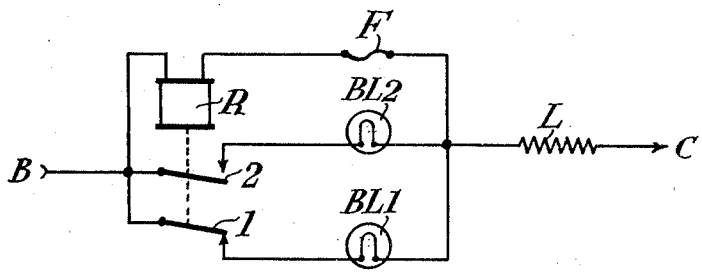
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ELECTRICAL APPARATUS

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ELECTRICAL APPARATUS

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My invention relates to electrical apparatus, and it has particular reference to the provision of novel and improved means for shifting from one element of an electrical circuit to a stand-by or alternate element upon failure of the first element. More particularly, my invention relates to means for maintaining uninterrupted operation over a circuit including a plurality of circuit elements, and incorporating means for introducing an alternate element into the circuit upon failure of one of the normally employed circuit elements.

In general, it is an object of my invention to provide novel and improved means for automatically replacing a circuit element, such as a ballast lamp, resistor, signal indication lamp, or the like, by a similar device upon failure of the first element.

Another object is the provision of novel and improved means for automatically maintaining uninterrupted operation over a circuit upon a failure of an element of the circuit.

Other important objects and characteristic features of my invention will be made clear as the specification progresses.

I shall describe one form of apparatus embodying my invention, and shall then point out the novel features thereof in claims.

The accompanying drawing is a diagrammatic view illustrating a preferred form of apparatus embodying my invention.

Referring to the drawing, the reference character R designates a voltage responsive relay connected in series with a current limiting device, such as a fuse F, and a load, designated by the reference character L, across a voltage source which may, for example, comprise a direct current generator not shown but having its opposite terminals designated by the reference characters B and C. The reference characters BL1 and BL2 designate circuit elements, such as ballast lamps, resistors, incandescent signal indication lamps, or the like. For the purposes of the present description, it will be assumed that the devices BL are ballast lamps of any suitable and well-known construction and comprising, for example, a filament formed of a material, such as iron wire, mounted in a sealed envelope and having the characteristic of changing its resistance with changes in the voltage applied thereto. Each lamp BL may therefore be employed to cause the current flowing in a circuit in series with the filament to remain substantially constant throughout a wide range of variations in the voltage impressed on the circuit.

One lamp BL1 or the other lamp BL2 is connected in multiple with relay R and in series with load L across the source according as relay R is released or picked up to close its back contact 1 or its front contact 2, respectively.

Relay R is selected and adjusted with respect to the constants of the circuit elements BL, load L and the voltage of the source so as to be energized at a value intermediate its release and its pick-up energy levels whenever current from the source is provided with multiple paths including either element BL and the relay. Whenever, however, neither element BL is effective to provide a path for current in multiple with relay R, as when the filament of lamp BL1 fails or burns out, then relay R is picked up and closes its front contact 1. Once relay R is picked up due to a failure of lamp BL1, the relay is energized above its released energy level and accordingly remains in its picked-up position when the other lamp BL2 is connected over front contact 2 of the relay in multiple with the relay winding.

Normally, the apparatus is arranged so that relay R is released as shown in the drawing, and lamp BL1 accordingly is connected in multiple with the relay over its back contact 1, whereby lamp BL1 maintains a substantially constant current flowing in the circuit including load L, and functions to limit the voltage impressed across relay R to a value insufficient to enable the relay to pick up. In the event, however, of a failure of the lamp filament, device BL1 is no longer effective to limit the voltage applied to relay R, whereupon approximately the full voltage of the source is applied to the relay to cause the relay to pick up and close its front contact 2 to connect the alternate or stand-by device BL2 across the load in multiple with the relay winding. Lamp BL2 becomes effective to limit the voltage applied to the relay, and thus causes the energy level in the relay to decrease to a value above its drop-away value, whereupon relay R retains its front contact 2 closed to maintain lamp BL2 connected in multiple therewith. It is apparent that apparatus embodying my invention provides means effective in the event of a failure of a circuit element normally connected in circuit with the voltage source to replace such element by a stand-by or alternate circuit element. It follows, therefore, that such apparatus provides means for maintaining uninterrupted operation over a circuit upon failure of a circuit element.

The current limiting device or fuse F is provided to preclude the possibility of improper op-

eration of the circuit in the event of a complete or partial short-circuit of the coil of relay R. Should the coil of relay R become short-circuited, the current through fuse F will of course increase, and by properly proportioning the fuse, it is apparent that the fuse may be adjusted to fail when the current through the coil of relay R increases abnormally due to a complete or partial short-circuit of the relay coil.

Although I have herein shown and described only one form of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In combination, a voltage source, a voltage responsive relay having its winding connected in series with said source, and two lamps one or the other connected to said source in multiple with said relay winding according as the armature of said relay is released or picked up respectively, the armature of said relay normally being released and said relay winding having a resistance selected with respect to the resistances of said lamps and the voltage of said source, to be effective when either lamp is energized in multiple with the relay winding to limit the current in the winding to a value below the pick-up but above the release value of the relay and effective when neither lamp is energized in multiple with the relay winding to permit the current in the winding to reach the pick-up value of the relay, whereby said relay normally maintains its armature released to cause said one lamp to be energized in multiple therewith until the filament of such lamp fails or burns out whereupon said relay armature is picked up to connect said other lamp to said source in multiple with said relay winding.

2. In combination, a voltage source, a voltage responsive relay having its winding connected to said source, two circuit elements, a circuit including a back contact of said relay for connecting one of said circuit elements to said source in multiple with said relay winding, and another circuit including a front contact of said relay for connecting the other of said circuit elements to said source in multiple with said relay winding, the armature of said relay normally being released whereby said back contact is normally closed, and said relay winding having a resistance preselected with respect to the constants of said circuit elements and the voltage of such source, to be effective when either circuit element is energized in multiple with the relay winding to limit the current in such winding to a value below the pick-up but above the release value of the relay and effective whenever neither circuit element is energized in multiple with the relay winding to permit the current in such winding to reach the pick-up value of the relay, whereby said relay normally maintains its back contact closed to cause said one circuit element to be energized until such element fails whereupon said relay closes its front contact and maintains such contact closed to cause said other circuit element to be energized.

3. In combination, a source of current, a load, a voltage responsive relay, a circuit connecting said load and the winding of said relay in series with said source, and two resistors one connectable in said circuit in multiple with said relay winding over a back contact of said relay and the other connectable in said circuit in multiple with said relay winding over a front contact of said relay, said relay normally being released and said relay winding having a resistance preselected with respect to the voltage of said source and to the values of said resistors, to limit the current in said relay winding to a value below its pick-up but above its release value whenever either resistor is energized in multiple with said winding but permitting the current in said relay winding to reach its pick-up value whenever neither resistor is energized in multiple with said winding, whereby said relay normally maintains its back contact closed to effect energization of said one resistor until such resistor fails and then said relay picks up and maintains its front contact closed to effect energization of said other resistor.

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