Oct. 15, 1929. L. T. BARNES 1,731,808

SWITCHING APPARATUS

Filed June 15, 1926 4 Sheets-Sheet 1

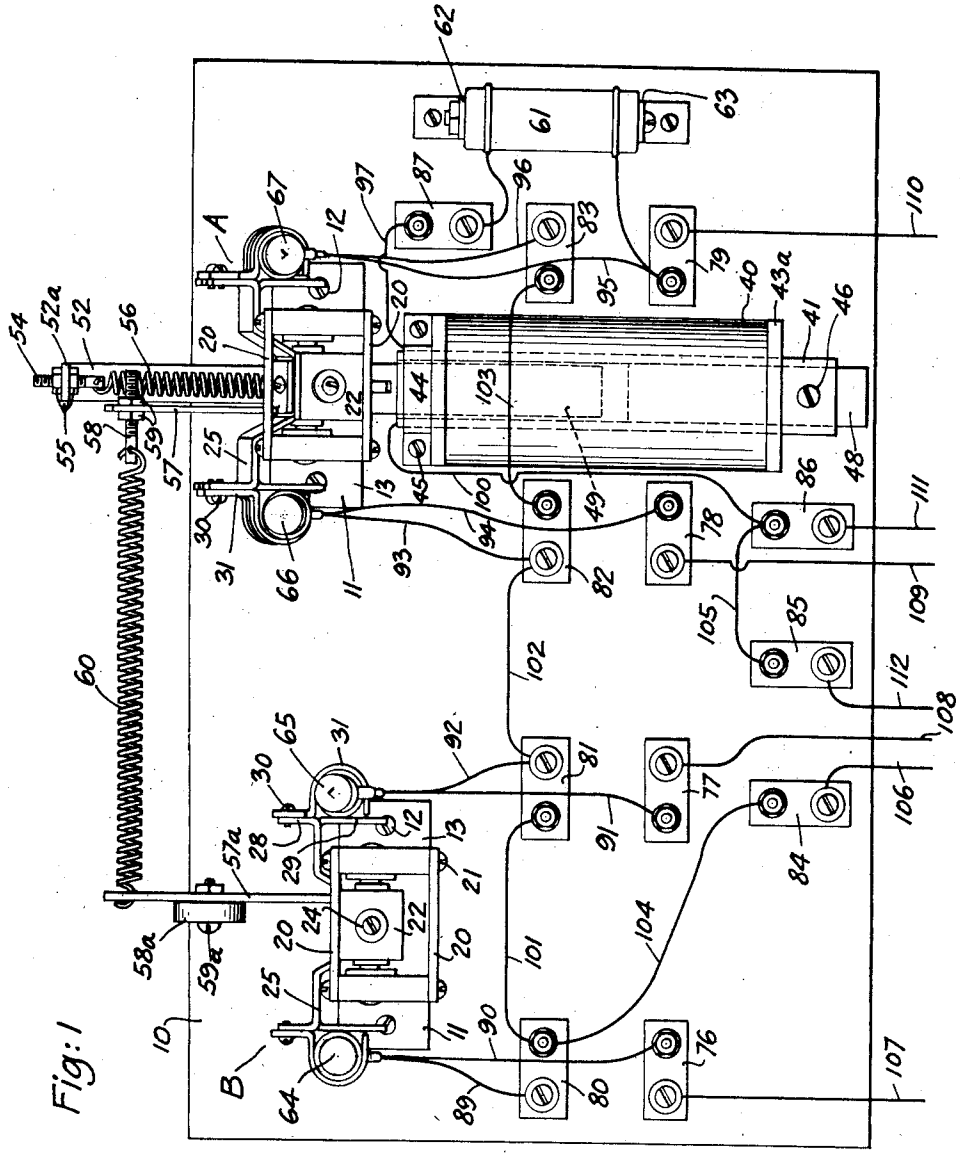


Fig: 1

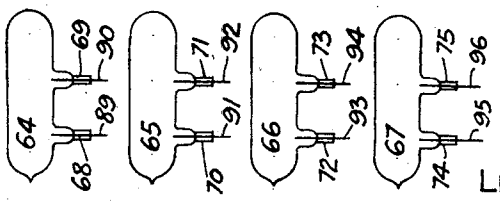


Fig: 2

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SWITCHING APPARATUS

Filed June 15, 1926 4 Sheets-Sheet 2

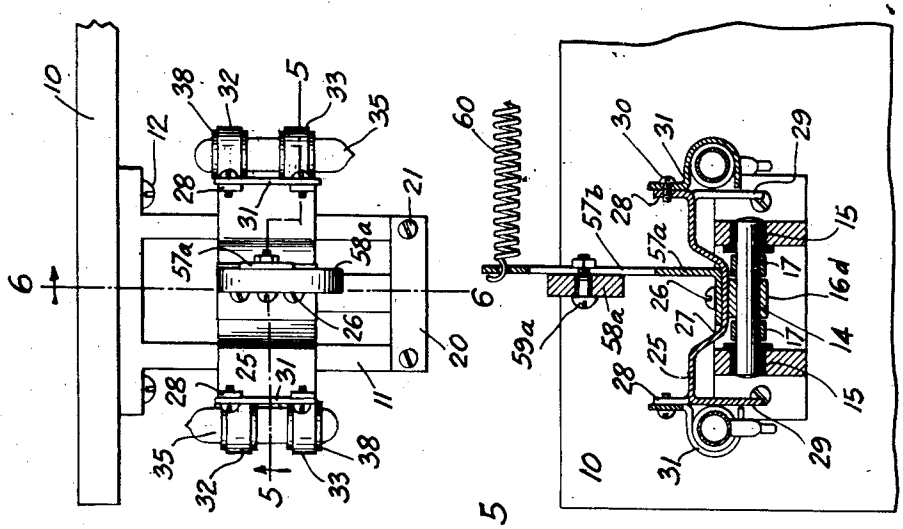


Fig: 4

Fig: 5

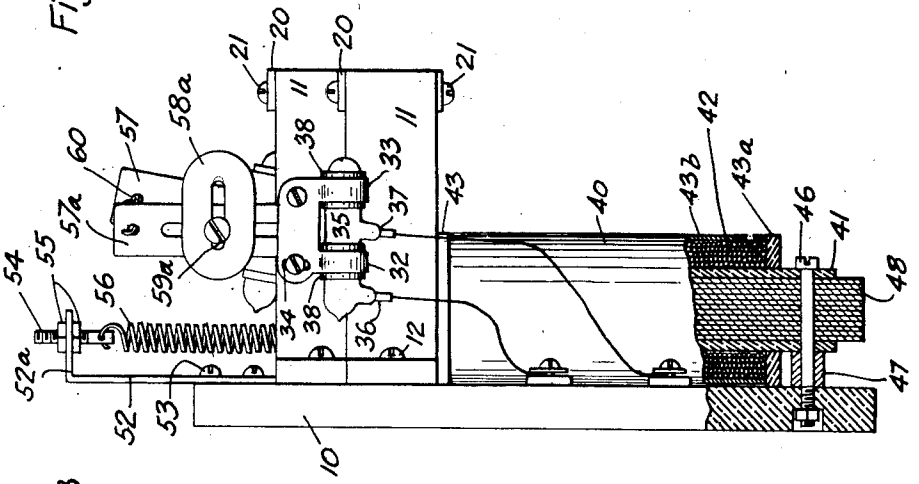


Fig: 3

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SWITCHING APPARATUS

Filed June 15. 1926 4 Sheets-Sheet 3

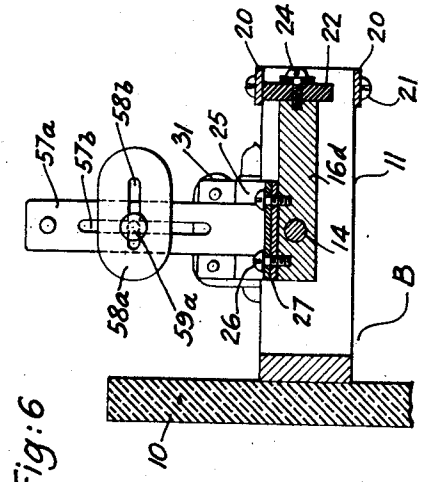


Fig: 6

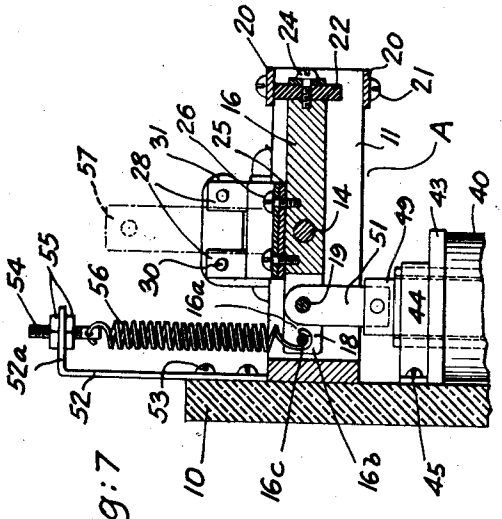


Fig: 7

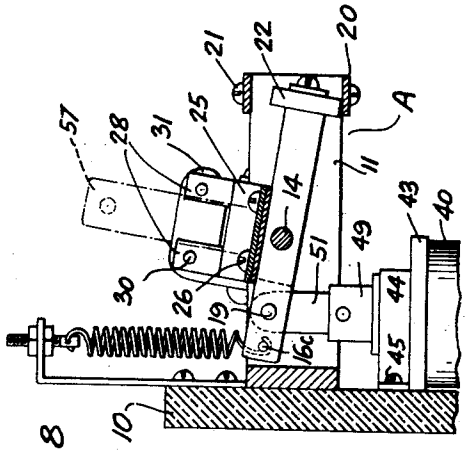


Fig: 8

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SWITCHING APPARATUS

Filed June 15, 1926 4 Sheets-Sheet 4

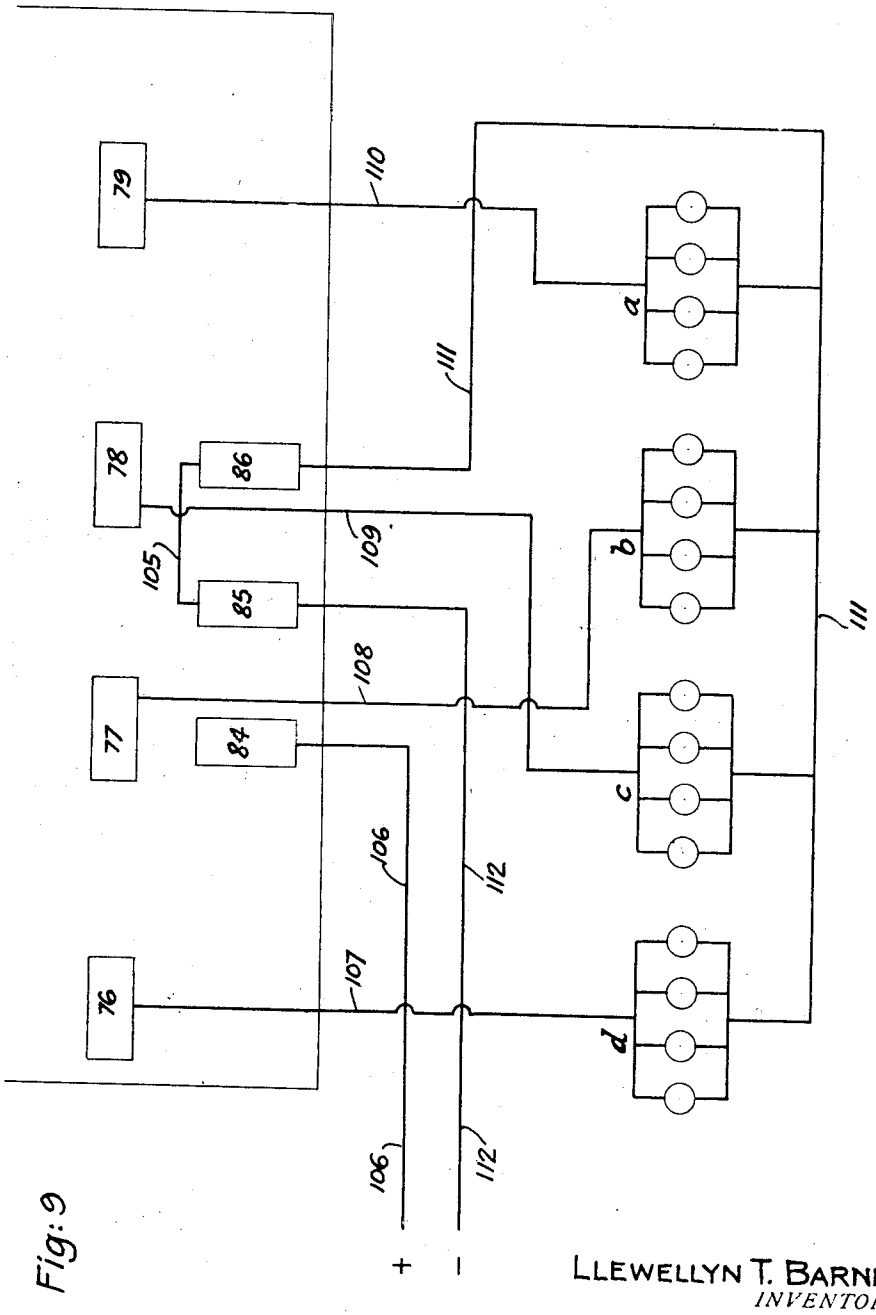


Fig: 9

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Patented Oct. 15, 1929 1,731,808

UNITED STATES PATENT OFFICE

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SWITCHING APPARATUS

Application filed June 15, 1926. Serial No. 116,151.

This invention relates to switching apparatus and more particularly to devices adapted to intermittently render the working circuit or circuits operative and inoperative, and is especially applicable to flashing lamps or the like, for electrical signs, etc., although not necessarily limited to such applications.

It is one of the particular objects of the invention to make switching apparatuses of this kind especially suitable for synchronous operation of a plurality of circuits, and to adapt the invention to operate such circuits which are closed in series and at high speed by means of a master control to produce flashing effects, travelling borders, revolving wheels, and similar advertising signs.

Other objects are to make apparatuses of this character simpler in construction by the elimination of motors and reducing gears, to make them more silent in operation, to provide them with means to adjust their speeds, to effect ease of replacement of parts subject to wear, and to make possible their application to a greater number of electrical displays, as well as for signalling purposes, than heretofore.

With these and other objects in view, my invention consists broadly of a set of electrical switches operated by a solenoid to alternately open and close circuits and a similar set of switches operated by mechanical connection with the solenoid operated set, the timing of opening and closing of the second set lagging somewhat behind that of the solenoid operated set owing to the peculiar form of mechanical connection between them which connection is adjustable, so that synchronous flashing of lamps connected to the switches may be obtained in alternate and progressive order as will be explained more fully hereafter.

A preferred embodiment of the invention is shown in the accompanying drawings in which

Fig. 1 is a front elevational view of the switching apparatus, shown in connection with a four circuit system, the wiring connecting the various parts of the apparatus being indicated in the drawings diagrammatically;

Fig. 2 is a series of side elevational views of switch tubes proper and their wire connections, shown diagrammatically only;

Fig. 3 is an end elevational view of the apparatus, partly in section;

Fig. 4 is a fragmentary plan view with the wiring omitted;

Fig. 5 is a fragmentary sectional view along the plane of line 5—5 in Fig. 4;

Fig. 6 is a fragmentary sectional view through the companion unit along the plane of line 6—6 in Fig. 4;

Fig. 7 is a similar sectional view through the master unit with the solenoid in energized position;

Fig. 8 is a similar sectional view through the master unit with the solenoid in de-energized position; and

Fig. 9 is a diagram showing the wiring connecting the apparatus with a number of lamp banks.

Like characters of reference denote similar parts throughout the several views and the following specifications.

10 is a suitable insulating base upon which is fastened a master unit A and a companion unit B. The master unit consists of a bracket 11 of U shape, mounted upon the base 10 by means of screws 12 through outwardly extending lugs 13. Crosswise through both legs of the U-shaped bracket 11 is driven a fulcrum or axle 14, anchored within the bracket 11 in hard rubber bushings 15. 16 is an oscillatory member or beam, pivotally mounted on fulcrum 14, and held in spaced relation to both legs of the bracket 11 by tubular washers 17. A rearwardly extending portion 16ª of the beam 16 is slotted at its end at 18, bored out transversely for a pin 19, and extends somewhat beyond the pin at

16[b] to receive another pin 16[c]. The front ends of legs of bracket 11 are connected at the top and at the bottom by cross bars 20, fastened to the legs by screws 21. 22 is a stop member, made preferably of felt and fastened to the front end of beam 16 by a screw 24, thereby causing a silent contact between the end of beam 16 and the top and bottom cross bars 20.

At the top of beam 16 is a switch bracket 25 of substantially rectangular shape, fastened to the beam by screws 26 and having a central portion 27 depressed sufficiently to prevent contacting of its outer portions with the bracket 11. Both sides of the bracket 25 are slotted and bent so as to form on each side two upwardly extending lugs 28 and a downwardly extending skirt 29 between them. Fastened to lugs 28, at each side of the bracket 25, by means of two screws 30 is a switch holder 31, each of which is provided with straps 32 and 33. 34 is one of the holes for screws 30, made of elongated shape, for purposes of adjustment.

35 is a switch member proper consisting of a glass tube arranged to receive a suitable conducting liquid, such as mercury, for instance. Each switch member has mounted therein two switch or working circuit contacts 36 and 37. These contacts extend into and are sealed in the tube. Straps 32 and 33 are bent around switch tubes 35 and hold each tightly against skirts 29 at both sides of bracket 25. 38 are asbestos rings around the tubes to avoid contact between the tubes and straps 32 and 33 and their breakage due to uneven expansion, the straps being of metal. The position of the switch holders and switch tubes 35 may be adjusted by loosening somewhat screws 30 and pushing the holder 31 up or down the limit of its elongated slot 34 and, when in the desired position, again tightening the screws.

40 is a solenoid which consists of a hollow square shaped bobbin 41 having a form wound coil 42 placed over it. Loose flanges 43 and 43[a], at both ends of the coil 42, and other suitable insulation 43[b] around it, serve as a covering for the coil 42. Bobbin 41 projects through flanges 43 and 43[a], and a bracket 44 fitted around three sides of the projecting end of the bobbin, is used to secure the top part of the solenoid to the base 10 by means of screws 45 and also retains the top flange 43 in position at the end of the coil. The lower end of bobbin 41 is drilled for a screw 46 secured to the base 10. 47 is a tubular washer over the screw 46 between the base 10 and the bobbin 41 to hold the same in parallel spaced relation. Mounted within the bobbin 41 at its lower end is a core 48, customarily made of laminated metal sheets which are rigidly held by screws 46 serving not only to secure the solenoid to the base, but also the core to the solenoid. Loosely mounted within the upper hollow part of the bobbin 41 and also made, preferably, of laminated metal sheets, is an armature 49 of square cross section to which is fastened by means of a pin, an armature link 51. The other end of the link 51 is fastened to the beam 16 within its slot 13 by means of the pin 19. 52 is a bracket fastened above bracket 11 to the base 10 by screws 53, having a frontwardly extending top 52[a]. 54 is a screw held adjustably within an opening through top 52[a] by lock nuts 55. 56 is a retractile coil spring fastened to pin 16[c] of the beam 16 and to the lower end of screw 54, its tension being adjustable by the screw 54.

At the top of bracket 25 is mounted a standard 57 having a base at right angles thereto which is fastened to the bracket by means of screws 26 which also secure it to the beam 16. 58 is a screw through an opening near the top of the standard, being adjustably held there by lock nuts 59.

Mounted alongside of master unit A, but at a somewhat lower level, is a companion unit B, having a bracket 11, fulcrum 14, cross bars 20, switch brackets 25, switch holders 31, switch members 35 of similar construction than the master unit, the same reference numbers denoting corresponding parts. The solenoid, however, has been omitted and an oscillating beam 16[d] is mounted upon axle 14, similar to beam 16 but having its end facing base 10 cut off flush with bracket 25.

Companion unit B has mounted upon bracket 25 a standard 57[a] having a slot 57[b]. 58[a] is an elliptically shaped flat weight being also slotted at 58[b]. 59[a] is a screw and nut adjustably securing the weight 58[a] to the standard 57[a].

60 is a retractile coiled spring fastened to the upper end of standard 57[a] and the screw 58 of the standard 57 of the master unit.

61 is a high resistance coil suitably insulated and mounted upon the base 10 by brackets 62 and 63.

To aid now the explanation of the electrical features of the invention, I shall designate the switch tubes proper of the companion unit, as 64 and 65, respectively, and those of the master unit as 66 and 67, respectively, as shown in Figs. 1 and 2, and the points where the wires are connected to the switch tubes as 68 and 69 for tube 64, and as 70 and 71 for tube 65, as 72 and 73 for tube 66, and as 74 and 75 for tube 67. Fig. 2 shows these tubes and their connections diagrammatically, tube 64 in elevation from the left side of the companion unit, 65 in elevation from the right side of the companion unit, tube 66 in elevation from the left side of the master unit, and tube 67 in elevation from the right side of the master unit.

Reference to Fig. 1 shows mounted on base 10 a set of four working circuit terminals, namely, 76, 77, 78 and 79, and similar terminals numbered 80, 81, 82, 83, 84, 85, 86 and 87. Connections between the contact points of

the switch tubes and the terminals are made by flexible wires, customarily insulated by beads (not shown) as follows:

Switch tube 64, contact 68 with terminal 80 by wire 89, contact 69 with terminal 76 by wire 90; tube 65, contact 70 with terminal 77 by wire 91, contact 71 with terminal 81 by wire 92; tube 66, contact 72 with terminal 82 by wire 93, contact 73 with terminal 78 by wire 94; tube 67, contact 74 with terminal 79 by wire 95, contact 75 with terminal 83 by wire 96.

One end of the winding of the solenoid 40 is connected by a wire 97 to terminal 87, the other end of the winding by a wire 100 to terminal 86.

Terminals 80 and 81 are connected together by a wire bridge 101; so are terminals 81 and 82 by a bridge 102, and terminals 82 and 83 by a bridge 103. Terminal 80 is also connected by a wire 104 with terminal 84, and terminal 85 and terminal 86 by a wire 105. Resistance coil 61 is interposed between and connected to terminals 79 and 87, as shown in Fig. 1.

Inspection of Fig. 9 shows a positive line wire 106 connected to terminal 84. The positive sides of four lamp banks *a*, *b*, *c* and *d* are connected to the terminals 76, 77, 78 and 79, by load wires numbered, respectively, 107, 108, 109 and 110. The negative sides of lamp banks *a*, *b*, *c* and *d* are all jointly connected by a negative load wire 111 to terminal 86, whence the current passes through bridge 105 and terminal 85 to a negative line wire 112, thereby completing the circuit.

In the switching apparatus, when at rest, the oscillating beams 16 and 16^d are resting on the lower cross bars 20 of the brackets 11, and switches 65 and 67 are closed or in circuit, while switches 64 and 66 are open.

To start the machine, current is admitted through line wire 106 to terminal 84 whence it is fed to terminals 80, 81, 82 and 83 by wire bridges 104, 101, 102 and 103. Current is thus admitted into switches 65 and 67 from terminals 81 and 83, by wires 92 and 96, respectively.

Through tube 67, being closed, current passes through the mercury contained therein into wire 95, terminal 79, through resistance coil 61 into terminal 87, by wire 97 into the solenoid 40 and thence through wire 100, terminal 86, bridge 105, terminal 85 into the negative line wire 112, thereby closing the circuit and energizing the solenoid, and current also passes from terminal 79, wire 110, lamp bank *a*, wire 111, terminal 86, thereby lighting lamp bank *a*. At the same time current lights lamp bank *b* by closing a circuit from terminal 81, wire 92, tube 65, wire 91, terminal 77, wire 108, lamp bank *b*, wire 111, terminal 86, bridge 105, terminal 85 to the negative line wire 112.

The energizing of the solenoid 40 causes the armature 49 to be drawn downwardly from the position shown in Fig. 8 to that shown in Fig. 7 which opens the switch 67 thereby extinguishing lamp bank *a*, and closes switch 66, completing a circuit from terminal 82, through wire 93, tube 66, wire 94, terminal 78, wire 109, lamp bank *c*, wire 111, terminal 86 bridge 105, terminal 85, into negative line wire 112, thereby lighting lamp bank *c*.

Attention is now drawn to the mechanical direct connection of the master unit A with the companion unit B by the coil spring 60 attached to the upwardly extending standards 57 and 57^a. As soon as beam 16 of the unit A is drawn upwardly, the upper end of the standard 57 travels rearwardly from a frontwardly slanting position to an upright position. The spring 60 is sufficiently rigid to move along the standard 57^a of unit B in the same direction as that of standard 57. However, because at the begining of this travel the spring 60 is put under a slight tension, the movement of the standard 57^a lags somewhat behind that of standard 57. This amount of lag or retardation may be varied by adjusting the tension of the spring by means of screw 58 and nut 59, and the inertia of the standard 57^a may be adjusted by varying the position of its clamping screw 59^a within slots 57^b and 58^b. By this means, it is possible to so adjust this mechanical connection, that is, the tension of the spring and the inertia of the standard of the companion unit, that at high speed, they will even travel in opposite directions.

Reverting to the electrical working of the apparatus, it is now clear that lagging somewhat after the energizing of the solenoid, the companion unit B is reversed and also its switch tubes 64 and 65, the tube 64 causing current from terminal 80, and wire 89, to be passed through the mercury within it to wire 90, terminal 76, wire 107, lamp bank *d*, wire 111, terminal 86, bridge 105, terminal 85, into the negative line wire 112, closing the circuit and lighting lamp bank *d*. At the same time, lamp bank *b* is extinguished, owing to the reversed position of the switch tube 65 which breaks the circuit passing through it.

As soon as the apparatus reaches its normal speed, it is obvious therefore, that, owing to the retarded motion of the companion unit, the master unit first lights up lamp bank *a*, through switch 67, then the companion unit lights lamp bank *b* through switch 65, then on the reverse travel, the master unit lights up lamp bank *c* through switch 66, while extinguishing lamp bank *a*, and companion unit lights up lamp bank *d* through switch 64, while extinguishing lamp bank *b*. This movement of closing circuits is so timed by the various adjustments above described that the lamp banks *a*, *b*, *c* and *d* will be lit up in progressive order, causing a moving effect

of the lights of which any desired number of combinations may be connected to the switching apparatus.

While I have shown only two units mounted upon one base, any number of companion units may be connected to the master unit, these additional units to operate either simultanously or in series with each other to function one after the other.

The spring 56 is placed above the oscillating beam 16 to offset the pulling action of the solenoid below it and to place the least stress upon the fulcrum of the beam.

I have shown the companion unit mounted on the base somewhat lower than the master unit solely for the purpose of providing sufficient length of adjustment for the weight on the standard 57^a for varying the lag between the two units, but I do not wish to limit myself to this particular relation, and may omit this adjustable feature entirely and vary the lag by regulation of the spring or other convenient means. Furthermore, while I have shown and described herein the connection between the two units in form of a coil spring, I do not wish to exclude any other form of resilient connection which causes one unit to be operated after the other. So, for instance, a rigid bar may be used to directly connect the units, being tightly secured to the master unit and loosely anchored in the companion unit, the amount of loose play of the bar within the companion unit determining the amount of retardation of this unit behind the operation of the master unit.

Further modifications of operating can be introduced by mounting the switch tubes in the same direction, so that a pair will always be functioning simultaneously.

In the drawings has been illustrated the application of the principle of the invention to a four circuit system used for the purpose of causing electrical flashing or travelling border effects. It is obvious that the construction may be varied to suit any plurality of circuits and made to adapt itself to many other purposes, not necessarily for electrical display, but may be used for signalling purposes, that is flashing a series of lamps when the circuit is closed, or to many other applications.

It is understood that various changes of form, proportion and minor details of construction may be resorted to without departing from the principles or sacrificing any of the advantages of the invention, as defined in the appended claims.

What I claim as new, is:

1. In a switching apparatus, the combination with a master unit having a plurality of switches and electrical means to open and close the said switches continually, of a companion unit mounted alongside of the said master unit having a plurality of switches, and a lateral resilient mechanical connection between the master and companion units, adapted to open and close the switches of the said companion units, adapted to open and close the switches of the said companion unit in retarded synchronism with the switches of the said master unit.

2. In a switching apparatus, the combination with a master unit having a plurality of switches and electrical means to open and close the said switches continually, of a companion unit mounted alongside of the said master unit having a plurality of switches, and a lateral resilient mechanical connection between the master and companion units, adapted to open and close the switches of the said companion unit in retarded synchronism with the switches of the said master unit, and mechanical means to vary the retardation of the said companion unit.

3. In a switching apparatus, the combination with a pair of solenoid operated oscillatory switches, of a second pair of oscillatory switches, alongside of the said solenoid operated switches, a projecting member from each pair of switches adapted to oscillate in parallel planes, and a lateral resilient adjustable mechanical connection between the said projecting members, adapted to open and close the switches of the said second pair in retarded synchronism with the switches of the said solenoid operated pair.

4. In a switching apparatus, the combination with a master unit having a plurality of pivotally mounted mercury tube switches, electrical means to periodically open and close the said switches, and mechanical means to return them to their original position, of a companion unit mounted alongside of the said master unit having a plurality of pivotally mounted mercury switch tubes, the switches of the said units oscillating in parallel planes, and a direct resilient laterally disposed mechanical connection between the master and companion units, adapted to open and close the switches of the said companion unit in retarded synchronism with the switches of the said master unit.

5. In a switching apparatus, the combination with a master unit having a plurality of switches, and electrical means to open and close the said switches, of a companion unit mounted alongside of the said master unit having a plurality of switches, and a laterally disposed coil spring between the master and companion units forming the only mechanical connection between the said units, adapted to open and close the switches of the said companion unit in retarted synchronism with the switches of the said master unit.

6. In a switching apparatus, the combination with a master unit having a plurality of switches, and electrical means to open and close the said switches, of a companion unit

mounted alongside of the said master unit having a plurality of switches, and a laterally disposed coil spring between the master and companion units forming the only mechanical connection between the said units, adapted to open and close the switches of the said companion unit in retarded synchronism with the switches of the said master unit, and means to vary the retardation of the said companion unit.

In testimony whereof I have hereunto set my hand.

LLEWELLYN T. BARNES.