Jan. 29, 1963 J. I. ROSCHUK 3,076,072

CARTRIDGE RELAY CONTACT

Filed May 9, 1960 4 Sheets-Sheet 1

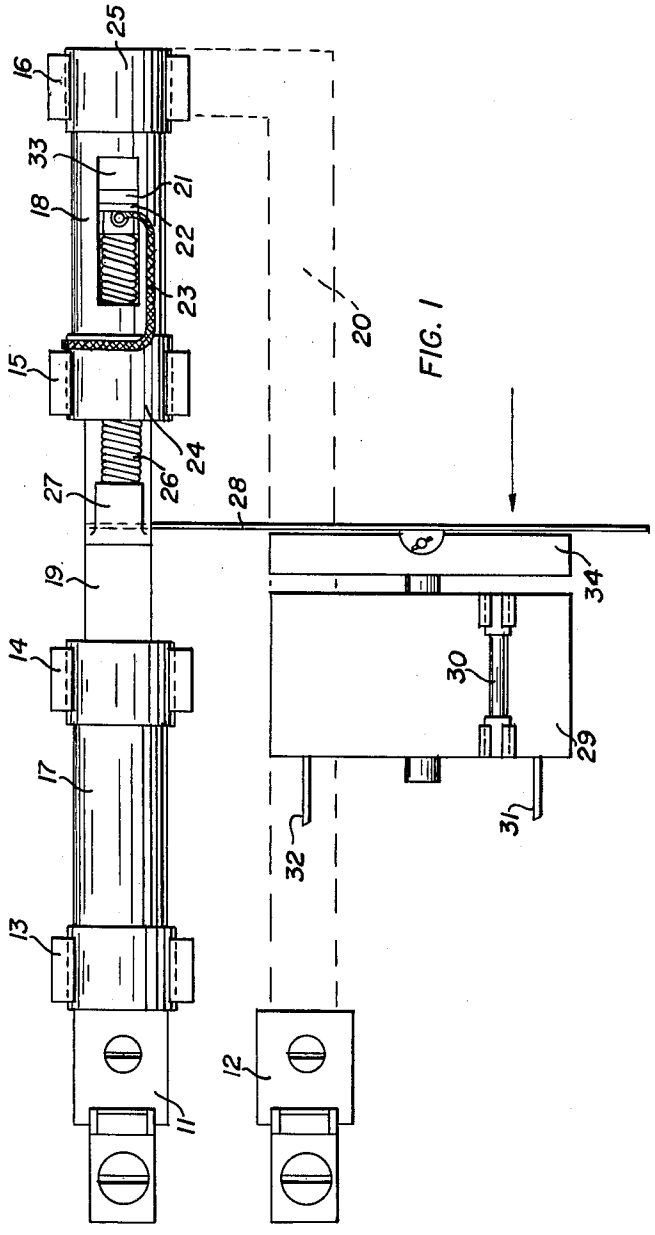


FIG. 1

INVENTOR
JOHN I. ROSCHUK
BY- Smart & Biggar.
ATTORNEYS

Jan. 29, 1963 J. I. ROSCHUK 3,076,072

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FIG. 2a

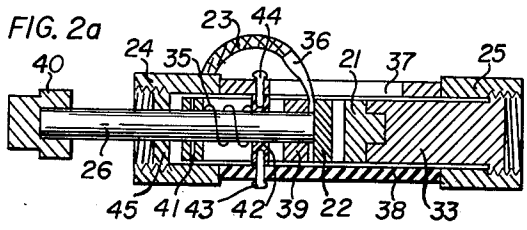
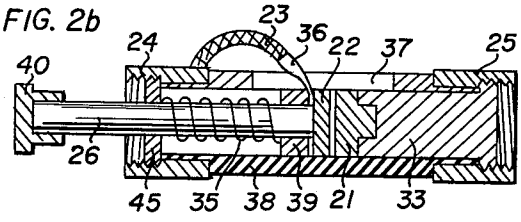


FIG. 2b



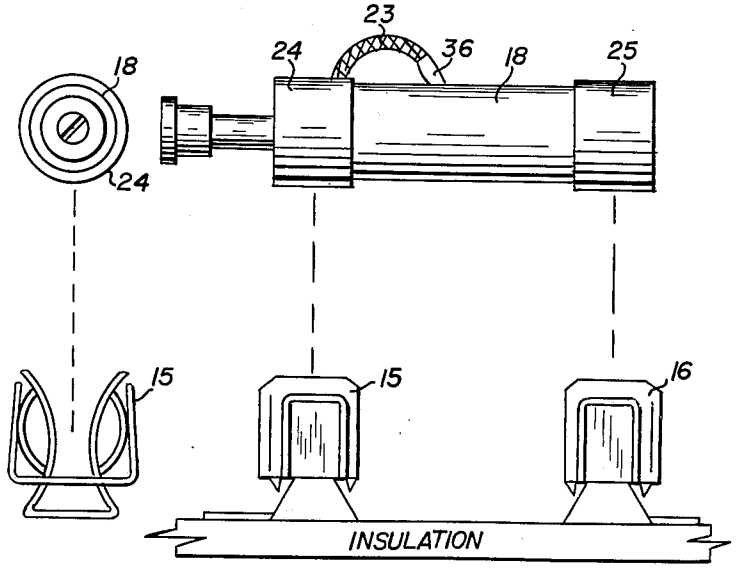


FIG. 4

INVENTOR
JOHN I. ROSCHUK
BY- Smart & Biggar
ATTORNEYS.

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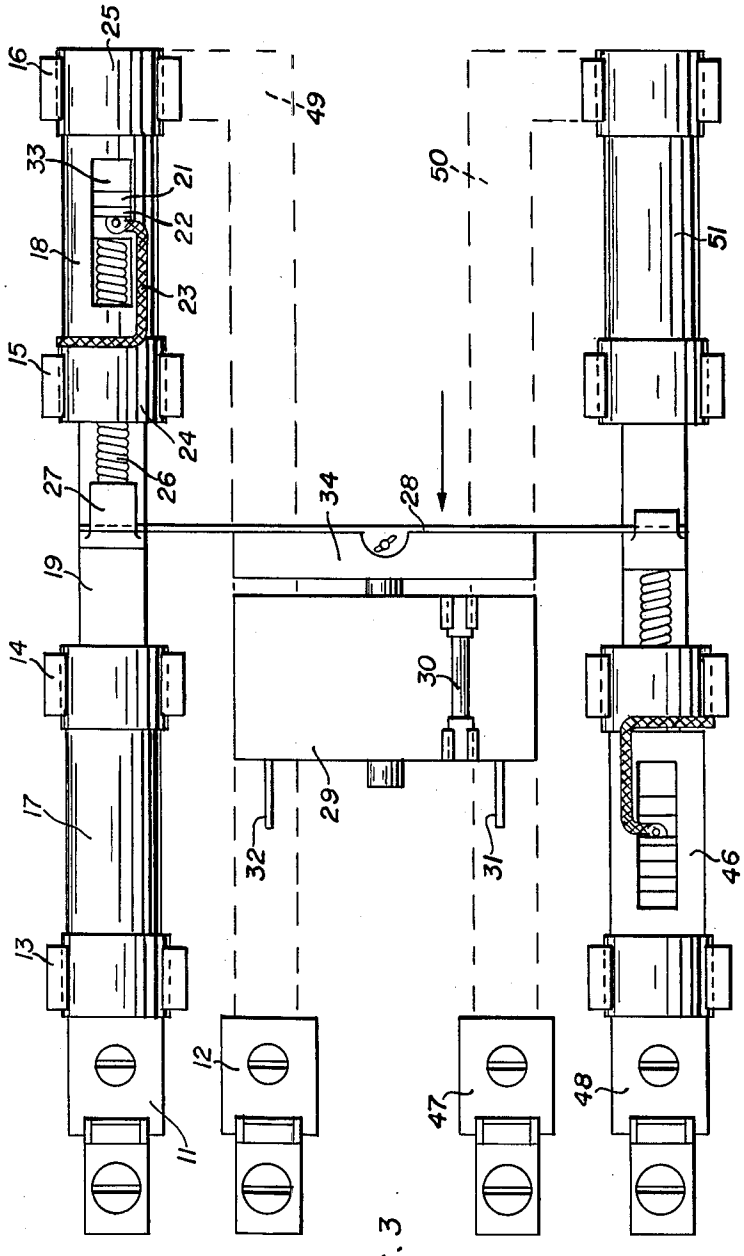


FIG. 3

INVENTOR
JOHN I. ROSCHUK
BY- Smart & Biggar
ATTORNEYS

Jan. 29, 1963 J. I. ROSCHUK 3,076,072

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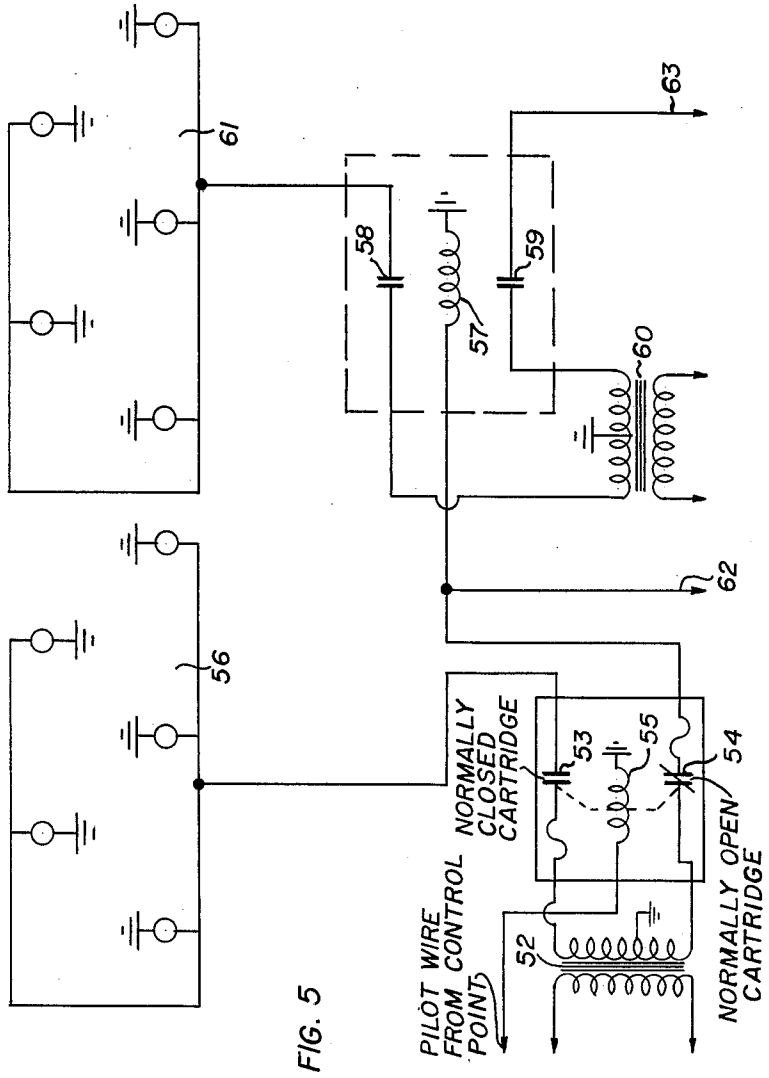


FIG. 5

INVENTOR
JOHN I. ROSCHUK
BY- Smart & Biggar
ATTORNEYS

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CARTRIDGE RELAY CONTACT

John Iwan Roschuk, 1940 Bannatyne Ave., Winnipeg, Manitoba, Canada

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10 Claims. (Cl. 200—87)

The invention relates to the construction of electric relays and in particular is concerned with replaceable relay contacts.

Relays such as those used in street-lighting systems are subject to mechanical and electrical failure. One of the most frequent causes of failure is the burning or pitting of contact surfaces due to transient overloads and to repeated opening and closing of the contacts. Heretofore it has been necessary, in the event of contact failure, to remove the entire relay from the installation so that the old contacts may be replaced by new ones. The removal of the relay assembly from the installation is frequently a difficult procedure. When a street lighting relay failure is reported, for example, a serviceman inspects the installation, and if faulty contacts are responsible for the failure, the serviceman replaces the unit by a new one. If the failure is reported at night, it is usually necessary to wait until daylight for the relay assembly to be replaced. The defective relay unit is then taken to a servicing shop, where trained personnel dismantle the assembly, replace the contacts, and reassemble the relay unit. The repair of the relay may consume a half-hour or longer, especially if a number of critical adjustments (e.g. spring tension) have to be made.

The present invention provides a relay unit having a cartridge-type relay contact assembly which can be readily replaced in the relay unit without taking the relay out of service. The relay unit is provided with clips such as those used for holding ordinary fuse cartridges, each of the clips being joined to a terminal of the circuit controlled by the relay. The contact assembly, which includes a fixed contact and a movable contact, is mounted in a cartridge similar to an ordinary fuse cartridge, each contact being joined to one of the ferrules on either end of the cartridge. The movable contact is adapted to be connected to an external mechanical linkage for operation by an electromagnetic solenoid or other control device. The cartridge contact assembly can easily be held fast due to the firm grip of the clips on the ferrules, and can be readily replaced by a new cartridge in the event of contact failure. The cartridge can be removed without the use of any tools (except possibly a conventional fuse puller) and replaced in a fraction of the time previously required to replace the entire relay unit. No extensive repar work is needed at a service shop because the cartridges are inexpensive and the defective ones can simply be thrown away. The cartridges can be used to contain normally open or normally closed contact assemblies, and relay units can easily be designed to hold each type of cartridge. Cartridge-type relay contacts may of course be used in applications other than street lighting, and can be designed for different current and voltage requirements. The use of these cartridges in such applications as street lighting cuts down the required inventory of complete units, since in many cases only the contact assembly and not the complete relay unit will have to be replaced. Conversion from normally open to normally closed contacts can also be easily attained.

The invention will now be described with reference to the accompanying drawings, in which:

FIGURE 1 shows a relay unit having a replaceable cartridge-type contact assembly;

FIGURES 2*a* and 2*b* show in section embodiments of the cartridge-type contact assembly: FIGURE 2*a* being a normally open contact assembly and FIGURE 2*b* a normally closed assembly;

FIGURE 3 shows a double pole relay unit including two cartridge-type contact assemblies, one of which is normally open and the other normally closed;

FIGURE 4 shows side and end views of a cartridge-type contact assembly and of clips suitable for holding the contact assembly; and

FIGURE 5 shows a street lighting system in which relays according to the invention can be used.

FIGURE 1 shows a relay unit comprising terminals **11** and **12**, clips **13**, **14**, **15** and **16**, a fuse **17**, a normally closed cartridge relay contact assembly **18**, and conductive continuity strips **19** and **20**. The strip **20**, shown in broken lines, is "underneath" the rest of the assembly. A fixed contact **21** is connected via a brass insert **33** to a ferrule **25**, and a movable contact **22** is connected to a ferrule **24** via a flexible jumper **23**. Movable contact **22** is connected to a plunger **26**, which is attached by means of a coupling cap **27** to a flexible control arm **28**. Control arm **28** is pulled in the direction of the arrow when current is applied to the coil of solenoid assembly **29**. A control circuit safety fuse **30** is shown in series with the coil windings, and terminals **31** and **32** connect the coil to the external control circuit.

The circuit to be controlled by the relay is connected to terminals **11** and **12**. As can be readily seen from the figure, the current path from terminal **11** to terminal **12** passes through fuse clip **13**, fuse **17**, fuse clip **14**, continuity strip **19**, cartridge clip **15**, ferrule **24**, jumper **23**, movable contact **22**, fixed contact **21**, insert **33**, ferrule **25**, clip **16**, and finally continuity strip **20**. The circuit is broken when current is applied to terminals **31** and **32** of the solenoid, causing solenoid armature **34** to be pulled in the direction of the arrow. The armature movement causes the control arm **28** to pull the plunger **26**, and thus the movable contact **22** is forced away from the fixed contact **21**.

The control arm **28** should be somewhat flexible in case the paths of movement of the armature **34** and the plunger **26** are not of equal length. Also the use of a flexible arm ensures that sudden jerks will not tend to break the control arm. The arm **28** can be connected to a plurality of contact assemblies. (See, for example, FIGURE 3.)

The ferrules **24** and **25** are preferably of the same shape and size as those of fuse **17**, so that standard fuse clips **13**, **14**, **15**, **16** may be used throughout the assembly. It will also be seen that with the fuse **17** and the contact assembly **18** mounted as shown, it is possible to convert the relay unit from a normally closed relay to a normally open relay simply by interchanging the positions of the fuse **17** and the cartridge **18**, and laterally reversing the cartridge **18** so that the plunger **26** may be connected to the control arm **28**.

For street lighting, the solenoid assembly **29** is preferably constructed so that its operating voltage range is between 65 volts and 130 volts. Although the majority of utility companies use a control circuit voltage as close to 115 volts as possible, voltage variations (especially voltage dips) occur on the system occasionally. These voltage dips should preferably not cause the relay contacts to revert to their normal position. Normally the solenoid coil will be designed for use with an A.C. control voltage.

FIGURES 2*a* and 2*b* show, in section, a cartridge contact assembly according to the invention. A cartridge **38**, similar to a fuse cartridge, is capped at both ends by conducting ferrules **24** and **25** composed of brass or other suitable material. A fixed contact **21** disposed inside the cartridge is electrically and mechanically connected to the ferrule **25** by a brass insert **33**, which acts

as a heat dissipator as well as a conductor. A movable contact 22 can slide back and forth in the tube when actuated by a plunger 26, which is connected to the contact 22. The plunger 26 is connected to an end cap 40 of non-conductive material. The end cap 40 may be attached to a control arm such as arm 28 shown in FIGURE 1. The movable contact 22 is electrically connected to the ferrule 24 by a jumper 23 and a jumper lug 36. The lug 36 is firmly compressed between the contact 22 and a brass retainer 39, the latter serving also as a heat dissipator. The contacts 21 and 22 are made of silver plated copper or other good quality contact material. A longitudinal slot-shaped opening 37 in the cartridge allows the jumper to be connected between the ferrule 24 and the contact 22. The opening 37 acts as a guide for the jumper 23 when the contact 22 moves from one position to another, and also permits immediate inspection of the condition of the contacts.

In a normally open contact assembly (FIGURE 2*a*), a washer 42 of fiber, nylon, or similar material, is attached to the cartridge 38 by pins 43 and 44. The washer 42 serves as a retainer for a contact spring 35. The spring 35 is compressed between the washer 42 and a spring retainer 41, which is firmly attached to the plunger 26, in the closed position of the relay. The spring 35 acts to open the relay in the absence of external force on the plunger 26. A conductive washer 45 is firmly attached to the ferrule 24, and acts as a guide for the plunger 26. The positions of the washers 45 and 42 determine the maximum opening between the fixed contact 21 and the movable contact 22.

In a normally closed contact assembly (FIGURE 2*b*), the washer 42 is omitted, although it is preferable to retain the washer 45 as a guide for the plunger 26. The spring 35 is now compressed between the washer 45 and the retainer 39, so that in the absence of external force on the plunger 26, the contact 22 is pressed tightly against the contact 21. The spring 35 is longer in the normally closed contact assembly than in the normally open assembly. Proper choice of springs and washer positions will allow both the normally open or normally closed contact assemblies to be used in different applications.

FIGURE 3 shows a 2-pole relay according to the invention. The relay unit 49 is identical with that shown in FIGURE 1, and relay unit 50 is the same as unit 49 except that unit 49 is a normally closed unit and unit 50 is normally open. The only difference in structure between the two units is that normally closed contact assembly 18 is on the right of control arm 28, and normally open contact assembly 46 is on the left, while fuses 17 and 51 are on the opposite sides of arm 28 from the cartridges 18 and 46 respectively. When solenoid armature 34 is retracted in the direction of the arrow, control arm 28 opens the contacts in cartridge 18 and closes the contacts in cartridge 46. Terminals 11 and 12, 47 and 48 can be connected to external circuits which are to be controlled.

Of course, the relay construction shown in FIGURE 3 could be used as a 2-pole normally open relay or a 2-pole normally closed relay simply by altering the positions of the cartridges.

FIGURE 4 shows side and end views of a contact assembly cartridge 18 and clips 15 and 16. This figure illustrates the ease with which a cartridge can be replaced in the clips. Ferrules 24 and 25 are firmly clasped by clips 15 and 16 respectively, ensuring good electrical conduction and mechanical stability.

FIGURE 5 shows a street lighting system using relays constructed according to the present invention. Occasionally a control circuit which is being used to control a plurality of circuits reaches the limit of its current carrying capacity. If it is desired to control additional circuits by the control circuit, it is sufficient to change one of the relays controlled by the control circuit from normally open to normally closed (or vice versa), and use the changed relay to control additional relays. In FIGURE 5, for example, a transformer 52 supplies current to a relay 53 controlled by a solenoid 55. If this relay was initially of the normally closed type and it was desired to control further circuits without increasing the current to the solenoid 55, it is sufficient to add a second relay of the normally open type to be controlled by the solenoid 55. Thus the relay 53 is shown as a normally closed relay connected to a lamp bank 56, whereas the relay 54 is the relay of normally open type which has been added. In order that the relay 54 may control additional circuits in the same manner as the lamp bank 56 is controlled by the solenoid 55, it is necessary for the relay 54 to operate relays of the opposite type to that of relay 54. Thus relays 58 and 59 are of the normally closed variety. Relay 58 is shown connected to a lamp bank 61, and the relay 59 may be connected to a similar load via a lead 63. A lead 62 can be used to control one or more relays such as 58 or 59.

It is readily seen that the solenoid 55 is able to cause all the lamps in the several lamp banks to turn on and off at substantially the same time. With the solenoid 55 energized (as shown in FIGURE 5), no current flows through the relay 53, so that the lamp bank 56 is unpowered. Relay 54 conducts, however, thus energizing the solenoid 57. Since the solenoid 57 is energized, the relays 58 and 59 do not conduct power from the transformer 60 to their respective loads. However, if the solenoid 55 is de-energized, the relay 53 closes to light the lamp bank 56, while the relay 54 opens to de-energize the solenoid 57, thus allowing the relays 58 and 59 to close and thus permit current to flow to their respective loads.

The replaceable cartridge contact assemblies are useful in the expansion of controlled lighting systems such as the one shown in FIGURE 5. If relay structures such as the one shown in FIGURE 3 are used, it is a simple matter to convert a normally open relay to a normally closed unit as desired. Thus it is possible to expand the number of circuits controlled by a control circuit indefinitely without the expense of installing new independent control circuits.

What I claim as my invention is:

1. A relay adapted to be connected in an electric circuit to be controlled by the relay, comprising a first terminal, a first clasping means conductively connected to the first terminal, a second clasping means, a second terminal conductively connected to the second clasping means, and a removable contact assembly cartridge having a first and a second ferrule, said first and second ferrules being made of conductive material and adapted to be clasped by the first and second clasping means respectively, a movable contact, means to conduct current from the first ferrule to the movable contact, a fixed contact, means to conduct current from the fixed contact to the second ferrule, means to cause the movable contact to touch the fixed contact, means to cause the movable contact to move out of contact with the fixed contact, an electric circuit external to the cartridge, at least one of said means to cause the movement of the movable contact being an external actuating device controlled by said external electric circuit and mechanically connected to the movable contact, whereby the movement of the movable contact in and out of contact with the fixed contact is controlled by the external circuit.

2. A relay as claimed in claim 1, wherein the means to conduct current from the first ferrule to the movable contact is a flexible jumper.

3. A relay as claimed in claim 1, wherein the means to cause the movable contact to touch the fixed contact is an external actuating device mechanically connected to the movable contact, and the means to cause the movable

contact to move out of contact with the fixed contact is a spring.

4. A relay as claimed in claim 1, wherein the means to cause the movable contact to touch the fixed contact is a spring, and the means to cause the movable contact to move out of contact with the fixed contact is an external actuating device mechanically connected to the movable contact.

5. A relay as claimed in claim 3, wherein the external actuating device is an armature caused to move towards a coil of wire by means of current flowing through the coil.

6. A relay as claimed in claim 1, wherein the first clasping means is connected to the first terminal through a fuse, the said fuse being mounted in a cartridge having a conductive fuse ferrule at each end, one fuse ferrule being removably mounted in a third clasping means conductively connected to the said first terminal, the other fuse ferrule being removably mounted in a fourth clasping means conductively connected to the said first clasping means, the fuse being connected between the two fuse ferrules, the third and fourth clasping means being spaced apart substantially the same distance as the distance between the first and second clasping means, and the several clasping means being adapted to clasp the ferrules of both the fuse cartridge and the contact assembly cartridge so as to permit an interchange in position of the said fuse cartridge and the said contact assembly cartridge.

7. A relay as claimed in claim 6, wherein an external actuating means capable of actuating the movable contact is disposed between the first and the fourth clasping means so as to be able to control the movable contact of a contact assembly cartridge mounted in the first and second clasping means or in the third and fourth clasping means.

8. A relay comprising a first terminal, a first fuse clip conductively connected to the first terminal, a second fuse clip, a second terminal conductively connected to said second fuse clip; a contact assembly cartridge having a tubular non-conducting casing, a first metallic ferrule on one end of the cartridge and removably clasped by the first fuse clip, a second metallic ferrule on the other end of the cartridge and removably clasped by the second fuse clip, a fixed contact, a metallic insert conductively connecting the fixed contact to the second ferrule, a movable contact adapted to be moved in and out of contact with the fixed contact, a flexible jumper conductively connecting the movable contact to the first ferrule, a plunger partially disposed within the cartridge and attached to the movable contact and extending outside the cartridge from one end thereof; a relay coil, an armature adapted to be moved when current flows in the coil, the armature being mechanically connected to the plunger so as to cause the movable contact to move from its rest position to a displaced position when current flows in the coil, and a spring adapted to return the movable contact to its rest position when flow of current in the coil is interrupted, the fixed contact being in contact with the movable contact when the movable contact is in one said position, and the fixed contact being out of contact with the movable contact when the movable contact is in the other of said positions.

9. A relay as claimed in claim 4, wherein the external actuating device is an armature caused to move towards a coil of wire by means of current flowing through the coil.

10. A removable relay contact assembly cartridge comprising a tubular non-conducting casing, a first metallic ferrule mounted on one end of the casing and adapted to be clasped by a fuse clip, a second metallic ferrule mounted on the other end of the casing and adapted to be clasped by a fuse clip, a fixed contact, a metallic insert conductively connecting the fixed contact to the second ferrule, a movable contact adapted to be moved in and out of contact with the fixed contact, a flexible jumper conductively connecting the movable contact to the first ferrule, a plunger partially disposed within the cartridge and extending outside the cartridge from one end thereof, the plunger adapted to be connected to an external actuating device so as to be able to move the movable contact from its rest position, and a spring adapted to return the movable contact to its rest position in the absence of external force acting on the plunger.

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