/DATA MIXER
VIDEO, DATA
VIDEO
DATA
LIGHT PROBE
DATA CHANNEL EXCHANGE
CHANNEL-1
CHANNEL-2
CHANNEL-32
DATA COMM-UNICATION CONTROL UNIT
TIMER
TV VERT. & HORIZ. DRIVE SIGNALS
DIVCON SYSTEM 10
MODEM
MODEM
REMOTE COMPUTER DATA PROCESSING CENTER
8

Fig. 2

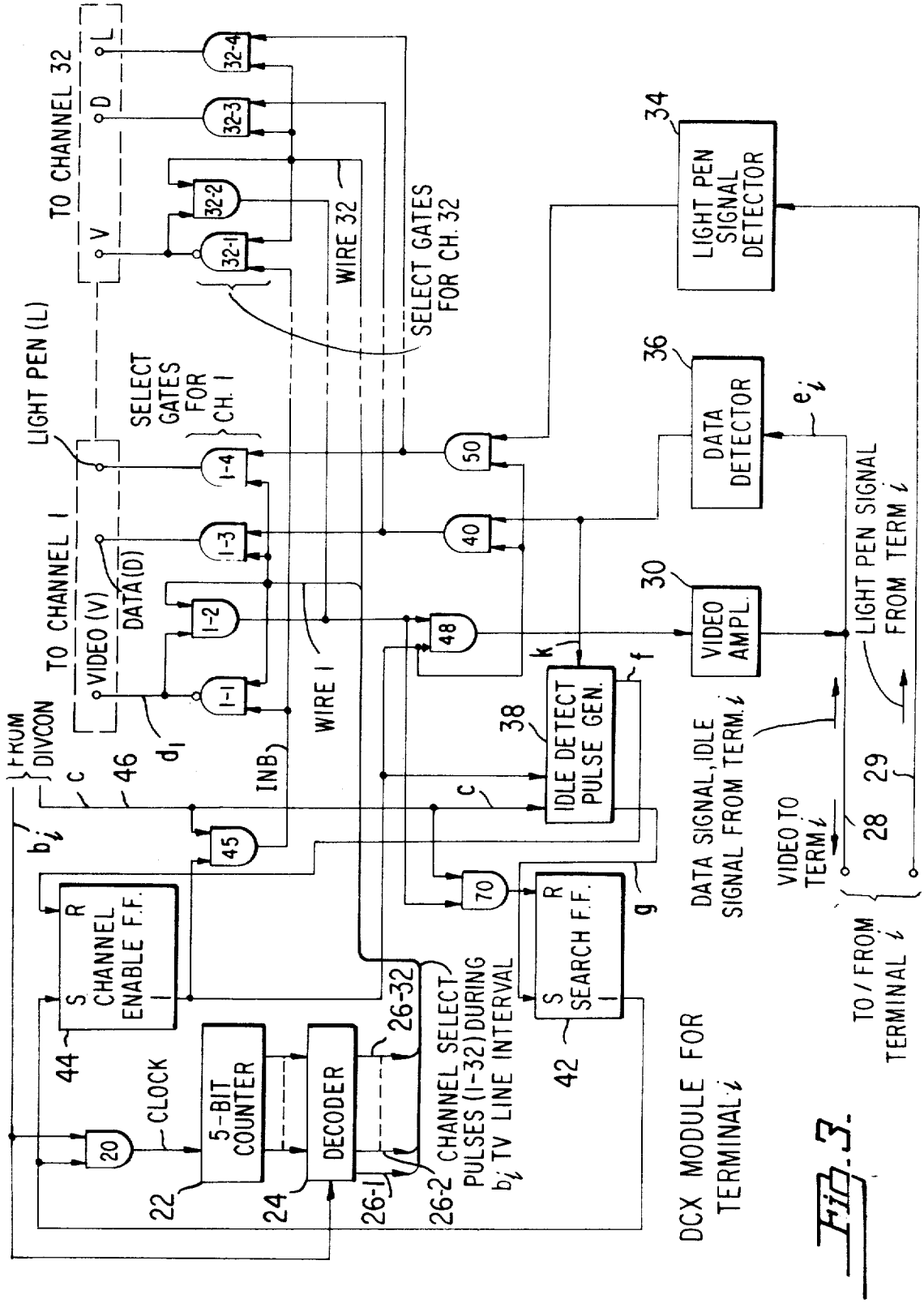

FROM DIVCON
LIGHT PEN (L)
TO CHANNEL 1
VIDEO (V)
DATA (D)
TO CHANNEL 32
SELECT GATES FOR CH. 1
SELECT GATES FOR CH. 32
WIRE 1
WIRE 32
INB
CLOCK
5-BIT COUNTER
DECODER
CHANNEL ENABLE F.F.
SEARCH F.F.
IDLE DETECT PULSE GEN.
CHANNEL SELECT PULSES (1-32) DURING b_i TV LINE INTERVAL
DCX MODULE FOR TERMINAL i
LIGHT PEN SIGNAL DETECTOR
DATA DETECTOR
VIDEO AMPL.
DATA SIGNAL, IDLE SIGNAL FROM TERM. i
VIDEO TO TERM i
LIGHT PEN SIGNAL FROM TERM i
TO / FROM TERMINAL i

Fig. 3.

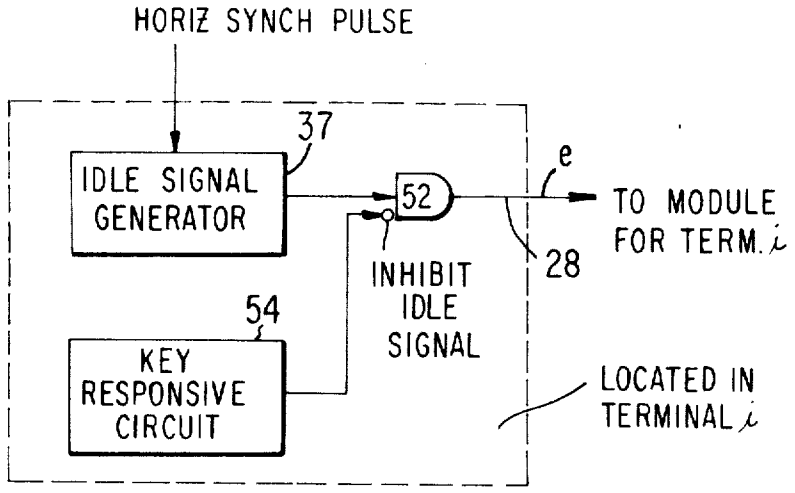

HORIZ SYNCH PULSE
37
IDLE SIGNAL GENERATOR
52
e
TO MODULE FOR TERM. i
28
INHIBIT IDLE SIGNAL
54
KEY RESPONSIVE CIRCUIT
LOCATED IN TERMINAL i

Fig. 4.

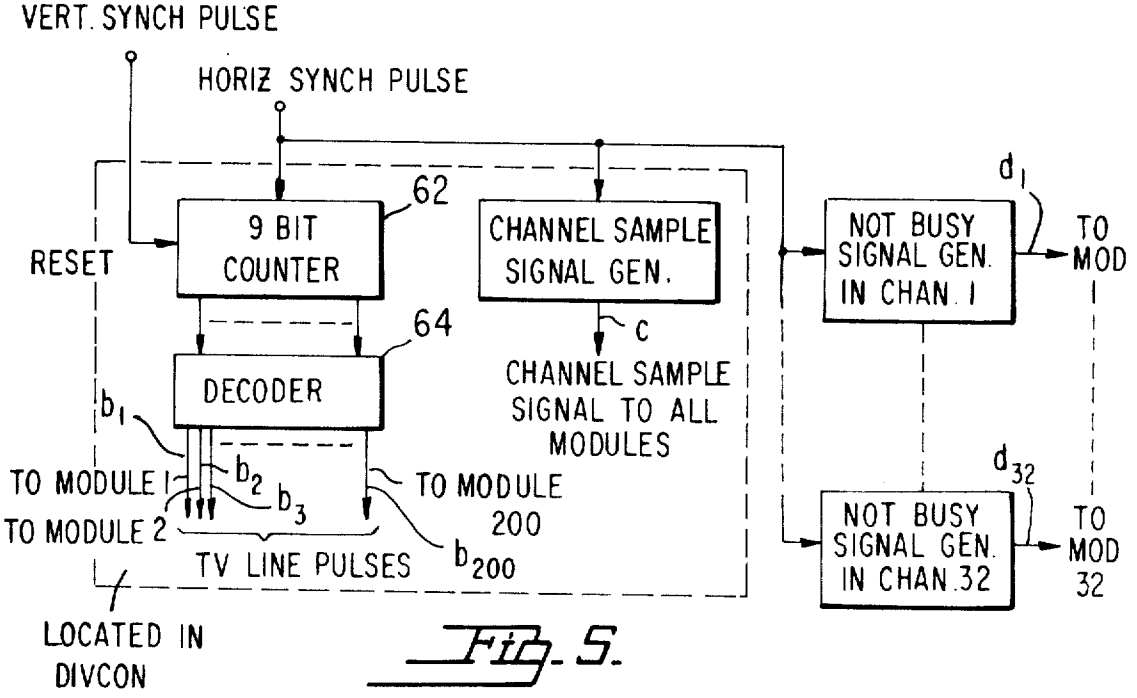

VERT. SYNCH PULSE
HORIZ SYNCH PULSE
RESET
9 BIT COUNTER
62
CHANNEL SAMPLE SIGNAL GEN.
64
DECODER
c
CHANNEL SAMPLE SIGNAL TO ALL MODULES
b1
TO MODULE 1
b2
b3
TO MODULE 2
TV LINE PULSES
TO MODULE 200
b200
LOCATED IN DIVCON
d1
NOT BUSY SIGNAL GEN. IN CHAN. 1
TO MOD
d32
NOT BUSY SIGNAL GEN. IN CHAN. 32
TO MOD 32

Fig. 5.

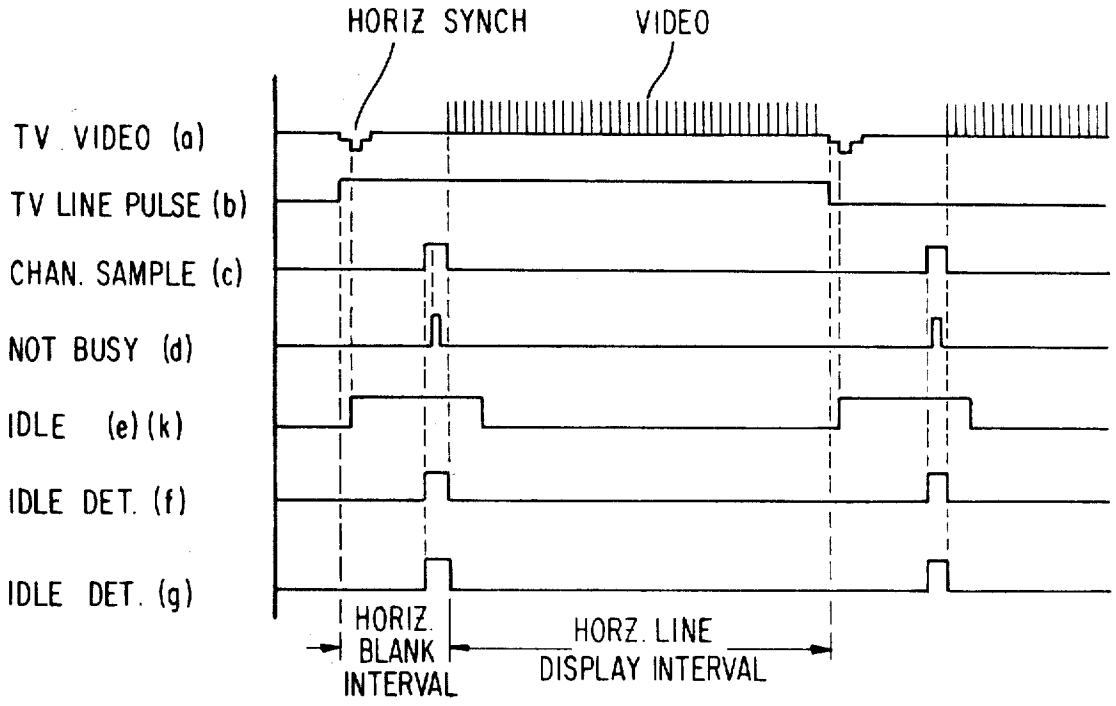

HORIZ SYNCH
VIDEO
TV VIDEO (a)
TV LINE PULSE (b)
CHAN. SAMPLE (c)
NOT BUSY (d)
IDLE (e) (k)
IDLE DET. (f)
IDLE DET. (g)
HORIZ. BLANK INTERVAL
HORZ. LINE DISPLAY INTERVAL

Fig. 6

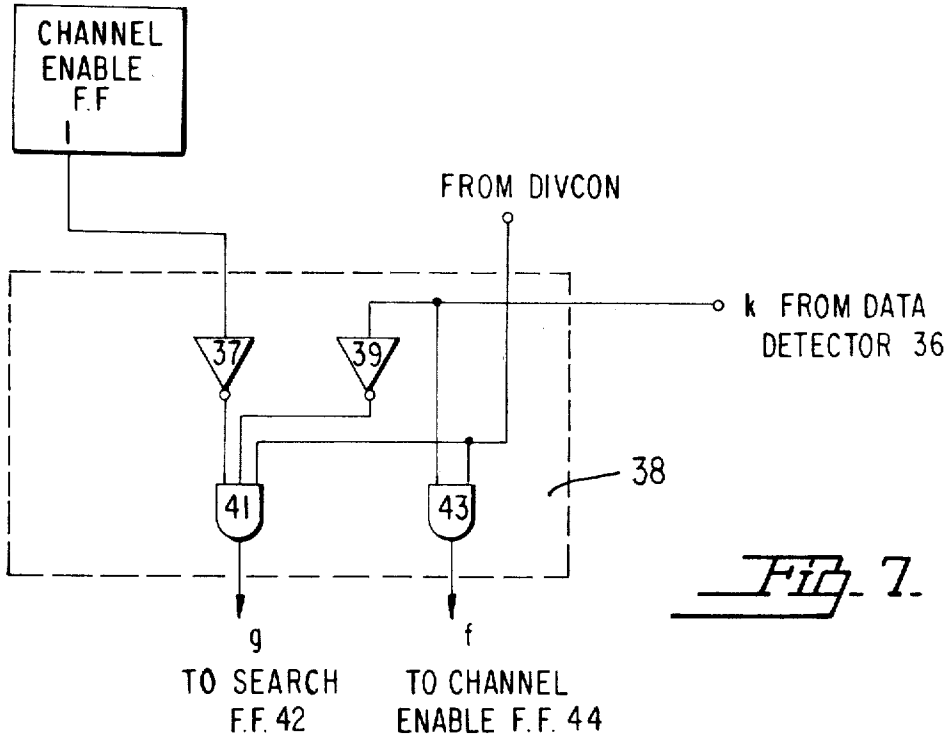

CHANNEL ENABLE F.F
1
FROM DIVCON
k FROM DATA DETECTOR 36
37
39
38
41
43
g
TO SEARCH F.F. 42
f
TO CHANNEL ENABLE F.F. 44

Fig. 7

MULTIPLE TERMINAL DISPLAY SYSTEM

BACKGROUND OF THE INVENTION

U.S. Pat. No. 3,426,344, issued Feb. 4, 1969 for "Character Generator for Simultaneous Display of Separate Character Patterns on a Plurality of Display Devices" by the present inventor and assigned to the same assignee as the present application, describes a multiple terminal display system. A typical such system, illustrated in FIG. 1 of the present application includes a digital data processing center **8** which comprises a digital computer, magnetic tapes, disks or other mass storage files, keyboards, and other peripheral equipment. The center transmits digital coded messages via control channels to the terminals and receives digital coded messages via these channels from the terminals. Each message - a block of digital data, corresponds to a page of television picture information.

A digital-to-video converter (DIVCON) **10**, connected to the computer by a telephone line, includes a plurality of channels, one per video terminal. Each channel includes a refresh memory for storing a computer originated digital coded message and a digital-to-video converter such as **13** for translating that message into a frame of video signals for display on its video terminal. The latter may include, for example, a television type monitor.

Each DIVCON refresh channel includes keyboard and light probe (sometimes known as "light pen") data input control logic circuits **6** and **7**, respectively, as shown in FIG. **1**. It is possible for the terminal operator to write information on the TV screen of his terminal by typing on his keyboard and having the keyboard control logic circuits **6** in the channel connected to his terminal write this data into the refresh memory of the same channel. It is also possible, using the light probe, to write check marks into questionnaires displayed on the TV screen and to select information indices displayed on the TV screen. In both cases this is accomplished by pressing the light probe against the face of the TV screen at the desired display position, as discussed shortly.

Two coaxial cables connect each terminal to a DIVCON channel as indicated in FIG. **1**. The TV video and keyboard data are multiplexed onto one cable by the mixers **5** in FIG. **1**, in well understood fashion, to save one cable per channel. The light probe position indicating signal, which may be produced in the manner described in U.S. Pat. No. 3,579,225, issued May 18, 1971, for "Light Probe for Persistent Screen Display System" to the present inventor, is transmitted on the second coaxial cable. It is also possible, as an alternative, to convert the light probe signal into X-Y position codes which can be transmitted with the keyboard data on the same cable **4** as the video signals. This would reduce the number of cables between each DIVCON channel and each terminal from two to one.

When a terminal operator desires to display information, the terminal is turned on and logic circuits in the terminal transmit a "Request for Index" code to the data communications control unit **11** shown in FIG. **1** via the control channel for that terminal. This code may be one which is permanently stored in the terminal and which is transmitted in response to the closing of a switch or the code may be transmitted in response to the depression of one or a combination of keys on the keyboard (other alternatives also are possible). The

data communications control unit **11**, which may be any one of a number of commercially available "mini computers," in turn, transmits an index request message to the data processing center **8**. In response to the index request message, the data processing center retrieves the index page from its mass storage files and transmits it to the required terminal.

The connections from the unit **11** to the various channels is typically via a multiple conductor cable, shown as a single line in FIG. **1**. In one system, by way of example, this cable may include from 34–37 lines; 8 for data in, 8 for data out, 10 for memory addresses, 5–8 for channel addresses, 1 for read/write control, 1 for cycle initiate, 1 for a data available indication. These are just representative as alternatives are available depending upon the machine and the particular installation.

The index page sent to a terminal may be a page of letters or a page of words, each letter or word identifying a different subject. The digital signals making up the index page are stored in the refresh memory in the channel for a terminal, and the corresponding video signals produced by the digital-to-video converter **13**, sometimes termed a character generator, in the same channel thereafter are repeatedly applied to that terminal for continuously refreshing the displayed information. In the case of a terminal having a cathode-ray tube type television raster display, as shown, the signals are read from the memory synchronously with the horizontal and vertical scanning of the electron beam, in well understood fashion.

Each terminal may include either push buttons or the like rather than a light probe for information selection, and also may include a keyboard and/or a printer (in FIG. **1**, terminal **1** is shown to include a keyboard, light probe and TV monitor, by way of example) although it is not essential that each terminal include all of this equipment. Considering only the light probe for the moment, when the terminal user wishes a page of information identified by a certain letter or topic on the index page to be displayed, he points the light probe at that topic or letter and actuates the light probe. In response to the signal produced by the light probe, the logic circuits in the channel for that terminal will transmit the X-Y position coordinates of the topic or letter pointed to by the light pen, to the data processing center. Using the X-Y position coordinates, the data processing center determines which topic or letter the terminal operator has pointed to on the index, retrives the requested data from its mass storage files, and transmits the selected data back to the required terminal.

As mentioned above, in the system described in the patents, there is one control channel required per terminal. Each control channel duplicates or substantially duplicates the equipment in each other control channel. Each includes, for example, a refresh memory, logic circuits **6** and **7**, converter circuit **13** and so on.

In certain applications where it is desirable to have a terminal present at many different locations but where each terminal is used only a relatively small fraction of the time, the cost for the system is relatively high considering the amount of time each terminal actually is in use. An example of this type of use is in a reasonably large sized hospital. Here it would be advantageous to be able to have a terminal in each patient's room as well as terminals in the doctor's offices, the supply rooms, the various administrative offices and so on.

However, the terminals in the patients' rooms would be used only when the nurse or doctor wished, for example, to display a patient's record, to enter new information into that record or for certain other uses occupying only limited time intervals. It is estimated, for example, that a system of the type shown in FIG. 1 for 200 cathode ray tube terminals would cost about $3,000 per terminal ($500 for the terminal itself and $2500 for the channel for that terminal).

SUMMARY OF THE INVENTION

In the system of the present application there are far fewer control channels than there are display terminals. A data channel exchange couples the channels to the terminals. In response to a request for service by a terminal, the exchange finds an available channel and connects it to that terminal. The system includes features such as the use of logic signals on the same line as video signals to indicate channel busy status; the use of a common line to carry video signals from a control channel to a display terminal and a request for service signal from the display terminal to the control channel, and others discussed in detail below.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a block diagram of the known multiple terminal display system discussed above;

FIG. 2 is a block diagram of a multiple terminal display system according to an embodient of the invention;

FIG. 3 is a more detailed block diagram of a single one of the modules of the data channel exchange shown in FIG. 2;

FIG. 4 is a block diagram of the circuit in one of the terminals for producing the idle signal;

FIG. 5 is a block diagram of the circuits in the DIVCON for producing the TV line pulses and the channel sample signals and the circuits in the control channels for producing the not busy signals;

FIG. 6 is a drawing of waveforms to help explain the operation of the system of FIGS. 2–5; and

FIG. 7 is a block diagram of the idle detect pulse generator of FIG. 3.

DETAILED DESCRIPTION

The embodiment of the invention shown in FIG. 2 includes a digital-to-video converter (DIVCON) system 10 similar to the system of FIG. 1. The DIVCON 10 is connected to the digital computer system 8 just as in FIG. 1.

In the system of FIG. 1 there are as many channels as there are terminals. As explained in the background section, this makes the system relatively expensive. In the system of FIG. 2 there are only a fraction of the number of channels as there are terminals. In the system chosen by way of example for illustration, there are only 32 channels, each including a refresh memory (either a memory individual to that channel or a specific group of locations in a larger memory, which larger memory may be common to serial terminals), logic circuits and so on, but there are 200 terminals. These 32 channels can handle only 32 terminals at any one time; however, in practice, no more than this number is expected very often to be demanding service at the same time. The actual number of channels required per given number of terminals is determined on the basis of statistical calculations similar to those employed by a telephone company in determining the number of trunk lines required for a building's switchboard. These calculations take into account the total number of video terminals; the average time each terminal will be in use; the peak number of terminals requesting access to a channel per hour; the channel availability factor (there should be a channel available about 99 percent of the time); and so on.

The 32 channels of FIG. 2 are coupled to the terminals by modules, there being one module per terminal. Each module is connected to its terminal by two coaxial cable wires and each module connects to all channels. At each module, there may be three wires per channel at the interface between the module and the 32 channels in which case each module has 96 lines at this interface. Operated in this way, the mixers 5 of FIG. 1 are relocated next to the DCX module as shown in FIG. 2. In addition, each module connects directly to the DIVCON 10 via two wires one carrying the *c* signal and the other a *b* signal as will be shown in more detail in connection with FIG. 3.

In operation, when a user wishes to place a terminal in operation he may, for example, have a key (or card or the like) that he inserts into the terminal. In response to the insertion of the key, means may be provided for determining whether that user is authorized to have access to the terminal and, if not, means may be provided for sounding an alarm either locally or at the computer, or at some other location. However, as none of this is of direct interest in the present application, it will not be discussed further here.

Assume that the user is an authorized user. Upon insertion of his key into a terminal, a signal is transmitted to the module for that terminal requesting access to the DIVCON and computer system. The module, upon receipt of this signal, searches from channel-to-channel until it finds one which is not busy. Upon locating that channel, the module connects its terminal to that channel and thereafter the terminal can communicate via its channel to the DIVCON and computer in ways similar to those discussed in the co-pending applications.

In brief, upon obtaining access to a channel, the terminal automatically may request the processing center 8 to retrieve from its mass memory a block of digital data corresponding to the frame of video information for an index page and transmit that block of data to the channel's refresh memory. The digital-to-video converter 13 in the channel thereafter translates the digital data to a frame of video signals and these are applied in repetitive fashion, to the terminal via the mixer 5 for display on its cathode ray tube screen.

Thereafter, by means of a light probe or other selection device, the user may select additional frames of information and by means of a keyboard, if one is present at that terminal, enter information into the displayed data. As a simple example, if the user is a nurse, she may enter onto the patient's record his present temperature, blood pressure and so on. This displayed record (stored in binary form in the refresh memory) subsequently may be transmitted to the computer for storage in its memory and/or printout. If the terminal includes a printer, that printer may receive, via the channel, from the computer, hard copy instructions or, if desired, may be instructed by the user to print out at the terminal, the record being displayed on the screen of the cathode ray tube.

One of the modules, legended the "i'th module" for the sake of generality, where i is any number from 1 to 200 in this example, is illustrated in FIG. 3. There are 200 modules such as shown in FIG. 3 and all may be identical.

The module of FIG. 3 receives a TV line pulse b_i from the DIVCON. This pulse is applied to normally disabled AND gate 20. The gate connects to a five bit counter 22 and the latter connects to a decoder 24. When the AND gate is primed and the counter 22 is counting, the decoder (enabled by the b_i pulse) produces during 32 different time intervals, 32 different channel select pulses, each on a different output lead 26-1, 26-2 . . . 26-32.

The channel select pulses are each applied to a different group of selection gates. For example, channel select pulse 1 (the channel select pulse appearing on line 26-1) is applied to the select gates 1—1, 1-2, 1-3 and 1-4 for channel 1. Select pulse 2 is applied to the select gates (not shown) for channel 2 and so on, select pulse 32 being applied to the select gates 32-1 . . . 32-4 for channel 32. The i'th terminal is connected to the i'th DCX module via two lines 28 and 29. Line 28 carries the data signals and the idle signals from the terminal to the module. It also carries the video signals from the selected channel through the video amplifier 30 to the i'th terminal, as will be discussed in more detail shortly. Line 29 carries a light pen signal from the i'th terminal to the light pen signal detector 34 in the i'th module.

The data detector 36 receives the data signals and idle signals from the video terminal. The idle signals e are amplified to signals k at the desired logic level and applied to the idle detect pulse generator 38. As is clear from FIG. 6 (which does not show the difference in amplitude between signals e and k) both signals occur at the same times. the same times.

The keyboard data signals received by detector 36 are applied to AND gate 40. These keyboard data signals occur during the video display time of each scan line and never occur during the same time as the idle signals and channel sample pulses c. Therefore, as will become clearer from the discussion of FIG. 7, which shows the details of generator 38, the latter ignores the keyboard data signals. In a similar way, the IDLE signal is ignored by the keyboard data input control logic circuit (6 in FIG. 1) in the DIVCON control channel. The idle detect pulse generator 38 is shown in more detail in FIG. 7. It includes two inverters 37 and 39 and two AND gates 41 and 43. Under one set of conditions, namely the presence of both of the signals c and k, AND gate 43 applies a reset signal f to the search channel enable flip-flop 44. Under another set of conditions, namely the absence of a signal from channel enable flip-flop 44, the absence of the signal k from the data detector 36, and the presence of the channel sample pulse c from the DIVCON, AND gate 41 produces a set signal g which it applies to the search flip-flop 42. The channel enable flip-flop (FIG. 3) when set, supplies a priming signal to AND gate 45 and to AND gates 40, 48 and 50 (all in FIG. 3). AND gate 45 receives a second input - the channel sample select pulse c, from the DIVCON via line 46. The circuit for producing pulse c, shown in FIG. 5, is discussed later.

In the operation of the system of FIG. 3, when the video terminal i is not in use, it continuously applies an idle signal e_i to the data detector 36. This and the other waveforms to be discussed are shown in FIG. 6. The circuit for producing the idle signal, shown in FIG. 4 comprises an idle signal generator 37 which is responsive to the horizontal synchronization pulses. It applies the idle signal, which occurs once each horizontal scan line interval, through the normally primed AND gate 52 (FIG. 4) to the line 28. The data detector 36 (FIG. 3), in response to the IDLE signal produces an output signal k which is applied to the idle detect pulse generator 38. The channel enable flip-flop 44 and search flip-flop 42 are in their reset condition at this time.

When an operator desires to use a terminal, he inserts a key into that terminal. In response to the insertion of the key, the key responsive circuit 54 of FIG. 4 supplies an inhibiting signal to the inhibit terminal of AND gate 52. This removes the idle signal e from line 28 of th module for that terminal.

In the absence of the idle signal e, the data detector 36 of FIG. 3 removes the inhibiting signal k from the idle detector pulse generator 38. In response to the next occurring channel sample pulse c from the DIVCON, the idle detector pulse generator 38 (see FIG. 7) produces an output pulse g which it applies to the set terminal S of the search flip-flop 42. (While in FIG. 6 pulses e, f and g are all shown to be present concurrently, this is done merely to show their relative time relationships. It can be appreciated by referring to FIG. 7 that pulse g is generated in response to pulse c in the absence of both the channel enable signal and the idle signal e (which is concurrent with the signal k) and pulse f is generated in response to the pulse c in the presence of the idle signal e.)

In response to the set flip-flop 42, gate 20 becomes primed. It now passes the TV line pulses b_i (see FIG. 5) produced by the DIVCON.

The TV line pulse b_i is applied to the i'th terminal once each 262 line times. These pulses may be generated in the manner shown in FIG. 5. The horizontal synchronization pulses are applied to a 9 bit counter 62 and the latter connects to a decoder 64. The decoder is capable of producing 2^9 or 512 output pulses on 512 different output lines, however, as only 200 of them are of interest (in view of the fact that there are only 200 terminals) only 200 output lines are shown. (The nine bit counter is employed rather than an eight bit counter as in some installations more than 256 terminals may be needed.) Each line from a decoder goes to a different module. Accordingly, each module is clocked to a new count during a different horizontal line time. This feature is important as it prevents more than one module from selecting the same not busy channel.

Returning to FIG. 2, when AND gate 20 is enabled, it applies the successive TV line pulses b_i it receives to the five bit counter 22. Each such pulse advances the count produced by the counter 22 by one. In response to each count and enable pulse b_i, the decoder 24 produces an output pulse on a different one of its output lines. For example, in response to the count of one, the decoder produces an output channel select pulse, having a duration of one completed TV scan line time, on line 26-1. This channel select pulse primes the select gates 1—1 . . . 1-4 for channel 1. Assume now that channel 1 is not busy. When in this condition, the channel applies to the vidoe terminal V a not busy signal d_1, once each horizontal line time. As shown in FIG. 5, this pulse is produced in synchronism with the horizontal synchronization pulses and is a relatively narrow pulse delayed in time with respect to the horizontal synch

pulse. The not busy signal is narrower than the channel sample signal *c* and occurs within the interval of the channel sample signal *c*. This signal *d* actually is superimposed on the video signal (*a*) of FIG. **6** (the video signal is not shown at *d* in FIG. **6** to avoid cluttering the drawing) but occurs during the horizontal blanking interval.

The not busy signal d_1 is applied through primed AND gate **1–2** to AND gates **48** and **70**, priming AND gate **70**. AND gate **48** is disabled at this time as flip-flop **44** still is reset. In response to the same channel sample signal *c* that started the pulse *g* and the not busy signal d_1, AND gate **70** becomes enabled and resets the search flip-flop. This disables the AND gate **20** and the five bit counter stops at the count of one.

The lagging edge of the pulse produced by the search flip-flop **42** sets the channel enable flip-flop **44**. This primes AND gates **45** and **48** (and **40** and **50**) and inhibits further g pulses. Each succeeding channel sample c which now occurs causes AND gate **45** to produce an inhibit not busy signal INB (of the same duration as pulse *c*) which causes AND gate **1—1** to place terminal V for channel **1** at a reference voltage level such as ground for a brief time interval starting slightly before the d_1 pulse and ending slightly after the d_1 pulse. This ground level indicates to all other modules that channel **1** is busy. The INB signal does not pass through any other of the first selection gates **2–1** (not shown) . . . **32–1** because they are all disabled by the absence of signal on leads **26–2 . . . 26–32.**

Upon the termination of each INB pulse, the video signal from channel **1** passes through AND gate **1–2** and through primed AND gate **48** to the video amplifier **30** and the latter applies this video signal to the terminal itself, terminal *i* in the case of FIG. **3.**

As mentioned above, the channel enable flip-flop **44** produces a priming signal on its **1** output terminal when the *i* terminal has obtained access to a channel in the manner described. This signal primes the three control gates **48, 40** and **50.** It is possible for the terminal to communicate via these three gates to the channel which has been selected, which is channel **1** in this example. As already mentioned, AND gate **48** permits video to be applied to the terminal via line **28.**

AND gate **50** permits the light probe signal to be applied from the terminal via the light probe detector **34** and the gates **50** and **1–4** to the light probe terminal L of channel **1.** In brief, when the light probe receives a "hit" this hit is detected by the light probe detector. The time at which this signal occurs is indicative of the place on the television screen at which the light probe was pointing when the hit was made. In more detail, the time at which the photodetector in the light probe senses the electron beam passing the light pen position, indicates the location on the screen of the character, symbol or the like at which the probe is pointing. This light probe signal indicates to the logic selection circuits in channel **1** a course of action to be followed as, for example, the new frame of information desired to be displayed.

The purpose of the data detector **36,** aside from that of producing the signal *k* in response to the idle signal, as already described, is to transmit keyboard information to the channel. This information flows from the keyboard through the detector and AND gates **40** and **1–3** to the data (D) terminal of channel **1.** This data may be stored in the refresh memory of channel **1** and translated by the character generator circuits (the digital-to-video converter **13**) within channel **1** to the video signals necessary for displaying a character on the cathode ray tube screen, as one example. The place on the screen that the character or characters will be located may be indicated by a cursor on the screen, in well-known fashion.

Assume now that in response to a particular count, such as one, produced by decoder **24** the channel corresponding to that count is not available - is busy. In this event the not busy signal d_1 will not be present. Accordingly, even though in response to the count of 1 the selection gates **1—1 . . . 1–4** are primed, AND gate **1–2** will not produce an output during the interval of the channel sample signal *c* when the not busy signal d_1 for channel **1** should be present. In the absence of an output from AND gate **1–2,** AND gate **70** remains disabled and the search flip-flop does not become reset. Accordingly, AND gate **20** remains enabled and the counter **22** continues to count the TV line pulses b_i. Similarly, the channel enable flip-flop **44** remains in its reset condition.

The process described above continues until the module finds a channel which is not busy. It then connects that channel in the manner described to the video terminal demanding access to a channel.

Returning now to the first set of circumstances mentioned above, that is, terminal i connected to channel **1,** assume now that the operator is done. He removes his key from the i terminal. In response thereto, the circuit of FIG. **4** starts again to generate the idle pulses e_i. In response thereto, the data detector **36** produces the signals *k* applied to the idle detector pulse generator. The next time the channel sample pulse *c* occurs, the idle detector pulse generator **38** (see FIG. **7**) produces an output pulse *f* which resets the channel enable flip-flop **44.** This disables AND gate **45** removing the INB signal from AND gates **1—1, 2–1** (not shown) . . . **32–1.** This permits the not busy signal d_1 which previously had been inhibited again periodically to occur at the TV horizontal line frequency indicating to all modules that channel **1** again is available.

The reset channel enable flip-flop **44** also disables control gates **48, 40** and **50.** The search flip-flop **42** previously was reset so that AND gate **20** also is disabled. Channel **1** is now available for other modules and terminal *i* is not in use. The next time terminal *i* comes into use, the five bit counter will start counting again, starting at the last count stored in the counter. Thus, if the five bit counter happens previously to have selected, say channel **24,** the first TV line pulse b_i it receives will change the count to **25.** This is perfectly all right as it makes no difference in which order the channels are queried.

In the background of the invention section of this application the cost per terminal for the FIG. **1** system is given as roughly $3,000. Using the same basis for calculations, the cost per terminal for the FIG. **2** system is:

a. $500 for the terminal itself just as in FIG. **1.**

b. There are 6 ¼ display terminals per channel making the channel cost per terminal $400.

c. The cost per module for the FIG. **3** circuit is estimated to be $50.

The figures above gives a cost of $950 per terminal a saving of roughly $2,050 per terminal.

What is claimed is:

1. A multiple terminal display system comprising, in combination:

means for producing digital data corresponding to different frames of video information;

m separate video display terminals, where m is a first plural integer, each of said terminals including means for selectively supplying a request for service signal;

n separate control channels coupled to said means for producing digital data, where n is a second plural integer smaller in value than said first plural integer, each of said control channels including request-for-service means responsive to a request for service signal supplied thereto from any terminal initially without service for causing an idle one of said control channels to be seized and retained by that terminal for its exclusive use only so long as that terminal continues to supply the said seized control channel with said request for service signal , and

wherein each control channel includes refresh memory means for storing a block of digital data and character generator means for translating that data to a frame of video information which, in response to that control channel being seized by a terminal, is forwarded for display by its seizing terminal.

2. The system defined in claim 1, wherein said means for selectively supplying a request for service signal of any of said *m* terminals includes associating means for associating that terminal with a single one of said control channels at a time, wherein said request-for-service means of a control channel includes busy-determining means operative when that channel is idle for returning a not-busy signal to a terminal without service associated therewith and operative when that channel is already seized by another terminal for returning a busy signal to a terminal without service associated therewith, and wherein an associated terminal includes signal-responsive means responsive to the return of a not-busy signal to its initial request for service for seizing that single one of said control channels with which it is then associated and responsive to the return of a busy signal to its initial request for service for associating that terminal with a different single one of said control channels.

3. The system defined in claim 2, wherein a frame of video information is composed of L display scan lines arranged in a raster, where L is a plural integer at least equal in value to *m*, and

wherein said busy-determining means returns said not-busy signal or said busy signal during each scan line, wherein said signal-responsive means of each different terminal has a different preselected single scan line assigned thereto for responding to a not-busy signal returned thereto only during that single scan line assigned thereto, whereby a simultaneous attempt at seizing an idle control channel by more than one terminal is prevented.

4. The system defined in claim 2, wherein each terminal includes a display portion normally decoupled from said control channels, and video-signal transmission means including said associating means for extending a video connection from a control channel to the display portion of a terminal only while that control channel is seized by that terminal.

5. The system defined in claim 4, wherein each terminal includes means for generating a data signal which is normally decoupled from said control channels, and data-signal transmission means including said associating means for forwarding said data signal from a terminal to a control channel only while that control channel is seized by that terminal.

6. The system defined in claim 4, wherein each terminal includes means for generating a light-pen signal which is normally decoupled from said control channels, and light-pen signal transmission means including said associating means for forwarding said light-pen signal from a terminal to a control channel only while that control channel is seized by that terminal.

7. The system defined in claim 1, wherein each respective one of said n control channels is connected to all of said *m* terminals by its own set of common conductors, whereby the total number of common conductors is equal to the product of the number of members of each set multiplied by the number of control channels and is independent of the number of terminals.

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