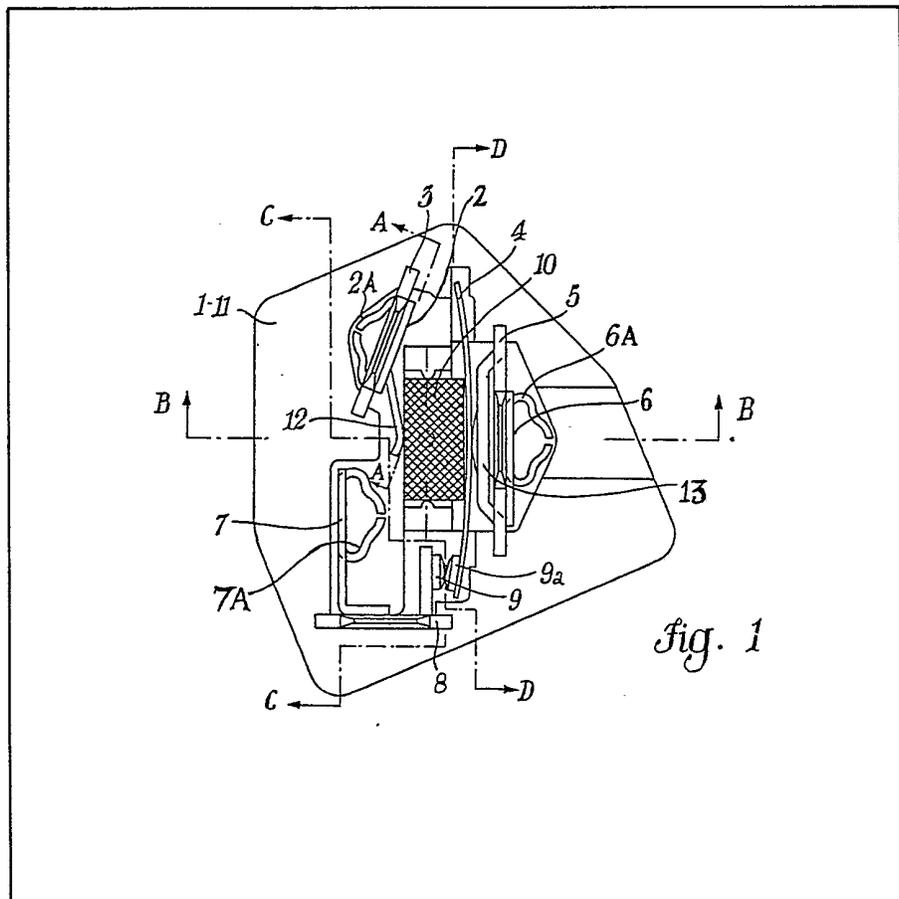


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(54) Electrical relay with thermal time delay

(57) A thermal relay, e.g. for use in starting monophas induction motors, comprises an actuator assembly of a preformed bimetal disc (4) and a heating tablet (10) preferably of material of positive coefficient of electrical resistivity, held together as a force fit between spaced terminals (2,3 and 5,6) in an insulating casing (1,11). A resilient leg (12) of terminal (2,3) presses against one face of the heating tablet (10), and bridge portion (13) of terminal (5,6) is adjustably abutted against the centre of the bimetal disc (4). A movable relay contact (9a) is carried by the bimetal disc and co-operates with a fixed contact (9) mounted on a third terminal (7,8) in the casing.

The ends of the bimetal disc (4) lie in narrow spaces formed in the casing (1) which limit the stroke of the bimetal disc.



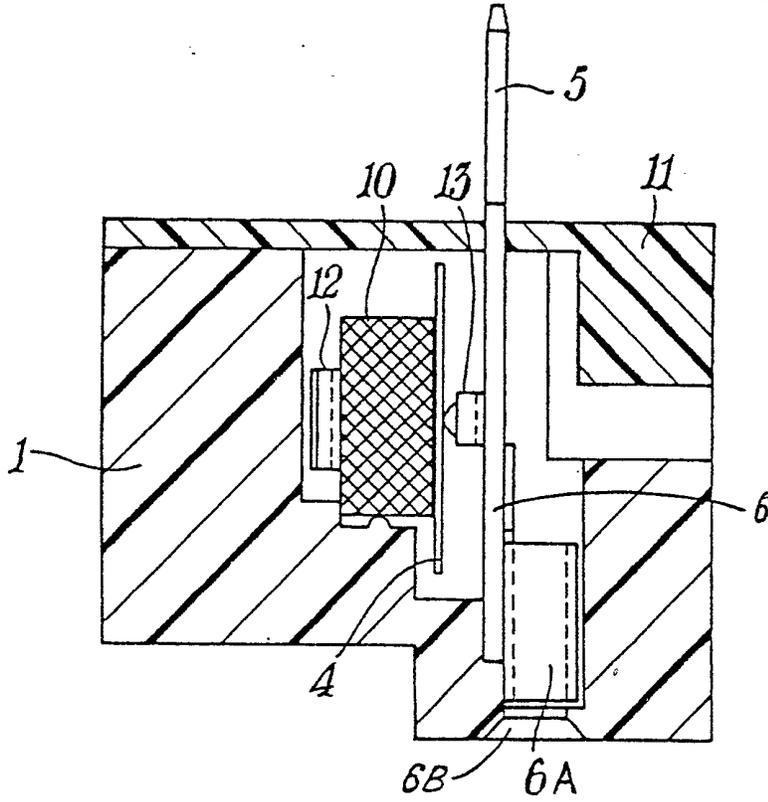


Fig. 3

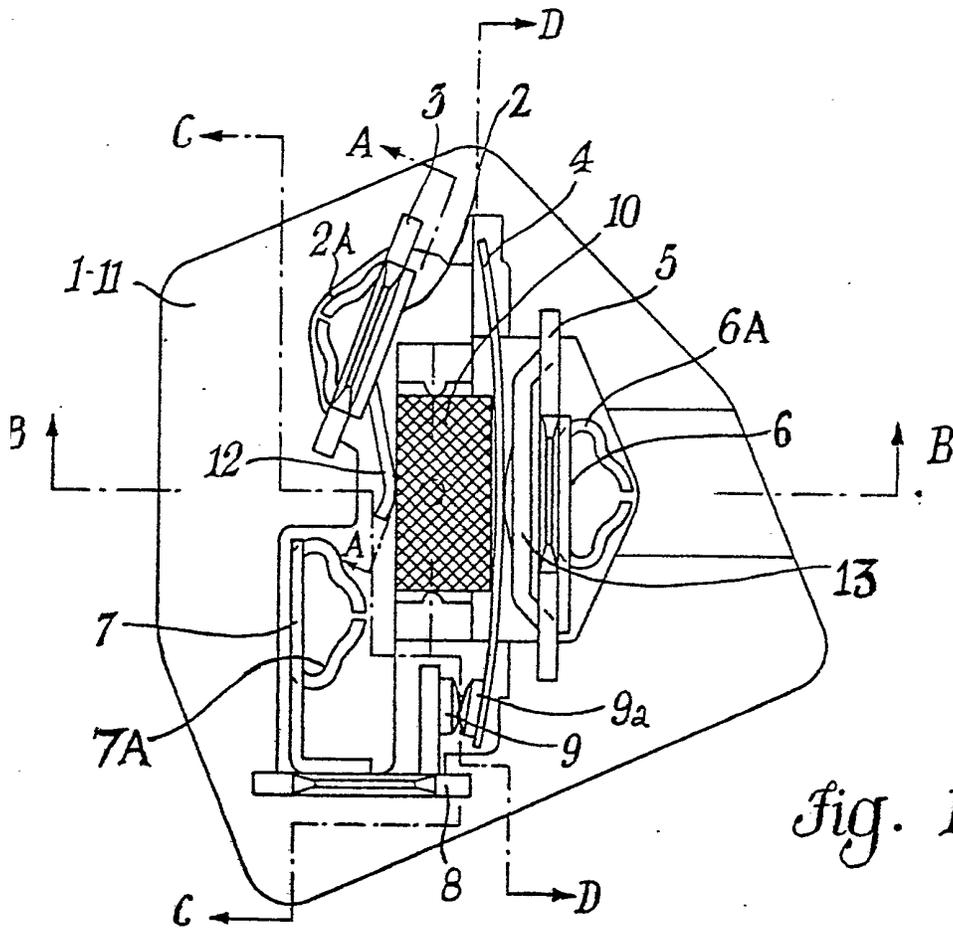
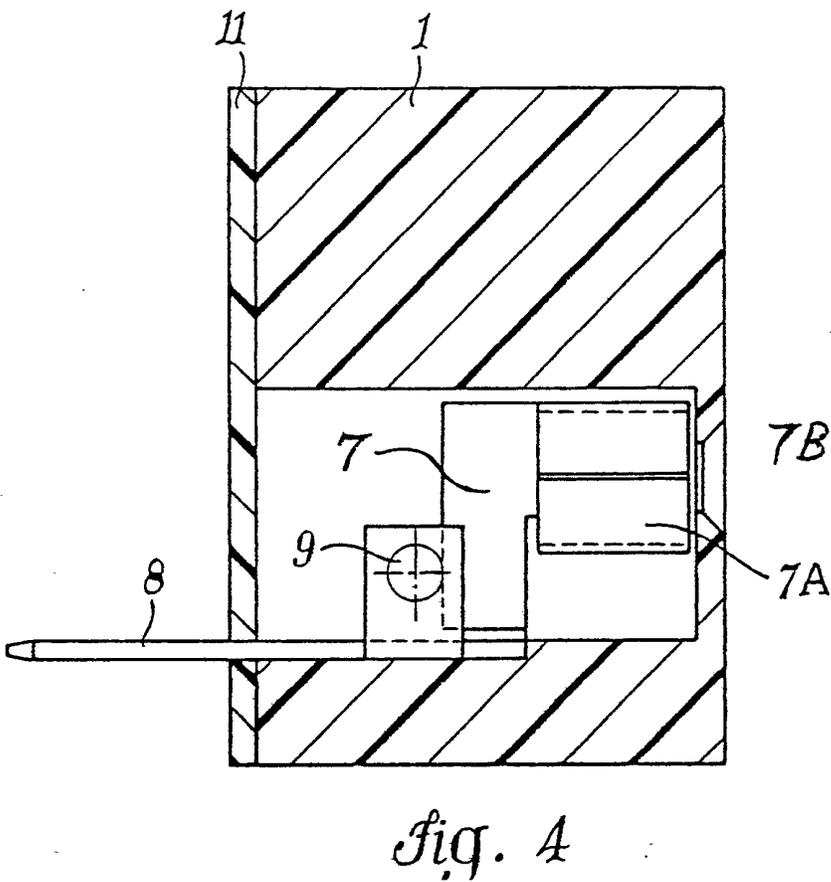
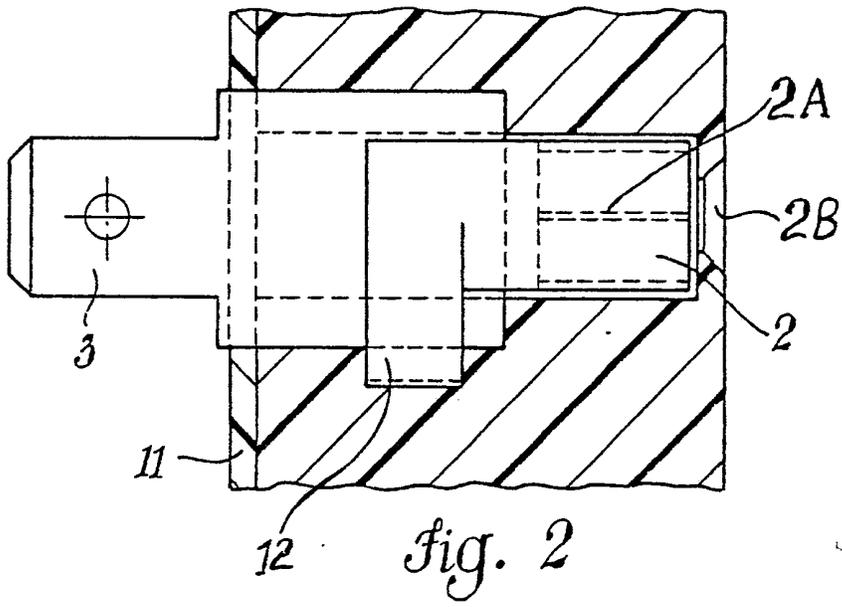


Fig. 1



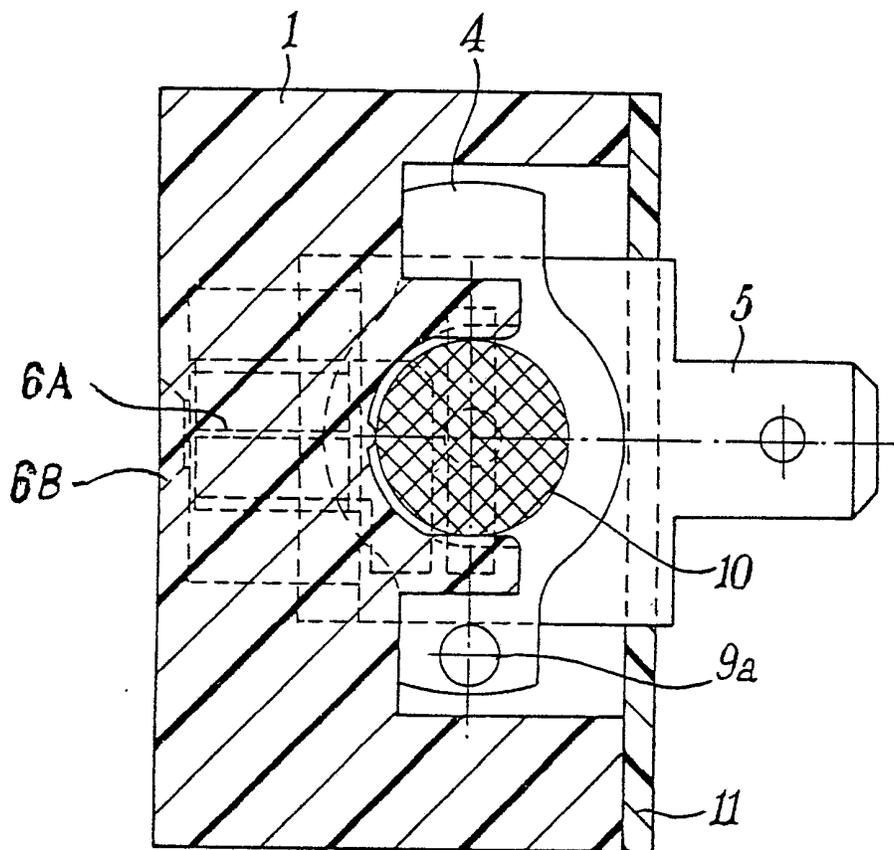


Fig. 5

SPECIFICATION

Electrical relay with thermal time delay

5 This invention relates to an electrical relay with thermal time delay, including a bimetal element and a heating element.

As it is known, in monophasic induction motors or asynchronous motors, particular expedients are
10 needed to overcome the start-up difficulties, especially under load conditions, before entering a normal operation condition. The start-up problem has been solved hitherto by various approaches, one of which provides for using an additional winding that is
15 excluded upon starting-up the motor. In order to obtain this result, a relay is employed with normally closed contacts that are opened after the expiration of a certain delay time.

Whilst the invention may be embodied in a relay
20 intended for such use as above explained, it should, of course, be understood that the start-up of monophasic induction motors, for instance motors to drive compressor units of freezers and the like, is only one example of the application possibilities of such relays;
25 in fact, they can be utilized in all those cases wherein a delayed operation of the relay is needed, that is in all those circuits in which a time delay is needed between the actuation and the response.

It is also to be remarked that, whilst the invention
30 may be embodied in a relay having normally closed contacts, no problem will be encountered in slightly modifying the structure as described in order to achieve a thermal time delay relay with normally open contacts for other applications where this might be
35 necessary.

According to the present invention from one aspect, an electrical relay with thermal time delay, particularly although not exclusively for use in starting monophasic electric induction motors, includes a casing of
40 insulating material; a first, a second and a third electric connection terminal; an actuator assembly including a heating element and a bimetal element; a first relay contact attached to the first terminal and a second relay contact attached to the bimetal element; the said
45 actuator assembly being operatively and preferably adjustably arranged by force fit between said second and third terminals.

The force fit arrangement of the tablet-bimetal assembly is designed so as to ensure excellent
50 thermal coupling, which in turn ensures operation time constancy. Such a force fit arrangement may be achieved by means of a deformed resilient leg portion of the second terminal which presses against a face of the treating element to hold the actuator assembly
55 against the third terminal.

Moreover such a force fit arrangement can be effected for instance by an adjustment screw means which varies the engagement between the bimetal element and protruding portion of the third terminal
60 associated therewith.

Anyway, a further adjustment possibility can be utilized by acting upon the contact element, without

the terminal being displaced.

65 Preferably the heating element may comprise a tablet of a material having a positive temperature coefficient (PTC) of electrical resistivity through which a heating current is passed when an electric power supply is connected to the relay.

In a preferred embodiment the stroke of the bimetal
70 element is defined and limited by fixed stop elements built in the casing. This has not only the purpose of facilitating the re-closure of the contacts upon disconnecting the device from the power supply, but also the purpose of significantly reducing the mechanical stresses which the bimetal element must withstand,
75 thereby increasing its useful life, expressed as number of operation cycles before failure.

The bimetal element as used in the relay of this invention preferably comprises a disc of preformed
80 type, characterized by two discrete critical temperatures at which the reversal of the mechanical curvature occurs.

Contrary to all already known start-up devices, most of which are of electro-magnetic type, the operation of
85 which depends on the current flowing there-through, the operation of the time delay thermal relay according to this invention is independent of the load current and at the same time it is effectively unresponsive to the normal variations of the mains voltage.

90 Further objects and advantages of this invention will be apparent to those skilled in the art from the following detailed description of the accompanying drawings, wherein a preferred embodiment of the invention is shown by way of example only and not of
95 limitation.

In the drawings:-

Figure 1 shows a plan view of the interior of a relay with all its component elements;

100 Figure 2 shows a cross-section view along line A-A in Figure 1;

Figure 3 shows a cross-section view along line B-B in Figure 1;

Figure 4 shows a cross-section view along line C-C in Figure 1; and

105 Figure 5 shows a cross-section view along line D-D in Figure 1;

Referring now to the drawings and particularly to Figure 1, there is shown a thermal relay embodying this invention which includes a casing 1 of an
110 insulating material, closed by means of a lid member 11. Three terminals 2, 6 and 7 are housed in casing 1 and protrude out of it with three connection tabs 3, 5 and 8, respectively. Spring contacts 2A, 6A and 7A of the respective terminals 2, 6 and 7 are accessible
115 through apertures 2B, 6B and 7B in the casing 1. An actuator assembly including a tablet 10 of a material of positive temperature co-efficient of electrical resistivity (PTC) and a bimetal disc 4 is operatively interposed between said first terminal 2, 3 and said second
120 terminal 5, 6.

The third terminal 7, 8 bears a contact pad 9, that can be defined as a stationary contact and is designed so as to engage a contact pad 9a, that can be defined as a movable contact, attached to the end portion of the

bimetal disc member 4.

In rest condition, the two contact pads 9, 9a are closed. When the mains supply is connected to terminals 2 and 6, tablet 10 heats up as current passes through it between terminals 2 and 6, and transfers a portion of the heat so produced to the bimetal disc member 4.

By taking advantage of the characteristics of tablet 10 and of bimetal disc member 4 that is thermally coupled thereto, the heat transferred to bimetal disc member 4 from tablet 10 causes this bimetal disc member to reach its first intervention temperature, whereby a snap action of the bimetal disc occurs which results into a reversal of its preformation curvature. This in turn causes the circuit of the two contact pads 9, 9a to be opened.

As it can be seen in particular in Figure 1, bimetal disc member 4 is mounted in casing 1 with its ends being inserted into well defined spaces in the casing so that the sides of these spaces provide fixed stop reference points by which the stroke of the bimetal disc member is limited. A first object of such a stroke limitation, as above already set forth, is to maintain the bimetal disc member in a position ready for reset, whereby the re-closure of the contacts is facilitated when the connection of the device to the mains supply is interrupted and the tablet 10 cools. A second object is to guarantee very low mechanical stresses on the bimetal disc, thereby increasing its useful life.

As far as the interposition of the tablet-bimetal disc assembly between terminals 2, 3 and 5, 6 is concerned, it should be noted that such interposition should be designed so as to provide an optimum thermal coupling between the tablet and the bimetal disc member, as well as an electrical path between the terminals 2, 3 and 5, 6 and this result is achieved by means of the pressure a resilient deformed leg member 12 of terminal 2 exerts due to its force deformation against a face of tablet 10. By this arrangement, any mechanical tolerances of the component parts are accommodated and the necessary pressure is exerted between said component parts to minimize the heat transfer losses. Thanks to this so optimized thermal coupling, the operation time constancy is guaranteed.

The time elapsing after the connection to the power supply until the contacts are opened is predetermined by means of a calibration step of the bimetal disc intervention temperature which is carried out by acting upon terminal 5, whose protruding bridge member 13 is abutted against bimetal disc member 4 (Fig. 3), by means of an adjustment screw (not shown) which varies the setting of the bridge 13 acting upon the center point of the bimetal member. The calibration may also be effected by suitably deforming terminal member 5.

This invention has been hereinbefore described in its preferred embodiments, but it should be understood that variations and changes can be made to the construction details by those skilled in the art without departing from the scope of this invention.

CLAIMS

1. An electrical relay with thermal time delay, particularly although not exclusively for use in starting monophase electric induction motors, which includes

a casing; a first, a second and a third electric connection terminal; an actuator assembly including a heating element and a bimetal element; a first relay contact attached to the first terminal and a second relay contact attached to the bimetal element; the said actuator assembly being operatively and adjustably arranged by force fit between said second and third terminals.

2. An electrical relay with thermal time delay, which comprises a casing in which are housed first, second and third electrical terminals, an actuator assembly of an electrical heating element and a bimetal element, and a pair of co-operating relay contacts whereof the first relay contact is a fixed contact mounted on the first terminal and the second relay contact is a movable contact carried by the bimetal element, and in which the said actuator assembly is operatively mounted as a force fit between the second and third terminals in such a way that the heating element is held in good thermal contact with the bimetal element and a path for heating current is established between the second and third terminals.

3. A time delay relay as claimed in Claim 1 or Claim 2, in which the heating element is a tablet of material having a positive co-efficient of electrical resistivity, through which the heating current for the element is passed.

4. A time delay relay as claimed in Claim 1 or Claim 2 or Claim 3, in which the bimetal element is a disc preformed so that reversal of its curvature occurs at two discrete critical temperatures.

5. A time delay relay as claimed in Claim 4 in which the bimetal disc has opposite end formations lying respectively in narrow spaces formed in the casing, side walls of the spaces acting as fixed reference stops to limit the operating stroke of the bimetal element.

6. A time delay relay as claimed in any one of the preceding Claims in which to achieve the said force fit a deformed resilient leg portion of the second terminal presses against a face of the heating element to hold the actuator assembly against the third terminal.

7. A time delay relay as claimed in Claim 6, in which the bimetal element of the actuator assembly is held against a protruding portion of the third terminal by the pressure of the resilient leg of the second terminal, adjustment screw means being provided for varying the engagement condition of the protruding portion of the third terminal with the bimetal element so as to adjust the said force fit.

8. A time delay relay substantially as specifically described herein with reference to the accompanying drawings.