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C. G. SUITS

2,011,381

ELECTRICAL SYSTEM PROVIDING SEQUENCE OPERATION

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Fig. 1.

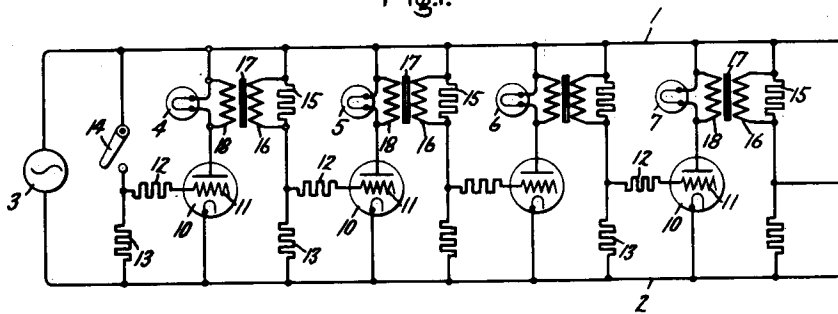


Fig. 2.

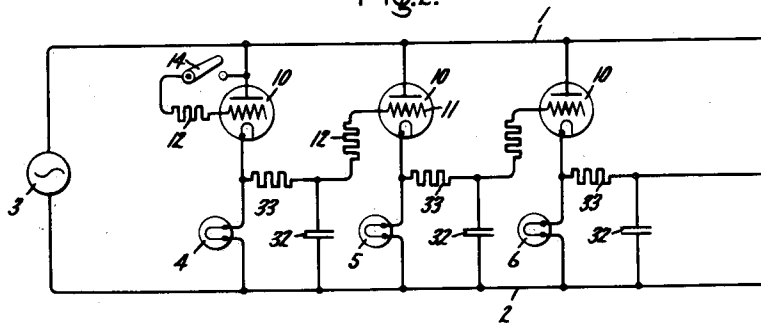


Fig. 3.

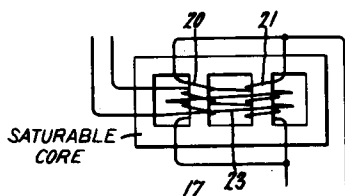
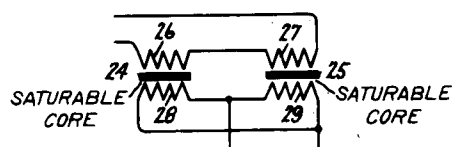


Fig. 4.



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ELECTRICAL SYSTEM PROVIDING
SEQUENCE OPERATIONChauncey G. Suits, Schenectady, N. Y., assignor
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4 Claims. (Cl. 177-346)

My invention relates to electrical systems containing a plurality of units which operate in a definite sequence. More particularly it relates to an electrical system providing a series of lamps which are operated successively either to become illuminated or extinguished in a predetermined sequence.

It is the object of my invention to provide an improved system of this character whose construction is simple and entirely electrical in character, having no moving parts, which is efficient in operation, and which is inexpensive to manufacture.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 is a circuit diagram of one embodiment of my invention; Fig. 2 is a circuit diagram illustrating a modified form thereof; and Figs. 3 and 4 illustrate two forms of saturable core reactor which may be used in the apparatus illustrated in Fig. 1.

In Fig. 1 an alternating current supply circuit is shown at 1 and 2 which may be connected with any suitable source of alternating current illustrated at 3, which for example may be a 110 volt, 60 cycle source. Connected across the supply circuits 1 and 2 is a series of branch circuits each containing a load device, such as an incandescent lamp, represented by 4, 5, 6, and 7. Such lamps, for example, may be beacon or field border lamps at an airport, the lamps of an electric sign or any other lamps which it is desired to have operate in a certain sequence. In each branch of the circuit and in series with the load device or lamp therein is the electron discharge valve device 10 which preferably is a vapor device having arc like characteristics. The control element or grid 11 of the vapor device in circuit with the first lamp 4 connects through a suitable controlling resistance 12 with another branch circuit including the resistance 13 and the switch 14. By the closing of this switch 14 a sufficiently positive potential is supplied to the grid 11 during each alternate half cycle of the supplied current to actuate the vapor device to cause it to pass current through the lamp. A similar vapor device is employed in each of the several branch circuits including lamps 5, 6 and 7, the grid of each device being connected through a similar resistance 12 to other branch circuits each including a resistance 13 and instead of a switch 14 the resistance 15. This resistance in each case is shunted by the alternating current winding 16 of

a saturable core reactor 17 whose direct current or saturating winding 18 is connected across the load device or lamp of the previous branch circuit.

For the sake of simplicity I have shown the saturable core reactors 17 in a purely diagrammatic manner in Fig. 1. Their actual construction may, for example, be as shown in Fig. 3 where the core of the reactor has four legs, the winding 16 comprises the coils 20 and 21 wound in opposite directions on the two inner legs of the core and connected in parallel, and the saturating winding 18 comprises the single coil 23 which surrounds both of said legs. A reactor of this type is disclosed in the Alexanderson Patent 1,328,610 of January 20, 1920. Instead of a single core reactor I may employ two separate transformers 24 and 25 as shown diagrammatically in Fig. 4. These transformers respectively have windings 26 and 27 which are shown connected in series and which together comprise the saturating winding 18 and have windings 28 and 29 shown connected in parallel and together comprising the alternating current winding 16. Windings 28 and 29 preferably are reversed in order to prevent alternating current from being induced in the direct current circuit.

With the apparatus as illustrated by Fig. 1 as long as the switch 14 is open the vapor device 10 whose grid connects therewith is inoperative to pass current. Hence lamp 4 remains dark. Since the saturating winding 18 of the first reactor 17 is not energized, the inductance of the alternating current winding 16 of this reactor is a maximum and the joint impedance of winding 16 and resistance 15 is too great to cause the actuation of the next vapor device 10. Hence lamp 5 remains dark and so on throughout the series, all of the lamps 4 to 7 inclusive remaining dark. When switch 14 is closed vapor device 10 is in circuit with the first lamp 4 immediately becomes conducting hence lamp 4 is illuminated. Saturating current is now supplied to the first reactor 17 which in accordance with the characteristic of saturable core reactors decreases the reactance of the alternating current winding 16 to such an extent that a voltage is supplied to the grid of the next vapor device sufficient to cause it to become conducting, hence lamp 5 is in circuit therewith immediately becomes illuminated. The impedance of winding 16 of reactor 17 does not change instantaneously but inherently experiences a time delay which is fundamentally due to the relatively long time constant of the closed winding which characterizes reactors of

this type. Hence lamp 5 is illuminated an appreciable time after the illumination of lamp 4. In a similar manner the illumination of lamp 5 causes the subsequent illumination of lamp 6 and so on throughout the entire series each successive lamp becoming illuminated after the illumination of the previous lamp. Similarly when switch 14 is opened the lamps of the series successively become extinguished, the wave of darkness traveling down the series like the wave of illumination. In addition to the use of apparatus such as I have shown and described for the operation of airport beacons, field borders lights, electric signs, etc., as mentioned above, the apparatus may be employed to advantage to mark the runways in airports in accordance with the wind direction and to control the speed of traffic in congested places such as in tunnels, suitable apparatus being employed to alternately close and open the switch 14. For the latter application of my invention, the light impulses may be caused to travel the length of the tunnel at a speed which is considered desirable for the traffic to maintain. Thus, it would comprise a traffic monitoring system. Various other uses of my invention in the field of traffic control and railroad crossing protection naturally suggest themselves but they need not be described in this application. One of the important advantages of my invention is that the various load or lamp circuits are controlled each from the previous circuit without the use of moving contacts where sparking might occur, hence completely avoiding any cause of radio interference.

In the modified form of my invention illustrated by Fig. 2 the several branch circuits contain lamps 4, 5, 6, etc. each controlled by a vapor electric device 10 as in Fig. 1. The grid of the first vapor device likewise is controlled by the switch 14 in circuit with the resistance 12. In this form of my invention, however, I obtain the delay characteristic by the use of a condenser and a resistance connected in series across each of the lamps. Thus across each of the lamps 4, 5, and 6, I have shown the condenser 32 in a series circuit with the resistance 33. The grid 11 of the vapor device of the next branch circuit connects through resistance 12 with the positively charged element of condenser 32 whereby when the condenser is charged to the proper potential the grid connected therewith is given a sufficient positive charge to render the device conducting.

The operation of this form of my invention will be readily understood from the foregoing. When the switch 14 is open the first vapor device 10 is non-conducting; hence the lamp 4 is dark, and since the vapor device of each subsequent branch circuit of the series is inoperative all of the lamps of those branches are dark. When switch 14 is closed, the first vapor device begins to pass current illuminating the first lamp 4. Since the vapor device 10 passes only rectified current the condenser 32 begins to receive a charge but is not fully charged until an appreciable time has elapsed due to the resistance 33. When the charge stored in the condenser 32 has reached a predetermined level a sufficient charge is sup-

plied through resistance 12 to the grid of the next vapor device to cause that device to pass current; hence illuminating lamp 5 in series therewith. In a similar manner the condenser 32 connected with the lamp 5 then begins to receive a charge and in like manner causes the subsequent illumination of lamp 6. Thus a wave of illumination is caused to travel down the entire series until all of the lamps are illuminated. Upon opening the switch 14, the lamps of the series successively are extinguished, the wave of darkness traveling down the series.

I have chosen the particular embodiments described above as illustrative of my invention and it will be apparent that various other modifications may be made without departing from the spirit and scope of my invention which modifications I aim to cover by the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A sequence operating system comprising an alternating current supply circuit, a plurality of branch circuits connected therewith each including a load device, a vapor electric discharge device arranged in series with one of said devices and provided with a control element, and a saturable core reactor connected with said supply circuit to be energized therefrom and connected with said control element to control the energization thereof, said reactor having a saturating winding connected across another of said load devices.

2. A sequence operating system comprising an alternating current supply circuit, a plurality of branch circuits connected therewith each including a load device, a vapor electric discharge device arranged in series with one of said devices and provided with a control grid, an auxiliary branch circuit connected with said supply circuit including the alternating current winding of a saturable core reactor, and means responsive to the current in said auxiliary branch circuit for supplying an energizing potential to said control grid, said reactor having a saturating winding connected across the load device in another of said branch circuits.

3. A sequence operating system comprising an alternating current supply circuit, a series of branch circuits connected therewith each including a load device and a vapor electric discharge device having a control element, and a series of saturable core reactors each connected with one of said control elements to control the energization thereof, each reactor having a saturating winding controlled by the energization of a preceding load device in the series.

4. A sequence operating system comprising an alternating current supply circuit, a series of branch circuits connected therewith each including a lamp and a vapor electric discharge device having a control grid, a series of auxiliary branch circuits connected with said supply circuit each including a saturable core reactor having a saturating winding connected across the lamp of one of the branch circuits of the series, and means for supplying a charge from each auxiliary branch circuit to one of said grids.

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