United States Patent

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[54] **MULTIPOINT CONTROL SYSTEM**
10 Claims, 6 Drawing Figs.

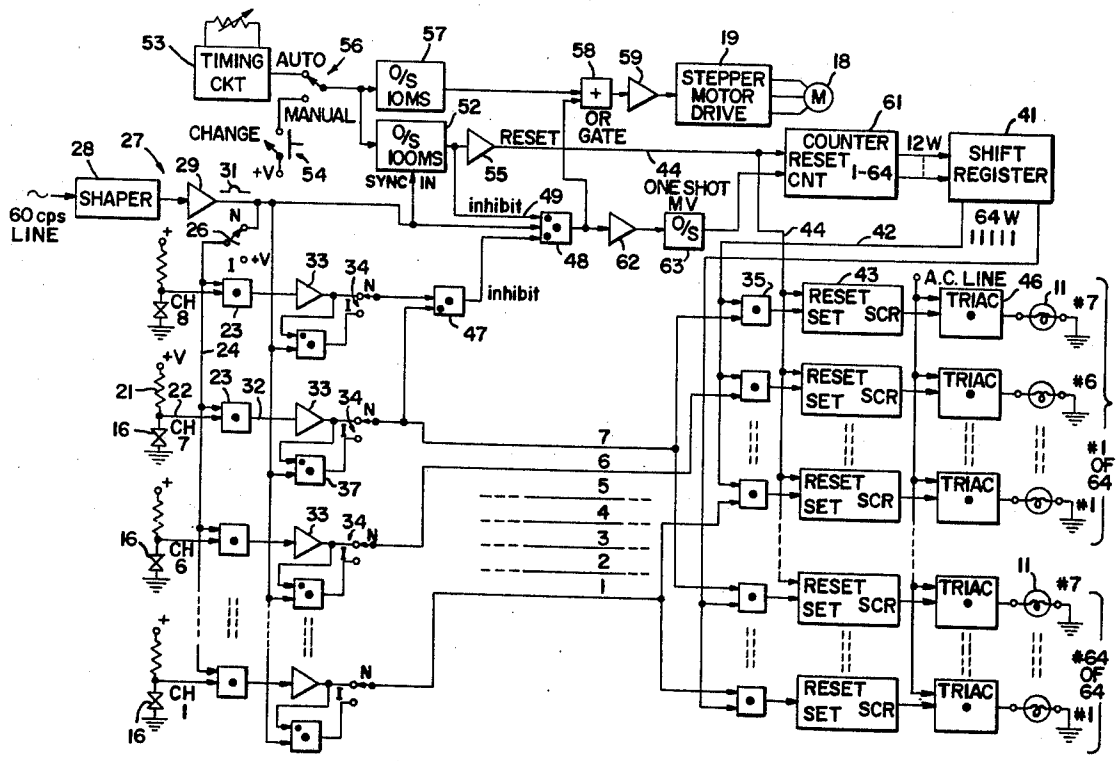
[52] **U.S. Cl.** **340/339,** 340/334
[51] **Int. Cl.** **G08b 5/36**
[50] **Field of Search** 340/334, 324, 324.1, 336; 178/42; 340/339

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ABSTRACT: A multipoint control system provides visual display of a message with a matrix of light sources arranged in columns and rows. An input tape is coded with the display information by blacking out certain squares of the tape format which is similar to the display format or punching holes in the tape. The tape is then passed over a column of photosensitive devices and the information transferred to silicon controlled rectifiers which drive triacs coupled to the light sources. A shift register provides for sequential activation of the respective display columns of the light sources. The coded format tape is indexed and synchronized with the activation of the light sources of the various columns.



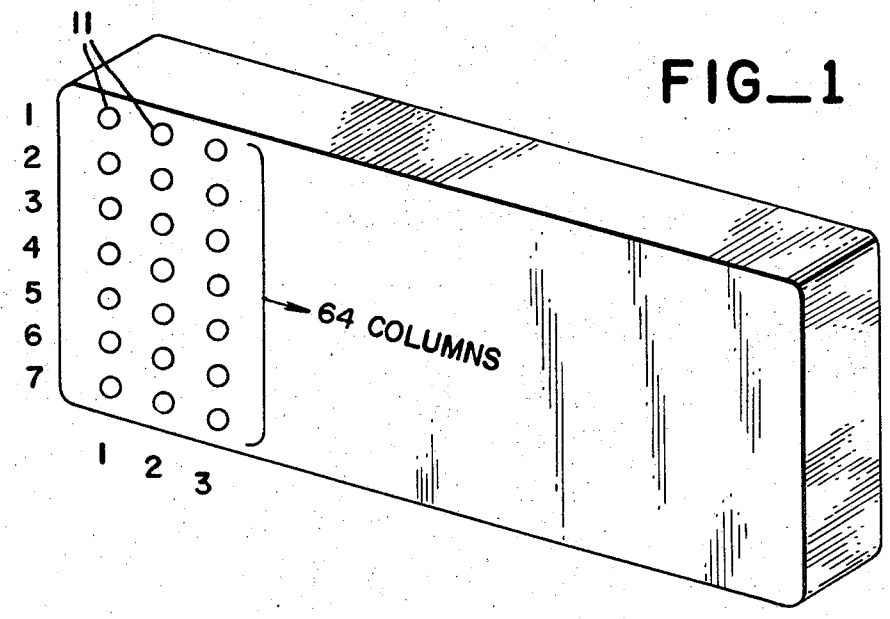


FIG_1

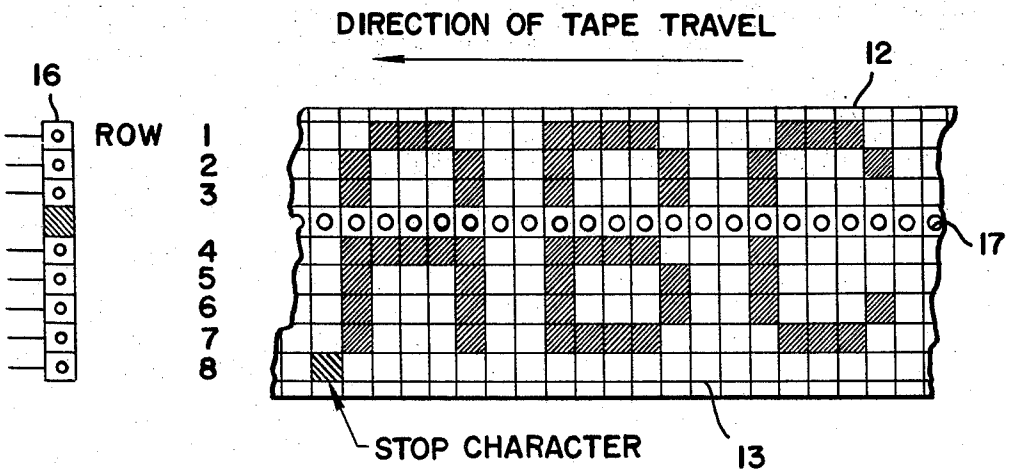
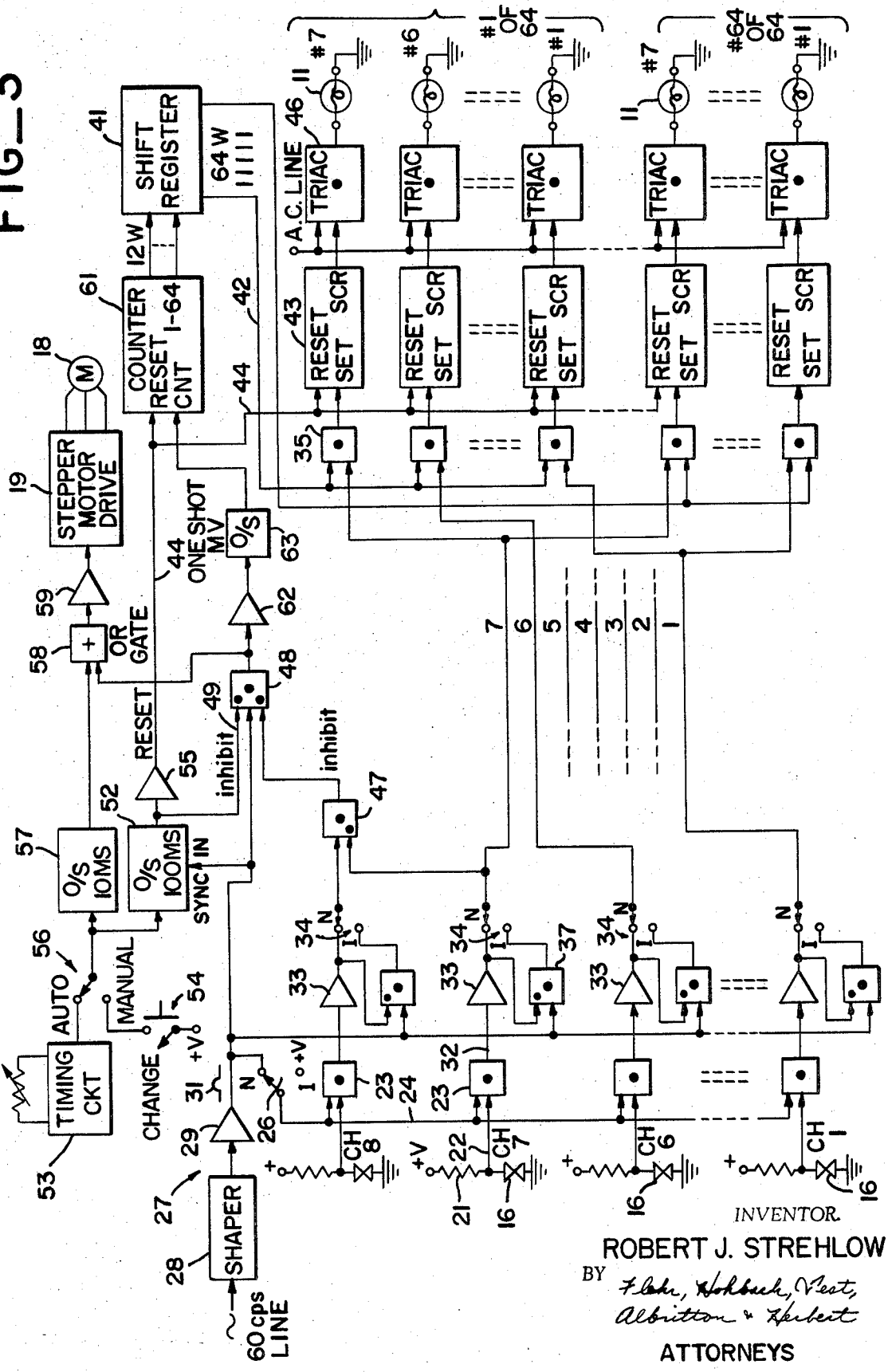


FIG_2

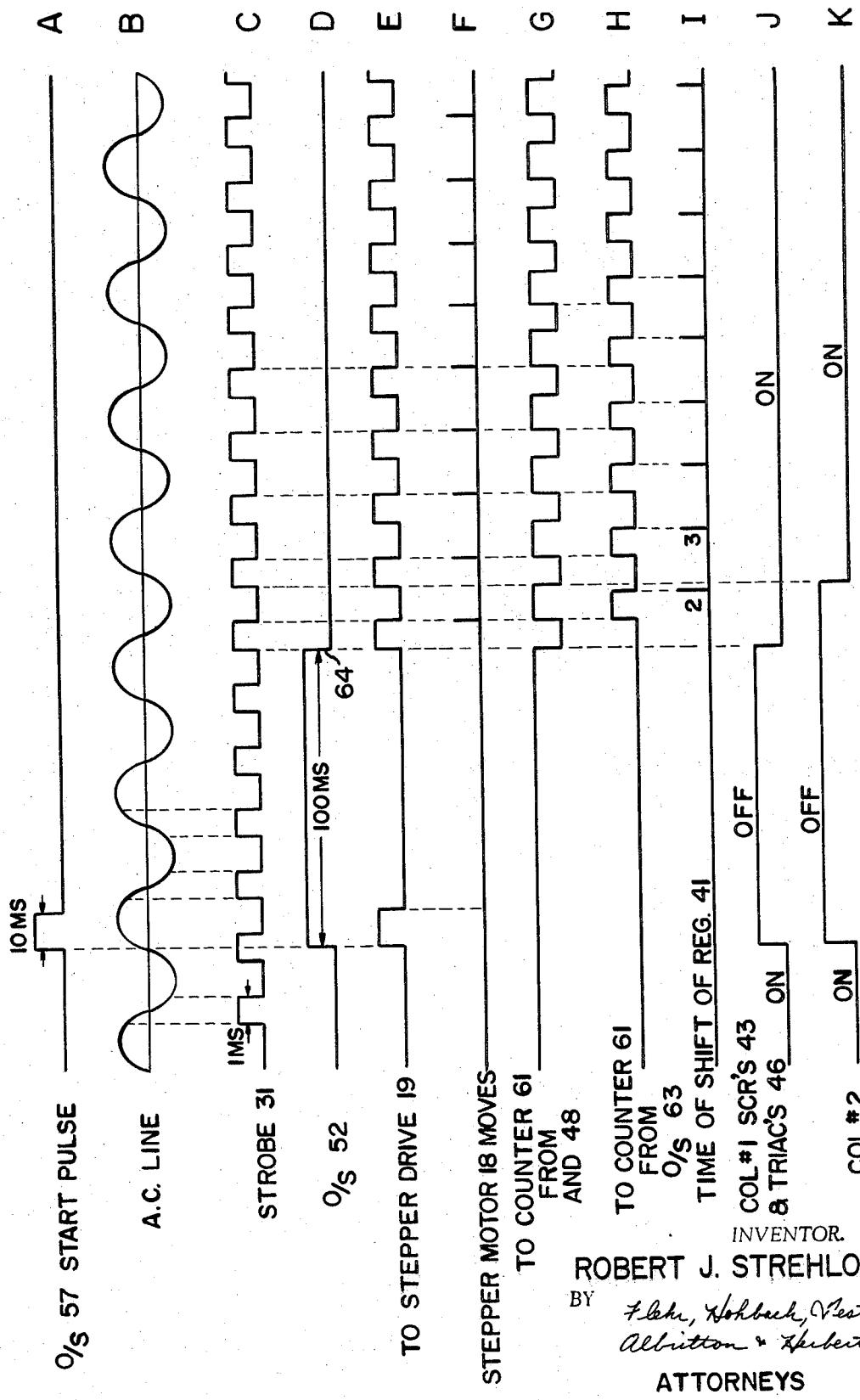
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FIG_3



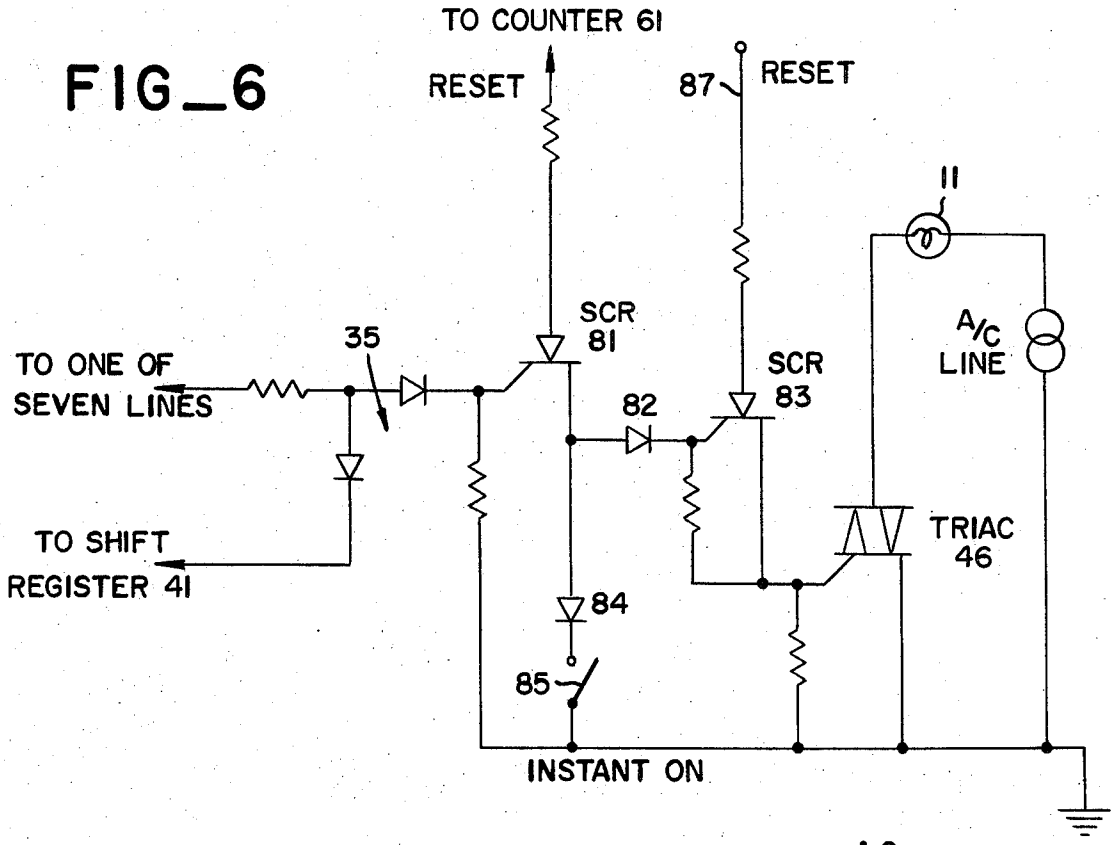
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FIG_4



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FIG_6



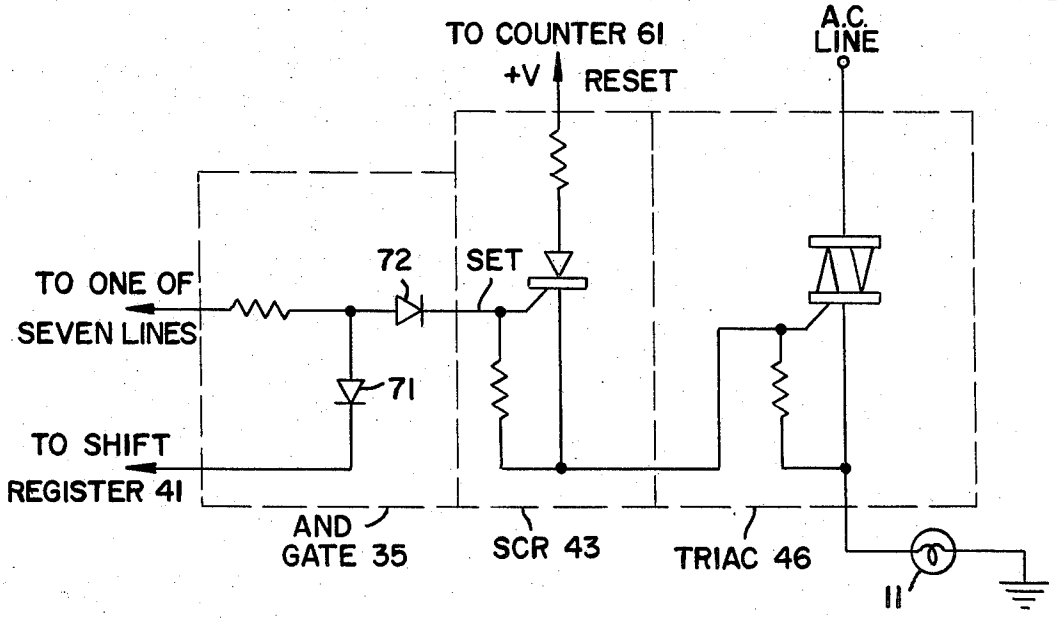


FIG_5

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MULTIPOINT CONTROL SYSTEM

BACKGROUND OF THE INVENTION

The present invention is directed in general to a multipoint control system and more particularly to a system for the display of visual information in a multipoint format of rows and columns.

The display of information in a multipoint visual display format has required a complex coding of the information to be displayed. In addition, the system circuitry required to sense the code input and translate it to a visual display has been cumbersome, inflexible and expensive.

SUMMARY OF THE INVENTION AND OBJECTS

It is therefore a general object of the invention to provide an improved multipoint control system.

It is another object of the invention to provide a system as above which is simple, flexible in use and inexpensive.

In accordance with the above objects, there is provided a multipoint control system for controlling a visual display unit with a plurality of individual visual display points arranged in a predetermined format of rows and columns. Each of the points has two types of visual display indications. The visual display is determined by a coded input. The improvement comprises a coded input tape having a code format arranged in rows and columns similar to the visual display format.

Code sensing means are arranged in a single column corresponding to a code format column of the tape. The sensing means have a plurality of information channels individually associated with a particular row of the column, the channel producing a signal in response to a code indication on the tape in that row. Successive columns of the input tape are moved into registration with the code sensing means.

A shift register is provided which includes sequentially activated control lines associated with each of the columns of the visual display points. Timing means synchronize the sequential activation of the control lines of the shift register with the successive column movement of the tape.

Each of a plurality of bistable switching means is coupled to one of the display points, to one of the control lines of the shift register corresponding to the column of the visual display point to which it is coupled, and to an information channel of the code sensing means corresponding to the row of the visual display point to which it is coupled. The switching means is responsive to the time coincidence of a signal on its associated channel and the activation of its control line for producing a predetermined one of the two types of visual display information.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the multipoint visual display unit embodying the present invention;

FIG. 2 is a plan view partially broken away of a portion of the coded tape reader of the present invention showing a coded tape and a photosensitive reading device;

FIG. 3 is a block diagram embodying the multipoint display control system of the present invention;

FIGS. 4A through 4K are timing diagrams useful in understanding the invention;

FIG. 5 is a detailed schematic diagram of a portion of FIG. 3; and

FIG. 6 is a detailed circuit diagram showing an alternative embodiment of FIG. 5.

DESCRIPTION OF THE EMBODIMENTS

Referring first to FIG. 1 the visual display unit illustrated has a visual display format of 64 columns, only the first three being indicated, and 7 rows. Each visual display point 11 may be a light source which has on and off conditions. Thus, a visual information display is produced by the illumination of preselected light sources 11.

The above display format is correlated with the code format on an input tape as illustrated in FIG. 2 which is utilized for determining the specific display on the visual display unit as illustrated in FIG. 1. More specifically the tape 12 is again divided into columns and rows corresponding to the number of columns and rows in which the display information is programmed. An eighth row on tape 12 is for a stop character. Thus, each space 13 on the tape 12 corresponds to a point on light source 11 of the display unit FIG. 1 which is in the same relative position. Visual display information such as the letters A, B, and C indicated on the tape in cross hatching may be placed on the transparent tape by blanking the space out to make it opaque to light or alternatively punching a hole in an opaque tape.

Means for sensing this type of code is provided by a single column of photosensitive devices 16 which are located in the path of movement of the tape 12 and are in registration with the individual eight rows of the tape. The tape itself is indexed so that its columns are placed in successive registration with the photosensitive devices 16. The moving means is a stepping motor 18 (see FIG. 3) which drives the tape by means of sprocket holes 17.

Each of the photosensitive devices 16 provides an output information channel which corresponds to the specific row of the format with which it is in registration.

The above channels are more specifically illustrated in FIG. 3 where the photosensitive devices 16 are shown along with the corresponding information channels. Only four out of eight are shown. The stepper drive generally indicated at 18, drives the tape 12 of FIG. 2. Representative individual light sources 11 are also illustrated in the row and column of the display format in which they are located. Only two columns are shown; specifically, the first of the 64 columns and the 64th column.

Channel 7 or row 7 representative of the remaining six channels and includes a photosensitive device 16 coupled to a positive voltage source, +V, through a resistor 21. The other terminal of the photosensitive device 16 is fed to common or ground terminal. As mentioned in conjunction with the coded input tape of FIG. 2, a transparent tape may be coated with an opaque design or on the other hand an opaque tape may be punched with holes. In the case illustrated in FIG. 2, where opaque squares are used to form the design, photosensitive device 16 is, in the absence of a code indication, illuminated clamping the line 22 to ground. Line 22 is coupled into the AND gate 23 which has as a second input a line 24 coupled through a switch 26 to a source of strobe or timing pulses 27. The timing pulse source includes a pulse shaper 28 powered by a 60 Hz. power line which is connected to an amplifier 29 to produce a strobe pulses 31.

A signal is produced on line 22 when an opaque code indication on tape 12 interrupts the activation of photosensitive device 16 allowing the +V voltage source to activate line 22. AND gate 23 in turn produces an output signal on its output line 32 upon the coincidence of signals on line 22 and 24. Line 32 is coupled to an amplifier 33 which is coupled through a switch 34 to an AND gate 35 which is associated with a light source 11 of the display unit. This light source is more specifically the first column and the seventh row as indicated. Switch 34 is in the N position as shown when an opaque code indication is used. Its second position I, which directs the output of amplifier 33 into an AND gate 37, is used when the code indication on the tape 12 is a punch. Switch 26 is ganged to switch 34 and also has similar N and I positions. When switch 26 is placed in the I position, line 24 has a +V potential permanently placed on it.

Referring more specifically to the display unit portion of FIG. 3 associated with the light sources 11, the AND gate 35 in addition to its information channel input from photosensitive device 16 includes a second coincidence input from a shift register 41. The shift register has 64 control lines, each one of the lines being associated with one of the 64 columns of the visual display format. Thus, all of the AND gates 35 of the first

column of which there are seven, are tied together at the single control line 42. The output of AND gate 35 is coupled to the set terminal of a silicon controlled rectifier circuit 43. The reset terminal of SCR 43 is coupled to a reset line 44 which extends to all the remaining SCR's for all of the columns of visual display format. Details of the setting and resetting action will be explained in conjunction with FIG. 5. The output of SCR 43 activates a triac 46 which functions as a bipolar switch to couple the AC line voltage to a light source 11. This AC line is coupled to all triacs of the display unit.

Channel 8 of the photosensitive reading portion of the present invention provides a stop pulse for the coded input tape. It is similar to channel 7 except that the output of its amplifier 33 is coupled through switch 34 to an AND gate 47. The other coincidence terminal of the AND gate is coupled to the output of amplifier 33 of channel 7. This coupling extends through an inverter as indicated by a dot at the input to AND gate 47. Thus, this AND gate is activated when a signal appears on channel 8 and there is no code indication on channel 7. The output of AND gate 47 is labeled "inhibit" and is coupled into one of the three coincidence terminals of AND gate 48 through an inverter indicated by the dot. AND gate 48 includes a second inhibit line 49 also coupled through an inverter. The third coincidence input 51 is coupled to the strobe or timing source 27 and in addition to a one shot multivibrator 52 which is activated either through a timing circuit 53 or a manual pushbutton 54. A selection between the timing circuit 53 and the pushbutton 54 is provided by a switch 56. Switch 56 is also coupled to a second one shot multivibrator 57 which in turn is coupled to an OR gate 58. The other input terminal to OR gate 58 is coupled to the output of AND gate 48.

The output of OR gate 58 is coupled through a differentiating amplifier 59 to activate a stepper motor drive 19 which causes motor 18 to drive the coded tape 12 (FIG. 2).

One shot multivibrator 52, in addition to being coupled to inhibit line 49, is coupled through an amplifier 55 to the reset line 44. Reset line 44 is also coupled to the reset terminal of a counter which has as its counting input the output of AND gate 48 which is coupled to the counter through an amplifier 62 and a one shot multivibrator 63 to provide a time delay. Counter 61 is coupled through 12 wires to shift register 41.

OPERATION

The operation of the multipoint control system of the present invention, as disclosed in FIG. 3, can best be understood by also referring to the time diagrams of FIGS. 4A through K. When a fixed visual display is present on the display unit, as illustrated in FIG. 1, the coded tape 12 will be stopped in a position so that the stop character as illustrated in FIG. 2 is in registration with the photosensitive device 16 of channel 8. This produces an output on the AND gate 23 related to that channel and thus a subsequent code indication to AND gate 47. On the other hand, in channel 7 since there can be no code indication for a proper stop indication, there is a no signal condition on the other input to AND gate 47 but since this is inverted an inhibit output is produced by the AND gate. This inhibit output is inverted in turn by the AND gate 48 to prevent the production of a stepping pulse to a stepper drive 19. These stepper pulses would normally be produced on line 51 by the strobe pulses 31.

A start pulse is produced either from the timing circuit 53 or activation of pushbutton 54. This activates through switch 56 both one shot multivibrator 57 to produce a 10 millisecond pulse as shown in FIG. 4A and in addition, one shot multivibrator 52 as shown in FIG. 4D. The output of multivibrator 57 activates stepper drive 19 through OR gate 58 to produce a stepper drive pulse as shown in FIG. 4E. This moves the tape 12 one step or one column to the beginning of the code information for the visual display. Since the tape 12 was moved from the stop position, the inhibit condition from AND gate 47 to AND gate 48 is discontinued. However, in its place there is a new inhibit condition from the 100 millisecond pulse of multivibrator 52 to prevent any further indexing or stepping of the tape by the strobe or stepping pulses 31. Strobe pulses 31 are indicated in FIG. 4C. At this time, during the 100 millisecond interval, the output from multivibrator 52 also provides a reset indication on line 44 to reset SCRs 43 to erase the previous message from the system, reset shift register 41, and set the counter 61 to its No. 1 position. The 100 millisecond pulse is also synchronized to the strobe pulses 31 by the interconnection between one shot multivibrator 52 and and strobe pulse source 27. This provides for recovery of the one shot on the leading edge of the strobe pulse 31 as shown at 64 in FIG. 4D.

During the 100 millisecond time delay, as shown in FIG. 4D, the condition of the photosensitive device 16 are detected since column 1 of the coded tape 12 is now in registration with them. If a code indication is present in the particular row with which a photosensitive device is associated, it will send a signal to associated AND gate 35. As mentioned previously, since the start pulse reset the counter 61 to 1 and also the shift register, the AND gate 35 associated with the first format column will thus be closed providing a set pulse to SCR 43. However, SCRs 43 cannot be activated until the cessation of the inhibit or reset pulse from multivibrator 52. This occurs at 64 of FIG. 4D in synchronization with the leading edge of strobe 31 of (FIG. 4C). The concurrent setting of SCRs 43 and triac 46 is indicated in FIG. 4J.

FIG. 4K illustrates when the second column of indicator light 11 is energized. This occurs after shift register 41 has shifted to its second, 2, condition as shown in FIG. 4I. AND gate 35 is later closed at the beginning of a strobe pulse 31 at which time the photosensitive devices 16 are read for their code indication and the SCRs 43 and triacs 42 associated with the second column are closed in response to a code indication. Since the strobe pulses 31 also provide stepper drive pulses as shown in FIG. 4E, through OR gate 58 and AND gate 48 at the time that the code indication is read, the stepper is prepared to immediately move to the next position. The move (FIG. 4F) is provided on the trailing edge of the strobe pulse because of its differentiation by differentiator 59 (FIG. 3). Thus, since the reading of a code indication or character is just done prior to the stepper motor movement this allows the maximum amount of time for the stepper drive 18 to reach its steady state condition from the previous indexing movement or step.

Switching of the SCRs 43 and the triacs 46 is also accomplished at or near the zero crossover line of the AC line signal indicated in FIG. 4B. This signal powers strobing unit 27 (FIG. 3) to provide a strobe pulse 31 which, as indicated by the dashed lines, occurs at substantially the line zero crossover point of the AC power input signal to triac 46. Note that the AC line signal of FIG. 4B is not to relative scale as compared to the millisecond indications given for the various other timing pulses.

As shown in FIGS. 4J and 4K, switching occurs at or near the leading edge of a strobe pulse. Thus, triacs 46 are turned on at or near zero line voltage which minimizes line transients and prevents the application of a step voltage change to the load connected to the triac. From another aspect, the use of triacs also allows the full AC line current to flow into the load avoiding the detrimental effects of DC current from some applications.

To complete the visual display, the strobe pulses 31 continue the stepping movement of tape 12 to, in effect, "wipe-on" the information of the coded tape at a rate of 120 columns per second. Thus, with a 64 column format, the information is displayed in approximately a one-half second.

One shot multivibrator 63 provides a 1 millisecond time delay (FIG. 4H) before the strobe pulse is applied to the shift register 41 to cause it to add another count as indicated in FIG. 4I. This delay insures that no information is being transferred to the SCRs 43 and triacs 46 during the time tape 12 is moving or the shift register is changing position.

The detailed circuitry of AND gate 35, SCR 43, and triac 46 is shown in FIG. 5 where the dashed blocks correspond to the

blocks of FIG. 3. The coincidence inputs to AND gate 35 are first from shift register 41 and secondly from one of the seven lines which extend to the photosensitive devices 16. Normally, a shift register provides a permanent ground on the diode 71 thus shunting any positive voltage on the signal line to ground. This prevents current from flowing through diode 72 to set input gate of SCR 43. However, when shift register 41 enables a particular column, ground is unclamped allowing a signal from the input line to set SCR 43. SCR 43 immediately provides a signal input to the gate of triac 46 to cause it to complete a conductive path from the AC line to ground through the light source 11. The condition is maintained until counter 61 resets SCR 43 by removal of its positive anode voltage.

For some applications, an instant "on" system may be desirable. In this mode, information from a coded input tape is read into a primary storage column with the information from a previous tape in secondary storage. Upon command, the secondary storage is erased and updated with the information transferred from the primary storage. Thus, the entire visual display format which is controlled by the secondary storage is illuminated in one instant.

The circuit of FIG. 6 provides the instant "on" feature which includes a triac 46 similar to that in FIG. 5 which is coupled to a light source 11 which is in series with an AC line voltage source. AND gate 35, similar to that of FIG. 5, is coupled however to an SCR 81 which serves as primary storage which in turn is coupled through a diode 82 through secondary storage, SCR 83. SCR 83 is coupled to triac 46 to provide a trigger input. SCR 81 has as its cathode terminal grounded through a diode 84 and a switch 85. One other modification to the circuit is the use of a different timing cycle for resetting the rest terminal 87 of SCR 83.

In operation, information is stored in SCR 81 in the same manner as described in conjunction with FIG. 5. The coincidence of a shift register level in the proper column along with a signal from one of the several lines from photosensitive sources 16 is necessary to trigger SCR 81 on. Normally, current flows from its anode through diode 84 and through closed switch 85 to ground. When it is desired to instantaneously update all of the control points the SCRs 83 are reset and thereafter switches 85 are opened. This causes the current which SCR 81 was formerly conducting, if any, to be transferred through diode 82 to trigger SCR 83 on. Thus, the SCRs 83 and the associated triacs 46 will now contain all of the visual display information. Thereafter, switch 85 may again be closed, the SCRs 81 reset and the succeeding message of visual display placed into the SCRs 81 in the same manner as the embodiment of FIG. 5.

Thus, the present invention provides a multipoint display system which has flexibility and is simple and inexpensive. In addition, the concept of the present system may also be used for control in nonvisual applications. For example, each of the visual display points could instead represent a motor or other control action; activation of groups of motors could be sequentially controlled.

I claim:

1. A multipoint control system for controlling a visual display unit with a plurality of individual display points arranged in a predetermined format of rows and columns, each of said points having two types of visual display indications, said visual display being determined by a coded input, the improvement comprising: a coded input tape having a code format arranged in rows and columns similar to said visual display forms; code sensing means arranged in a single column corresponding to a code format column of said tape said sensing means having a plurality of information channels individually associated with a particular row of said column said channel producing a signal in response to a code indication on said tape in such row; means for moving successive columns of said input tape into registration with said code sensing means; a shift register including sequentially activated control lines associated with each of said columns of said visual display points; timing means for synchronizing the sequential activation of the control lines of said shift register with the successive column movement of said tape; and a plurality of bistable switching means each coupled to one of said display points, to one of the control lines of the shift register corresponding to the column of the visual display point to which such switching means is coupled, and to an information channel of said code sensing means corresponding to the row of said visual display point to which such switching means is coupled, a single switching means being responsive to the time coincidence of a signal on said associated information channel and the activation of said associated control line for producing a predetermined one of said types of visual display information.

2. A multipoint control system as in claim 1 together with gating means coupled to said code sensing means for gating any code indication on said tape in synchronization with said timing means.

3. A multipoint control system as in claim 1 together with an AC power source which is coupled to a display point by said bistable switching means, in which said timing means provide a timing pulse in substantial synchronization with the zero crossing level of the AC power source signal to switch said bistable switching means at substantially the same time as said zero crossing of said AC signal.

4. A multipoint control system as in claim 1 together with time delay means coupled to said timing means for inhibiting said tape moving means while said bistable switching means are being reset to a first predetermined condition.

5. A multipoint control system as in claim 1 together with differentiating means coupled between said timing means and said tape moving means for providing for movement of said tape only at the trailing edge of a timing pulse of predetermined width.

6. A multipoint control system as in claim 1 together with switching means coupled to said code sensing means to condition such sensing means to accept a code format on said tape of either written opaque data or punched holes.

7. A multipoint control system as in claim 1 together with additional switching means for storing said visual display information and thereafter displaying it in a single instant.

8. A multipoint control system as in claim 1 in which said means for moving said tape is indexed.

9. A multipoint control system as in claim 1 in which said bistable switching means store the information on each coded import tape together with means for resetting all of said switching means to a common condition.

10. A multipoint control system for controlling a plurality of individual control points arranged in a matrix having a format of rows and columns, each of said points having two control conditions, the control conditions of each of said points being determined by a coded input to said system, the improvement comprising: a coded input tape having a code format arranged in a matrix with rows and columns corresponding to said control point matrix; code sensing means arranged in a single column corresponding to a code format column of said tape said sensing means having a plurality of information channels individually associated with a particular row of said column said channel producing a signal in response to a code indication on said tape in such row; means for moving successive columns of said input tape into registration with said code sensing means; a shift register including sequentially activated control lines associated with each of said columns of said control points; timing means for synchronizing the sequential activation of the control lines of said shift register with the successive column movement of said tape; and a plurality of bistable switching means each coupled to one of said control points, to one of the control lines of the shift register corresponding to the column of the control point to which such switching means is coupled, and to an information channel of said code sensing means corresponding to the row of said control point to which such switching means is coupled, a single switching means being responsive to the time coincidence of a signal on said associated information channel and the activation of said associated information channel and the activation of said associated control line for producing a predetermined one of said types of control conditions.