

May 19, 1931.

E. A. EVERETT ET AL

1,805,764

ELECTRIC CIRCUITS

Filed March 23, 1928

2 Sheets-Sheet 1

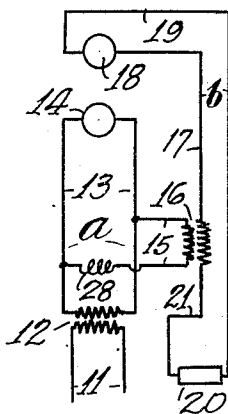


Fig. 1

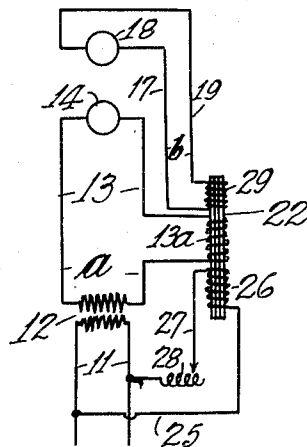


Fig. 4

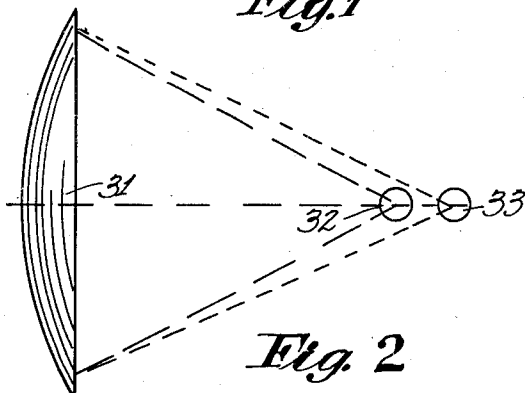


Fig. 2

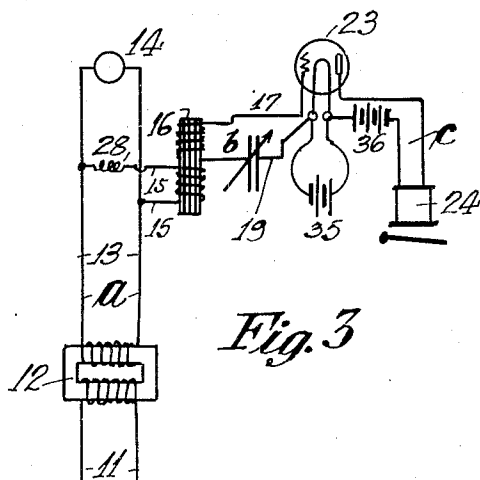


Fig. 3

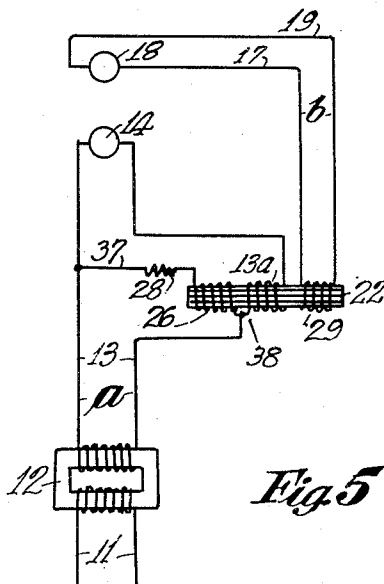


Fig. 5

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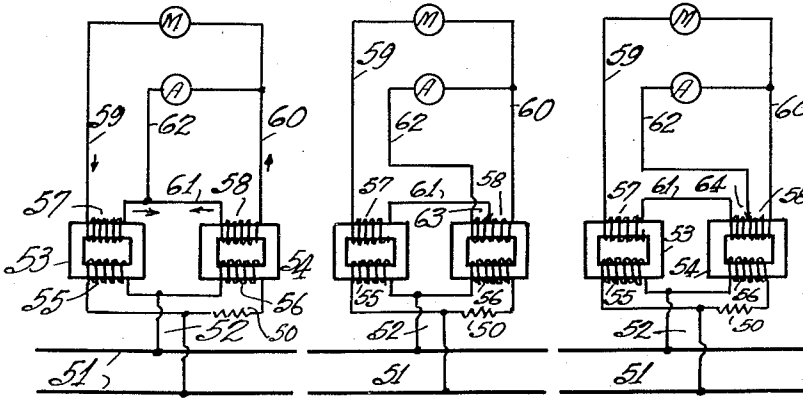


Fig. 6

Fig. 7

Fig. 8

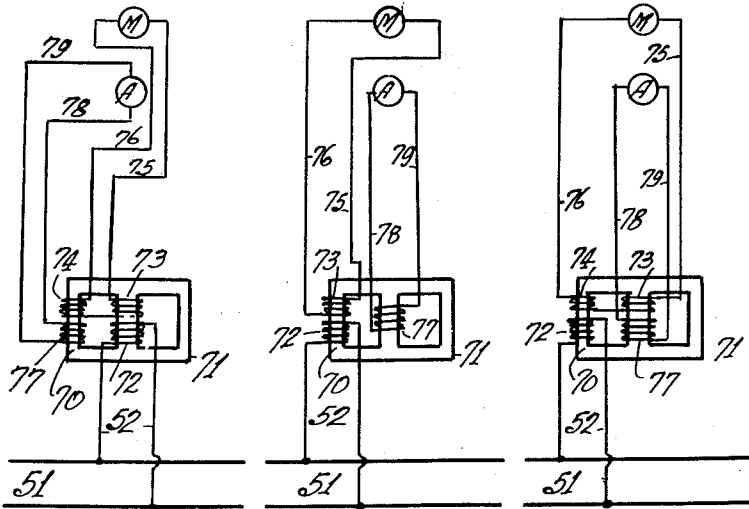


Fig. 9

Fig. 10

Fig. 11

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UNITED STATES PATENT OFFICE

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ELECTRIC CIRCUITS

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This invention relates to operating circuits and to certain relations that are obtained by inductively coupled circuits whereby when one circuit is actively energized the other circuit remains inactive but becomes energized as soon as the first circuit is deenergized. The first circuit contains a device which is normally energized. The second circuit contains a device which is normally deenergized. These circuits are so coupled that, without the intervention of moving parts when the device in the first circuit is disconnected the device in the second circuit becomes operative until the device in the first circuit is restored. One practical application of this invention is found in the circuits controlling the lights in a projector. An electric bulb in one of these circuits normally supplies the light for the projector, but when this bulb burns out the bulb in the second circuit automatically becomes illuminated and takes the place of the extinguished lights, thus increasing the reliability of the projector.

The invention is more particularly described in the following specification and some forms of its application are illustrated in the accompanying drawings, in which, Fig. 1, is a simple arrangement of circuits embodying the invention, Fig. 2 shows one application of the controlled lights in connection with a projecting lens, Fig. 3 is another circuit arrangement similar to Fig. 1, using an amplifying tube in the second circuit, Fig. 4, is another arrangement using a differential winding on a transformer to secure the desired results, Fig. 5, is a modification of the circuit shown in Fig. 4; Fig. 6 is an arrangement showing a pair of differentially wound transformers applied to accomplish the purpose of this invention, Figs. 7 and 8 show arrangements modified from Fig. 6; Fig. 9 is another arrangement in which the circuits are inductively coupled through a three legged transformer for securing the desired results and Figs. 10 and 11 are modifications of the circuit shown in Fig. 9.

This invention comprises a main circuit which is normally energized from a transformer and has a light bulb included in this circuit which is normally energized. Induc-

tively coupled with this main circuit is an auxiliary circuit which includes a light bulb or other translating device. The first circuit is so connected with the second circuit that if the light bulb or translating device in this circuit is disconnected, the auxiliary circuit is automatically energized and the auxiliary light in this circuit is made immediately effective to take the place of the light in the main circuit which has been extinguished.

There are at least two general ways in which the object of the invention may be secured. In one of these arrangements a transformer is connected in multiple with the light in the main circuit and as the light bulb is of much less impedance than the transformer primary it substantially provides a shunt on the transformer circuit so that the auxiliary circuit fed from the secondary of this transformer is partially deenergized so that the translating device in this circuit does not operate. When the bulb in the main circuit burns out or is removed the transformer primary is no longer shunted so that the auxiliary circuit is then fully energized to operate the translating device. When the bulb in the main circuit is replaced, the shunt of the transformer is renewed and the auxiliary circuit is correspondingly deenergized. In another arrangement the main circuit is connected in series with a transformer winding and a secondary winding of this transformer energizes the auxiliary circuit. A third winding is provided on this transformer and connected with a source of energy to oppose and neutralize the winding connected with the main circuit. Thus while the main circuit is active the opposing winding prevents the auxiliary circuit being energized, but when the main circuit is interrupted the opposing winding is free to energize the auxiliary circuit and bring the translating device in this circuit into use.

One practical use for this invention is found in railway signal lights where reliability is of importance. The lamp in the main circuit is normally used to project the beam from the lens, but it is highly desirable should this lamp burn out to have a second

lamp take its place and continue the signal indication. This result is secured by the present invention without the use of interposed moving parts and contacting devices.

In an application of this kind it is desirable to be able to detect from the indication of the signal when the lamp in the main circuit is extinguished. One means of detecting when the auxiliary light is in use is by placing this light somewhat out of focus of the projecting lens so that a beam of less strength than the normal beam is projected indicating that the normal light is extinguished. Another method that may be used for this purpose is to embody in the auxiliary circuit some characteristic which will be translated to the light and appear in the projected light beam. A flasher relay such as used in signs for causing an intermittent display of the light, embodied in the auxiliary circuit, will produce such characteristic and indicate when the main light should be replaced.

Referring to the drawings, Fig. 1, 11 is the supply mains, 12 is the main transformer, 13 is the main circuit fed from transformer 12 and 14 is the light bulb in the main circuit *a*. The auxiliary transformer 16 by the connections 15 is bridged across the main circuit *a* in series with the resistance or reactance 28. The secondary of this transformer energizes the auxiliary circuit *b* including the conductor 17, lamp 18, wire 19, flasher relay 20 and conductor 21. When the lamp 14 is in circuit the auxiliary transformer and reactance 28 is substantially short circuited so that the current in circuit *b* is insufficient to light the bulb 18, but when lamp 14 is out of circuit the current is increased in transformer 16 and bulb 18 becomes operative until another lamp is replaced at 14.

One application of this arrangement is shown in Fig. 2 in which 31 is the projecting lens, 32 is the main bulb corresponding to 14 which is located at the focal point of lens 31 and 33 is the auxiliary bulb corresponding to 18 which is displaced from the focal point of the lens. The light projected from 33 will produce a weaker beam than the light from 32 thereby affording a means of detecting when the light 33 is active. When the flasher relay 20 is used in the auxiliary circuit *b* the light from 33 is intermittent thereby producing a characteristic from this bulb which can easily be detected.

The circuit in Fig. 3 comprises the main circuit *a*, the auxiliary transformer 16 and the auxiliary circuit *b* which is connected to the electron tube 23 through an adjustable condenser. The filament of this tube is energized by battery 35 and it controls the circuit *c* including the battery 36 and relay 24 in accordance with the presence or absence of the bulb 14 in the main circuit *a* through the auxiliary transformer 16 as described in connection with Fig. 1.

The circuit in Fig. 4 includes the supply mains 11, main transformer 12, main circuit *a*, the bulb 14 and the coil 13*a* in series with bulb 14 located on the transformer 22. This transformer is also energized by coil 26 connected by wires 25 and 27 through the adjustable reactance, or resistance 28 to the mains 11. The coils 13*a* and 26 are so connected on the transformer 22 as to create opposing fluxes in the transformer core which are adjusted to neutralize each other. When this condition is established the coil 29 connected with the auxiliary circuit *b* is deenergized and remains deenergized until the balance of the currents in coils 13*a* and 26 is upset. This balance is upset when the bulb 14 is burned out or removed thereby deenergizing coil 13*a* and permitting coil 26 to energize coil 29 and operate the light 18. Restoring the bulb 14 restores the balance between 13*a* and 26 and deenergizes coil 29 and circuit *b*.

The circuit in Fig. 5 is modified from the arrangement in Fig. 4 by coupling the coils 26 and 13*a* differentially on the transformer core 22 and feeding the main circuit *a* into both of these coils at 38. The coil 13*a* is connected in series with the bulb 14 and the balancing coil 26 is connected in series with 28 and wire 37 to the opposite side of the main circuit. It is apparent that when the circuit of 13*a* is interrupted by the removal of bulb 14 that the coil 26 becomes a primary to energize the secondary coil 29 and the auxiliary circuit *b* connected therewith. When the circuit of 13*a* is completed the balance is restored and the circuit *b* is deenergized.

The circuit in Fig. 6 is adapted for the purpose of this invention by the use of a pair of independent transformers which are connected to oppose each other. The power mains 51 by the connections 52 energize the primary of transformer 53 and the primary circuit of transformer 54, the latter having a resistance or reactance 50 in series therewith. The connections to these primaries are made in opposition, as shown, so that the secondaries oppose each other. The primary coil 55 energizes the secondary coil 57 and the primary coil 56 energizes the secondary coil 58. Coils 57 and 58 are connected by the conductor 61 and these coils are so connected with relation to the primary coils that the currents oppose each other in the conductor 61.

The main circuit includes the coil 57, conductor 59, main lamp M, conductor 60, coil 58 and conductor 61. The auxiliary circuit includes coil 58, conductor 61, conductor 62, lamp A and conductor 60. For one operating condition the voltage of coil 57 is twice the voltage of coil 58, the latter being adjusted or regulated by the resistance 50. The operation of this arrangement is understood as follows: When the main circuit is com-

plete the coil 57 energizes this circuit and preponderates over the current from coil 58 to the extent that lamp bulb M is lighted. A meter placed in the auxiliary circuit of conductor 62 indicates practically no current passing in this circuit under these conditions. The explanation appears to be that the reactance of coil 58 by the opposing current is so reduced as to short circuit the lamp A.

When the main circuit is interrupted it is apparent that the auxiliary circuit is then fully energized from the coil 58 of transformer 54. This arrangement thus provides the same operating conditions as obtained with the circuits previously described.

The circuit in Fig. 7 is substantially the same as the circuit in Fig. 6 with the exception that an autotransformer action is obtained in coil 58 by the connection at 63. This arrangement is further modified in Fig. 8 where the conductor 62 connects to an intermediate point of coil 58 at 64. Tests of these circuits show substantially the same operating characteristics as obtained with the circuit shown in Fig. 6.

The arrangement shown in Fig. 9 is somewhat similar to Fig. 4 but is applied through a three legged transformer. The primary coil 72 energizes the secondary coil 73 and the coil 74 in series therewith and energizes the main circuit including conductors 75, 76 and lamp M. The auxiliary circuit including the conductors 78 and 79 and the lamp A is energized by coil 77. The winding of coil 74 is so connected as to oppose the flux from coil 72 in the leg 70 of the transformer thereby deenergizing coil 77. When the main circuit is opened, the coil 74 is deenergized and the flux from 72 is free to energize coil 77 and energize lamp A.

In Fig. 10, the primary coil 72 is placed on leg 70 of the transformer and the main circuit is energized from coil 73 on the same leg. The auxiliary circuit is energized from coil 77 on the middle leg. In one test of this circuit it was found that the voltage of the auxiliary circuit when the main circuit was energized was 6 volts and the voltage of this circuit increased to 13 volts when the main circuit was deenergized which affords a sufficient operating margin for the purpose intended. It is apparent that the increased flux from the primary coil when 73 is open is forced through the middle leg of the transformer thereby increasing the voltage in coil 77.

The circuit in Fig. 11 is similar to the circuit in Fig. 9 except that the position of the primary coil is changed, being placed on the leg 70 and the coil 77 is placed on the middle leg on the transformer. The coil 73 in the main circuit neutralizes the flux through the middle leg and deenergizes coil 77 while the main circuit is energized. When the main circuit is deenergized part of the flux cre-

ated by coil 72 passes through coil 77 and energizes the auxiliary circuit.

From the variety of circuits that have been selected to illustrate the working principles of this invention, it will be understood that circuits can be inductively coupled in many ways to secure the desired results. These illustrations are not to be taken as exhaustive, but are merely typical of some forms in which the invention may be applied.

It should be understood that the flasher relay shown only in Fig. 1, or the electron amplifier shown only in Fig. 3 may be embodied in any of the circuits as desired and the arrangements shown are not to be construed as applying solely to lamp circuits.

Having thus described the invention, we claim:

1. In a system as described, the combination, a main circuit including a lamp bulb, a transformer having a primary coil connected with said main circuit, an auxiliary circuit connected with the secondary of said transformer and including a lamp bulb, means for normally deenergizing the circuit of the lamp bulb in said auxiliary circuit and for energizing said bulb when the main circuit is deenergized.

2. In a system as described, the combination, a main circuit including a lamp bulb, an auxiliary circuit including a lamp bulb, a transformer having a primary coil connected in said main circuit and a secondary coil connected in said auxiliary circuit and means whereby the auxiliary circuit is substantially deenergized while the bulb in the main circuit is energized and the auxiliary circuit is energized when the bulb in the main circuit is deenergized.

3. In a system as described, the combination, a main circuit including a translating device, an auxiliary circuit including an auxiliary translating device, a transformer having a primary coil connected in said main circuit and a secondary coil connected in said auxiliary circuit and means whereby the auxiliary circuit is normally deenergized and the interruption of the circuit of the translating device in said main circuit causes the energization of said auxiliary translating device.

4. In a system as described, the combination, a main circuit including a translating device, an auxiliary circuit including an auxiliary translating device, a transformer having a primary coil connected in said main circuit and a secondary coil connected in said auxiliary circuit and means whereby said auxiliary translating device is normally deenergized and is automatically energized upon the interruption of the circuit of the translating device in said main circuit.

5. In a system as described, the combination, a main circuit including a translating device, an auxiliary circuit including a sec-

ond translating device, a transformer having a primary coil connected with said main circuit and a secondary coil connected with said auxiliary circuit, means for energizing said main circuit, means including said transformer for energizing said auxiliary circuit and means embodied in said main circuit for substantially deenergizing said auxiliary circuit under certain conditions of operation of said main circuit.

6. In a system as described, the combination, a main circuit including a translating device, an auxiliary circuit including a second translating device, means for energizing each of said circuits and a transformer having a primary coil connected with said main circuit and a secondary coil connected with said auxiliary circuit means whereby when the translating device in the main circuit is energized said second translating device is deenergized and when the translating device in the main circuit is deenergized said second translating device is energized.

In testimony whereof we affix our signatures.

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