

United States

Hornung

[11] 3,879,723

[45] Apr. 22, 1975

- [54] **DESTINATION SIGN SYSTEM USING LIQUID CRYSTAL DISPLAY DEVICES**
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- [73] Assignee: **Transign, Inc.**, Pontiac, Mich.
- [22] Filed: **Dec. 21, 1972**
- [21] Appl. No.: **317,486**
- [52] U.S. Cl. **340/336; 340/324 R; 350/160 LC**
- [51] Int. Cl. **G09f 9/32**
- [58] Field of Search .. **350/160 LC; 340/336, 324 R, 340/324 M, 334**

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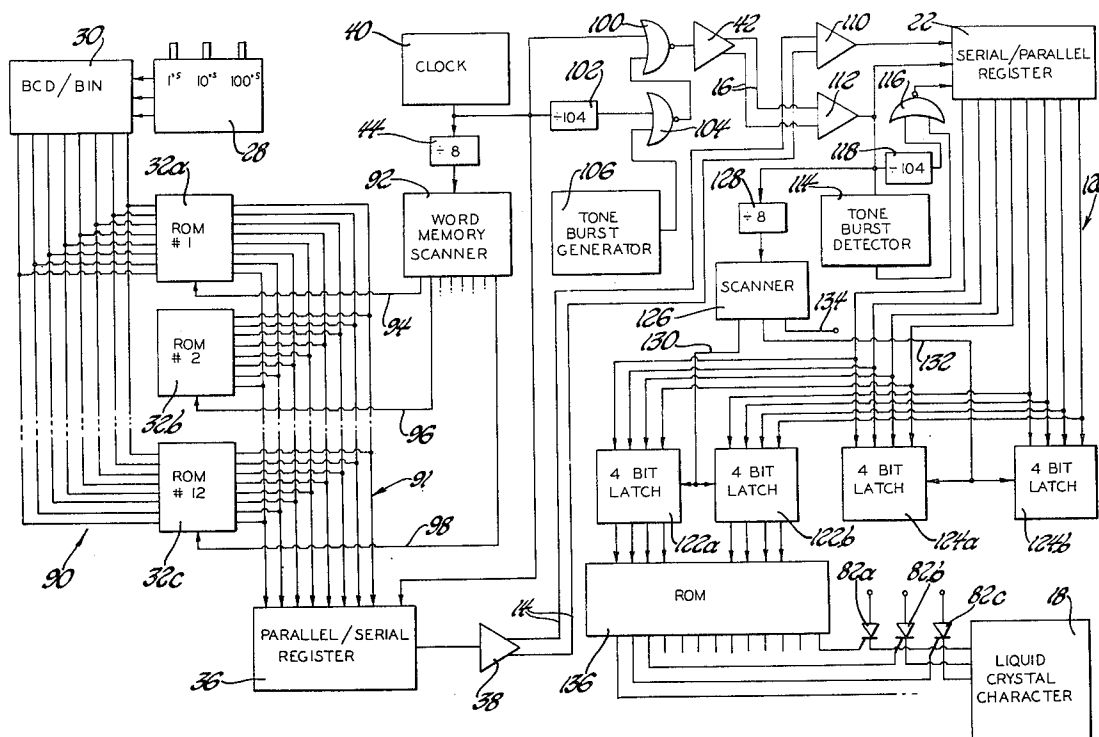
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[57] **ABSTRACT**

A destination sign is disclosed for use in buses and trains with a remote control which permits the opera-

tor to selectively cause display of any one of a large number of names or words. The sign is comprised of liquid crystal type display devices and the information to be displayed is selected from a memory device where it is stored in binary word form. A clock controlled scanner causes sequential reading of plural memory devices a word at a time which are fed through a first parallel/serial register to the remote sign in serial form, bit-by-bit. At the remote sign the serial data, under synchronized control means from the clock, is fed through a serial/parallel register to a set of latch registers under the control of a clock controlled scanner. The latch registers hold a data word corresponding to each character of the liquid crystal display and provide continuous actuation thereof. The synchronizing signal from the clock not only synchronizes the data feed through the serial/parallel register, but also by means of a tone burst generator and detector means provides a reset signal for the serial/parallel register after all data words have been transmitted. Thus the latch registers are updated at the end of each sequence of data transmission. In addition to the continuous energization and updating of the liquid crystal display devices of the sign, the sign includes back-lighting means, louver means, and partial reflector means to enhance the readability of the sign.

4 Claims, 6 Drawing Figures

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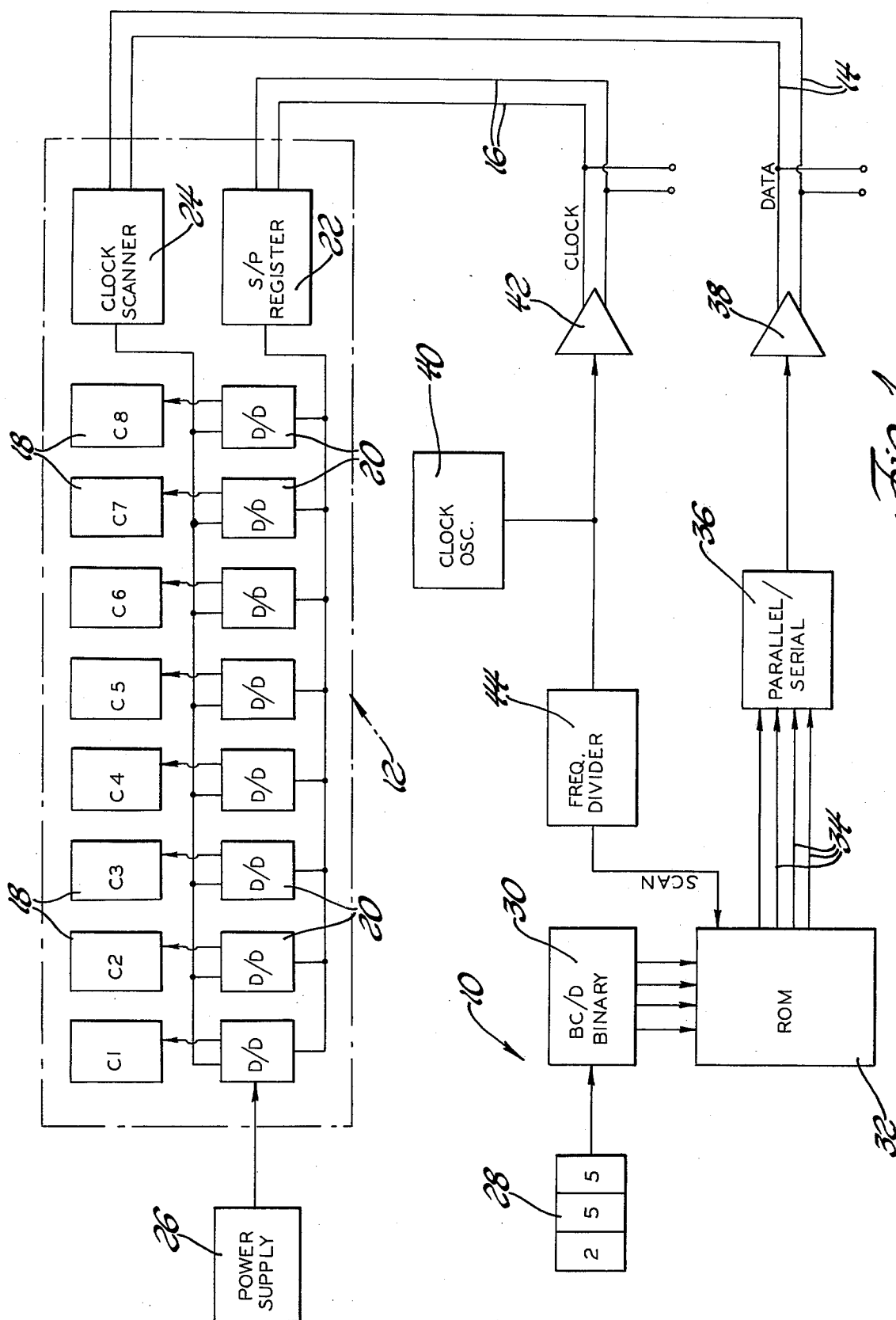
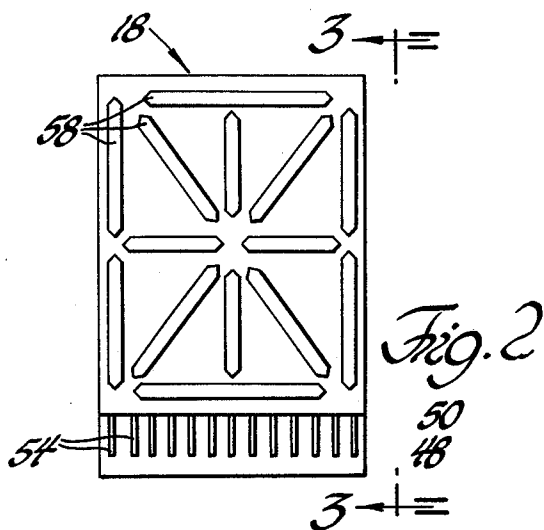
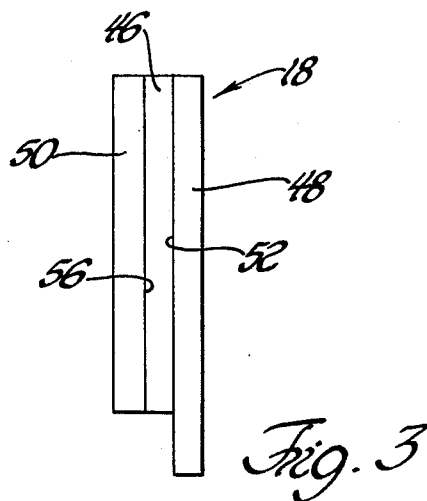
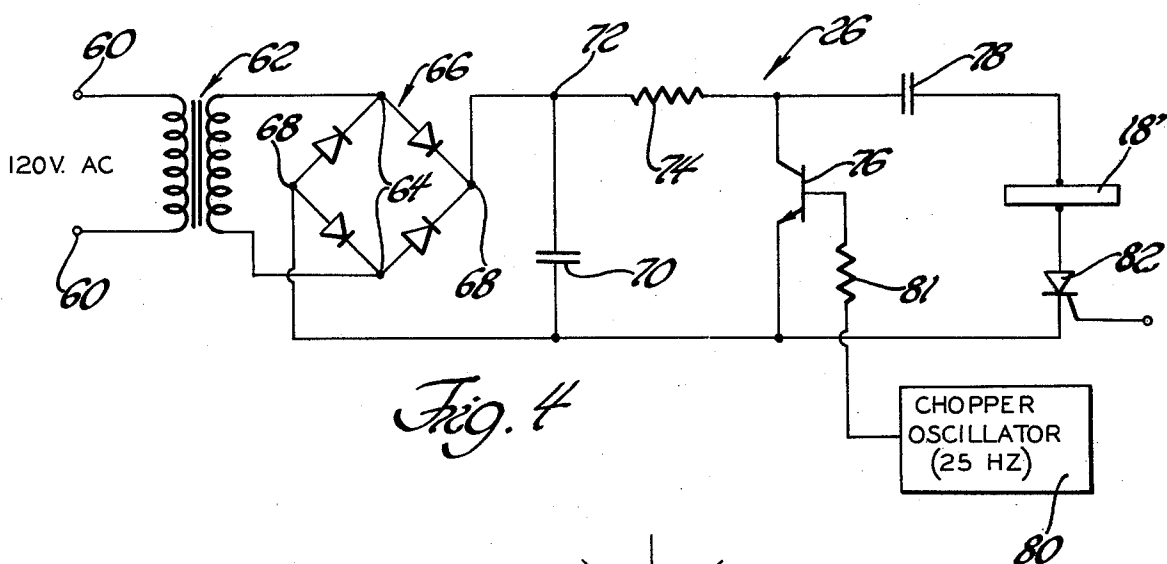
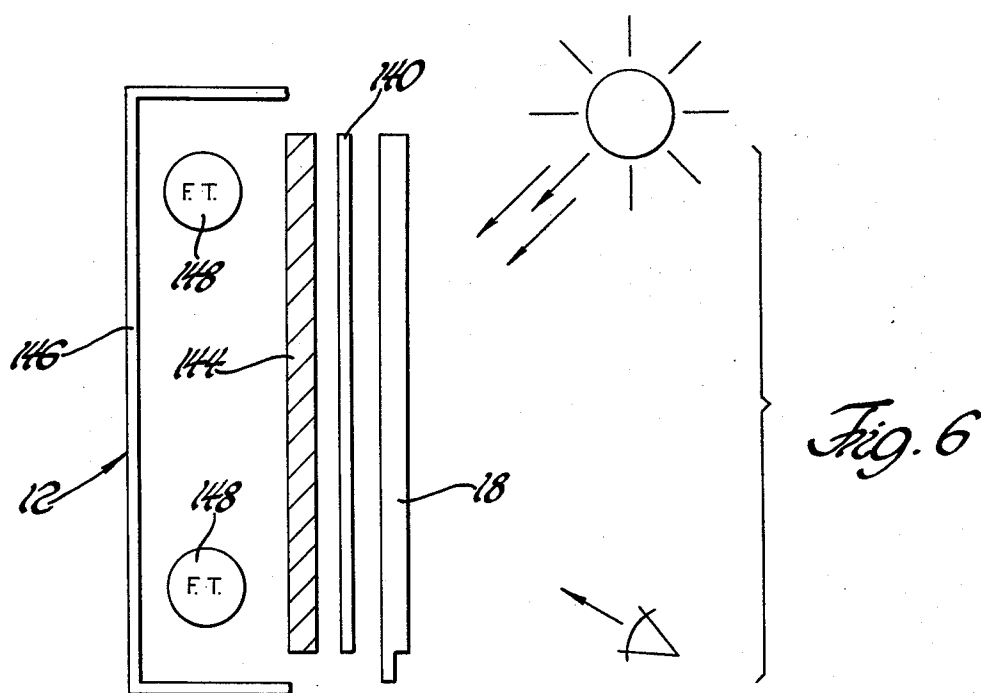


Fig. 1



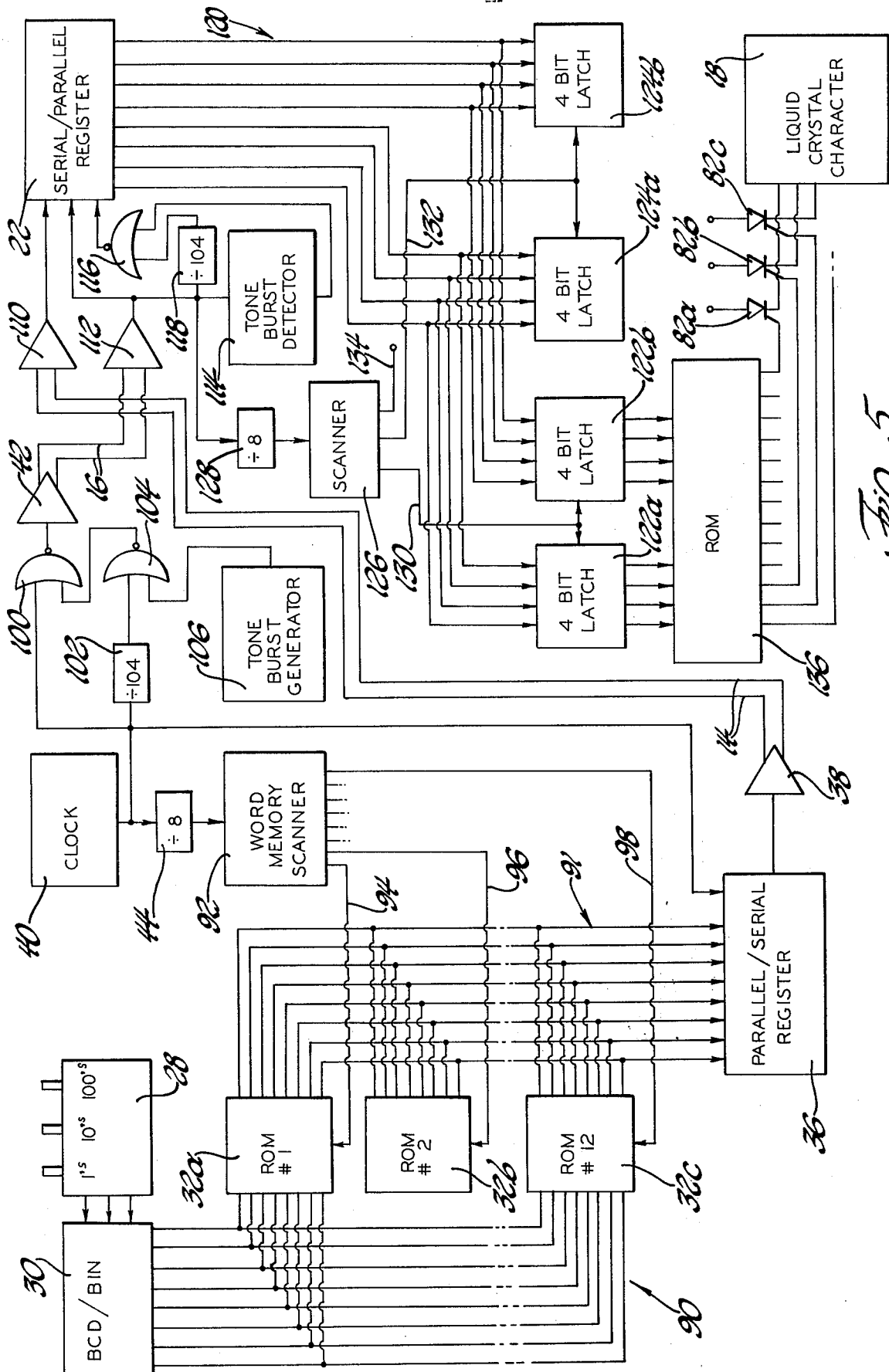


Fig. 5

DESTINATION SIGN SYSTEM USING LIQUID CRYSTAL DISPLAY DEVICES

INTRODUCTION

This invention relates to display devices of the type used to present alpha-numeric information and particularly to a programmable destination sign system for use in mass transit vehicles and the like wherein liquid crystal display devices are employed.

BACKGROUND OF THE INVENTION

It is well known that most mass transit vehicles such as buses and trains carry destination signs either externally, internally or both for the purpose of conveying certain information to passengers and respective passengers. One well known prior art destination sign employs a curtain or scroll of flexible material such as fabric or plastic having a serially arranged sequence of destination statements or the like which may be selected by manually rotating the curtain or scroll until the proper message appears. A later improvement on such destination signs employs programmable input means and a curtainmoving servo system such that an operator might select a given message automatically and from a remote station simply by providing certain address information by way of switches, punch keys or the like.

Both of the prior art devices described above have the disadvantage of requiring a relatively large curtain or scroll having all of the possible destinations or other messages prefabricated therein. Accordingly, such destination signs lack adaptability with respect to changing destination indicators or with respect to the use of such systems for displaying information other than that which is principally related to destination.

BRIEF SUMMARY OF THE INVENTION

In accordance with the present invention a programmable display system for information is provided having the attributes of mechanical simplicity, ease of message programming and extremely high adaptability to varying information conditions such that a large number of messages may be available for selection without the requirement for a bulky prefabricated message curtain or scroll. In general this is accomplished by means of a display system comprising a plurality of display devices of the so-called liquid crystal type. The use of liquid crystal display devices for various purposes, including advertising and message communication, has been documented in the technical literature as well as in the patent literature. Liquid crystal display devices are described, for example, in an article entitled "LIQUID CRYSTAL DISPLAYS" by R. W. Gurtler and Craig Maze appearing in the November 1972 issue of the *IEEE SPECTRUM*, pages 25 through 29. The use of such crystal display devices in a destination sign system or the like completely eliminates the need for a prefabricated mechanical curtain or scroll and facilitates the use of an electronic system for generating a pattern of data signals which may be applied in the proper fashion to an array of liquid crystal message segments to instantly compose any of a large number of various information displays.

In accordance with the second feature of the invention a destination sign system or the like is provided wherein the input and message programming portions are interconnected with one or more remote liquid

crystal sign portions by way of a minimum number of electrical conductors thereby reducing wiring costs and complexities in destination sign systems and the like wherein the sign portions are often necessarily located substantial distances away from the input or control devices. In general this is accomplished by means of a digital input portion wherein the message to be displayed is programmed by means of a simple digital code and wherein the data signals representing the number and sequence of liquid crystal character segments to be actuated is generated in parallel form, transmitted to the sign in serial form along with a synchronizing clock signal, reconverted to at least partial parallel form at the sign, and applied to the liquid devices in parallel or partially parallel form.

In accordance with a third, more detailed, feature of the invention, a synchronizing signal is provided whereby the message displayed in the liquid crystal sign is repeatedly refreshed in a periodic fashion and renewed in response to the entering of a new input code only after a complete display cycle has been realized. In general this is accomplished by means of a synchronizing and storage arrangement comprising a sync signal generator operating in conjunction with the system clock to establish a periodicity to the message data transfer from programmer to sign and a latch arrangement which operates to present continuous data oriented actuation signals to the liquid crystal segment switches during the presentation of any given message.

In accordance with a still further feature of the invention liquid crystal lifetime is increased by the use of a power supply which provides for the generation of an effective alternating current energizing wave form while at the same time generating D.C. energization voltages for the data transfer system logic. This preferred power supply is energizable by an A.C. input signal and includes a rectifying bridge and capacitor arrangement to generate a stable D.C. reference, and further includes chopper means decoupled from the D.C. signal takeoff point for generating an effective alternating current signal for application to the combination of a liquid crystal sign segment and a switch therefor.

A still further feature of the invention involves the provision of an improved destination sign for vehicular use wherein the message to be displayed exhibits enhanced readability under a broad range of lighting conditions from bright sunlight to total darkness. In general, this is accomplished by means of an arrangement of liquid crystal display devices in combination with a partially reflective mirror surface, a thin and selectively oriented louver film and artificial back-lighting means such as fluorescent tubes, the whole arrangement being oriented and constructed so as to provide maximum readability from the typical viewing angle while at the same time preventing the observation of the fluorescent tubes.

In summary the present invention has for a particular objective the provision of a substantially improved destination sign system for vehicular use so as to permit the operator to quickly and easily generate any one or more of a large number of messages to be displayed and to replace the usual scroll type curtain which has been present in the destination sign field for many years. It is, however to be understood that the present invention is not limited in application to vehicular destination signs but may find advantageous application in other areas including, for example, airline and other trans-

portation terminal displays for time tables, gate numbers, arrivals, departures, etc., rapid transit vehicle destination and run number displays including monorails, convention rails, etc., advertising media, entertainment, news presentations and so forth.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a transit sign system embodying the present invention;

FIG. 2 is a plan view of a liquid crystal display element for representing alpha-numeric characters in the system of FIG. 1;

FIG. 3 is a side view of the liquid crystal display character of FIG. 2;

FIG. 4 is a schematic circuit diagram of a power supply for liquid crystal display device energization;

FIG. 5 is a detailed block diagram of an illustrative embodiment of the invention; and

FIG. 6 is an exploded side view of a destination sign for buses and like transit vehicles in combination with the system of FIG. 1.

DETAILED DESCRIPTION OF THE SPECIFIC EMBODIMENT

Referring to FIG. 1, the block diagram of the illustrative embodiment of the invention is shown to comprise a digital signal generating input section 10 for use by an operator in specifying, according to a predetermined code, any of a large number of messages to be graphically displayed by means of a multi-character crystal display sign 12. The input section 10 includes means, hereinafter described in greater detail, for generating serialized digital data signals which are transmitted to the remotely located liquid crystal sign 12 by means of the so called "twisted pair" transmission line 14. In addition, the input section 10 comprises means for generating clock signals for synchronizing purposes, these signals being transmitted from the input section 10 to the sign 12 by means of a second twisted pair transmission line 16. As indicated in FIG. 1 the twisted pair transmission lines 14 and 16 represent the only electrically conductive connections between the input section 10 and the sign 12. Accordingly the sign 12 may be remotely located from the control area, the wiring requirements between the two being minimized by the relatively small number of conductive paths required. As is also shown in FIG. 1, additional signs may be conducted in parallel with sign 12.

In FIG. 1 the sign 12 is shown to comprise a lineal array of juxtaposed liquid crystal display devices 18. In FIG. 1 the display devices are labeled from left to right C-1 through C-8, it being understood that each device 18 is capable of representing each of the alphabetic and numeric characters in accordance with a particular number and arrangement of input data signals which are received by that device. Although only eight liquid crystal display devices 18 are shown in FIG. 1 it is to be understood that the sign 12 may comprise a larger or a smaller number of such devices and a sixteen-character sign is more typical. Each of the liquid crystal display devices 18 is energized by means of a digit driver 20 comprising a decoding arrangement and switch set hereinafter described in greater detail. The digit drivers 20 are actuated in groups of eight display bits or display device segments at one time by means of an eight-bit serial-to-parallel converting register 22. The register 22 is connected to receive the serialized

data signals from the input section 10 by way of the twisted pair transmission line 14. In addition, the digit drivers 20 are caused to operate in a synchronized sequence by means of a clock driven scanner 24 which is connected to receive the clock signals by way of the twisted pair transmission line 16. The clock scanner 24 is connected to each of the digit drivers 20 for distributing the data signals to the devices 18 in groups of eight bits each until all devices receive such signals as are required to compose a given message. Finally, a power supply 26 is connected to the switch portions of each of the digit drivers 20 to present an eighty volt alternating current, square waveform for energization of the liquid crystal display segments in accordance with the data signal pattern.

Input section 10 of the destination sign system shown in FIG. 1 comprises a three-digit, manually-operated input device in the form of a set of three thumbwheel switches. Each of the thumbwheel switches has ten positions and accordingly the device 28 is capable of selecting any one of as many as nine hundred ninety nine message codes, each code representing a different message to be programmed into and displayed by the sign 12. Again the thumbwheel switch device 28 as well as the number of selectable messages is specified for purposes of example only and, as will be apparent to those skilled in the art, the subject invention is not limited to thumbwheel switch input devices or to manual input devices of any kind. For example the input or control means of the system shown in FIG. 1 may comprise a data processing machine such as a computer, a radio receiving network, a flow transducer, etc.

The thumbwheel switch input device 28 is connected to a code converter 30 which operates to convert the binary coded decimal signals from the thumbwheel switches 28 to pure binary form and to enter the message code in parallel form into a programmable read only memory 32. The read only memory is a large digital storage device capable of converting a relatively small number of input signal combinations in binary code into a larger number of output signals having a predetermined relationship to the input signals. Accordingly it will be apparent to those skilled in the art that the read only memory 32 is simply a device for converting information from a highly compressed code form into a more or less compressed form (in this case a less compressed code form) thereby to generate an equivalent signal combination comprising the number of actual signals which are required to actuate any given output device. The read only memory 32 may take any of various forms but is preferably in the form of a diode matrix or a magnetic core array of a well known prior art type.

The signal combinations which are generated by the read only memory 32 are presented in parallel form on output lines 34. These output lines are connected to a parallel-to-serial converter 36 which operates to present data signals in serial form and at a clocked rate. These serialized data signals are presented to a line driver 38 such as a suitable amplifier device which is connected directly to the twisted pair transmission line 14. Accordingly it is to be understood that for each message code a plurality of data signals are generated by means of the read only memory 32. These data signals are then serialized by means of the parallel-to-serial converter 36 and transmitted to the sign 12 by way of the twisted pair transmission line 14.

The transmission of serialized signals in binary code form requires the synchronization of the sign 12 and the input section 10 so that the various digits or bits in the binary wave train transmitted over the data transmission line 14 can be separated from one another and properly distributed among the liquid display devices 18 of the sign 12. For this purpose a clock oscillator 40 is provided. The output of the clock oscillator 40 is connected to a second line driver 42 to transmit the clock signal over the twisted pair transmission line 16 to the sign 12. In addition, the output of the clock oscillator 40 is connected through a frequency divider to the read only memory 32 and the converter 36 so that the signals are read from the read only memory 32 and presented to the data line 14 at the clock rate.

Looking now to FIGS. 2 and 3 one of the liquid crystal display devices 18 will be described in greater detail. Although the liquid crystal device 18 is essentially a prior art device, some detailed description is believed to be in order thereby to facilitate a better understanding of the need for and use of various data signals which are generated in the system described in FIGS. 1, 4 and 5.

Each liquid crystal display device 18 comprises a rectangular thin film 46 of liquid crystal material, the particular material being preferably of the nematic type as described in various prior art publications including U.S. Pat. No. 3,622,224 issued to Joseph J. Wysocki and Robert W. Madrid on Nov. 23, 1971. The thickness of the liquid crystal film 46 is on the order of 0.006 inches and accordingly the dimensions and proportions shown in FIGS. 2 and 3 are not to be construed as a representative of an actual device but rather have been exaggerated for purposes of illustration. Film 46 of liquid crystal material is hermetically sealed between two flat plates 48 and 50 of transparent and nonconducting material such as plastic or glass. The inner surface 52 of plate 48 is coated with a transparent silver oxide electrode which extends continuously over the face thereof and is electrically connected to one of the externally exposed and vertically depending conductive terminals 54 shown on the lower portion of plate 48 in FIG. 2. The inner surface 56 of plate 50 is selectively and discretely plated with transparent silver oxide segments 58 which are arranged in the fourteen segment pattern shown in FIG. 2 so as to be selectively energizable for the purpose of representing each of the alphabetic and numeric characters. Each of the segments 58 is electrically connected to one of the terminals 54 thus to permit selective application of voltages to the segments for the purpose of creating a high intensity field between selected segments 58 and the electrode facing on the inner surface 52 of plate 48. As is well documented in the prior art with respect to liquid crystal devices, this application on a highly localized field produces an optical mutation of the liquid crystal material within the field so as to permit the excited area of the liquid crystal display device 18 to be optically distinguishable from the unexcited areas. Accordingly, each of the liquid crystal display devices 18 in the sign 12 requires some combination of 14 individually selectable data bits plus proper connection of the common electrode on the inner surface 52 of plate 48. It will be readily appreciated that a 16 character sign having 14 segments per character requires 224 separate data input signal paths.

Referring now to FIG. 4 a schematic representation of the power supply 26 from the circuit of FIG. 1 is shown. Power supply 26 comprises input terminals 60 which are adapted to receive 120 volt A.C. energization from a typical transit vehicle converter. Input terminals 60 are connected across the primary coil of a step down transformer 62, the secondary coil of which is connected across the input terminals 64 of a rectifying diode bridge 66. The output terminals 68 of the diode bridge are connected across a capacitor 70 which receives an eighty volt D.C. charge so as to provide a constant eighty volt D.C. signal at the circuit point 72 for use in connection with various circuitry logic requiring D.C. energization. The upper plate of capacitor 70 is connected through a resistor 74 to the collector electrode of a transistor switch 76 which acts as a chopper to chop the eighty volt D.C. signal appearing at the output terminal 68 of bridge 66 and to apply an effective eighty volt peak-to-peak square wave signal to the liquid crystal segment 18' through a decoupling capacitor 78. Transistor 76 is turned on and off by a 25 Hz oscillator 80 having a 50 percent duty cycle. The output of the oscillator 80 is connected through a bias resistor 81 to the base of the transistor 76. In addition the application of the chopped eighty volt signal to the liquid crystal segment 18' which represents a portion of any given liquid crystal display device is controlled by means of an SCR switch 82. As shown in FIG. 4 the gate electrode 84 of the SCR switch is connected to receive a data signal.

Summarizing the operating of the liquid crystal display device of FIG. 2 when used in the circuit of FIG. 1 and energized by the circuit of FIG. 4 it can be seen that the receipt of a suitable data signal at the register 22 in the system of FIG. 1 along with the suitable clock signal results in the actuation of at least one of the digit drivers 20 to select at least a segment 58 of a liquid crystal display device 18 for excitation. Whenever this occurs a data signal is applied to the gate electrode of SCR switch 82 to cause the eighty volt peak-to-peak A.C. signal to be applied through the decoupling capacitor 78 to the liquid crystal 18' which is represented by the segment 58 selected for high field excitation. The A.C. signal being applied to that representative portion of the liquid crystal display device 18 causes an optical transmutation of that portion of the liquid crystal display device, thus establishing that portion or segment as part of the message to be displayed.

Referring now to FIG. 5 there is shown a more detailed block diagram of a destination sign system employing liquid crystal characters 18. The block diagram of FIG. 5 follows the general organization illustrated in FIG. 1 and like components are identified with like reference characters.

In FIG. 5 the three digit thumbwheel input device 28 is shown to include three output lines connected to the binary coded decimal-to-binary code converter 30. The converter 30 is provided with eight output lines 90 which are connected in parallel to each of twelve read only memories of which memory 32A, 32B and 32C are illustrated in FIG. 5 as being representative. It will be appreciated that the individual read only memories illustrated in FIG. 5 make up the memory 32 shown in FIG. 1. The read only memories are each provided with a set of eight output lines connected in parallel to the input of the parallel-to-serial converting register 36. The memories 32A, 32B and 32C together with the re-

maining nine memories which are not shown are read into the register 36 in sequence under the control of the system clock 40 which is connected through the frequency divider 44 to a word memory scanner 92 having twelve sequentially actuated output lines. Output line 94 is connected to read only memory 32A to enable data transfer from that memory to the register 36. Output line 96 from scanner 92 is connected to read only memory 32B to output an eight-bit word from that memory to the register 36 at the next clock time. Finally output line 98 enables the transfer of an eight-bit word from read only memory 32C to the register 36 at the twelfth clock time. The clock 40 preferably operates at 6 KHz and the divider 44 has the effect of dividing this frequency by a factor of eight. The result is a sequence of 12 "read enable" signals on line 94, 96 and 98, the thirteenth time being reserved for a tone burst sync signal to be explained hereinafter. The need for a sequence of 13 read times results in the dividing factor of frequency dividers 102 and 118 being 104 or thirteen times eight. As explained with reference to FIG. 1 the output of the parallel-to-serial register 36 is clocked out to the line driver amplifier 38 under the control of the clock 40 to present a serial data wave train in binary code to the transmission line 14.

In FIG. 5 the clock 40 is also shown to be connected to an inverting OR gate 100 which operates to apply the clock signal to the line driver amplifier 42, the output of which is connected to the twisted pair transmission line 16. OR gate 100 selectively passes to the line driver amplifier 42 one of two signals comprising the basic clock signal or a synchronizing signal in the form of a short duration tone burst. To generate the tone burst, the output of clock 40 is connected through a frequency divider 102 to one input of OR gate 104. In addition a constantly running tone burst generator has the output connected to the other input of gate 104. The output of gate 104 is connected to a second input of gate 100. The frequency division factors of dividers 102 and 44 are related by a factor of thirteen, thus giving rise to a periodicity of tone burst or sync signal generation which is the same as the periodicity of the data cycle produced by the word memory scanner 92. In other words, the entire data train is repeated and transmitted in the first 12 clock times of divider 44 and the sync signal occurs at the thirteenth clock time.

The twisted pair transmission line 14 which carries the data signal train is connected to a receiver amplifier 110 and thence to the serial-to-parallel register 22 which is disposed at the destination sign location. Similarly twisted pair transmission line 16 carrying the clock signal is connected to the input of the receiver amplifier 112, the output of which is also connected to the serial-to-parallel register 22 for synchronizing purposes. As will be apparent to those skilled in the data processing art the function of the clock signal as applied to the register 22 is the establishment of bit times or strobe times which are synchronized with the data cells which exist in the serialized signal train on twisted pair transmission line 14. Each clock or strobe signal operates to open a time window to permit the data waveform state which exists during that window to enter the register 22 as a bit of intelligence, the value of the bit depending on the voltage of the input waveform, either high to represent a binary "one" or low to represent a binary "zero". The output of amplifier 112 is also connected to a frequency discriminating tone

burst detector 114 which operates to single out the high frequency tone burst from the standard clock signal and to apply a reset pulse to the register 22 upon the occurrence of the tone burst. The tone burst detector output signal is gated by OR gate 116 having one input connected to the output of the tone burst detector and the second input connected to receive the clock signal after having been reduced in frequency by a factor of 104 by the frequency divider 118. Accordingly, the contents of serial-to-parallel register 22 are "refreshed" at the end of each data train.

The output of the serial-to-parallel register 22 comprises eight output lines 120 which are energized simultaneously and in parallel. The lines 120 are connected to a set of 16 "data latches" corresponding to the sixteen liquid crystal character display devices 18 which are used in a particular destination sign. Each data latch comprises the combination of two four-bit latch devices; for example in FIG. 5 the left hand-most latch comprises four-bit latch 122A and four-bit latch 122B connected to receive the eight bits from the register 22 in groups of four each. The next latch comprises four-bit latch device 124A and four-bit latch device 124B, it being understood that sixteen such combinations of two four-bit latches are provided.

The latch devices are simply holding registers implemented in T²L logic to maintain the data content of one message from register 22 during the change to a new message signal. A suitable device is available from National Semiconductor Inc. of Pasadena, Calif. In other words, the latches operate as a buffer. The eight-bit data signals are distributed between the four-bit latch pairs by means of a scanner 126 which receives the clock signal after having passed through a frequency divider 128 having a division factor of eight. Scanner 126 has sixteen output lines of which line 130 is connected to enable the latch pair comprising devices 122A and 122B. A second output line 122 from scanner 126 is connected to enable the latch pair comprising devices 124A and 124B. A third output line 124 from scanner 126 is connected to a still further pair of latch devices. Accordingly, the eight-bit data read from the register 22 are applied to the sixteen pairs of latch devices, one pair at a time, to apply data to the liquid crystal characters 18 one at a time and typically from left to right in the sign 12 of FIG. 1. It is to be understood, however, that during the initial application of data to the liquid crystal characters 18 of the sign 12, the distribution of data on the character by character basis occurs so rapidly as to present the visual impression of an instantaneous and simultaneous actuation of all characters in the particular message being displayed.

The function of the latch devices 122, 124, etc., is to continuously present a combination of data signals to a plurality of sixteen read only memory devices 136 which convert the eight-bit input code thereto into a fourteen-bit output code appearing on lines 138. As shown in FIG. 5 the output lines 138 carry D.C. voltages when energized and are electrically connected to the gate electrodes of the SCR switches 82 in circuit with the various segments of the liquid crystal character 18 which might be selected by any particular output code. As shown in FIG. 5, SCR 82a is controlled by the first of fourteen lines in the output lines at 138 whereas SCR switch 82b is controlled by the twelfth output line and SCR 82c is controlled by the thirteenth output line.

Fourteen such SCR switches exist for each liquid crystal character 18 and 16 of the read only memory devices 136 exist for a 16 character sign.

Looking now to FIG. 6 an exploded view of a preferred configuration for sign 12 is illustrated. The sign 12 shown in FIG. 6 is particularly well suited for use as an external destination sign on transit vehicles wherein the destination message is preferably readable under varying lighting conditions including both day and night conditions. Sign 12 comprises a plurality of liquid crystal display devices 18 of the type described with reference to FIGS. 2 and 3. Each of the liquid crystal devices 18 is backed up by a 50 percent reflective mirrored surface 140 and a plastic louvered film 142 having individually spaced louvers 144 disposed on an upward angle approximately 30°. A suitable louvered film is available from the 3M Company and is referred to by the manufacturer as a "display film." The laminated combination of liquid crystal device 18, mirror 140, and louvered film 142 is disposed within an opaque housing 146 having a plurality of selectively energizable fluorescent lighting tubes 148.

As shown in FIG. 6 the sign 12 is typically viewed from somewhat beneath the normal elevation of the sign such that the viewing angle is intercepted by the 30° louvers to prevent the viewer from observing the fluorescent lighting tubes 48 under normal conditions. At the same time, the louvers permit excessive back-lighting to be exhausted upwardly where it is not visible to the observer. As is also shown in FIG. 6, sunlight is typically reflected off of the 50 percent mirrored surface 140 to the viewer enhancing the contrast of the liquid crystal display when properly energized.

To summarize the operation of the circuit of FIG. 5, the operator selects a message to be displayed and positions the thumbwheels of switch device 28 to represent that message. From the thumbwheel positions, code conversions and expansions are carried out until a data signal comprising a relative large number of bits is generated. This data signal is then serialized and transmitted along with a clock signal and a reset signal to the sign 12. At the sign, the serialized data train is synchronously detected and fed into the register 22 for conversion into a sequence of eight-bit parallel words. These words are distributed among the buffer latches 122, 124, etc. which retain the current data code until a new message is selected. The latches feed the memories 136 which output signal combinations in such number as to energize all of the selected segments of respective display devices 18. The message is continuously displayed until a new message code is set via the thumbwheels.

It is to be understood that the specific embodiments of the invention which have been described herein are illustrative only and are not to be construed as limiting the invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A programmable display system for information comprising: a plurality of field-responsive liquid crystal character display devices disposed in lineal juxtaposition to form a sign, each of said character display devices comprising a plurality of separately actuable character-forming segments whereby each device may represent any of a plurality of individually recognizable characters, input means for producing any of a plurality of digital input programs, data storage means con-

nected to said input means and responsive to said programs for producing a plurality of multiple bit data words each representing segments of a character in said sign to be actuated to represent the programmed information; and transmitting means for distributing said data words to said segments of said liquid crystal character display devices, said transmitting means comprising first register means connected with said storage means for serializing the bits of said data words, clock means, first scanning means controlled by said clock means and connected with said storage means for causing said plurality of data words to be read one at a time into said register means, said input means, storage means, clock and transmitting means being located remotely from said sign, receiving means located proximate said sign and including a latch register means for each character of said sign; second register means for receiving said plurality of data words with the bits thereof in serial form and for converting the bits of each word into parallel form, a first transmission line connecting the first and second register means for transmission of the bits of the data words in serial form, each of said latch register means being connected between said second register means and a respective character display device, power supply means for said liquid crystal display devices, a plurality of electronic switch devices connected respectively to said segments and to said power supply and having an actuating input for selective actuation thereof, means connected between said latch registers and said switch inputs for selectively actuating the switch devices in accordance with said data words, second scanner means connected by a second transmission line to said clock and controlled thereby and connected to said second register means for causing transfer of one word at a time from the second register means to successive latch register means, whereby each latch register means maintains continuous actuation of its respective display device during the subsequent actuation of the remaining display devices in said sign, generator means for generating a synchronizing signal having a frequency which is less than the frequency of said clock means, said generator means being connected with said second register for synchronizing the actuation thereof with said data words, detector means connected with said second register for detecting the occurrence of said synchronizing signal at the end of transmission of all of said plurality of data words, and reset means connected between said detector means and said second register for resetting said second register after receipt of said plurality of data words whereby the succeeding transmission of said data words will be effective to provide data to said latch registers in accordance with such succeeding transmission.

2. A display system as defined in claim 1 wherein said sign comprises in addition to said plurality of liquid crystal character display devices, a separately actuable back-lighting means for illuminating said sign under low ambient light conditions.

3. A display system as defined in claim 2 wherein said sign includes in addition, a set of louvers between the liquid crystal character display devices and the back-lighting means for concealing the back-lighting means from certain predetermined viewing angles.

4. A display system as defined in claim 3 including a partially mirrored surface area between the liquid crystal character display devices and the louvers for partially reflecting ambient light incident on the sign.

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