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ELECTRIC DISPLAY APPARATUS.

APPLICATION FILED MAR. 31, 1908. RENEWED JUNE 2, 1916.

1,220,110.

Patented Mar. 20, 1917.

4 SHEETS—SHEET 1.

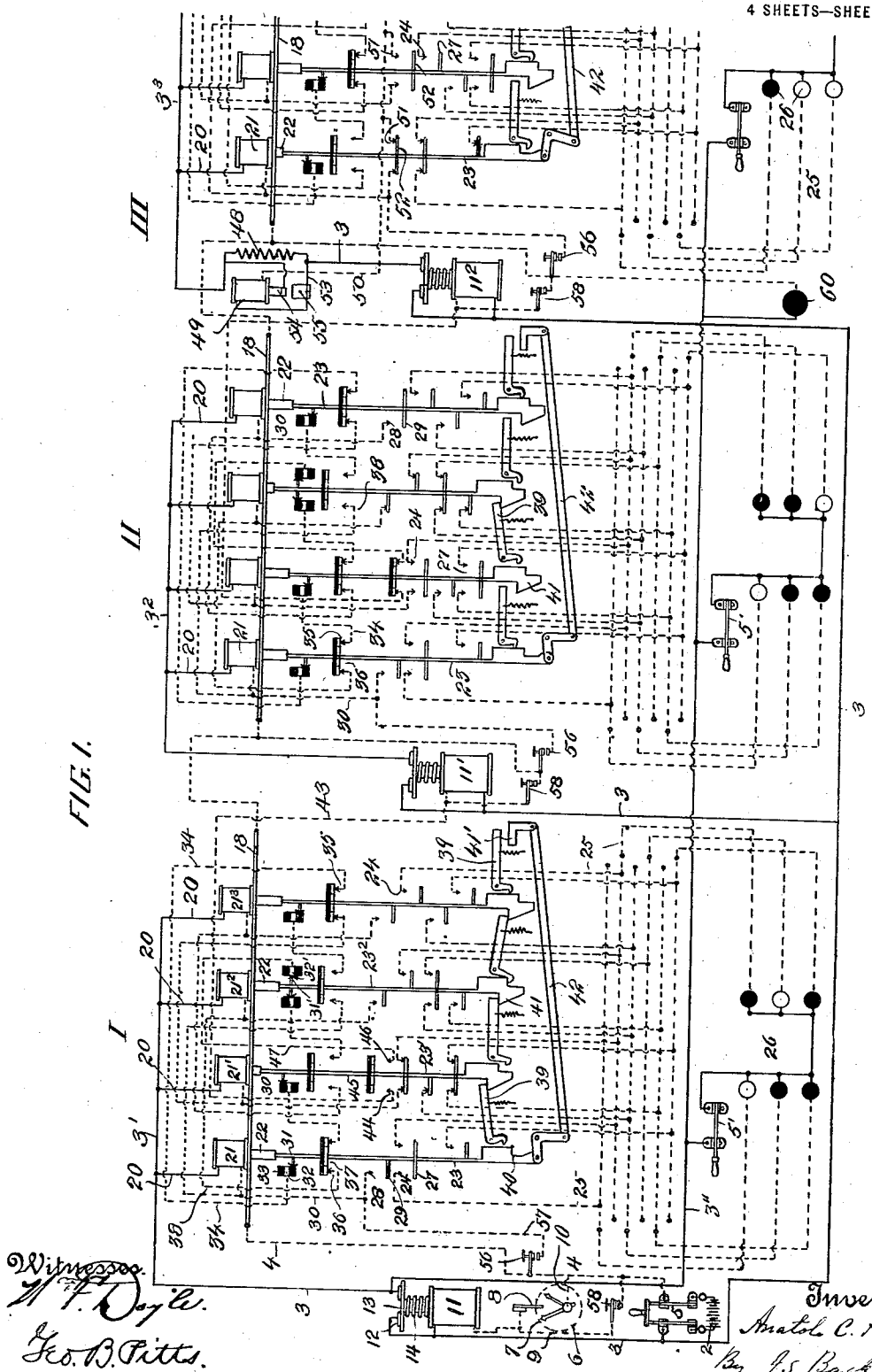


FIG. 1.

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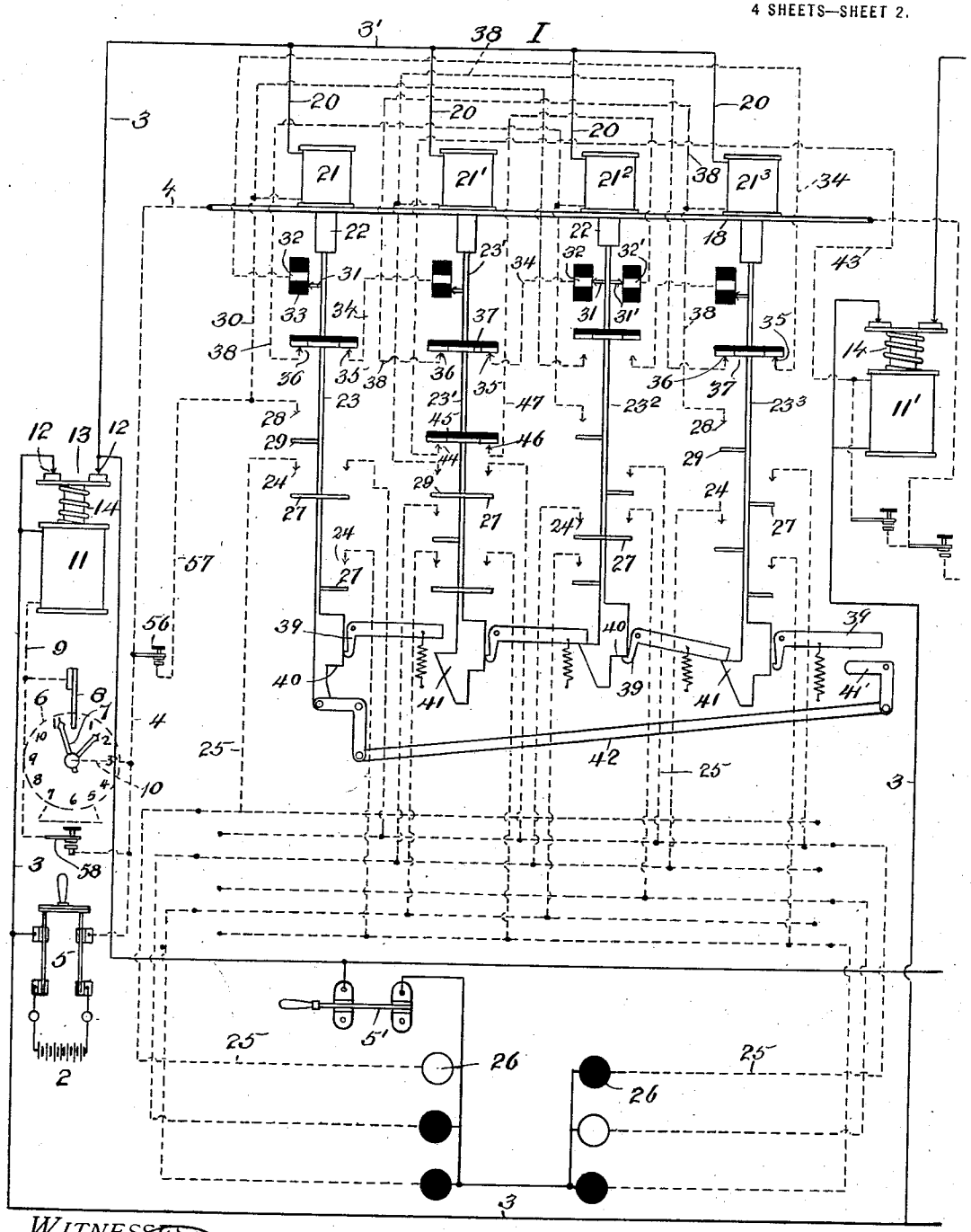
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4 SHEETS—SHEET 2.



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FIG. 2.

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4 SHEETS—SHEET 3.

FIG. 3.

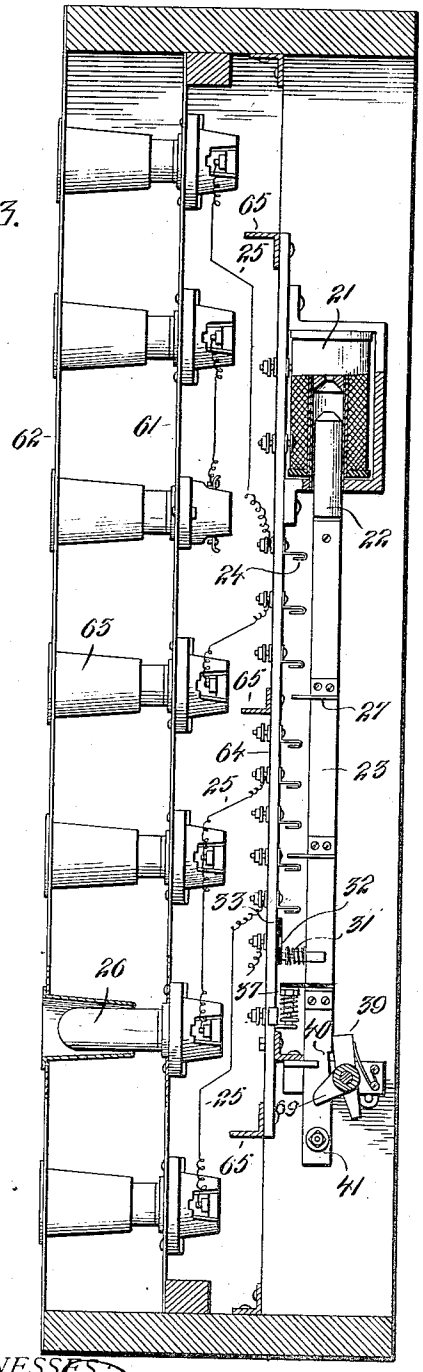


FIG. 4.

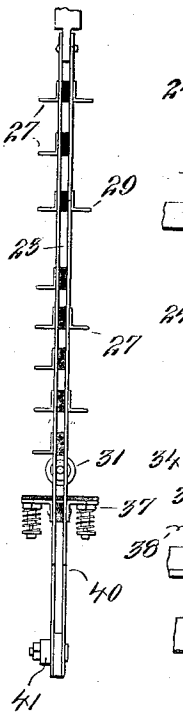
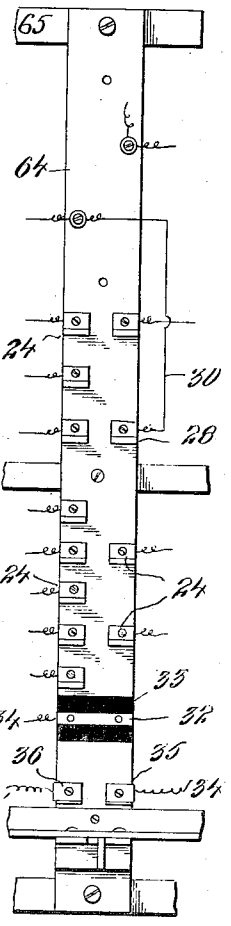


FIG. 5.



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4 SHEETS—SHEET 4.

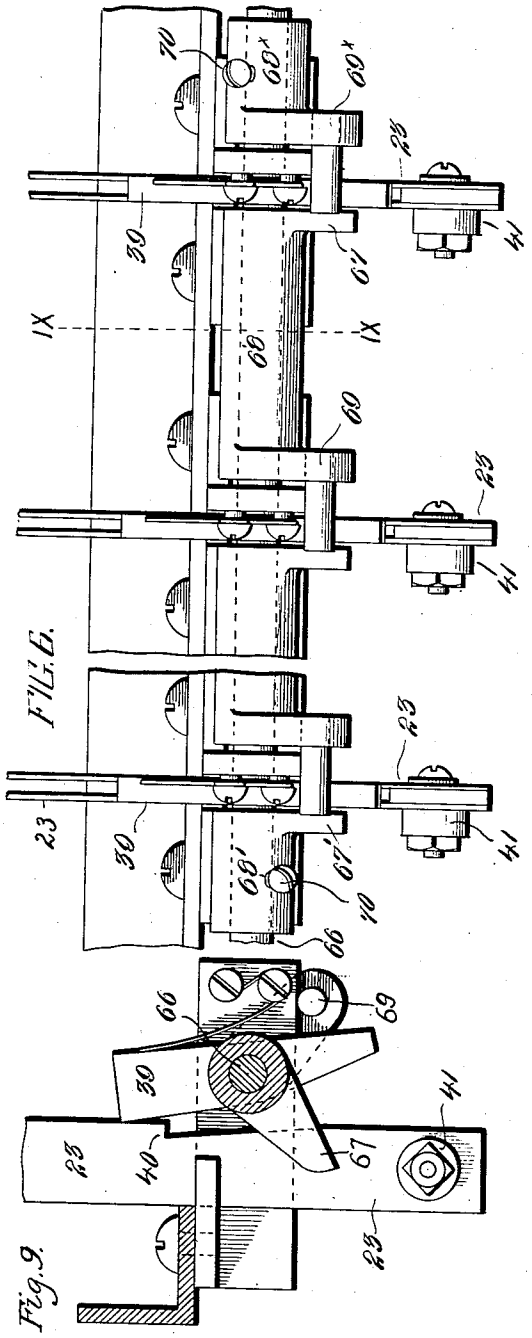


FIG. 6.

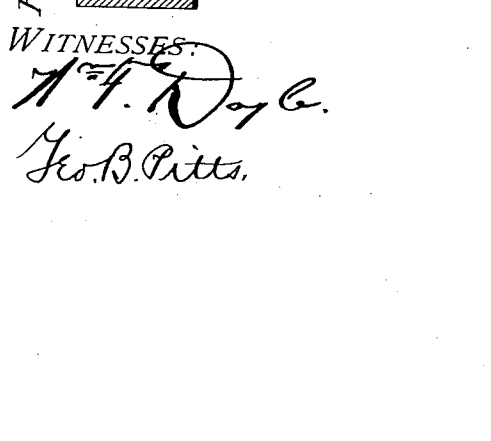


Fig. 9.

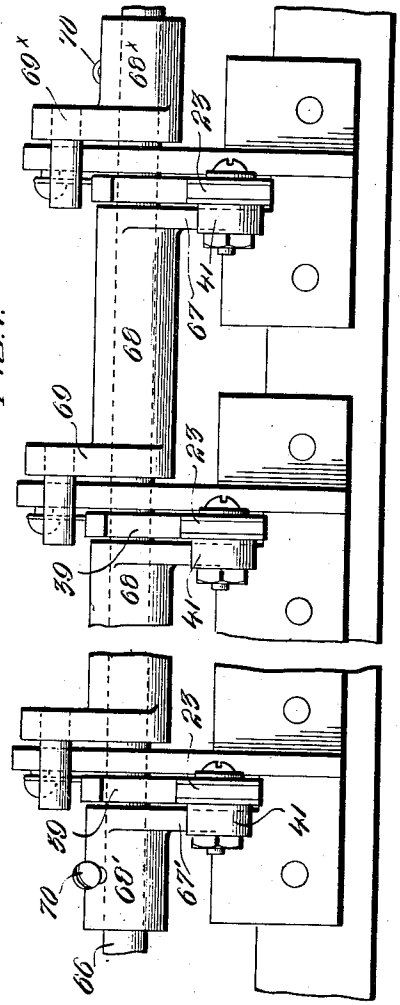


FIG. 7.

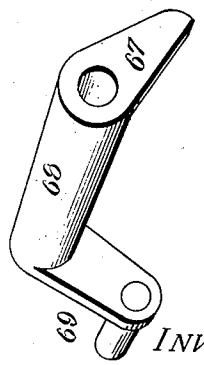


FIG. 8.

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UNITED STATES PATENT OFFICE.

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ELECTRIC DISPLAY APPARATUS.

1,220,110. Specification of Letters Patent. Patented Mar. 20, 1917.

Application filed March 31, 1908, Serial No. 424,455. Renewed June 2, 1916. Serial No. 101,384.

To all whom it may concern:

Be it known that I, ANATOLE C. HEINY, a citizen of the United States, and resident of New York city, county and State of New York, have invented new and useful Improvements in Electric Display Apparatus, of which the following is a specification.

My invention relates to electrically illuminated sign or display apparatus in which characters such as figures or letters are produced by the illumination of properly grouped lamps and are changed at will; the lamps by means of which the characters are formed being arranged in separate groups or sets, commonly spoken of as monograms or panels.

The invention has for its object to improve the operating mechanism by means of which the changes in the lamps of a single group, to successively produce different characters, are effected; and whereby the successive changes in different groups of apparatus to display changes of the characters at the different monograms are also effected, the devices or mechanism employed being electrically operated throughout.

The invention is especially well adapted for use in connection with display apparatus employed to indicate time, a change in the characters displayed being made once every minute. The invention is not, however, limited to this particular use, but is adapted to display the registering of a meter, or for other purposes where illuminated electrical display apparatus is now employed.

In the accompanying drawings in which the invention is illustrated, Figure 1 is a diagram illustrating the principle and method of operation of the invention used to control the illumination of three groups of six lamps each.

Fig. 2 is a diagram on a larger scale than Fig. 1 illustrating the circuits of but a single group of lamps and apparatus, some of the parts being in different positions from those represented in Fig. 1.

Fig. 3 is a vertical sectional view through a casing in which are arranged the illuminating apparatus and controlling devices embodying my invention.

Fig. 4 is a front view of one of the movable bars carrying a set of contacts, such as may be employed in a system like that illustrated in Fig. 1.

Fig. 5 is an elevation of a stationary contact-carrying bar in association with which the bar represented in Fig. 4 may be used.

Fig. 6 is a rear elevation of the lower ends of several of the movable contact-carrying bars and means coöperating therewith for controlling their movements.

Fig. 7 is a bottom plan view of the parts illustrated in Fig. 6.

Fig. 8 is a detail perspective view of part of the latch-releasing mechanism illustrated in Figs. 6 and 7.

Fig. 9 is a vertical sectional view taken on the line IX—IX of Fig. 6.

I have in the drawings, in some instances, designated corresponding parts which are duplicated, by means of the same reference characters, but have distinguished one from the other by the use of exponents applied to such characters; and I shall in this description when referring indiscriminately to any one of a series of similar parts having a similar designation, but with different exponents, disregard the exponents, employing them only when it is desired to direct attention to a particular one of such similar parts.

In the diagram, Fig. 1, I have represented the operating mechanism for controlling the illumination of the lamps at the different monograms as arranged in three groups, designated I, II and III, respectively. The first group, I, corresponds with the selecting and operating mechanism controlling the display at the minutes monogram of a time indicating apparatus; the second group, II, the devices employed for controlling the display at the ten minutes monogram; and the third group, III, those controlling the hours display.

Before describing in detail the invention and the manner in which it is embodied, I will first in a general way state what takes place when the apparatus is in operation, supposing that several panels or monograms of lamps are employed to indicate, by their illumination, the time of day.

The groups of lamps, and the groups of operating devices that severally control their illumination, are connected in multiple with a main electric circuit. A master control device, such as a clock, is located in a circuit which it opens and closes intermittently, the closing preferably being for relatively short periods of time. In this circuit is situated

an electromagnetic circuit-making-and-breaking device, by which that branch of the main electric circuit that leads to and is connected with the group of operating devices that control the primary or first group of lamps, is opened or closed; the arrangements being such that this branch circuit is open, the lamps accordingly being unilluminated, so long as the master control device closes its own circuit. Whenever the said branch circuit is closed the solenoid or electro-magnet in the group of devices controlling the first monogram is energized and operates through appropriate devices to close circuits through a certain group of lamps which become lighted and display a character. The moment the said branch circuit is again broken through the operation of the master control device the lamps are extinguished, and the said solenoid or other electro-responsive device employed in the units or minutes groups last to be energized becomes magnetically inert and the circuits it operated to close are opened. At the same instant that these last referred to operations take place the parts controlled by the last said solenoid or electro-magnet operate to establish new circuit relations of such a nature that the moment the branch circuit is again closed the electro-magnet or solenoid in the series or group next in advance of that last energized, will be brought into the circuit and excited, and it in turn will operate to cause the illumination of a different group of lamps. Thus the electrical controlling devices successively operate first to establish and then to break the lamp circuits; and each as it breaks its own set or group of lamp circuits sets certain electrical connections or current switching devices so that the controlling device next in series to be operated is put in connection with the main line.

Whenever a predetermined cycle of changes in one group—the units or minutes group for instance—has been completed, there is simultaneously with the changes there taking place to begin anew, the cycle, a change effected in the circuits for controlling devices for the next group of lamps—the tens or ten minutes group—corresponding with the change that is made in the first group whenever the master control device closes its own circuit, such changes in the second group being controlled by the devices of the first. Thus, at each cycle of changes in a first group there is one change in the second, and at each cycle of changes in the second, a single change in the third group, and so on.

Referring more particularly to Fig. 1, 2 represents a battery or other source of electricity. It is connected on one side with the several sets of lamps, and with the controlling devices therefor, by wire 3, which may for convenience be termed the positive line, and on the other side by wire 4, termed the negative line.

5 represents the main cutout for the apparatus, and 5′, 5′, the switches or cutouts for the lamps of the individual panels. At some convenient place in the main line is located the master control device 6, which may be a clock. One of the shafts, as that carrying the second hand, carries a contact 7 connected with the line 4 by conductor 10. A stationary contact 8 is situated in position to be engaged by the revolving contact 7 and is connected with the positive line by conductor 9. In this connection, 9, is located a solenoid 11 the core of which carries a cross-piece 13 adapted to bridge the two contacts or terminal pieces 12, to which parts of the positive line 3 are united. A spring 14 holds the bridge-piece in engagement with the contacts 12 whenever the solenoid is in open circuit.

Each group or set of devices for controlling the illumination of the lamps at one panel or monogram is represented as comprising four solenoids, 21, 21′, 21^2, 21^3 and associated circuit making and breaking parts controlled thereby and arranged to cause the display in succession of four different groups of lamps. These groups of solenoids are connected with the leads 3′, 3^2 and 3^3 of the positive line 3 by branch conductors 20. Each solenoid has its core 22 connected with the bar 23 that carries the movable contacts of the circuit closers controlling the different circuits. Each bar is in metallic connection with the negative line 4 through the frame piece or other suitable connection through the conducting bar or strip 18, and serves as a conductor for the current going out over the different contacts which the bar carries.

24, 24 designate the stationary terminals of the wires 25 leading from the lamps 26. With these terminals engage the contacts 27, carried by the bar 23 and in metallic connection therewith, whenever that bar is moved by the attractive force of the solenoid. A wire 30 leads from the solenoid 21 and is connected with the stationary contact 28 with which engages, whenever the core 22 is attracted and the bar moved, a contact 29 carried by the latter. Since one end of the coil 21 is connected with the positive line, and the bar 23 is connected with the negative line, a closed circuit, through the solenoid, is established whenever the contacts 28, 29 are in engagement, and is maintained until the main line circuit is broken.

31 designates a contact brush carried by the bar 23 and arranged, as it travels with the bar, to pass over a stationary conducting strip 32 mounted on an insulated support 33. When the bar is in its normal inactive position, the brush 31 lies to one side of, but

not in contact with, the strip 32; and when the bar is in its active position, that is when moved by the attractive force of the solenoid, it lies on the other side of the strip 32, but still not in engagement therewith. But when the bar occupies a middle position, as it does for a short space of time just after its solenoid becomes deënergized, as will be presently described, the contacts 31 and 32 lie in engagement, and a circuit is closed including the solenoid 21 next in advance of the one last excited and just deënergized. This circuit is traced as follows, see Fig. 2: From the positive side of the battery 2 over the conductors 3, 3′ and 20 to the solenoid 21^3, which is next in advance of the one that has been just deënergized, and which in Figs. 1 and 2 is designated 21^2; thence by the conductor 38 to a stationary contact 36 that is situated adjacent to one of the bars 23 that is back of the one occupying the said mid-position, preferably the one 21′, next immediately back thereof; thence by a bridge 37 carried by the last said bar but insulated therefrom, to a stationary contact 35, to the wire or conductor 34, the strip 32, the brush 31 in contact therewith, the bar 23^2 carrying said brush and now occupying a mid-position, and the conductors 18 and 4 back to the battery or other source of current.

In order to maintain the bars 23 in the mid-positions referred to, the following described mechanism may be employed. 39 designates a spring latch adapted to engage with a shoulder 40 on a bar 23. These parts are so related that the bar may freely move relative to the latch piece whenever the core 22 is attracted, but when the latter is released and the bar moves away from the solenoid the latch catches and holds it before it has reached its inactive position, although not until it has moved far enough to separate all the contacts controlled by it except the ones 31 and 32, which as has been described, are brought into engagement when the bar is held in this position. 41, 41 are strikers carried by the bars 23 and arranged to trip the latches 39. Each striker controls the latch of the bar next back of the one by which it is carried, and operates to release that bar whenever its own bar is raised or moved into active position, indicating that a circuit has been completed through its own solenoid and that its contacts, including the ones 28, and 29, are closed. As the last bar of a group, 23^3, stands, in the cycle of operations of the devices comprised in that group, next in rear of the first bar, provision must be made for tripping the latch of the bar 23^3 from the movement of the bar 23. In the diagram now being described there is a conventional showing of means for effecting this result. The striker for the latch of the bar 23^3 is designated 41′, and is operated from the bar 23 through a train of operative connections 42.

The mechanism thus far described is all that is required to operate, according to my present invention, a single group of lamps. But where a plurality of such groups are used a change must be effected in the group II whenever there has been a complete cycle of changes in the group I, and a similar change made as between groups II and III, and so on. Therefore it becomes necessary to provide each group of selecting and operating devices with certain other circuit controlling means which are arranged to periodically control the operations of the devices in the group next in advance. Let it be supposed that the apparatus is employed to show illuminated figures, and that the first group of control devices to the left governs the illumination of the lamps showing the minutes figures, the second group, the group showing the tens minutes figures and the third group the hours. It follows that whenever a 0 is displayed at the minutes panel or monogram (indicating that the solenoid corresponding with 21^3 of Fig. 1 has been energized) there must be a change at group II. This change is effected through the following described means, see Figs. 1 and 2. 11′ is a solenoid interposed between the first and second groups of controlling devices. It is similar to the solenoid 11, already described, being on one side connected directly with the main positive line 3, and on the other side connected with the negative line through connections in the group I, to be pointed out. The movements of the core of this solenoid, 11′ control the opening and closing of the branch line leading to the group of devices, II. The connections of the coil with the negative line, instead of being, as in the case of the solenoid 11, through a clock or other master control device, 6, is as follows: The negative line or conductor from the coil of solenoid, 11′, is designated 43, and leads to a stationary contact 44 situated adjacent to the bar of the solenoid 21′, group I, that is the second solenoid back of the last one of the series, which last one, as stated, controls the display of the character 0. This bar 23′ carries an insulated bridge 45, adapted when the bar is in normal inactive position to unite the contact 44 with another contact 46 connected by a conductor 47 with a stationary contact 32′ near the bar 23^2, that is, the next to the last bar of the group. With this last contact there engages, whenever the bar is arrested in its intermediate position by the latch 39, a movable contact 31′ carried by and in metallic connection with the bar.

Now let it be supposed that the bar 23^2 which carries the lamp contacts that cause

the display of the character 9 at the units monogram has just been released from the influence of its solenoid and has moved to its mid-position where it is held by the catch piece 39 as represented in Fig. 2. This will cause a separation of all of the contacts of that bar, except those at 31, 32 and 31′ and 32′, which will be closed. No current will however pass to the group of devices I so long as the circuit controlled by the clock is kept closed and the main circuit thereby maintained open.

At the same time, that is, at the moment the bar 23^2 is arrested in its mid-position, there is established a circuit through the coil of the solenoid 11′ that controls the branch of the main circuit leading to group II, which solenoid on being energized breaks the said circuit and causes all the lamps of such group to be extinguished. This circuit will be from the battery by the positive line 3 to the solenoid 11′ of the circuit breaker between groups I and II, through the coil thereof, and, by wire 43, to the contact 44 at bar 23′, thence by bridge 45 to the contact 46, line 47, contacts 32′, 31′, bar 23^2 and strip 18 to the negative line 4, and so back to battery. This, as stated, causes the solenoid 11′ to be energized, which in turn breaks the circuit in the branch of the main line leading to group II, whereupon, all of the solenoids thereof being out of circuit, the bars 23 will be released and will assume positions separating all of the lamp contacts. But the bar of the solenoid last energized in group II will be arrested in an intermediate position, establishing such circuit relations that as soon as the solenoid 11′ is deënergized and the devices of group II again connected in circuit with the battery, the solenoid next in advance will be put in circuit and become operative. As soon as the circuit including the branch leading to group I is closed at 12—13, by the separation of the contacts 7 and 8 of the master control device and the deënergizing of the solenoid 11, current passes by the following circuit, viz.; by the positive line 3 and leads 3′, 20, to the coil of the solenoid 21^3, thence by the conductor 38 to the contact 36, then by the bridge 37 carried by the bar 23′ to the contact 35, over the conductor 34, contacts 32 and 31 and bar 23^2 to the negative line 4 and so back to battery. This will cause the solenoid 21^3 to be energized and the character "0" will be displayed at the units monogram. The attraction of the bar 23^3 operates the latch 39 and releases bar 23^2 which assumes normal position, breaking the contacts 31, 32, 31′, 32′, whereupon the circuit of the solenoid 11′ is broken, at 31′, 32′, which causes the circuit connections with devices of group II to be reëstablished.

When next to the last bar 23 of group II is operated, causing the display of the character 5 at the second monogram in an apparatus for indicating time, or the character 9 in an ordinary decimal counting apparatus, the operations just described with reference to group I will take place in the second group, causing a single operation of the circuit breaker between groups II and III, with the result that there will be a single change at the third monogram showing hours or hundredths, as the case may be. As the circuits through the operating mechanism of group III are maintained for relatively long periods of time, it is found advantageous to cut into the circuits, after being established, a resistance to prevent disastrous heating of the coils. I therefore interpose in the line, a resistance 48, which however is cut out until after one of the solenoids 21 has been energized and by the attraction of its switch bar 23 established the desired connections. 49 indicates a coil connected by wire or other conductor 50 with stationary contacts 51 located adjacent to the several movable bars 23 and with which there engage contacts 52 carried by the bars, as the latter are moved under the influence of the solenoids 21. The other end of the coil 49 is connected by conductor 53 with the resistance 48. A movable core 54, actuated by the solenoid 49 is suitably connected with the lead wire 3^3 that supplies the third group of actuating and controlling devices with current. Whenever the current is cut off from the devices of the third group, by the circuit breaker situated between groups II and III or otherwise, the solenoid 49 of course receives no current and its core accordingly falls away and into engagement with a stop 55 to which the positive line 3 is connected, thus making a direct connection from such line to the lead 3^3 and by it with the group of devices, III, and at the same time cutting out or shunting the resistance 48. As soon therefore as the circuit of this group is reëstablished a powerful current is sent through such solenoid 21 as may be connected with the line to receive it, attracting the core 22 and causing a rapid movement of it and the bar 23 to close the circuits controlled by the latter, including that of the coil 49. This becoming excited, attracts its core 54 breaking the direct connection from the positive line to the branch 3^3, and sending the current from the positive line to the branch through the resistance 48, which will reduce it to such an extent that, while the bar 23 will be held in position to maintain its contacts, the amount of current passing through the solenoid will not be sufficient to disastrously heat the latter.

56, 56 are circuit closers connected respectively on one side with the negative line 4, and on the other side, through conductors 57, with the negative terminals of the coils of

the first solenoids 21 of each group. These circuit closers are employed in starting the apparatus and operate to close circuits through the said first solenoids whenever they are operated. Supposing all of the parts in each group to be in normal inactive position, the operation of the several circuit closers 56 will close a circuit in each group as follows: From the battery by the positive line 3 and branch 20 through the solenoid 21, thence out through the conductors 30 and 57, through the circuit closer 56 and by the negative line 4 back to the battery. The first bars, 23, of each group will then be actuated and the characters 1.11 will appear at the monograms. If this should correctly indicate the hour nothing further need be done except to allow the master clock to control the operations of the several groups of devices, as has been described. But suppose the time of starting were 1.32 instead of 1.11. A simple subtraction will show that a change indicating twenty-one minutes in advance must be made, that is to say, a single change must be made at the first group of controlling devices and two changes at the second group, none being required at the third or hours group. To effect these changes and thus permit the starting of the display mechanism to correspond with the time, the following means are employed: 58, 58 are circuit closers, one for each group of operating devices, situated in connections between the negative line or lead for each group and the wires 9 connected with the negative terminals of the solenoids 11. These circuit closers are independent one of the other so that the manipulation of any one causes a change only in the group with which it is associated.

It will be seen by reference to Fig. 1 that the several groups of lamps are connected in multiple with the source of electricity, the positive line going to the circuit making and breaking devices controlled directly by the master clock or other control device, so that the opening of the circuit controlled directly thereby causes all of the lamps to be extinguished. One lamp, 60, representing a period and located between the characters designating hours and those designating minutes, is so connected that it always remains illuminated except when the main circuit is broken as last described.

I will now describe the operation of the apparatus. The first acts to be performed are to connect the several panels with the supply circuit, which is done by closing the circuit closers 5′, and to connect the entire system with the source of supply through the circuit closer 5. The circuit closers 56 may then be operated to start the apparatus of each panel, and the circuit closers 58 operated to adjust the parts to positions from which the apparatus may be allowed to work automatically, as has been described. The clock or other master control device is then set into operation. It will be supposed that the apparatus being described is constructed and arranged to indicate time and that at each of the three panels, diagrammatically represented in Fig. 1, the first electro-magnet 21 has been energized, and the first bar, 23, of each group of operating devices has been thereby lifted or moved. The circuits as now established may be traced as follows: First, that through the electromagnet or solenoid 21, is from the source of current supply along the conductors 3 and 20 to the coil of the solenoid or other electroresponsive device, thence by the wire or conductor 30 to the stationary contact 28, with which the movable contact 29 now engages, this connection having been made when the bar 23 was moved, thence over the said bar 23 and the conductors 18 and 4 back to the source of supply. Second, the circuit through the lamps whose lighting is controlled by the bar 23, is from the source of current supply over the conductors 3, 3″ to the lamps 26, thence by wires or conductors 25 to the stationary contacts 24 with which now engage the movable contacts 27 carried by the bar 23, the circuit continuing from the contacts 24 and 27 along the bar 23 and the conductors 18 and 4 back to the source of current.

It will be seen that, in the arrangement of contacts illustrated in Figs. 1 and 2, the bar 23 controls the illumination of the uppermost lamp in the left hand row and the two end lamps in the right hand row.

These lamps remain lighted until the contacts 7 and 8 at the master control device come into engagement, whereupon a new circuit is established through the solenoid 11, which may be traced as follows: From the source of current supply along the conductor 3 to the coil of the solenoid, thence by the wire 9 to the contacts 8, 7 of the master control device, and thence by the conductors 10 and 4 back to the source of supply. The solenoid being energized attracts its armature, which breaks the circuits including the solenoid 21, and the lamps 26, at the points 12, 12. Thereupon the armature of the solenoid 21 falls away therefrom, the bar 23 moves and the circuits of the lamps which it controls are opened. The bar 23 is arrested in its movements by the latch or dog 39 and held in such position that the contacts 31, 32 are in engagement, whereupon there is established a new circuit, including the solenoid next in advance of 21, and designated 21′,—this circuit being traced as follows: From the source of supply over the conductors 3, 3′ and 20 to the coil of the solenoid 21′, thence by the conductor 38 to a stationary contact 36 located at one of the bars 23 in advance of the one 23′—the

bar 23^3 in the arrangement shown, with which contact, the bar 23^3 being in normal or inactive position, engages the bridge piece 37 carried by the said bar, and from which point the circuit includes the said bridge piece, the other stationary contact 35, the conductor 34, leading to the stationary contact 32 at bar 23, the movable contact 31 carried by the said bar, which is now, as stated in mid-position, the bar 23 and conductors 18 and 4 to the source of supply. This last circuit is maintained only momentarily, or until the latch 39 holding the bar 23 in its mid-position is tripped by the movement of the bar 23′, whereupon the bar 23, being now released, moves sufficiently far to break the circuit at the contacts 31 and 32. The conditions are now similar to those described in tracing the circuit through the solenoid 21, except that the solenoid 21′ instead of 21 is in circuit, and the parts which it controls are in active position while those controlled by 21 are inactive. A different set of lamps at the monogram, that controlled by the bar 23′, is therefore illuminated. At each closing of the circuit by the master control device the operation of the parts described is repeated, one solenoid or electro-responsive device and the parts it controls being put out of use while the set of devices next in advance is put in operation.

These operations continue until the cycle of movements at the panel are completed and the next panel, that controlling the display of the tens figures, for instance,—should receive an electrical impulse that will cause a change in the display at this second panel. As has been stated, the bar designated 23^3 in the diagrams accompanying this specification is supposed to be one which causes the display of the figure 0 at the monogram, and when this is displayed there should be a simultaneous change at the next monogram, and this change is effected as follows: The bar 23^3 is moved upon the energizing of the solenoid 21^3, and the circuit through this coil is completed at the moment the bar 23^2 is arrested in its mid-position. This latter bar carries a contact 31′ that comes into engagement with the stationary contact piece 32′ and controls the circuit through the solenoid 11′ of the tens group of devices when the bar is arrested in its mid-position, as has been described. The circuit through this latter solenoid is traced as follows: From the source of electric supply over the conductor 3 to the coil of the solenoid 11′, thence by the conductor 43 to the stationary contact 44 at bar 23′, thence by bridge piece 45 engaging therewith to the other stationary contact 46 with which the bridge piece engages, thence by conductor 47 to the stationary contact 32′, the contact 31′ engaging therewith, the bar 23^2 carrying the latter contact and the conductors 18 and 4 to the source of supply. The energizing of the solenoid 11′ causes a break in the circuit of the group II, similar to the break in the circuit of the group I when the solenoid 11 is energized as has already been described, and this results in a change in the display at the monogram of the group II, as will be understood without further detailed explanation.

In practically installing an apparatus embodying my invention the lamps and the selecting and operating mechanism may all be mounted in a single frame, as indicated in Fig. 3, or the lamps and operating mechanism may be widely separated as may be found most practicable.

In Fig. 3 the lamps 26 are represented as being supported by a plate 61 located behind the front perforated plate 62 of the panel or monogram. Each lamp is preferably surrounded by a shield and reflector 63 to improve the illuminating effects of the apparatus. The solenoids 21 and the stationary contacts of the apparatus are mounted upon insulating bars or plates 64 carried by cross bars 65 suitably arranged and placed within the frame. The spring actuated latch pieces 39 are arranged to engage with the shoulders or notches 40 cut in the mid ribs or webs of the bars 23.

These latches are preferably constructed as represented in Figs. 6 and 7 and consist of a series of dogs mounted upon a rocking shaft 66 extending across the bars 23 and suitably supported in the frame. A series of finger pieces 67 are mounted upon the said rocking shaft and extend into the paths of movement of the strikers 41 carried by the bars 23. These fingers are preferably connected with sleeves 68 mounted upon the shaft 66, which sleeves at the ends opposite the fingers also carry pins or projections 69 adapted to be brought into engagement with the tail ends of the spring catches or holding dogs 39, when the sleeves are rocked. These parts are so arranged that the spring latches or holding dogs 39 allow the bars to freely move upward, and, when they are released, to move away from the solenoids far enough to separate the contacts, except those at 31, 32; until they, by engagement with the shoulders, arrest the bars in an intermediate or mid-position. When the next succeeding bar 23 in the series is moved under the attractive force of its solenoid the striker carried thereby comes into engagement with one of the fingers 67 on the shaft 66, and, rocking the latter, moves the latch or holding dog 39 that was in operation from engagement with the bar 23, which then is free to assume its normal inactive position. The connection designated 42 in the diagrammatic representation in Figs. 1 and 2 between the first bar of the series and the latch

for the last one through or by means of which the said latch is tripped when the first bar is moved, consists of the shaft 66 and the finger 67′ and contact pin or projection 69ˣ. The finger 67′, which is engaged by the projection 41 of the first bar of the series, is carried by the sleeve 68′ which is secured fast to the shaft 66 by a set screw 70. The projection 69ˣ that acts upon the catch or dog 39 for the last bar of the series is carried by a sleeve 68ˣ which also is secured fast to the shaft. Thus when the first bar of the series is raised by the attractive force of its operating magnet or solenoid the last bar of the series is released from its holding catch or dog through the train of devices just described.

I have herein uniformly referred to the parts designated 11, 21 and 49 as solenoids, but I wish it to be understood that the solenoid has been represented and referred to merely as one style of operative electro-responsive device.

What I claim is:—

1. In a display apparatus, the combination of lamps arranged in a group, stationary contacts with which the lamps are connected, circuit controlling devices arranged to respectively close the lamp circuits so as to cause different combinations of the lamps of the group to be illuminated, electro-responsive devices controlling the said circuit closing devices, a current supply circuit with which the electro-responsive devices may be respectively connected, means controlled by the said circuit controlling devices for bringing the electro-responsive devices successively into connection with the supply circuit, the said connecting means of each circuit controlling device being arranged to come into operation as the said device is disconnected from the supply circuit, means for holding said connecting means temporarily in operation, and means for releasing them when the next electro-responsive device of the series is operated.

2. In a display system, the combination of lamps arranged in a group, contacts with which the said lamps are connected, circuit controlling devices arranged to respectively engage with certain of the contacts to close circuits through different combinations of lamps of the group for illuminating them, electro-responsive devices controlling the circuit closing devices, a current supply circuit with which the electro-responsive devices may be respectively connected, means controlled by the said circuit closing devices for bringing the electro-responsive devices respectively into connection with the supply circuit, the said connecting means of each circuit-controlling device being arranged to come into operation as the said device is disconnected from the supply and the lamps it controls thereby extinguished, means for holding said connecting means temporarily in operation, means for releasing them when the next electro-responsive device of the series is operated, and means for periodically breaking the supply circuit connections of the said electro-responsive devices between each change in the illumination of the lamps.

3. In a display system, the combination of lamps arranged in a group, contacts with which the lamps are connected, circuit controlling devices arranged to respectively engage with certain of the said contacts to close circuits through different combinations of lamps of the group for illuminating them, electro-responsive devices controlling the said circuit controlling devices, a current supply circuit with which the said electro-responsive devices and the lamps of the group may be respectively connected, means for controlling the successive action of the electro-responsive devices, and means for periodically breaking the supply circuit connections of the said set of electro-responsive devices and of the group of lamps between each change in the illumination of the lamps.

4. In a display system, the combination of lamps arranged in a group, contacts with which the lamps are connected, circuit closing devices arranged to respectively engage with certain of the contacts to close circuits through different combinations of lamps of the group for illuminating them, electro-responsive devices each controlling a circuit closing device, a current supply circuit for the electro-responsive devices, a pair of circuit closers operated by the circuit controlling devices, one circuit closer of said pair controlling the connection of the electro-responsive device that operates that circuit closing device with the supply circuit, and the other of the pair being arranged to operate momentarily when its own electro-responsive device becomes inactive and control the connection of the next electro-responsive device to operate with the supply circuit and means for opening the circuit at the last said circuit closer when the next electro-responsive device of the series becomes active.

5. In a display system the combination of lamps arranged in a group, contacts with which the lamps are connected, circuit controlling devices arranged to respectively engage with certain of the contacts to close circuits through different combinations of lamps of the group for illuminating them, electro-responsive devices controlling the said circuit controlling devices, a current supply circuit with which the electro-responsive devices may be connected, means for establishing connections between the supply circuit and the next electro-responsive device to be operated whenever the circuits of the lamps just illuminated are

opened, and means for opening the said circuit between the main line and the said next electro-responsive device when it operates to close the circuits through the set of lamps it controls.

6. In a display system, the combination of electric lamps, contacts with which they are connected, circuit closing devices respectively controlling the circuits of the lamps, electro-responsive devices for moving the said circuit closing devices, a current supply circuit with which the electro-responsive devices are connected, means for holding the circuit closing devices in intermediate positions immediately on their electro-responsive devices becoming inactive, means for closing the circuits of the electro-responsive devices successively next to be operated, as the circuit closing devices assume the said intermediate positions, and means for releasing in succession the circuit closing devices from the parts which hold them in intermediate positions.

7. In a display system, the combination of electric lamps, contacts with which the lamps are connected, circuit closing devices respectively controlling the circuits of the lamps, electro-responsive means for moving the said circuit closing devices, a current supply circuit with which the electro-responsive means are connected, means for holding the circuit closing devices in intermediate positions immediately upon being released from the action of the electro-responsive means, means for closing in succession the circuit of each electro-responsive device next to be operated as each circuit closing device successively assumes its intermediate position, and each comprising contact devices closed as the parts come to the said intermediate position, and connections from the said contacts through circuit closing devices carried by a third circuit closing device and which are closed when the said device occupies its normal inactive position, and means for releasing the circuit closing devices from the parts that hold them in the intermediate positions as the circuit closing devices are successively operated.

8. In a display system, the combination of electric lamps connected in groups, a series of electro-responsive devices corresponding with the several groups of lamps, a series of movable bars operated by the electro-responsive devices, means for arresting the bars in intermediate positions as they are released from the influence of the electro-responsive devices, three sets of circuit closers carried by each bar, one set controlling the lamp circuits and arranged to be closed when the bars are attracted by the electro-responsive devices, another set arranged to be closed when the bars occupy their intermediate positions, and a third set arranged to be closed when the bars occupy their inactive positions, connections between each circuit closer of the second set and circuit closer of the third set, and connections between each of the last said circuit closers and the electro-responsive device next to be operated in series, substantially as set forth.

9. In a display system, the combination of electric lamps arranged in a group, contacts with which the lamps are connected, a series of electro-responsive devices for controlling the different combinations of lamps in the group to be illuminated, movable bars operated by the electro-responsive devices, a set of circuit closers carried by each bar controlling lamp circuits, and other circuit closers carried by the bar for putting the electro-responsive device controlling that bar into the main circuit whenever the lamp circuits are closed, a main circuit with which the electro-responsive devices are connected, means for opening and closing the main circuit, and means for automatically bringing the said electro-responsive devices successively into the main line, substantially as set forth.

10. In a display system, the combination of electric lamps arranged in groups in each of which the lamps are to be illuminated in different combinations, groups of circuit closing devices corresponding with the groups of lamps and controlling the successive illumination of the different combinations of lamps thereof, electro-responsive means controlling the said circuit closing devices, a circuit breaker for each group of circuit closing devices, by which the main line connections therewith are opened and closed, and means controlled by the circuit closing devices of one group for controlling the operation of the circuit breaker of the next group in advance whenever a complete cycle of changes in the first group has been completed.

11. In a display system, the combination of electric lamps arranged in groups in each of which the lamps are to be illuminated in selected sets to form characters that are successively displayed, circuit closing devices also arranged in sets corresponding with the lamp groups and respectively controlling the circuits of the sets of lamps therein, electro-responsive means controlling said circuit closing devices, a main circuit having branches leading to each set of circuit closing devices and with which the electro-responsive devices are connected, a circuit breaker for opening and closing the main circuit to the first set of circuit closing devices, a master control device governing the operations of the said circuit breaker, a second circuit breaker in the branch of the main circuit leading to the second set of circuit closing devices, and means for controlling the operations of the second circuit

breaker, controlled by the first set of circuit closing devices and arranged to operate said second circuit breaker whenever a complete cycle of changes in said first set has been effected.

12. In a display system, the combination of electric lamps arranged in groups in each of which the lamps are to be displayed in successively illuminated sets, circuit closing devices also arranged in sets corresponding with the lamp groups and controlling the circuits of the sets of the lamps therein, electro-responsive means controlling said closing devices, a main circuit having branches leading to each set of circuit closing devices with which the electro-responsive devices are connected, a circuit breaker in each branch circuit leading to each set of circuit closing devices, said circuit breakers operating to open and close each its own circuit, a master control device governing the operations of the circuit breaker of the first set of circuit closing devices, and means in each set of circuit closing devices for controlling the operation of the circuit breaker controlling the branch circuit of the following set of circuit closing devices whenever a complete cycle of changes in the said set of circuit closing devices next preceding the last said circuit breaker has been effected, substantially as set forth.

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Witnesses:
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