

Jan. 30, 1968

R. G. BOWMAN

3,366,945

ROTARY SWITCH CONTROLLED ALPHA NUMERICAL DISPLAY SYSTEM

Filed Feb. 12, 1963

3 Sheets-Sheet 1

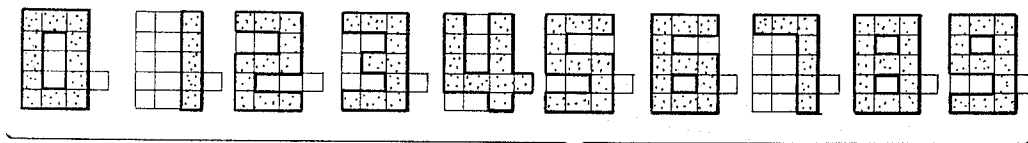
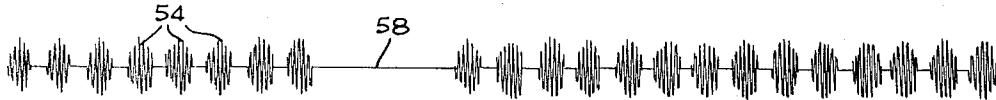
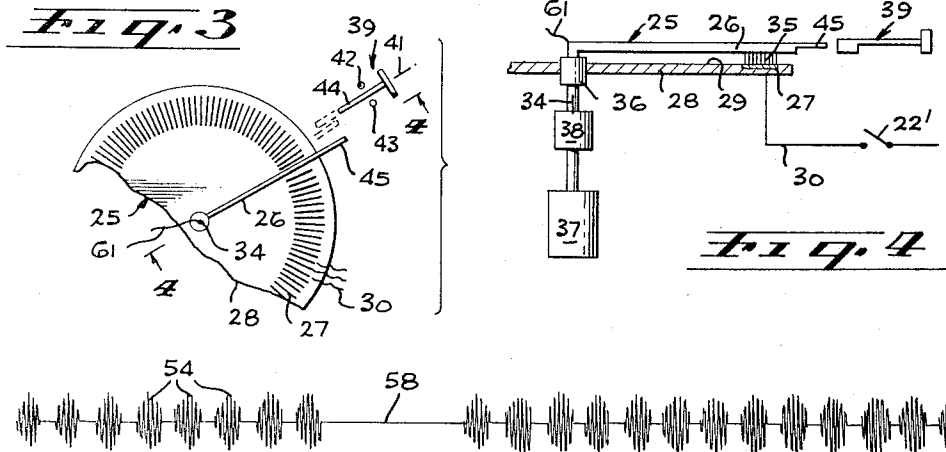
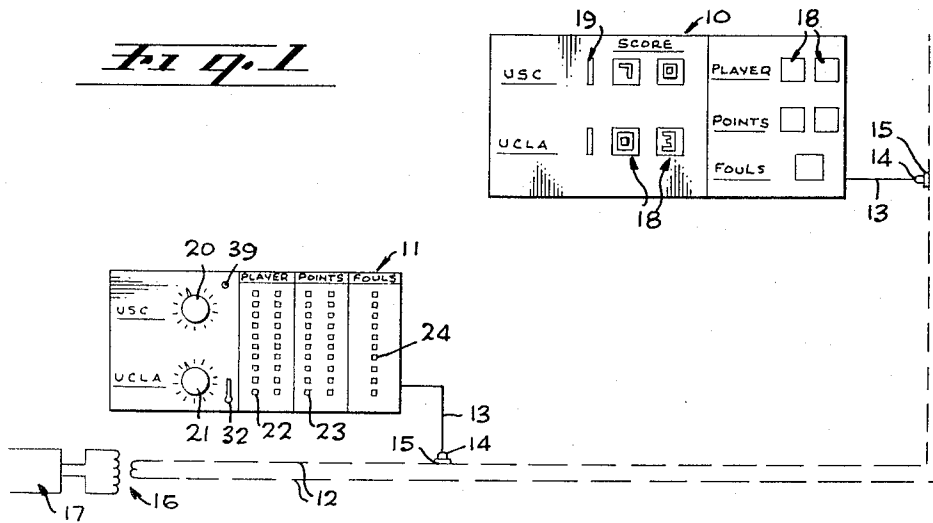


Fig. 7

INVENTOR.

RICHARD G. BOWMAN

BY

William F. Green
ATTORNEY

Jan. 30, 1968

R. G. BOWMAN

3,366,945

ROTARY SWITCH CONTROLLED ALPHA NUMERICAL DISPLAY SYSTEM

Filed Feb. 12, 1963

3 Sheets-Sheet 2

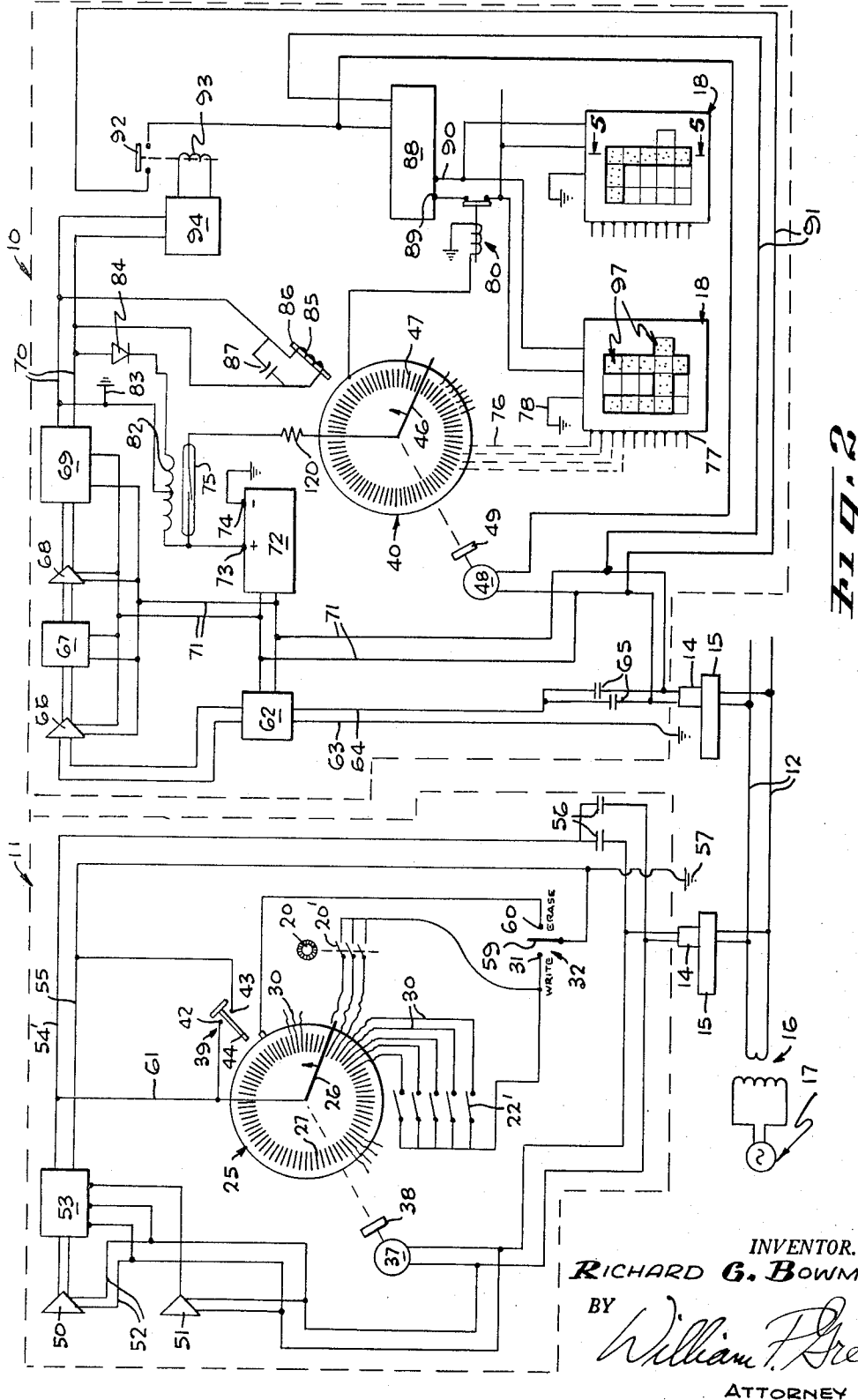


Fig. 2

INVENTOR.
RICHARD G. BOWMAN
BY *William F. Green*
ATTORNEY

Jan. 30, 1968

R. G. BOWMAN

3,366,945

ROTARY SWITCH CONTROLLED ALPHA NUMERICAL DISPLAY SYSTEM

Filed Feb. 12, 1963

3 Sheets-Sheet 3

Fig. 5

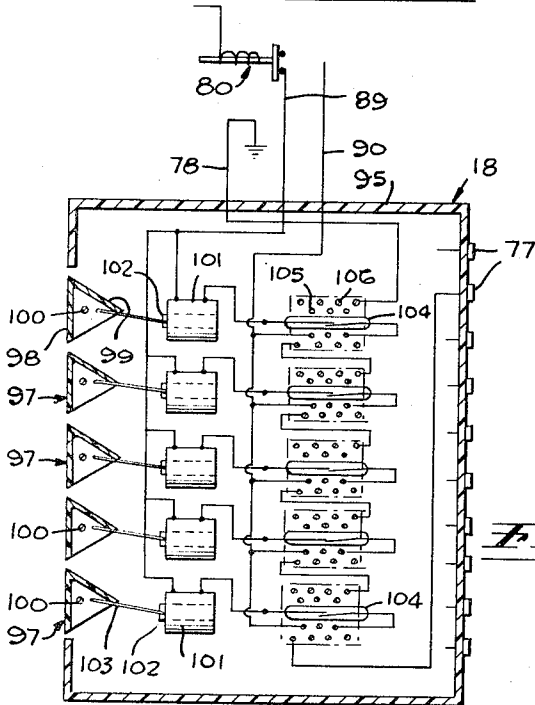


Fig. 10

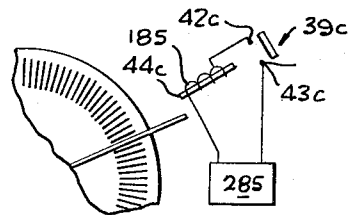


Fig. 11

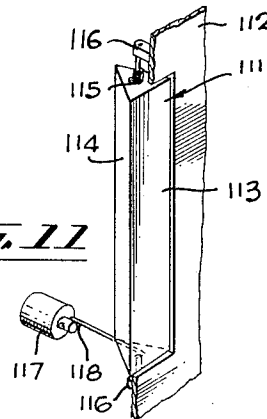


Fig. 8

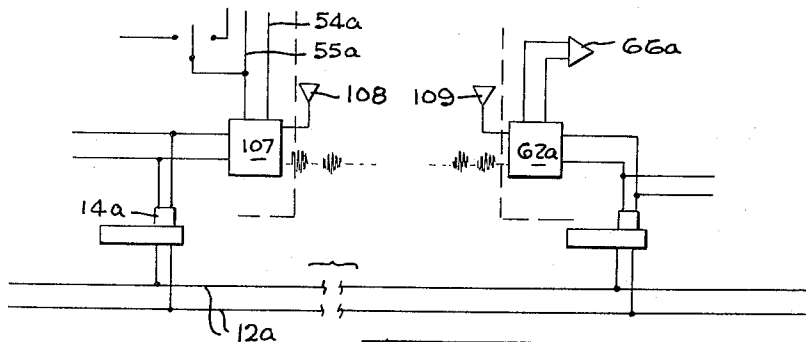
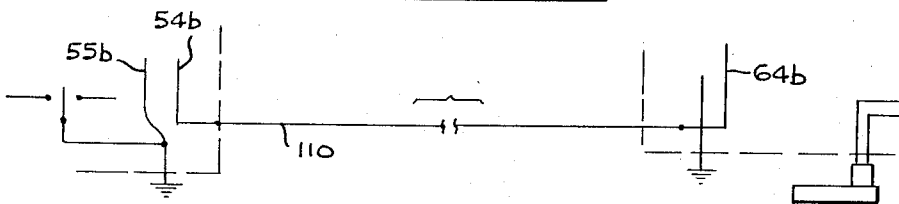


Fig. 9



INVENTOR.
RICHARD G. BOWMAN

BY
William P. Green
ATTORNEY

1

3,366,945

ROTARY SWITCH CONTROLLED ALPHA NUMERICAL DISPLAY SYSTEM

Richard G. Bowman, 7652 Bella Vista,
Los Angeles, Calif. 90045

Filed Feb. 12, 1963, Ser. No. 257,890

9 Claims. (Cl. 340—324)

This invention relates to an improved alpha numerical type remote controlled display system, adapted for use as a scoreboard system for athletic events, or for any of numerous other uses in which it may be desired to selectively display any of various different numerals and/or letters at a particular location. The invention will be discussed primarily herein as applied to scoreboard situations. Certain particular features of some of the apparatus disclosed in this application are covered in my co-pending application Ser. No. 257,922, filed Feb. 12, 1963, on "Display Unit for Scoreboards or the Like," now Patent No. 3,250,031.

In most sports, it is necessary that the official scorer be located at a point which is a substantial distance from the main scoreboard of the stadium, arena, or field at which the event is taking place. To enable the transmission of information from a control unit at the scorer's location to the board, prior remote control systems have generally required the provision of a multiple conductor electrical cable extending between the control location and the scoreboard. In view of the very extended length of cable normally required for this purpose, the cost of the cable is a substantial factor in the cost of the overall scoreboard system, and the installation of the cable is frequently much greater than its cost. Further, the installation of such a cable is frequently inconvenient in many scoreboard situations, or other instances in which alpha numerical type display units are employed, and may necessitate the positioning of the scoreboard or control unit at an otherwise undesired location simply to enable proper connection to the cable.

A major object of the present invention is to provide an alpha numerical type remote control arrangement which may, if desired, completely eliminate the necessity for the installation of any special cables or conductors between the control unit and scoreboard or other display unit. In the preferred form of the invention, the only connection of any type between the control panel and display assembly is through the already present AC power lines from which the assembly receives its operating power. Thus, the only installation that is necessary is to mount the two devices at the desired locations, and then plug each into a conventional power outlet. The two devices contain timed coding and decoding elements which are driven in predetermined timed relation in a manner forming a telemetering system capable of transmitting different bits of control information successively over a single transmission media, preferably the power lines as mentioned. Also, the coding and decoding elements are maintained in the desired timed relation in extremely simple manner by designing them to be controlled by the frequency of the main alternating power supplied by the power lines. This may be attained by utilizing synchronous motors for driving the coder and decoder, with these motors turning exactly in correspondence with the alternations of the power source. The control signals applied to the power lines may then be supplied at a higher frequency which will not interfere with the main power, and which can be filtered from the main power lines at the scoreboard location to perform a separate control action.

If it is preferred in a particular instance, the control signals may be transmitted by radio waves, or if desired

2

may be transmitted by a single separately installed wire extending between the control and display locations. Such a single conductor is of course much easier to install than the conventional multiple conductor cable, and in addition need not carry as high currents as is required in the usual multiple conductor cable arrangement.

A further object of the invention is to provide a remote control system of the discussed type in which interference or noise introduced unintentionally into the control signal cannot cause undesired actuation of the display assembly. For this purpose, I employ a unique arrangement in which control signals are transmitted in the form of interruptions of an otherwise uninterrupted train of pulses. Since noise in the system cannot act to set up an interruption of this type in the transmitted pulse train, such noise is effectively prevented from unintentionally actuating the display assembly to a changed condition.

Additional features of the invention relate to a novel manner of controlling erasure of previously displayed numerals or the like, with the apparatus being designed to enable an operator to preset his control switches to any desired display condition, and then by momentary actuation of the single erase switch, cause all previously displayed information to be erased and the new preset information to be displayed.

The above and other features and objects of the invention will be better understood from the following detailed description of the typical embodiments illustrated in the accompanying drawings in which:

FIG. 1 is a representation of a scoreboard system constructed in accordance with the invention;

FIG. 2 illustrates the electrical circuit diagram of the control box and scoreboard device of FIG. 1;

FIG. 3 is an enlarged view of the FIG. 2 coder;

FIG. 4 is a view taken on line 4—4 of FIG. 3;

FIG. 5 is a somewhat diagrammatic vertical section taken on line 5—5 of FIG. 2;

FIG. 6 illustrates the pulse train signal which is utilized for transmitting information from the control box to the scoreboard;

FIG. 7 shows the manner in which each of the display units may form the various numerals from 0 to 9;

FIGS. 8, 9 and 10 illustrate fragmentarily the circuit diagrams of two variational forms of the invention; and

FIG. 11 shows another form of display unit.

Referring first to FIG. 1, I have illustrated in that figure a basketball scoreboard 10 which is adapted to be actuated remotely by a control unit 11. The two units 10 and 11 may be located at different points in a stadium or gymnasium which is supplied with conventional 110 volt 60 cycle alternating current through power lines 12 installed in the usual manner within the walls, floors, or ceiling of the building in which the apparatus is mounted. Units 10 and 11 are both connected to these power lines by conventional cords 13 and plugs 14 connectible into receptacles 15 mounted in the walls of the building. Preferably, plugs 14 and receptacles 15 are of the grounded type, having in addition to the two power leads, a third grounding plug or connection. Receptacles 15 to which devices 10 and 11 are connected desirably receive exactly the same alternating current potential, with the potential at one outlet or receptacle being in phase with that at the other outlet. This result may be attained by connecting both of the outlets 15 to the secondary of the same step-down transformer 16 (this transformer being assumed to be the last power supply transformer in the main power transmission system, from an initial source represented at 17 in FIG. 1).

The scoreboard has a number of typically identical numeral display units 18, each capable of writing selectively any numeral from 0 to 9, and may include two additional units 19 for writing only the numeral 1, so

that together units 18 and 19 indicate the score of the game at a particular time, the number of the player who has just made a basket or a foul, and the number of points or fouls made to that time by the specified player. Control box 11 has switches for selecting which numerals will be written on the scoreboard, which switches may include a pair of rotary multiple position switches 20 and 21 for controlling the score indications. For the left hand one of the two display units 18 used in indicating a player's number, control box 11 may have a first series of 10 interleaved push button switches 22 for writing the numerals 0 through 9 respectively. These switches are desirably connected together mechanically by a conventional type of latching mechanism so that only one push button can be pressed in at a time, and when any push button is depressed it will remain so until released automatically by actuation of the next successive push button. Similar sets of interlocked push buttons are provided at 23 for controlling the other three display units 18 associated with the words "player" and "points" on the scoreboard. A final set of six similarly interlocked latching push buttons are provided at 24, for writing the numerals 0 through 5 of the display unit 18 which is associated with the word "fouls" on the scoreboard.

In FIG. 2, the circuit diagram of control unit 11 is represented in the broken line box forming the left hand portion of the figure, while the broken line box 10 in the right portion of the figure represents the circuit diagram of scoreboard 10 of FIG. 1. The power lines 12, plugs 14, outlets or receptacles 15, transformer 16, and power source 17 are all given the same numeral designations as in FIG. 1.

Control unit 11 includes a rotary coder 25, having a rotating contact element 26 adapted to successively electrically engage a series of evenly circularly spaced stationary contacts 27. As will be best understood by reference to FIGS. 3 and 4, stationary contacts 27 may be carried by a circular disc 28 of electrically nonconductive material, such as a suitable resinous plastic material, with contacts 27 being embedded within narrow radially extending recesses formed in the disc. Between the locations of contacts 27, the upper surface 29 of disc 28 may be flush with the upper surfaces of the contacts. Separate electrical connections are made from the different individual contacts 27 to different individual leads 30 through the various switches controlled by elements 20, 22, 23 and 24 of FIG. 1, and to a terminal 31 of a later to be discussed "erase" switch 32. In FIG. 2, the switches actuated by the various push buttons 22 have been designated 22', there being 10 such switches (less than 10 illustrated). The switches controlled by rotary element 20 of FIG. 1 are designated 20' in FIG. 2, with 21 such switches being provided to write the numerals 0 through 9 on each of two associated display units 18 and to write the numeral 1 on an associated one of the display units 19. The rotary element 20 has as many different possible settings as there are possible scores to be written by that element, say for example every score from 1 through 150, with these different settings being indicated by markings 33 about element 20 (see FIG. 2). In any particular setting of element 20, that part acts through cams or other mechanism to appropriately close the proper ones of the switches 20' to write the desired number in the upper score line of the scoreboard 10. It will of course be understood without further discussion that the second rotary element 21 has a similar set of 21 switches associated with it, connected to predetermined ones of the contacts 27 of coding unit 25, and similarly each of the columns of push buttons 23 and 24 has an individual switch for each button.

As contact 26 rotates about its axis 34 (FIG. 4), the contact successively scans past and engages the different stationary contacts 27. Contact 26 may extend essentially radially from axis 34, and carry a series of brush fingers 35 which project toward, and form the actual electrical

connection with, contacts 27, brushes 35 of course being designed to engage only a single one of the contacts 27 in any particular setting. At its radially inner end, contact 26 may be journaled in suitable manner for rotation about axis 34, as by a bearing structure represented at 36, and is driven continuously and at a predetermined rate of speed about axis 34 by a synchronous motor 37 through a slip clutch 38. Motor 37 is energized by 60 cycle alternating current from power lines 12, and turns contact 26 at a predetermined uniform rate of speed which is accurately controlled by the alternations of the energizing current. Clutch 38 is adapted to allow contact 26 to be forcibly held against rotation by a synchronizing lock member 39 (FIG. 2), while the motor 37 continues to turn, when an operator desires to initially synchronize a rotary decoding unit 40 in the scoreboard assembly with coding device 25. Except when the contact is thus held against rotation, the friction of clutch 38 is sufficient to drive the contact positively and directly from motor 37.

Lock member 39 is illustrated typically as taking the form of a push button switch adapted to be pressed inwardly along an axis represented at 41 to close the circuit between a pair of contacts 42 and 43. The switch is spring pressed outwardly to its illustrated open condition of FIG. 2, and returns to that condition when released after manual actuation to closed condition. The inwardly projecting stem 44 of synchronizing switch 39 is normally received out of the path of rotary movement of the outwardly projecting tip end portion 45 (FIG. 3) of contact 26, but when element 39 is pressed inwardly to the switch closing position, the extremity of stem 44 moves into the path of movement of portion 45 of contact 26, and temporarily stops the contact in the position illustrated in broken lines in FIG. 3.

Decoding device 40 may be considered as being constructed substantially the same as coder 25, and has a rotary contact 46 which successively scans past and engages stationary contacts 47 spaced in correspondence with contacts 27 of the coder. A synchronous motor 48 energized by the same power lines 12 as is motor 37 drives rotary contact 46 through a slip clutch 49, and at exactly the same rate as that at which contact 26 of the coder turns. Thus, when contact 26 of the coder closes the circuit to one of the associated contacts 27, rotary contact 46 of the decoder closes a circuit to a correspondingly positioned one of its associated stationary contacts 47.

The signal generating means of control unit 11 may include two separate oscillators 50 and 51, energized from power lines 12 through leads represented at 52, and acting to produce two different frequencies which are mixed together in a modulator 53 to produce an intermediate frequency train of pulses 54 as illustrated in FIG. 6. The frequencies of the two oscillators may, as an example, be 200 kilocycles and 18 kilocycles respectively. This pulse train leaves modulator 53 through a pair of leads 54' and 55 for delivery through power lines 12 and a ground connection to the scoreboard assembly 10. More particularly, lead 54' is connected through a pair of capacitors 56 to both sides of the associated part 14 and therefore both of the power lines 12, while lead 55 is connected through the grounding prong of plug 14 to ground, as represented at 57 in FIG. 2. Capacitors 56 are so selected as to effectively prevent the transmission of the 60 cycle line current therethrough, while at the same time conducting the high frequency RF pulse train from modulator 53 through the capacitors and to the power lines 12. For this purpose, capacitors 56 may each typically have a value of .01 microfarad.

The scoreboard apparatus 10 is designed to respond to an interruption in the train of pulses 54, this interruption being represented at 58 in FIG. 6. Coder 25 is capable of causing such an interruption in the pulse train by forming a short circuit between lines 54' and

55 whenever any of the switches 22', 20', or the like is closed during the interval when rotating contact 26 is in engagement with a corresponding one of the stationary contacts 27. For this purpose, all of the contacts 22', 20' etc., are connected in parallel to the previously mentioned left hand or "Write" contact 31 of switch 32. Switch 32 may be a three position toggle switch, whose movable contact 59 is normally returned to the illustrated open or "Hold" position, but is actuatable manually and momentarily into engagement with either the "Write" contact 31, or the "Erase" contact 60. Movable contact 59 is connected to lead 55. The "Erase" contact 60 of switch 32 is connected to one of the stationary contacts of coder 25, so that the circuit between leads 54' and 55 may be closed through the "Erase" contact also. Rotating contact 26 is electrically connected to lead 54' through a line represented at 61. Besides the other discussed circuits for providing a short circuit between leads 54 and 55, it is noted that synchronizing switch and stop element 39 acts when closed to provide such a circuit, and thereby form an interruption in the pulse train, so long as switch 39 is manually held closed.

The high frequency pulse train is received by the scoreboard assembly 10 through its plug 14, which delivers the signal to a tuned circuit 62. One of the input lines 63 to tuned circuit 62 is grounded through plug 14, and is thus connected to line 55 of the control circuit, while the other input lead 64 of tuned circuit 62 is connected through a pair of capacitors 65 (of a rating corresponding to capacitors 56 of the control circuit) to both power lines 12, and thus through the power lines to the second side 54' of the output circuit of the control unit. In this way, the RF signal of FIG. 6 reaches tuned circuit 62, which is designed to respond selectively to the particular frequency of the RF signal, and deliver it through a radio frequency amplifier 66 to a detector 67 and audio frequency amplifier 68. The amplified audio frequency signal is then passed to a demodulator 69 which delivers a direct current output to lines 70. This direct current output in lines 70 is present when the normal pulse train of FIG. 6 is being transmitted from control unit 11 through power lines 12 to the scoreboard, but the DC output in lines 70 is interrupted when the pulse train is interrupted as represented at 58 in FIG. 6. The power supplies to the various electronic components 62, 66, 67, 68 and 69 are taken from the main power line, as represented by leads 71 in FIG. 2.

The direct current signal in lines 72 acts to control the delivery of a triggering potential from a direct current power source 72 through decoding unit 40 to the various display units 18. Power source 72 receives alternating current energizing power through lines 71 from the power lines 12, and produces a direct current output potential at terminals 73 and 74. The former of these, the positive terminal, is connected through a reed switch 75 to the rotating contact 46 of decoder 40. From contact 46, the circuit continues through the various stationary contacts 47 of the decoder, and their individual leads 76 which are connected to individual input terminals 77 on the various display units 18. After passing through any of the display units, a trigger signal leaves the display unit through a line 78 which is connected through ground back to the negative side of power supply 72. Each display unit 18 has 10 of the terminals 77, corresponding to the numerals 0 through 9, respectively, and will write on the face of the display unit 18 a numeral corresponding to whichever of the terminals 77 receives a triggering signal. The coil of an "erase" relay 80 is connected into another triggering circuit, by connection of one side of the coil to the negative side of power source 72 through ground, and connection of the other side of the coil to a predetermined one of the stationary contacts 47 of the decoder, which contact 47 is positioned in exact correspondence with the particular contact 27 of the coder

to which "erase" contact 60 of the switch 32 of the control box is connected.

Reed switch 75 is of a conventional type referred to by that designation, including two normally open contacts received within an elongated sealed glass tube, and adapted to be actuated to circuit closing condition electromagnetically by a coil 82 disposed about or adjacent the reed switch. The left hand half of this coil 82 is energized continuously by power source 72, through a lead connected to positive terminal 73 and a ground connection 83 attached to the center of the coil. Thus, the left hand side of the coil creates a biasing field tending to close reed switch 75. The right hand side of coil 82 normally receives an equal and opposed direct current from demodulator 69, through a rectifier 84. So that as long as demodulator 69 has its normal output (when the uninterrupted pulse train is being transmitted to the power lines), the fields of the two halves of coil 82 cancel one another, and the reed contacts of switch 75 remain open. When there is an interruption in the direct current output from demodulator 69, at the time of an interruption in the transmission of the main pulse train from control box 11, the current flowing through the right hand half of coil 82 ceases, and the current in the left half is then effective to close the reed switch.

The normal direct current output from demodulator 69 is also conducted to a solenoid 85, which acts to normally hold in retracted position a latching element 86. Part 86 is operable upon de-energization of coil 85 to a locking position in which it is in the path of rotary movement of the extremity of contact 46, and halts that contact in a setting corresponding exactly to the setting in which element 39 of the control box halts its associated rotary contact 26. The automatic return of element 86 to its locking position, upon de-energization of solenoid 85, is effected by a conventional return spring built into the solenoid structure. In association with solenoid 85, there is provided a delay unit, which prevents the solenoid from becoming de-energized sufficiently to allow locking of element 86, unless the DC signal on lines 70 is discontinued for a predetermined substantial period of time, say for example two seconds, which period is greater than the interval during which that signal can be discontinued as a result of closure of a pulse train interrupting circuit through any of the contacts of coder 25. The interval of discontinuance of the pulse train and therefore the signal on lines 70, as a result of closure of a circuit through any of the contacts 27 of coder 25, may, as an example, be three milliseconds. The delay unit associated with solenoid 85 may be simply a capacitor 87, connected in shunt across the solenoid, and having an R-C time factor sufficient to prevent locking of element 86 unless the predetermined extended period of signal interruption occurs in line 70.

The signals fed to display units 18 from power source 72 through coder 40 are, as stated previously, simple triggering signals, which control the initial actuation of units 18 to different display conditions. The primary electrical power for maintaining display units 18 in their actuated condition after having been triggered is supplied to the display units from a main or larger direct current power supply circuit 88, whose output is delivered to display units 18 through two lines 89 and 90, into the former of which there is connected the normally closed movable contact 79 of erase relay 80. The energy input to DC power circuit 88 comes from power lines 12 through two leads 91, one of which has connected into it the movable contact of a relay 92 actuated by a solenoid 93, which receives the signal from demodulator 69 through a second delay circuit 94. As long as the pulse train is received by the scoreboard system, the output from demodulator 69 is conducted through delay unit 94 to solenoid 93, to normally hold the associated movable contact in closed position, so that the main power supply to DC power circuit

88 is turned on. If the signal in lines 70 leading from demodulator 69 is interrupted for a predetermined period of time, which is greater than the interval required for release of solenoid 85, for example a period of five seconds for unit 94 as against two seconds for capacitor 87, this extended interruption in the signal will be sufficient to allow release of the movable contact of relay 92 to its open position, to thereby turn off the main holding power to display units 18. It is also noted that the power circuit to synchronous motor 48 of coder 40 includes the movable contact of relay 92, so that opening of the relay also de-energizes motor 48.

The specific structure of display units 18 is described in detail, and covered specifically, in the co-pending application referred to hereinabove. FIG. 5, taken in conjunction with FIGS. 2 and 7, represents somewhat diagrammatically as much as the structure of the individual display units 18 as is felt desirable for indicating, in the present application, the manner in which the different signals supplied to the display units actuate those units. Specifically, it is noted from FIGS. 2 and 5 that each of the display units 18 includes a typically rectangular housing 95 having an opening 96 formed in its front wall within which there are receivable three vertical rows of individual display elements 97, and one additional display element 97 to the right of these three rows. Each display element has the vertical cross-section (FIG. 5) of an equilateral triangle, to present two faces 98 and 99 which are selectively movable into viewing position by pivotal movement of element 97 about a horizontal pivot shaft 100. Surfaces 99 on elements 97 may be of a neutral color, say white, while the surfaces 98 are of a contrasting readily visible color, say red, green, black or the like. Elements 97 normally swing by gravity to positions in which their neutral faces 99 are exposed to view, but are individually actuable to the FIG. 5 full line positions by energization of individual solenoids 101, which swing elements 97 about their pivot shafts 100 through electro-magnetic movement of the solenoid armatures 102, which are connected to elements 97 by actuating rods or arms 103. The various elements 97 are actuable by their solenoids in a number of different patterns, to write the 10 numerals 0 to 9 in the manner illustrated in FIG. 7.

In association with each of the solenoids 101, there are provided individual reed switches 104, each having a triggering coil 105 and a holding coil 106 disposed about the switch. Direct current holding power is supplied to each of the holding coils 106 and its associated solenoid 101, through the associated reed switch 104, from the previously mentioned power supply lines 89 and 90, with each of the series circuits 101, 104, 106 being connected to lines 89 and 90 in parallel with all of the other corresponding circuits. Thus, if any of the reeds 104 is initially closed by its related trigger coil 105, the holding circuit will function thereafter to retain the relay closed, and maintain solenoid 101 and its element 97 in actuated condition.

The triggering signal to each of the trigger coils 105 is delivered through the trigger coils from one of the terminals 77 to line 78. For each of the terminals 77, a predetermined group of the trigger coils 105 are connected in series, to close the proper reed switches 104 for writing a desired numeral. For example, in FIG. 5, I have illustrated a series connection of all of the trigger coils required for writing the numeral one, which may be written by delivery of an appropriate signal to the next to top terminal 77, the top terminal being the numeral zero. In FIG. 5, all five of the elements 97 in the right hand full row of such elements (as viewed in FIGS. 2 and 7) are actuated, while the other elements 97 remain in neutral positions, so that this right hand row writes the numeral 1. Referring back to FIG. 1, in the two display units 19 which are capable only of writing the numeral one, and no other numeral, only a single vertical row of

the elements 97 may be employed, these elements being adapted to be actuated as a group either to neutral or viewing positions.

To now summarize the manner of operation of the apparatus of FIGS. 1 through 7, assume that the scoreboard 10 and control box 11 have been installed at appropriate locations within a stadium or arena, or on an outdoor field where the game to be scored is football or another outdoor game, and assume that the plugs 14 of the two sections have been connected into grounded type receptacles 15 connected to the secondary of a common step down transformer 16. When the units are first connected to power lines 12 in this manner, the "write" and "erase" switch 32 may be in its FIG. 2 completely open position. The motors 37 and 48 are immediately energized by connection of plugs 14 into the associated receptacles, to commence rotation of moving contacts 26 and 46 of the coder and decoder at exactly the same rate about their respective axes. Since the alternating current fed to the two motors 37 and 48 is identical in frequency and phase, the synchronous motors and their driven contacts move necessarily at precisely the same rate. However, contacts 26 and 46 may not point in exactly the same directions upon initial connection of plugs 14 into their outlets 15.

The initial connection of plugs 14 into their power supply receptacles also energizes electronic units 50, 51, 53, 62, 66, 67, 68, 69 and 72, so that units 50, 51 and 52 commence the production of an uninterrupted pulse train (see FIG. 6), which train is delivered through power lines 14 to the scoreboard. The pulse train is at a ratio frequency which can be transmitted through the power lines without interference with the main 60 cycle current, and can be tuned in by unit 62, to ultimately produce a direct current output in lines 70 leading from the demodulator 69. This output acts through delay unit 94 to close relay 92, and thereby turn on the main energizing direct current from circuit 88 through lines 89 and 90 to display units 18. The same signal in lines 70 energizes solenoid 85, to retract element 86 to a position in which contact 46 may turn freely. Also, the direct current signal in lines 70 produces a current in the right hand portion of coil 82 (FIG. 2) acting to counter balance the bias current in the left hand portion of that coil and maintain reed switch 75 in open position.

With the apparatus in the discussed condition, the operator may first press synchronizing push button 39 inwardly to a position in which its extremity 44 stops contact 26 in the broken line position of FIG. 3, and the push button simultaneously closes a synchronizing circuit between leads 54' and 55, acting to interrupt the transmission of the radio frequency pulse train to power lines 12. This of course interrupts the signal in lines 70 of the scoreboard circuit, to de-energize solenoid 85 after a two second delay period, so that element 86 stops contact 46 in the same position in which rotary contact 26 has been previously halted by element 39. After an interval in excess of the two second delay period, say three or four seconds, the operator releases push button 39, to simultaneously recommence the rotation of contacts 26 and 46 exactly in unison. More particularly, as element 39 is released it of course moves its extremity 44 out of the path of contact 26, to start the rotation of that contact, and similarly the release of element 39 opens the circuit through that element to again start the transmission of the pulse train through lines 54 and 55 and power lines 12 to the scoreboard. This immediately re-applies the direct current from demodulator 69 to lines 70, to immediately energize solenoid 85 and pull element 86 out of the path of contact 46. Part 39 is so designed that the braking of the electrical circuit by its contact portion is simultaneous with the mechanical release of contact 26, and solenoid 85 of the scoreboard circuit is so designed as to respond immediately to re-energization, though the previously discussed delay is introduced into

its response to an interruption in the signal in lines 70. Having thus synchronized the coder and decoder, the apparatus is now in condition for actuation of display units 18 by the various switches of control box 11. Assume for example that the operator desires to cause the left hand one of the display units 18 opposite the word "player" in FIG. 1 to write the numeral three. To do this, the operator first presses whichever of the buttons 22 on the control box (FIG. 1) is labelled three, to thereby close a corresponding one of the switches 22' of FIG. 2. After that switch has been closed, and while it is held in closed position by the associated latching mechanism which holds the last pressed button 22 in closed position, the operator actuates toggle switch 32 to its "write" position, in which movable contact 59 engages stationary contact 31. The switch 32 is held in this position long enough for a full revolution of contacts 26 and 46, so that when contact 26 reaches a position of engagement with the particular lead 30 which is connected to the closed switch 22', a circuit is closed from lead 54' through contact 26, the engaged contact 27, the closed switch 22', and "write" switch 32 to lead 55, to momentarily (say for about five milliseconds) short circuit the pulse train signal, and thereby cause an interruption in that pulse train and in the direct current signal in lines 70 of the scoreboard circuit. This interruption temporarily stops the flow of current through the right hand portion of coil 82, so that the left hand biasing portion of that coil is then effective to actuate reed switch 75 to closed position, and close a triggering circuit through decoder 40 to one of the display units 18. At the instant of closure of reed switch 75, rotating contact 46 of the decoder is in engagement with a particular predetermined one of the stationary contacts 47, which is positioned exactly the same as the particular coder contact 27 with which rotating contact 26 is in engagement, so that the triggering signal is transmitted through the engaged stationary contact 47 of the decoder and the associated line 76 to a particular one of the terminals 77 corresponding to the numeral which is to be written. This signal passes through the appropriate triggering coils 105 in series, and leaves the display unit through line 78 to return to the negative side of power supply 72 through ground. The momentary closure of the triggering circuit (typically a three millisecond-one ampere pulse) is sufficient to close all of the reed switches 104 (FIG. 5) through which the triggering signal is passed, and thereafter the main holding current from source 88 holds those relays closed, and energizes the associated solenoids 101 to move the associated elements 97 to their actuated positions in which faces 98 instead of the neutral faces 99 are visible. In this way, the selected numeral is written.

As will be apparent, for each of the display units 18 there are 10 contacts 47 on decoder 40 and 10 contacts 27 on decoder 25, as well as 10 switches 22', or 10 switches 20' actuated by one of the rotary elements 20 or 21. Thus, the apparatus may be actuated to write any desired number on any of the display units 18, and appropriate single switches may also be provided for actuating the display units 19 to conditions for writing the numeral 1.

It is contemplated that, after a particular set of information has been written onto the scoreboard, the operator may, while that information remains on the scoreboard preset all of the push buttons 22, 23 and 24, and the rotary switches 20 and 21, to positions for writing a new set of numerals on the board, and after the switches have been appropriately set, the switch 32 may first be actuated to the right (as viewed in FIG. 2), to close an erase circuit through contact 60 and then be actuated to the left to close the "write" circuit through contact 31, for writing the new information on the various display units. The engagement of movable contact 59 of switch 32 with "erase" contact 60 closes a circuit through an

erase contact 27 of coder 25 to form a short circuit between leads 54' and 55, temporarily interrupting the pulse train and the DC potential on lines 70 of the scoreboard circuit, to thereby apply a signal to the corresponding erase contact 47 of the decoder, which signal energizes relay 80 to open the contact 79 of that relay, and thereby open the circuits to all of the holding coils in all of the display units 18 and 19. Thus, all of the display elements are returned to their neutral positions in which faces 99 are exposed, preparatory to writing of the next successive numbers upon actuation of toggle switch 32 to its "write" position.

As stated previously, the very short duration interruptions in the signal from demodulator 69 upon closure of any "write" or "erase" circuit through individual contacts 47 are not long enough to either lock the element 86 of decoder 40, or allow opening movement of the movable contact of relay 92. If during use of the apparatus it becomes necessary for any reason to resynchronize the coder and decoder, this may be done by simply pressing push button 39 to its actuated position for a period in excess of the two second delay period of capacitor 87. This interval is not sufficient to open relay 92, but when the entire apparatus is shut down by removing plug 14 of the control box 11 from its receptacle 15, the resultant extended interruption in the pulse train and the signal in lines 70 is long enough to satisfy the delay period built into unit 94, and cause opening of relay 92, to thereby de-energize main power source 88 and motor 48 of the scoreboard. The plug 14 of the scoreboard is left in its plugged in condition, so that the small power source 72 and the electronic units 62, 66, 67, 68 and 69 remain in alert condition, capable of reclosing relay 92 and placing the rest of the apparatus in operating condition immediately upon insertion of the plug 14 of the control box into its receptacle. Thus, the entire control of the scoreboard is effected from box 11, and there is no necessity at any time to manually break the circuit to or de-energize the scoreboard.

FIG. 8 illustrates fragmentarily a variational form of the invention which may be considered as identical with that of FIGS. 1 through 7 except that the pulse train signal from control box 11 to the scoreboard is transmitted by radio waves, rather than through power lines 12. For this purpose, the two pulse train output lines 54a and 55a (corresponding to lines 54 and 55 of FIG. 2) are connected to a radio transmitter 107, receiving power from power lines 12a through plug 14a, to transmit radio waves from an antenna 108 to a receiving antenna 109 and tuner 62a, which takes the place of the tuner 62 of FIG. 2 and supplies a received pulse train to RF amplifier 66a. The rest of the circuit of the FIG. 8 arrangement may be the same as that shown in FIG. 2 and the other figures of the first form of the invention.

FIG. 9 shows another arrangement which may be the same as that of FIGS. 1 through 7 except that the line 54b (corresponding to line 54 of FIG. 2) is connected to a specially installed single conductor cable 110 whose opposite end is connected directly to the line 64b of the scoreboard circuit, to transmit the pulse train signal through line 110 and ground, rather than through the power lines 12 and ground. The arrangement shown in FIGS. 1 through 7 is presently preferred, however, over both of the alternate arrangements shown in FIGS. 8 and 9.

It is contemplated that, if desired, the synchronizing latching element 44 of FIG. 2 may be actuated electrically rather than mechanically. FIG. 10 illustrates such an arrangement, in which a solenoid 185 actuates latching element 44c (corresponding to element 44 of FIG. 2). Solenoid 185 and its magnetically controlled latching element and return spring may be identical with solenoid 85 and armature 86 of the decoder and their return spring, and be energized by identical signals, with solenoid 185 being connected into an electrical energizing

circuit with the same switch 39c (across contacts 42c and 43c corresponding to contacts 42 and 43 of FIG. 2) which controls the decoder solenoid. The power for solenoid 185 may be supplied by a power source represented at 285.

FIG. 11 represents another type of display unit, which may be utilized for writing the numeral 1, or for providing any other type of vertically or horizontally elongated display. In FIG. 11, there is represented at 111, a display element, which may have the same triangular cross section as do the various elements 97 of FIG. 5, but which is elongated to present two vertically elongated display faces 113 and 114. In the position of FIG. 11, element 111 has its face 113 exposed, and flush with the housing wall 112 disposed about element 111. A solenoid 117 has its armature connected to element 111 by a link 118, to swing element 111 to a position in which face 114, instead of face 113, is exposed to view, and flush with wall 112, upon energization of the solenoid. At its upper and lower ends, element 111 has two stub shafts which are journaled within bearings 116 mounted to wall 112, to mount element 111 for its desired swinging movement about a vertical axis between the two display positions. A coil spring represented at 115, and having its opposite ends connected to wall 112 and element 111 respectively, may normally return element 111 to the FIG. 11 position in which face 113 is exposed to view. As will be apparent, face 113 may be of a neutral color corresponding to the outer surface of housing wall 112 while face 114 is of a contrasting color to form the desired numeral 1 when the solenoid is energized. The solenoid is of course controlled by one of the pairs of contacts on the coder and decoder, and through a reed control circuit corresponding to the circuits associated with each of the solenoids 101 of the main display unit. If desired, a word to be displayed may be written on one of faces 113 and 114, such as the word "bonus," "foul," or the like. Also, the element 111 may be mounted to turn about a horizontal axis and be horizontally elongated, to form an underline beneath a word printed on a scoreboard, or to provide any other desired display character or symbol. The manner of actuation of element 111 by the solenoid will be apparent without any further discussion.

What is claimed as new is:

1. A display system comprising a rotary coder operable to successively scan a series of contacts, means for emitting a train of pulses, a plurality of control switches associated with different ones of said contacts respectively for closing circuits therethrough, means responsive to closure of one of said control switches to interrupt said pulse train, a rotary decoder operable to successively scan a second series of contacts in timed relation to the scanning of said first contacts by said coder, a display unit actuable to different display conditions by signals fed through different ones of said second contacts respectively, and means for delivering electric signals to said unit through said decoder in response to said interruption in said pulse train.

2. A display system as recited in claim 1, in which said last mentioned means includes means producing a biasing potential, means producing a potential counteracting said biasing potential so long as said pulse train continues but responsive to an interruption in the pulse train to also interrupt said counteracting potential, and means then responsive to said biasing potential to pass said electric signals to said unit.

3. A display system as recited in claim 1, in which said last mentioned means includes means producing a biasing potential, means producing a potential counteracting said biasing potential so long as said pulse train continues but responsive to an interruption in the pulse train to also interrupt said counteracting potential, and a reed switch then actuable magnetically by said biasing potential and

operable when closed to pass said electric signals to said unit.

4. A display system as recited in claim 1, in which said means for interrupting said pulse train includes means forming a short circuit across the discharge side of said pulse emitting means upon closure of a circuit through one of said first contacts and the associated control switch.

5. A display system comprising a rotary coder operable to successively scan a series of contacts, means for emitting a train of pulses, a plurality of control switches associated with different ones of said contacts respectively for closing circuits therethrough, means responsive to closure of one of said control switches to interrupt said pulse train, a rotary decoder operable to successively scan a second series of contacts in timed relation to the scanning of said first contacts by said coder, a display unit actuable to different display conditions by signals fed through different ones of said second contacts respectively, means for delivering electric signals to said unit through said decoder in response to said interruption in said pulse train, and means for retaining said decoder against scanning movement in response to an interruption of increased duration in said pulse train.

6. A display system comprising a rotary coder operable to successively scan a series of contacts, means for emitting a train of pulses, a plurality of control switches associated with different ones of said contacts respectively for closing circuits therethrough, means responsive to closure to one of said control switches to interrupt said pulse train, a rotary decoder operable to successively scan a second series of contacts in timed relation to the scanning of said first contacts by said coder, a display unit actuable to different display conditions by signals fed through different ones of said second contacts respectively, means for delivering electric signals to said unit through said decoder in response to said interruption in said pulse train, means for retaining said coder against scanning movement, means for interrupting said pulse train upon said retention of the coder against scanning movement, and means for retaining said decoder against scanning movement in response to an interruption in said pulse train by said last mentioned means and of a duration greater than is required for delivery of said electric signals to said display unit.

7. A display system comprising a rotary coder operable to successively scan a series of contacts, means for emitting a train of pulses, a plurality of control switches associated with different ones of said contacts respectively for closing circuits therethrough, means responsive to closure of one of said control switches to interrupt said pulse train, a rotary decoder operable to successively scan a second series of contacts in timed relation to the scanning of said first contacts by said coder, a display unit actuable to different display conditions by signals fed through different ones of said second contacts respectively, means for delivering electric signals to said unit through said decoder in response to said interruption in said pulse train, means for retaining said coder against scanning movement, means for interrupting said pulse train upon said retention of the coder against scanning movement, means for retaining said decoder against scanning movement in response to an interruption in said pulse train by said last mentioned means and of a duration greater than is required for delivery of said electric signals to said display unit, a power supply switch for passing energizing power to a portion of said display system, and means for opening said power supply switch in response to an interruption of still greater duration in said pulse train.

8. A display system comprising a rotary coder operable to successively scan a series of contacts, a rotary decoder turning in timed relation to said coder and scanning a series of second contacts, a display unit actuable to different display patterns by said coder and decoder, synchronizing first holding means operable to mechanically lock said coder against scanning movement in a predetermined

13

setting, second holding means for locking said decoder in a corresponding setting, means for emitting a train of pulses, means for interrupting said pulse train upon actuation of said first holding means, and means responsive to said interruption in the pulse train to automatically actuate said second holding means. 5

9. A display system as recited in claim 8 in which said last mentioned means includes delay means for preventing said actuation of the second holding means unless said interruption in the pulse train continues for a predetermined delay interval. 10

References Cited

UNITED STATES PATENTS

2,436,824	3/1948	Potter	340—164	15
2,476,673	7/1949	May et al.	340—316	

14

3,063,719	11/1962	Rosenberger	340—323	X
1,965,393	7/1934	Schleicher	340—151	
3,047,662	7/1962	Smith	340—151	X
3,108,255	10/1963	Lester	340—150	
3,176,272	3/1965	Faust et al.	340—151	X

FOREIGN PATENTS

910,540	6/1946	France.
646,505	11/1950	Great Britain.

THOMAS B. HABECKER, *Acting Primary Examiner.*

NEIL C. READ, *Examiner.*

H. I. PITTS, *Assistant Examiner.*