

April 9, 1935.

J. M. KELLY

1,997,463

EXCESS CURRENT INDICATOR

Filed Jan. 8, 1929

2 Sheets-Sheet 1

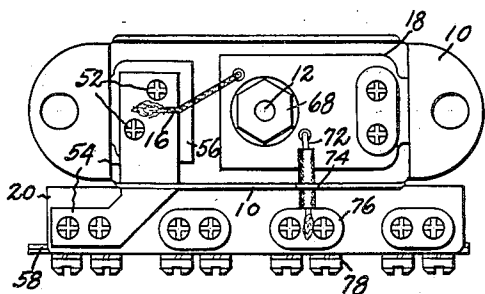
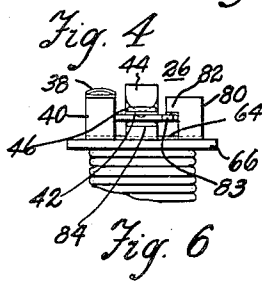
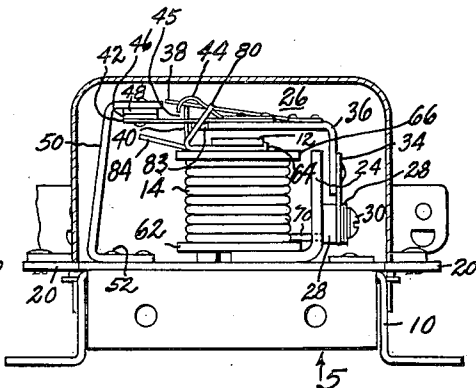
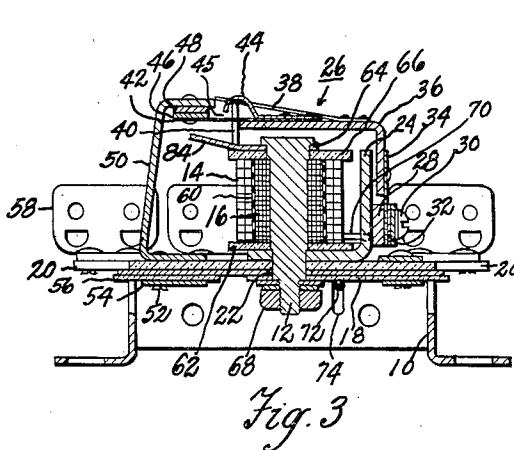
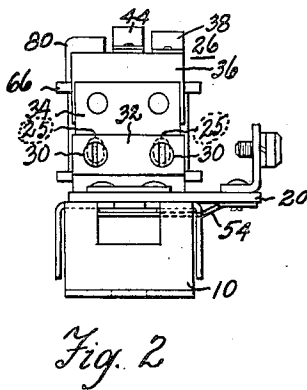
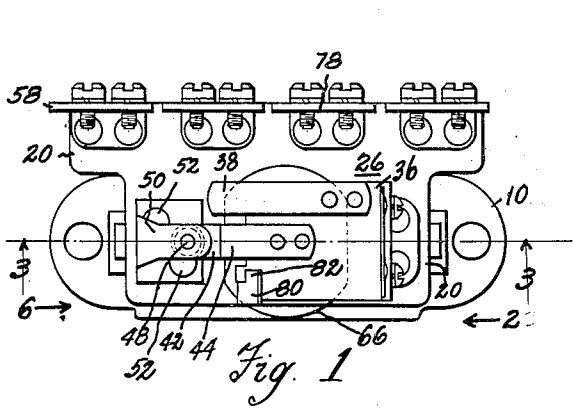


Fig. 5

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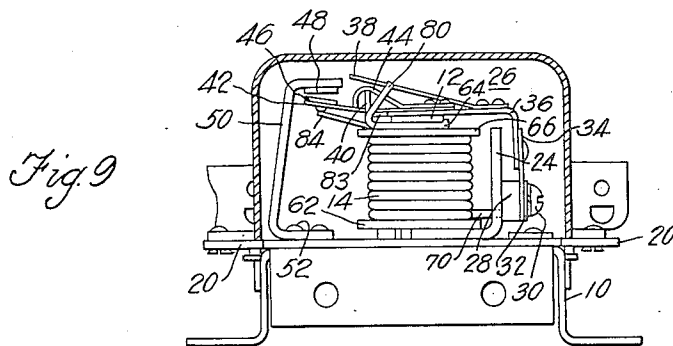
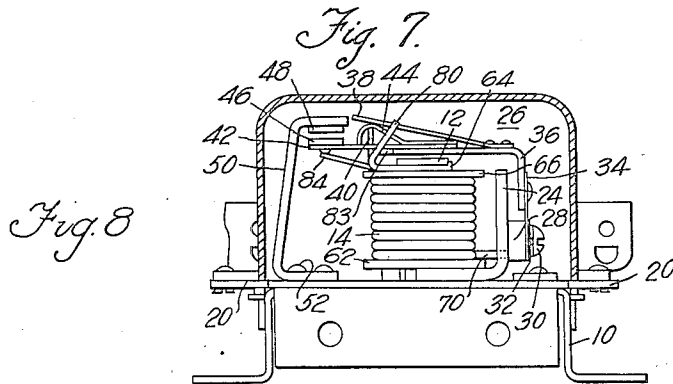
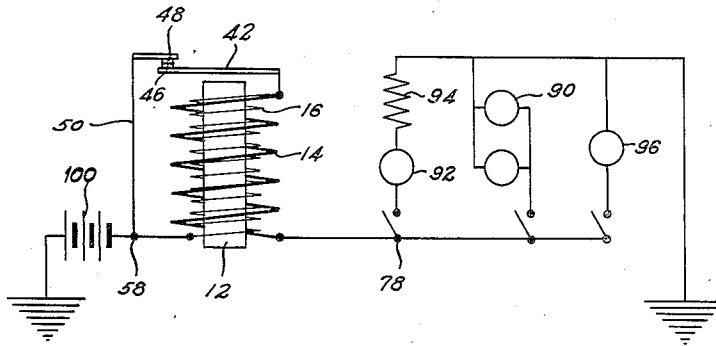
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EXCESS CURRENT INDICATOR

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

1,997,463

EXCESS CURRENT INDICATOR

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Application January 8, 1929, Serial No. 331,043

4 Claims. (Cl. 177—311)

This invention relates to circuit breakers in particular to circuit breakers for lighting systems in motor vehicles.

One object of this invention is to provide a device that will indicate the excessive flow of a current through the lighting circuit caused by an overload. This is accomplished by connecting in the lighting circuit a relay constructed to intermittently interrupt the circuit through the lights to cause the lights to flicker and to cause an audible noise in order to signal the operator that there is an overload in the lighting circuit.

Another object is to provide a device which will entirely cut out the lights when a short circuit occurs in the lighting circuit. This is accomplished by providing a coil shunted across the contacts which will hold the contacts open when the resistance in the lighting circuit is reduced sufficiently to practically shunt this coil across the battery terminals.

Another object is to provide a relay with a pair of interrupter contacts which are positive in their action and responsive to the flow of a continuous excessive current through the circuit, but are not responsive to temporary surges or transient currents caused by switching operations. This is accomplished by the use of an armature biased downwardly by an electromagnet and upwardly away from the electromagnet by a leaf spring. The upward and downward movements of the armature are each limited by suitable stops. A leaf spring which is fixedly mounted on the armature supporting one of the interrupter contacts urges the contacts together. Means normally spaced away from the leaf spring cooperates with the armature, separating the contacts, and as this means is spaced from the leaf spring, the armature is permitted to move slightly without the contacts being interrupted, which permits a surge to pass through the electromagnet actuating the armature a slight distance without actually separating the contacts.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred embodiment of one form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a plan view with the cover removed.

Fig. 2 is an end elevation looking in the direction of the arrow 2 in Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1.

Fig. 4 is an elevation of a side view with the cover in section.

Fig. 5 is a view looking in the direction of the arrow 5 in Fig. 4.

Fig. 6 is an end elevation of an armature assembly looking in the direction of the arrow 6 in Fig. 1.

Fig. 7 shows a schematic wiring diagram of the circuit.

Figure 8 is an elevation of a side view with the cover in section showing the contacts in open position caused by excessive currents.

Figure 9 is a view similar to Figure 8 showing the contacts held in open position caused by deleterious currents.

Referring to the drawings, the reference character 10 indicates a metallic base or support. Mounted on, but insulated from this base is the magnetizable core 12, having a series coil 14 and a shunt coil 16. The core 12 is insulated from the base 10 by the insulating members 18 and 20 and by the air space 22 surrounding the core, and forms an electrical contact with the armature support 24. Attached to the armature support 24 is the armature assembly 26, spaced apart by a member 28 and secured together by screws 30 passing through spring retaining member 32, spring 34, spacing member 28 and screw threadedly engaging member 24. In spring 34 is a pair of slots 25, which permit the adjustment of the armature assembly 26. Riveted to spring 34 is the L-shaped armature 36 having riveted there-to a leaf spring 38 resting on a support 40 integral with member 64 held in position by the head of the core 12 as best seen in Fig. 3. The support 40 cooperating so as normally to hold the armature in a raised position. Also riveted to the armature 36 is the contact carrying leaf spring 42, and the member 44 which causes separation of the contacts after a predetermined downward movement of the armature. The air gap 45 between the leaf spring 42 and the member 44 may be adjusted by bending member 44. The leaf spring 42 supports a contact 46 cooperating with a contact 48 mounted on an upright member 50 attached to the base 10 by rivets 52, but insulated therefrom, said rivets 52 also making an electrical contact with member 54 which is insulated from the base 10 by means of the insulating member 56. The spring 42 is biased so that it tends to hold the contacts 46 and 48 together and operates somewhat against the force of the spring 38. The spring 38 is biased so as to not only overcome the downward force on the armature due to the biasing of spring

42 when the contacts 46 and 48 are in engagement, but also to resist the movement of the armature in response to magnetic pull, and return the armature 36 to its normal position. Hence, a wiping movement occurs between the contacts 46 and 48 when a slight downward movement of the armature occurs, and before the contact breaker 44 contacts the spring 42 to break the connection between the contacts 46 and 48. The adjustment of the air gap 45 predetermines the amount of armature movement necessary to break the contacts. Member 54 extends through a slot in the side of the base (not shown) to the terminal 58 connected to the battery as shown in Fig. 7 and riveted to the insulating member 20. To member 54 is soldered one terminal of the shunt winding 16, the other terminal of the shunt winding 16 forming an electrical contact with the core member 12.

The coils 14 and 16 are insulated from each other by an insulating material 60, from the armature support 24 by the insulating washer 62, and from member 64, by insulating washer 66. The core assembly is held in place by means of the nut 68 engaging the insulating member 18 upon being tightened onto the threaded end of the core member 12. A terminal 70 of the coil 14 is soldered to the armature support and the other terminal 72, extends through the base, but insulated therefrom through a slot 74 and soldered to member 76 riveted to the insulated plate 20 and electrically connected to the terminal 78 connected to the lights such as 90, 92 and 96. The armature stopping member 64 has an upright 80 integral with member 64. The upright 80 has an offset portion 82 engaging an extension 83 of the armature 36, as best seen in Figs. 4 and 6. This upright member 80 may be adjusted by changing the angle it makes with the armature 36. Also mounted on member 64 is the upright 49 supra and the adjustable contact abutting member 84, which limits the downward movement of the leaf spring 42. When the spring 42 is forced against the contact abutting member 84, the spring 42 tends to aid the action of the spring 38 and to hold the armature 36 away from the core 12. This action of the spring 42 causes it to increase the force against which the magnetic pull must operate when a predetermined position in the operation is reached.

Suitable values for the series coil 14 have been found to consist of about 17 turns of #14 bare enamel wire whose total resistance is approximately .030 ohms. The shunt coil 16 consists of 1200 turns of #34 bare enamel wire whose total resistance is about 38.7 ohms. The coils are so constructed and arranged as to set up a flux when the contacts are open, which is cumulative or additive.

The circuits are as follows :

A. With the contacts closed the shunt coil 16 is short circuited through the contacts so no current is carried by this coil as long as the contacts are closed and as long as the current through the series coil is continuous. When the lighting circuit is closed, a current is carried from the battery to terminal 58 through member 54, through rivets 52, through upright member 50, through contacts 48 and 46, through leaf spring 42, through armature assembly 26 to terminal 70, through series coil 14 to terminal 72, and through the car lighting system which may include a pilot light 92 connected in series with a resistance 94, head lights 90, a tail light 96 and whatever other lights may be desired. When-

ever surges flow through series coil 14, currents are generated in the shunt coil 16 which are proportional to the rate of change of current in the series coil 14.

B. When the contacts are open a current is carried from the battery to terminal 58 through member 54 through the shunt coil 16 through the core 12 through armature support 24 through series coil 14 through the balance of the circuit outside of the relay to the battery. From this it may be seen that the coils 14 and 16 are in series when the contacts are open as best seen in the schematic wiring diagram disclosed in Fig. 7.

Operation

As long as the current through the lighting circuit does not exceed the current required to light all of the lights, the relay contacts 46 and 48 will be held in a closed position, as the flux due to the current in the series winding 14 is not sufficient to set up a magnetic pull which will overcome the tension in spring 38, as disclosed in Figures 3 and 4.

Whenever a switching operation takes place in the lighting circuit, surges of transient current will flow through the coil 14. These, however, will not affect the opening of the contacts for the reason that the armature 36 may be moved slightly toward core 12 without breaking the contacts 46 and 48, and for the reason that coil 16 which is short circuited as long as the contacts are closed will set up a counter M. M. F. which opposes the M. M. F. of the current coil 14 due to an E. M. F. being generated in coil 16 whenever there is a sudden change of current in coil 14. This E. M. F. also is conducive to a reduction of the surge for the reason that energy is thereby partly consumed.

Whenever there is a condition in the lighting circuit which causes an increase in the flow of current through coil 14, which is of such a magnitude that it will injure the lighting system and which will hereinafter be referred to as an excessive current, the magnetic pull upon the armature 36 will interrupt the contacts 46 and 48. Now as soon as these contacts are interrupted and in the position disclosed in Figure 3, the current cannot flow through these contacts, but instead, it flows through the shunt coil 16, which is now in series with the series coil 14. As the resistance of the shunt coil 16 is very high, the current will be reduced and consequently, the magnetic pull will be decreased so that the tension of spring 38 will again close the contacts. In addition to this the stop 84 prevents member 36 from engaging the core 12 so that there is an air gap between these members. The flux through the magnetic circuit is not sufficient, however, to hold the parts in this position as the spring 38 will overcome the flux and cause the contacts 46 and 48 to close. From this it can be readily seen that the contacts will vibrate, causing the lights to flicker, if the lighting circuit is closed and if the condition should take place while the lighting switch is open, the vibrating contacts will cause an audible signal, thereby indicating to the operator that the circuit has some abnormal condition or overload existing therein.

When this condition is such that the excessive currents through the circuit cause a deleterious effect, such as a short circuit, the magnetic pull by the shunt coil 16 in series with the series coil 14 is sufficient to hold the contacts open as long

as the deleterious condition is present, thereby reducing the current through the circuit to less than one-sixth of an ampere when a 6-volt battery is used. As best seen in Figure 9, member 36 is now held against the core 12 and the flux is sufficiently strong through the magnetic circuit to maintain core member 36 in this position thereby holding contacts 46 and 48 open until the current through the circuit is reduced.

From this it may be seen that during the flow of current, which does not exceed the normal full-load current required in the lighting circuit and during the flow of surges through the circuit, the relay contacts will remain closed.

As soon as the currents become excessive, but not deleterious, the relay will cause a flickering of the lights and an audible signal to indicate to the operator that the lighting circuit is defective and when the currents reach such a magnitude that they are deleterious to the circuit, the contacts will be held open until the circuit is repaired, the opening of the lighting switch, or the running down of the battery.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. A relay for an electrical circuit comprising, in combination, a pair of cooperating interrupter contacts, an electromagnet having a plurality of windings, an armature magnetically associated with the electromagnet and biased downwardly thereby, a leaf spring for biasing the armature upwardly, a stop limiting the upward movement of the armature, a second leaf spring mounted on the armature and having one of said contacts mounted thereon, said second leaf spring being biased so as to tend to keep said contacts in engagement, a second stop limiting downward movement of the contact that is mounted on the second leaf spring so that said second leaf spring additionally biases the armature against further downward movement, means mounted on said armature and normally spaced from the second leaf spring and cooperating with the second leaf spring for effecting breaking of the contacts before said second stop is reached, and connections between said windings and circuit whereby said contacts intermittently interrupt the circuit when an overload occurs and remain open when a short circuit occurs.

2. A relay for an electrical circuit comprising, in combination, a pair of cooperating interrupter contacts, an electromagnet having a plurality of windings connected to the electrical circuit, an armature magnetically associated with the electromagnet and biased downwardly by the magnetic pull of the electromagnet, spring means biasing the armature upwardly, means limiting the upward movement of the armature, resilient means mounted on the armature and having a portion extending therefrom, one of said contacts being mounted on said extending portion, said resilient means being biased to urge the contacts together, means mounted on the armature and normally spaced from the extending

portion of the resilient means, said means contacting the resilient means after predetermined movement of the armature to effect disengagement of the contacts, and a stop for limiting downward movement of the contact that is mounted on said resilient means so that said resilient means exerts additional upward biasing force on the armature.

3. A relay for an electrical circuit comprising in combination, a pair of cooperating interrupter contacts, an electromagnet having a plurality of windings, an armature magnetically associated with the electromagnet and biased downwardly by the magnetic pull of the electromagnet, spring means biasing the armature upwardly, means limiting the upward movement of the armature, resilient means mounted on the armature and having a portion extending therefrom, one of said contacts being mounted on said extending portion, said resilient means being biased to urge the contacts together, means mounted on the armature and normally spaced from the extending portion of the resilient means, said means contacting the resilient means after predetermined movement of the armature to effect disengagement of the contacts, a stop for limiting downward movement of the contact that is mounted on said resilient means so that said resilient means exerts additional upward biasing force on the armature, and connections whereby said contacts, when disengaged, effect a decrease in the magnetic pull of the electromagnets upon the armature such that the armature will be intermittently actuated unless the said magnetic pull is sufficient to overcome the said additional upward biasing force.

4. A relay for an electrical circuit comprising, in combination, a pair of cooperating interrupter contacts, a movable armature for effecting engagement and disengagement of the contacts, a leaf spring mounted on the armature and supporting one of said contacts, electromagnetic means magnetically associated with the armature and having two windings, said electromagnetic means attracting said armature in response to current in said circuit, one of said windings being short circuited when the contacts are engaged, and said windings being connected in series when the contacts are disengaged so that upon disengagement of the contacts the resistance of the electromagnetic means is increased, resilient means urging the armature away from the electromagnetic means, a stop for limiting the movement of the armature away from the electromagnetic means, a stop cooperating with the leaf spring to limit movement toward the electromagnet of the contact that is mounted on the leaf spring so that said leaf spring resists movement of the armature toward the electromagnetic means, and means normally spaced from the leaf spring to permit a movement of the armature toward the electromagnet before this last mentioned means effects disengagement of the contacts, said relay operating intermittently until the current through said windings is sufficient to maintain the contacts disengaged.

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