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J. T. FITZSIMMONS

CIRCUIT INTERRUPTER

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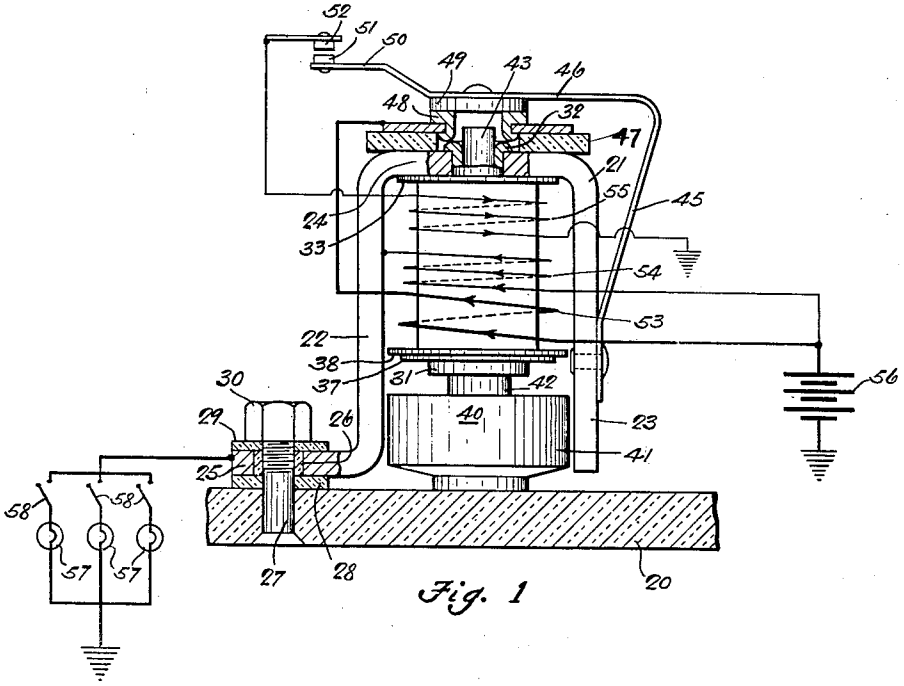


Fig. 1

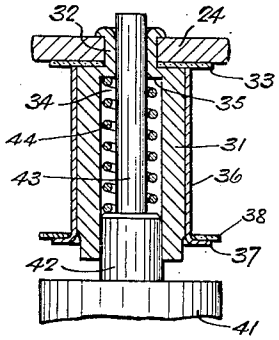


Fig. 2

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CIRCUIT INTERRUPTER.

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This invention relates to improvements in protective devices for electrical circuits including work devices, and particularly such work devices as are used in connection with motor vehicles.

In the illuminating system of substantially all motor vehicles of the present day, tungsten filament lamps are used. The resistance of tungsten, when cold, is comparatively low, and, when a plurality of tungsten filament lamps are introduced into a circuit, an initial, heavy surge of current will flow through said lamps until the temperature of the filaments is raised sufficiently to increase the resistance thereof, at which time the extra heavy drain on the current source is materially reduced. This drain becomes material in the lighting system for motor busses which are generally provided with a large number of lamps, all used at the same time.

One of the primary objects of the present invention is to provide a protective or limiting device in circuit with the lamps of the illuminating system or other work devices of a motor vehicle, which, when an abnormal flow or surge of current passes therethrough due to the cold condition of the lamp filaments or to a short-circuit of any of the work devices, will open the main circuit between the current source and such lamps or work devices and establish a higher-resistance, secondary circuit to such lamps or work devices. This secondary high-resistance circuit is maintained until the resistance of the lamps is built up to a proper value by the warming of the filaments, or until the short-circuit on any of the work devices is removed, at which time the main circuit will again be restored.

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 form of the present invention is clearly shown.

In the drawings:

Fig. 1 is a diagrammatic, fragmentary view showing the circuit interrupter and its electrical connections with the source of current and work devices.

Fig. 2 is a detail sectional view showing the core construction and its plunger armature.

Referring to the drawings, the numeral 20 designates a base of either insulation or non-magnetic material upon which is mounted the circuit interrupter.

The interrupter comprises a field frame 21, of U-shaped construction, having legs 22 and 23, and cross-arm 24. The leg 22 has a foot 25 arranged at right angle thereto, said foot having an aperture in which an insulating collar 26 is provided. The foot is secured to the base 20 by means of stud 27, insulating washers 28 and 29 being placed between the foot and base, and foot and stud nut 30, respectively.

By referring to Fig. 2, the core of the electromagnet is shown comprising a main body portion 31, one end of which is reduced as at 32. This reduced portion 32 extends into an aperture in the cross-arm 24 of the field frame 21, the edge of said portion 32 extending beyond the outer surface of said cross-arm and is spun or riveted over so that the core is secured rigidly to the field frame. The aperture in the cross-arm 24 is so positioned that the core lies midway between the two arms 22 and 23. An insulating collar 33 is provided between the cross-arm 24 and the core.

The core has a central, longitudinal passage 34 throughout its entire length, this passage, however, being of larger diameter in the main body portion 31 than in the reduced portion 32. This variation in the diameter of the passage forms the shoulder 35. A sleeve 36, of any suitable non-magnetic material, fits snugly around the core portion 31, one end of said sleeve 36 abutting against the insulating collar 33, while the other end has a flange 37. An insulating collar 38 fits about the sleeve 36 and rests on the flange 37.

The plunger armature is designated by of the frame and said head. A reduced portion 41 of such a diameter that only a small gap is formed between the legs 22 and 23 of the frame and said head. A reduced portion 42 extends into the larger diameter portion of the passage 34 in the core so that a sliding fit obtains. A stem 43, extending from the portion 42 and of lesser diameter,

projects through the smaller diameter portion of the passage 34. A spring 44 surrounds said stem and is interposed between the shoulder 35 and armature portion 42, said spring tending to push the armature into engagement with the base 20, as shown in Fig. 1.

On the leg 23 there is secured a spring arm 45 which has a portion 46 bent over to lie parallel with the cross-arm 24. On this cross-arm there is provided an insulating block 47 to which is secured a hollow contact member 48 so arranged on said field frame 21 that the stem 43 of the armature may pass through said hollow contact member 48 and engage the movable contact member 49, carried by the spring arm portion 46, in such a manner that it will normally lie in engagement with said stationary contact.

An extension 50 to the portion 46 carries the movable member 51 of the auxiliary contacts, the stationary member 52 thereof being secured to the interrupter and insulated therefrom in any suitable manner. These auxiliary contacts 51 and 52 are always open when the main contacts 48 and 49 are closed, and are always closed when the latter are opened by the armature.

Three windings 53, 54 and 55 are carried by the core. Winding 53 is of low resistance and has its one end connected to the main stationary contact 48, while its other end is in circuit connection with the source of current, shown to be a battery 56. Winding 54 is wound in the same direction as 53, but is of greater resistance than said winding 53. One of its ends is grounded on the leg 22, or any other suitable portion of the field frame 21, while its other end is connected to the source of current 56. Thus, the winding 54 is connected in parallel with winding 53 and in shunt with the contacts 48 and 49. The winding 55 is wound reversely to the windings 53 and 54, and is of lesser resistance than the winding 54 but greater than the winding 53. Its one end is connected to the auxiliary stationary contact member 52, while the opposite end thereof is grounded to connect with the ground of the battery 56.

Work devices shown as lights 57 are adapted to be connected to the interrupter foot 25 by means of switches 58. On motor vehicles, lights having tungsten filaments are most commonly used. It is well-known that tungsten, when cold, offers very little resistance to current flow, so that when a tungsten filament light is first connected in circuit, a great rush of current will at first occur, this current flow being reduced as the filament in the light warms up. Where a great number of such lights are turned on, quite a bit of electrical energy is uselessly expended before the filaments are warmed sufficiently to offer a normal resistance to the current flow.

By the use of this interrupter, this initial rush of current is substantially reduced.

Supposing, for example, all the lights 57 are simultaneously introduced into the circuit by the closing of switches 58. The initial rush of a substantially heavy current flow will leave the battery, flow through winding 53 across contacts 48 and 49, through spring arm 45, frame 21, across the lights 57 back to the battery via the ground connections. This flow of current being abnormal, the winding 53 will energize the core 31 to attract the armature 40 and move it against the effect of the spring 44 to engage the contact member 49 and move it out of engagement with its cooperating contact 48, thus breaking the circuit through winding 53. Now, the flow of current from the battery will deviate and pass through the higher resistance winding 54 on its way to the lights, thus substantially reducing the flow from the battery while still maintaining the armature in attracted position due to the direction of flow through the winding 54.

Opening of contacts 48 and 49 will close the auxiliary contacts 51 and 52. However, as the resistance of the work circuit is much less than the resistance of winding 55, which is now connected in series with winding 54, the current will continue to flow through the work circuit until the filaments of the lights have become sufficiently warm to offer substantially the same resistance as winding 55. When this occurs, part of the current will deviate and flow from the winding 54, through frame 21, spring arm 45 and its portions 46 and 50 across contacts 51 and 52 through winding 55 back to the battery via the ground connections. Winding 55 being reversed to winding 54, it will destroy the effect of winding 54 and permit the spring 44 to return the armature to its normal, inoperative position on the base 20. This closes contacts 48 and 49 and restores the circuit through the low-resistance winding 53, the current flow now being of the proper value.

In case of a short-circuit at the lights, which, reduces the resistance in this circuit below a minimum allowable value and permits an excessive flow of current through the winding 53, this winding will energize the core 31 so that the armature 40 will be moved to open contacts 48 and 49 as described. The winding 54 being connected in parallel with winding 53, will maintain the armature in the contact-opening position as long as the short-circuit is permitted to exist. The short-circuit being of lesser resistance than the reverse winding 55, a substantial current flow through said winding will thus be precluded and, therefore, no opposing effect will obtain against the holding effect of the winding 54. However, as soon as the short-circuit

is removed, the resistance of the circuit will be restored to normal, causing a deviation of part of the current flow from said circuit, through the circuit including the reverse winding, thereby bringing into operation the demagnetizing effect of said winding and thus restoring the low-resistance circuit through winding 53 by the return of the armature and consequent closing of contacts 48 and 49.

While the form of embodiment of the 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 protective device for circuits including work devices, comprising in combination, a solenoid magnet provided with a pair of normally-closed contacts and a hollow core containing a plunger armature, said core having a plurality of windings wound about it, one of said windings being adapted to open the contacts when the resistance of the work circuit is reduced below a minimum allowable value, another winding being adapted to hold said contacts open while such low resistance is maintained in the work circuit, the third winding being provided for counteracting said holding winding and permitting the contacts to close when the resistance in the work circuit is again restored to its minimum allowable value.

2. A protective device for circuits including work devices, comprising in combination, a solenoid magnet provided with a pair of normally-closed contacts and a hollow core including a plunger armature, said core having a plurality of windings wound about it, one of which is adapted to open the contacts when the resistance of the work circuit is reduced below a minimum allowable value, another being adapted to hold said contacts open while such low resistance is maintained in the work circuit, the third winding being adapted to be brought into circuit by the opening of the contacts for counteracting said holding winding and permitting the contacts to close when the resistance in the work circuit is again restored to its minimum allowable value.

3. A protective device for circuits including work devices, comprising in combination, a solenoid magnet having a pair of normally-closed main contacts; a pair of normally-open, auxiliary contacts and three windings about a common core, one winding being adapted to open the main contacts and to close the auxiliary contacts when the resistance of the work circuit is reduced below a minimum allowable value, the second winding being provided for holding the main contacts open and the auxiliary contacts closed while the resistance in the work circuit is maintained at a value below the minimum allowable value; and the third winding in circuit with the auxiliary contact for counteracting said holding means and permitting the main contacts to be closed when the resistance in the work circuit is again restored to its minimum allowable value.

4. A protective device for circuits including work devices, comprising in combination, a solenoid magnet having a hollow core surrounded by a main electromagnet winding, a secondary electromagnet winding and a counteracting winding, said core having a plunger armature therein and supporting a pair of normally-closed contacts; the main electromagnet winding being adapted to open the contacts when the resistance in the work circuit is reduced below a minimum allowable value, the secondary electromagnetic winding being provided for maintaining the contacts open while said resistance in the work circuit is maintained at the said low value; and the counteracting electromagnetic winding for destroying the effect of the secondary electromagnetic winding and permitting the contacts to close when the resistance in the work circuit is again restored to its minimum allowable value.

5. A protective circuit interrupting device for circuits including work devices, comprising in combination, an electromagnet of the solenoid type including a core having a plunger armature; a pair of normally-closed contacts adapted to be opened by said armature; a pair of auxiliary contacts normally open, one of said contacts being operatively connected to one of the normally-closed contacts; a main winding on the core, one end of which is connected to one of the normally-closed contacts; a secondary winding of comparatively higher resistance than the main winding, connected in shunt with the normally-closed contacts; and a third winding of lesser resistance than the secondary winding and connected in series therewith but wound in opposition to the aforementioned two windings, one end of said winding being connected to one of the normally-open contacts.

6. A protective circuit interrupting device for circuits including work devices, comprising in combination, an armature; a pair of normally-closed contacts; a main winding for operating the armature to open said contacts when the resistance in the work circuit is reduced below a minimum allowable value; a secondary winding of comparatively higher resistance than the main winding, wound in the same direction as said main winding and connected in parallel therewith, said secondary winding being adapted to maintain the armature in its attracted, contact opening position while the resistance in the work circuit is maintained at its aforementioned low value; and a counteracting winding of lesser resistance than the sec-

ondary winding and connected in series with the secondary winding, but wound in opposition thereto, said counteracting winding being ineffective to counteract the secondary winding while the resistance in the work circuit is maintained below its minimum allowable value.

7. A protective circuit interrupting device for circuits including work devices, comprising in combination, an armature; a pair of normally-closed contacts; a main winding for operating the armature to open said contacts when the resistance in the work circuit is reduced below a minimum allowable value; a secondary winding of comparatively higher resistance than the main winding, wound in the same direction as said main winding and connected in parallel therewith, said secondary winding being adapted to maintain the armature in its attracted contact-opening position while the resistance in the work circuit is maintained at its aforementioned low value; and a counteracting winding of lesser resistance than the secondary winding and connected in series but wound in opposition to said secondary winding, said counteracting winding becoming effective to destroy the effect of the secondary winding when the resistance in the work circuit is substantially equal to the resistance of said counteracting winding.

8. A protective circuit interrupting device for circuits including work devices, comprising in combination, an armature; a pair of normally-closed contacts; a main winding for operating the armature to open said contacts when the resistance in the work circuit is reduced below a minimum allowable value; a secondary winding of comparatively higher resistance than the main winding, wound in the same direction as said main winding and connected in parallel therewith, said secondary winding being adapted to maintain the armature in its attracted contact-opening position while the resistance in the work circuit is maintained at its aforementioned low value; and a counteracting winding of lesser resistance than the secondary winding and connected in series but wound in opposition to said secondary winding, said counteracting winding being ineffective to counteract the secondary winding while the resistance in the work circuit is of comparatively lesser value than the resistance in the counteracting winding.

9. A protective circuit interrupting device for circuits including work devices, comprising in combination, an electromagnet of the solenoid type including a core having a plunger armature; a pair of main contacts including a stationary contact, and a movable contact supported by a spring arm and normally in engagement with the stationary contact, said movable contact being adapted to be moved out of engagement with the stationary contact by the plunger armature; a main winding on the magnet core, one end of said winding being connected to the main stationary contact; an auxiliary pair of contacts including a stationary member, and a movable contact member carried by the spring arm of the main contacts so that said auxiliary contacts will be open when the main contacts are closed; a secondary winding on the core, of higher resistance than the main winding, and connected in shunt with the main contacts, said secondary winding being adapted to maintain the armature in attracted, main-contact-opening position after a current flow in excess of the maximum allowable value has passed through the main winding and energized the core to attract the armature, said excessive current flow being due to the resistance in the work circuit falling below its minimum allowable value; and a counteracting winding wound on the core reversely to said other two windings and brought into series connection with the secondary winding by the closing of the auxiliary contacts, said winding being effective to counteract the secondary winding and release the armature to permit the main contacts to close only when resistance in the work circuit substantially equals the resistance of the counteracting winding.

In testimony whereof I hereto affix my signature.

JOHN T. FITZSIMMONS.