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EXCESS CURRENT CIRCUIT BREAKER

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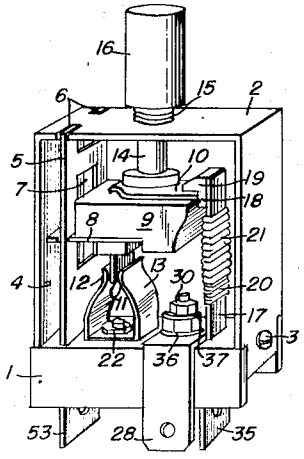

FIG. 1

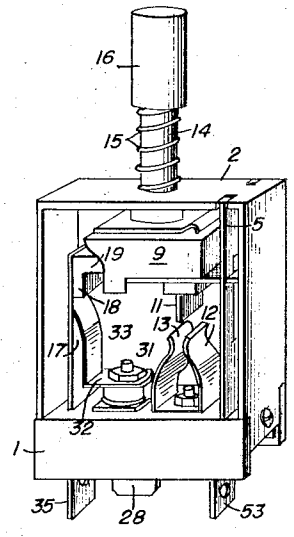

FIG. 2

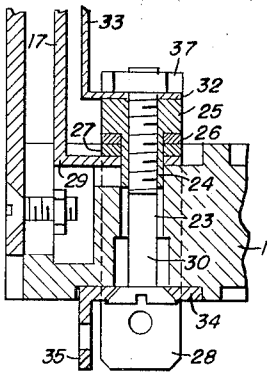

FIG. 3

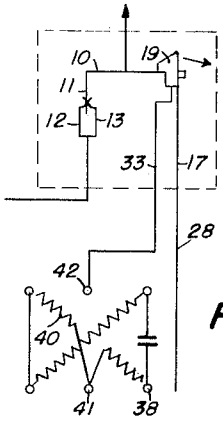

FIG. 5

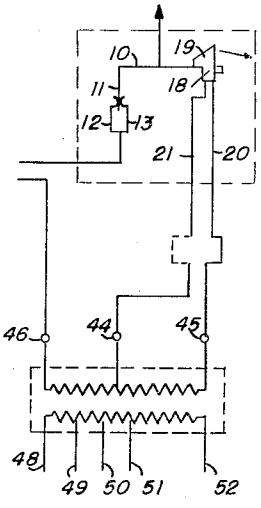

FIG. 4

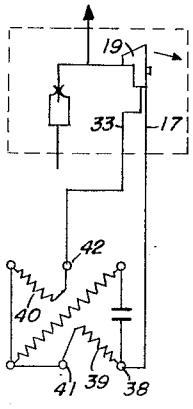

FIG. 6

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EXCESS CURRENT CIRCUIT BREAKER

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It is known in excess current circuit breakers to use a bi-metal spring as switching element which itself carries or controls a contact; it is further known to arrange that also the second contact member be movable and to provide the contact member which is controlled by the bi-metal spring with a locking projection intended to stop the other movable contact member, which may be constructed as a contact bridge in the position which will enable the passage of the current.

The invention relates to all these forms of excess current circuit breakers, its object being to provide an arrangement which, in the case of one circuit breaker may be used with especially great advantage and in the case of another circuit breaker less advantageously, but which in the case of all circuit breakers it has the advantage of being applicable over a greater range. The present invention consists in that the contact member influenced by the bi-metal spring has connected to it more than one current path, at least one of which influences the bi-metal spring.

In this way an excess current circuit breaker of very small dimensions is obtained as a safety means for motors, high frequency and other electric devices, which inter alia, can be used for several voltages, for instance 110 and 220 volts, without any change over of the circuit breaker itself being required.

Thus, one and the same circuit breaker can be secured in an apparatus which can be switched over from 110 to 220 volts and vice versa, without it being necessary to replace the excess current circuit breaker, since owing to the improved excess current circuit breaker being arranged for a plurality of current paths, the arrangement may be such that each current path is connected to a separate connecting member.

The heating of the bi-metal spring may be effected in a manner known per se through one current path directly through one or more other paths indirectly. However, it is also possible to carry out the heating of the bi-metal spring through all the current paths indirectly.

Circuit breakers which are intended to be used in connection with an electrically supplied device that can be switched over to several voltages may, according to a further feature of the invention, be so constructed that the heating of the bi-metal spring is effected directly for all kinds of voltages, that only one current path includes the bi-metal spring or a heating winding of the bi-metal spring, and that the current paths which are independent of the bi-metal spring pass directly through the contact member that is influenced by the bi-metal spring. A circuit for such an excess current circuit breaker is preferably so arranged that in the case of the higher voltage, for instance 220 volts, the windings of the apparatus to be protected are connected in series with one another and led directly to the bi-metal spring or a winding heating the same, and in the case of the lower voltage, for instance 110 volts, the windings are connected in parallel with one another and only one is led through the bi-metal spring or its heating winding, the other one being

led to the contact part of the bi-metal spring through the other current path which does not influence the bi-metal spring.

In this way an arrangement is obtained by means of which only one single heating device is used for the several current paths.

The indirect heating of the bi-metal spring may be effected by means of a winding arranged thereon in a manner known per se. If two current paths are intended to influence the bi-metal spring, the one current path may be led directly through the bi-metal spring and the other one through a winding provided on the bi-metal spring; instead thereof, two windings electrically insulated from each other may be arranged superposed on the bi-metal spring.

According to a further feature of the invention, each current path is led to a downwardly directed connecting lug, plug pin, or the like, which is mounted on the base of the circuit breaker, and may preferably be provided with a holding device.

A very compact construction may be obtained by a bush of insulating material being inserted from the inside of the circuit breaker into a hole of the base, which bush is provided with a collar by means of which one current path of the circuit breaker is pressed against the connecting terminal and by a screw being provided inside the bush which secures the bush to the base and connects the second current path to the connecting terminal.

In this way the invention provides an arrangement in which a plurality of current paths can be introduced into the circuit breaker through a single hole, thereby enabling the circuit breaker to be made of very small dimensions. If the circuit breaker is constructed in the form of a flat body as is possible even for the double application of its construction according to the invention, then the connecting parts of the individual terminals or current paths are preferably so arranged that the connecting part of the one current path is led out of the base parallel to the other terminal of the circuit breaker, whereas the connecting part of the other current path is led downwards laterally with respect to the base, and preferably abutting against it. In this way, it is easily possible to provide the circuit breaker according to the invention on small devices, apparatus or motors, without their becoming unsightly by its incorporation therein.

In the arrangement in which use is made only of one heating winding or the like acting on the bi-metal spring, or in which the bi-metal spring itself is adapted to the two kinds of voltages, the arrangement may be such that the current path which does not influence the bi-metal spring is constituted by a conductor of flexible material electrically connected to the contact of the bi-metal spring, for instance a flat conductor, preferably a copper foil, which is placed laterally with respect to the bi-metal spring and is connected to its terminal.

According to a further feature of the invention, all the current paths lead to a contact member which is secured to the free end of the bi-metal spring. In this way, not only is the bi-metal spring inserted in the circuit of the device to be protected, but it also forms directly part of the contact that interrupts the circuit. The whole of the circuit breaker arrangement can thereby be made more compact.

It is known to use a contact bridge in connection with circuit breakers provided with only one current path, which contact bridge is released in the case of an excess current by the bi-metal spring, or by its contact, but the use of such a contact bridge is of special importance in the case of a circuit breaker according to the present invention, since the circuit breaker adapted for a number

of current paths can be used for the switching of very large powers.

The accompanying drawings illustrate, by way of example and diagrammatically, several constructions according to the invention.

Figure 1 is a perspective view of a circuit-breaker according to the invention;

Figure 2 is a circuit breaker for several current paths, only one of which has an influence on the bi-metal spring;

Figure 3 shows the connecting point within the circuit breaker on an enlarged scale;

Figure 4 is a diagram of connections of the circuit breaker, in which both current paths have an influence on the bi-metal spring; and

Figures 5 and 6 illustrate a circuit arrangement for a circuit breaker as shown in Figure 2.

Referring to the drawings, a U-shaped frame **2** is secured to the base **1** of the circuit breaker by means of screws **3**. This frame encloses the circuit breaker and it also serves as a support for the contact bridge **10**. A guiding member **5** is arranged parallel to the side wall **4** of the frame **2**, being attached to the base **1** by means of a pin, not shown, inserted therein and to the frame **2** by means of two pins **6** inserted in suitable recesses provided in the frame, whereby the guiding member is firmly held in position. The member **5** is provided with a window-like recess **7** in which there is guided a slide **8** secured to an insulating body **9**, which supports the contact bridge **10**, consisting of an angular piece of sheet metal that passes through the insulating body **9** and projects with its lower end **11** into the region of two contact springs **12, 13**. A guiding rod **14**, which is electrically insulated from the contact bridge **10**, is connected to the insulating body **9** and is displaceable in the frame **2** against the action of a spring **15**. **16** is a button operating the guiding rod.

A bi-metal spring **17** is provided on the side of the switch facing away from the guiding member **5**, which bi-metal spring is provided at its free end with a contact **18** which is in contact with the contact bridge when the circuit breaker is switched on. The contact **18** is provided with a projection **19**, which lies over the contact bridge **10** and holds the contact bridge in the position shown in Figure 1. In the example of construction shown in Figure 1, a winding **20** is provided over the bi-metal spring **17** and another winding **21** is superposed thereon. The two windings are electrically insulated from each other and also from the bi-metal spring.

The two contact springs **12, 13**, are secured by means of a screw **22** to the base **1** and the windings of the bi-metal spring are also connected thereto by means of a screw **30**. The terminal **53** is secured to the base by means of a screw **22**.

The operation of the switch shown in Figure 1 will be referred to after the construction shown in Figures 2 and 3 has been described, since the section shown in Figure 3 illustrates also the manner of securing the heating resistances.

A hole **23** is provided in the base **1**, and into it there is introduced from above a bush **24** of insulating material provided with a collar **25**, by means of which the bush rests on a washer **26** and places the angularly bent end **27** of the connecting member **28** on the angularly bent part **29** of the bi-metal spring **17**. A screw **30** is inserted into the hole of the bush **24** the screw-nut **31** pressing the angularly bent end **32** of a flat conductor **33** against the bush collar **25**. The head of the screw **30** is in electrical connection with the angularly bent end **34** of the second connecting terminal **35**.

Instead of the flat conductor **33**, the end **36** of the winding **21**, and instead of the angularly bent end **37** of the bi-metal spring **17**, the end **37** of the winding **22** shown in Figure 1 may be connected to the corresponding terminals.

If, for instance, a motor which can be switched over from 110 to 220 volts is to be provided with a circuit breaker according to the invention, the construction described with reference to Figures 2, 5 and 6 is to be preferred in the case of powerful motors.

39 and **40** are the motor windings which are connected together at **41** in series with each other. Such a connection is used if the motor is driven with 220 volts. The conductor leading to the connection **28** of the bi-metal spring **17** is connected to the end **38** of the winding **39**; the current path **33** of the circuit breaker shown in Figures 2 and 5 leads to the terminal **42**, which is not used in this form of construction.

Thus the motor is supplied with current through the terminal connected to the coil **40**, the current passing through the two windings **40, 39**, the bi-metal spring **17**, its contact **19**, the contacts **10, 11, 12** and **13**, back to the source of current. If an excess current arises in the two coils **39, 40**, the bi-metal spring **17** in Figure 5 is bent to the right, so that the position shown in Figure 2 is obtained, since, with sufficient bending of the bi-metal spring, the contact bridge **10, 11** is released, whereby the spring **15** presses the button **16** upwards. Thereby the circuit is interrupted at the contact **10—19** and **11—12, 13**.

If the motor has to be supplied with a voltage of only 110 volts the two windings **39, 40** are connected in parallel with each other; this takes place preferably by the end of the coil **40** being connected to the terminal **42**. Thereby the incoming current is divided at the beginning of the coil **40** into two current paths; the one current path runs through the coil **40**, the terminal **42**, the connection **45**, the flat conductor **33** and the contact **19** of the bi-metal spring, and the other current path, through the connecting terminal **41**, the winding **39**, the connection **28**, and the bi-metal spring **17**, to the contact **19**.

Now if any excess currents arise, the coil **39** and the bi-metal spring **17** are heated so that the latter is bent to the right, as already described, and releases the contact bridge **10, 11** to separate the contacts.

It will be seen that by dividing the current arriving at the winding **40** only half of the current is led to the bi-metal spring **17**, that is to say, that the amperage to be passed through the bi-metal spring **17** in the case of 220 volts when the two windings **39** and **40** are connected in series has to be such that in the case of a voltage of 110 volts, the excess currents that arise shall have the same effect on the bi-metal spring as in the case of a voltage of 220 volts, although the amperage in the case of 110 volts is practically double.

Instead of constituting the current path **33** by a foil, for instance a copper foil, as is illustrated in Figure 2, use may be made of a strand, the condition in that case being, that this current path, which does not influence the bi-metal spring, shall not influence purely mechanically the characteristic of the bi-metal spring, that is to say, the flexibility of this material must be such that without offering any appreciable resistance it will partake of the movement of the bi-metal spring when an excess current arises.

In the case of smaller currents an arrangement is preferred such as shown in Figures 1 and 4. As already described in the case of this arrangement, two windings **20, 21** are provided on the bi-metal spring **17**. These two windings represent each time the current path according to the diagram shown in Figure 4. In this diagram **43** is a transformer, **44** and **45** being the terminals of which for its connection to the excess current circuit breaker. The terminal **44** of the primary winding **47** of the transformer is used in the case of a voltage of 110 volts and the terminal **45** in the case of a voltage of 220 volts. The winding **20** is connected to the terminal **35** and the winding **21** to the terminal **28**. If an excess current arises in the electrical device supplied by the transformer **43** in the case of a supply voltage of 220 volts, the winding **20** of the bi-metal spring **17** heats up, so that the bi-metal spring **17** shown in Figures 1 and 4 bends to the right and releases the contact bridge **10**, whereby the circuit to be protected

is interrupted at **10—19** and **12, 13—11**. If, on the other hand, the transformer is used with a supply voltage of 110 volts, the current flows through the current path **21**, so that when an excess current arises the heat generated in this winding causes a bending of the bi-metal spring **17**.

The tappings **48**, **49**, **50**, **51** and **52** of the secondary winding of the transformer serve in a manner known per se for the tapping of different voltages, for instance: the tapping **48** as zero line, the tapping **49** for 4 volts, the tapping **50** for 6 volts, the tapping **51** for 12 volts, and the tapping **52** for supplying a voltage of 300 volts.

The following ranges of figures are given without limiting the invention thereto. It is advantageous, in the case of currents between 0.1 and about 4 amperes, to use two windings to influence the bi-metal spring; in the case of normal currents between 4.1 and 8 amperes one current path may consist of a winding and the other one be constituted by the bi-metal spring itself. Preferably the bi-metal spring serves as a current path in the case of a voltage of 110 volts.

As already mentioned, the construction according to Figures 2, 5 and 6 is used more particularly for devices working with larger currents.

The excess current circuit breaker according to the invention is especially suitable as a selective protection for transformers used with any devices, or for devices which are exposed to the danger of fire. It is especially successfully used in connection with motors, radio-apparatus, television apparatus, transformers associated with instruments and protective transformers for electric installations, industrial plants, and special toys. It can also be used with special advantage as a safety member for small electrical devices.

Generally, it will be sufficient to provide an excess current circuit breaker according to the invention with two current paths. However, use may also be made of more than two current paths.

Instead of providing several current paths for different voltages use may be made of current paths for other loads. Finally, instead of providing a number of heating windings on one metal spring, several bi-metal springs may be used, one for each current path and mechanically connect together the bi-metal springs in any suitable way so that they all act on one contact.

I claim:

1. An overcurrent circuit breaker comprising in combination a body member, a first and a second contact means supported in spaced relation in said body, bridge means to releasably engage said first and second contact means to interrupt current flow, a plurality of input terminals on said body, a bimetallic actuator connected at one end thereof to a respective one of said terminals and at the other end to said first contact means, and a conductor connected at one end to another one of said terminals and at the other end to said first contact means whereby to achieve divided input current flow, said first contact means comprising a nose member bent back upon itself to overlie in part at least in interfering relation with said bridge means in normal conductive condition and upon actuator distortion in response to excess current to remove from interfering relationship with the said bridge means to thereby terminate current flow and prevent re-establishment of current flow while said actuator is contorted.

2. The invention according to claim 1 including yielding means to urge said bridge means to disengaged position upon distortion of said bimetallic actuator.

3. A circuit breaker comprising in combination a body member, a bimetallic actuator supported in said body member, first contact means carried by said actuator, second contact means carried by said body, bridge means to releasably engage said first and second contact means, a plurality of input terminals, a plurality of coils wound on said actuator and arranged to indirectly heat the same, said coils connected at one end thereof to respective ones of said input terminals and at the other end to said first contact means to achieve a divided input current flow, yielding means to open said first and second contact means upon distortion of said actuator, and an output terminal connected to said second contact means.

4. A circuit breaker comprising in combination a body member, a bimetallic actuator supported in said body, contact means releasably engaged by said bimetallic actuator, a plurality of input terminals on said body, a plurality of coils fixed to said actuator and arranged to indirectly heat the same upon passage of current therethrough, said coils connected at one end thereof to respective ones of said input terminals and at the other end thereof to said contact means to achieve a divided input current flow, and yielding means to open said contact means upon distortion of said bimetallic actuator.

5. An overcurrent circuit breaker comprising a body member, first and second contacts supported in spaced relation by said body member, a conductive bridge movable to connect said first and second contacts to establish a circuit, means urging said bridge out of connection with said contacts, a bimetallic latch carrying at one of its ends said first contact and arranged to secure said bridge normally in connecting position, a plurality of external terminals connected respectively to said first and second contacts and to the other end of said bimetallic latch, and a pair of heating coils surrounding said bimetallic latch and connecting between a pair of said terminals and said first contact.

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