Nov. 16, 1948. R. E. PROUTY ET AL 2,453,726

INDUCTION MOTOR STARTING RELAY

Filed April 4, 1945 2 Sheets-Sheet 1

Fig. 1.

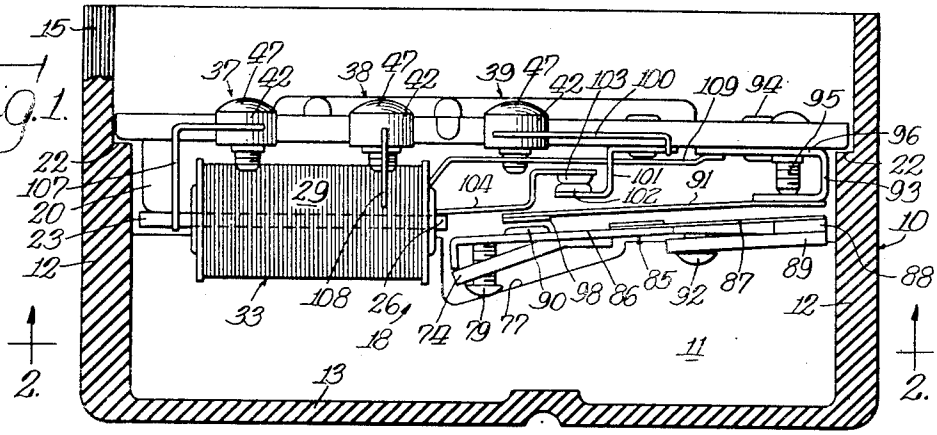


Fig. 2.

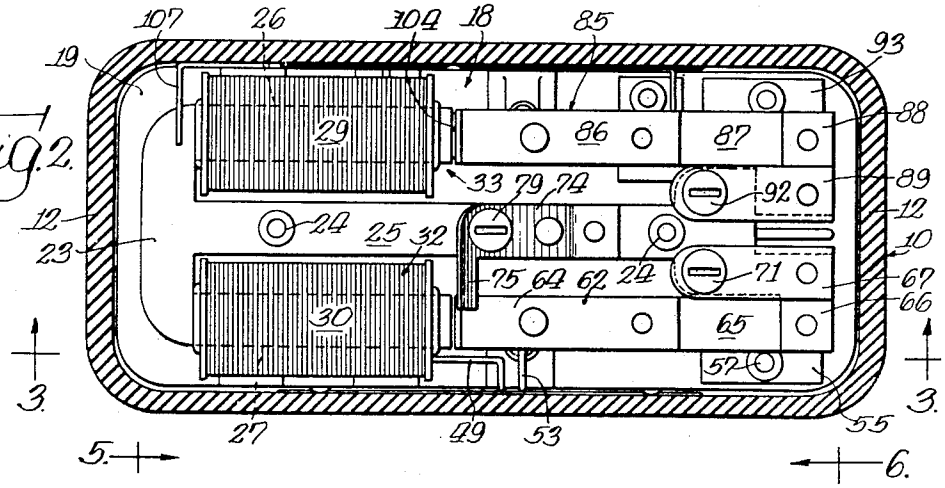
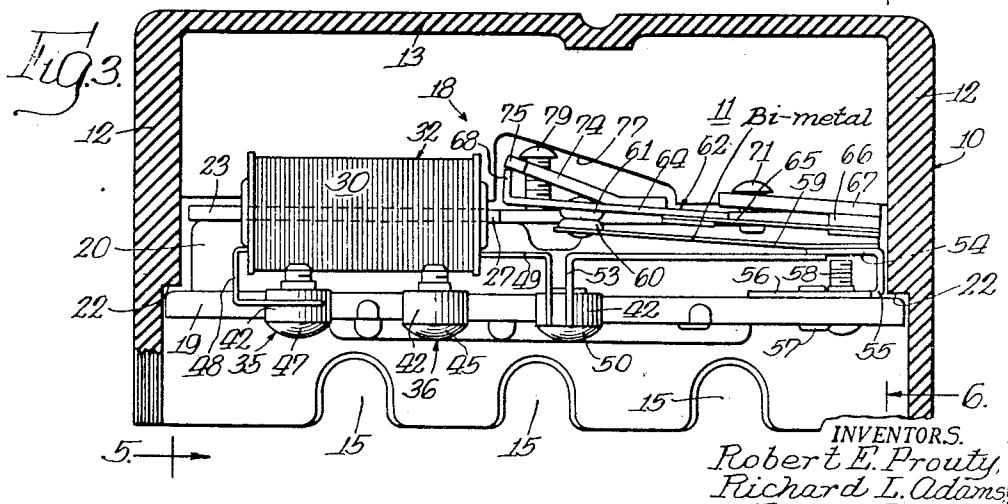


Fig. 3.



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Fig. 4.

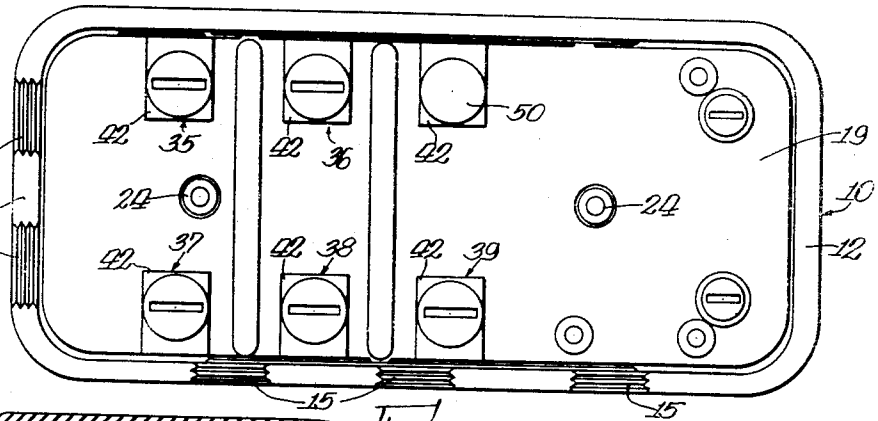


Fig. 5.

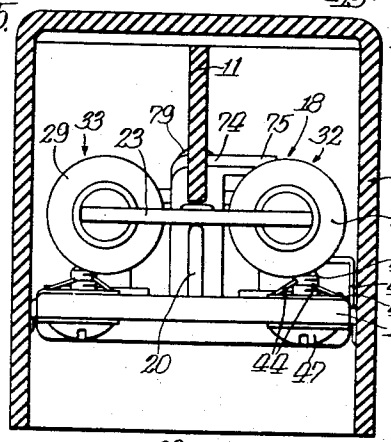


Fig. 6.

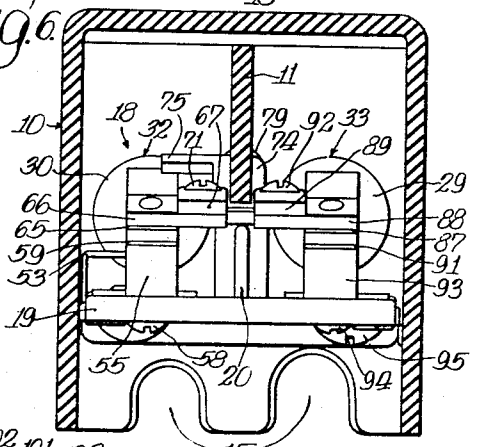


Fig. 7.

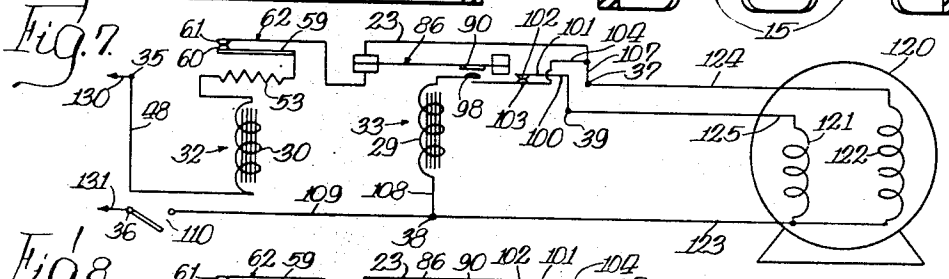
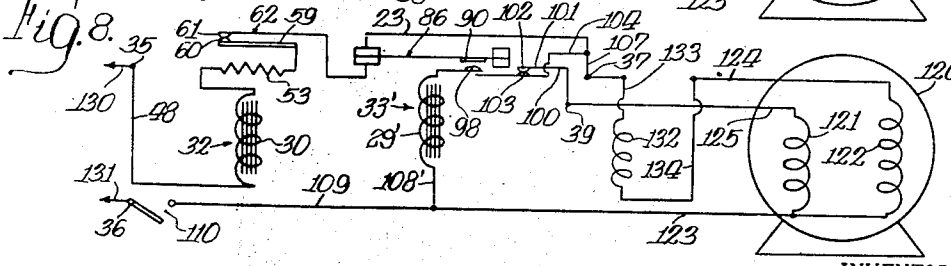


Fig. 8.



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2,453,726

UNITED STATES PATENT OFFICE

2,453,726

INDUCTION MOTOR STARTING RELAY

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Application April 4, 1945, Serial No. 586,596

17 Claims. (Cl. 318—221)

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Our invention relates to an improvement in a relay, and more particularly to a relay for starting and controlling an electric motor.

The great difficulty with most motor starters of the prior art is that they require brushes which are thrown off by centrifugal force after the motor has reached a predetermined speed to cut out a starting winding, or are provided with wiping contacts for that purpose both of which are subject to wear or become injured in use so that after a limited number of operations the brushes or wiping contacts do not perform as intended and the motor is unable to start.

It is an object of our invention to provide a relay type of contact for starting an electric motor which will operate without substantial wear or being subject to injury for an enormous number of operations.

A further object of our invention is to provide a relay for use with an electric motor having a running winding and a starting winding in which the relay comprises normally closed contact means adapted to be connected in circuit with the starting winding, and means including a tuned reed responsive to a predetermined speed of rotation of the motor to open the normally closed contact means and thereby open the circuit of the starting winding.

In order to accomplish these objects we propose to provide a tuned reed fixed at one end and associated with the motor to be controlled so that the reed vibrates due to speed of rotation of the motor, and which reed in the embodiments of the invention herein disclosed comprises, in part, an armature for an electromagnet. The reed is adjusted to vibrate in resonance at a predetermined frequency and carries a contact which is adapted to have contacting engagement with a second contact carried by a suitable flexible contactor. These two contacts are adjusted to be normally opened. A holding coil or electromagnet is provided for the armature of which the reed forms a part, and the normally open contacts and the coil of the electromagnet are connected electrically with a suitable current supply. A single pole mechanical switch having normally closed contacts is mounted adjacent the flexible contactor and one of the normally closed contacts of the switch is positioned to be actuated by movement of the flexible contactor when the latter is caused to be flexed by attraction of the armature to separate the normally closed contacts and open the mechanical switch. The flexible contactor is adjusted to have limited free movement before it opens the normally closed contacts of

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the mechanical switch which are connected in series electrically with the starting winding of the motor.

In such a device when a main control switch for the motor is closed supply voltage is applied to the motor and current flows in the running winding and the starting winding and through the normally closed contacts of the mechanical switch. However, current does not flow in the electromagnet for the armature of which the tuned reed forms a part, because the circuit is open due to the normally opened contacts of the reed and flexible contactor. As the motor starts to run and the speed builds up, the motor reaches a predetermined speed which is equal to the resonant frequency of the reed causing the reed to vibrate with sufficient amplitude to close the normally opened contacts. This closing of the normally open contacts energizes the electromagnet and attracts the armature causing the same to engage the flexible contactor and open the normally closed contacts of the mechanical switch. Since these normally closed contacts are in series with the starting winding opening of them causes opening of the starting winding circuit and the motor continues to run on the running winding only.

A preferred feature of one form of the invention herein disclosed is in connecting the aforesaid electromagnet in parallel relation with the running winding so that the electromagnet maintains the starting winding circuit open until the main control switch for the motor is opened. If the main control switch is opened the electromagnet will be deenergized releasing the armature, and the relay is set for another starting cycle.

A further preferred feature of another embodiment of the invention is in providing the aforementioned electromagnet with a pair of coils one of which is adapted to be connected in series relation and the other in parallel relation with the running winding of the motor with the coil in series relation being operable during momentary overloads on the line and running winding to neutralize the magnetic effect of the coil in parallel relation to release the armature and cut the starting winding in circuit.

A further preferred feature which may be incorporated with either of the embodiments of our invention herein disclosed resides in the provision of an additional electromagnet and an armature therefor connected in series relation with the starting and running winding of the motor serving as a cutout for the electric motor

in the event of a continuous overload on the line. The armature of this last referred to electromagnet is provided with a contact having engagement with a contact carried by a bi-metal strip which strip is adapted to flex upon heating due to overload to separate the contacts, which when that occurs opens the circuit in advance of the electromagnetic means first above discussed.

The relay is also of simple construction providing a device which is of low cost permitting its use in a wide number of installations particularly for small motors for use, for example, with refrigerators and other apparatus.

Other objects and advantages of our invention will appear from the detail description.

Now, in order to acquaint those skilled in the art with the manner of utilizing and constructing relays in accordance with our invention, we shall describe in connection with the accompanying drawings certain preferred embodiments of our invention.

In the drawings:

Figure 1 is a side elevational view of a relay constructed in accordance with our invention with the housing therefor being shown in section;

Figure 2 is a bottom view of the relay in the position shown in Figure 1 taken substantially on the line 2—2 of Figure 1, looking in the direction indicated by the arrows;

Figure 3 is a side elevational view of the other side of the relay of Figure 1, taken substantially on the line 3—3 of Figure 2, looking in the direction indicated by the arrows;

Figure 4 is a bottom view of the device in the position shown in Figure 3;

Figure 5 is an end view of the relay of Figures 1 through 4, which has been taken substantially on the line 5—5 of Figure 3, looking in the direction indicated by the arrows;

Figure 6 is an end view of the relay of Figures 1 through 4, taken substantially on the line 6—6 of Figure 3, looking in the direction indicated by the arrows;

Figure 7 is a circuit diagram of the relay of Figures 1 through 6 and showing its connection with the windings of an electric motor and a source of current supply; and

Figure 8 is a circuit diagram of a modified form of relay of our invention.

Referring now to Figures 1 through 6, we have shown a housing 10 preferably made of insulating material and which is of rectangular shape in plan. A partition 11 preferably formed integrally with the housing 10 extends lengthwise thereof between the end walls 12 and the bottom wall 13. The device will be described assuming that it is to be mounted on a motor frame in the position shown in Figure 1 so that the wall 13 may be considered to be the bottom wall of the housing and the housing being open at its upper end. It is to be understood, however, that the device and housing may be mounted in any position desired without affecting the proper operation of the relay. The partition 11 extends from the bottom wall 13 of the housing substantially midway thereof. One end wall 12 and one side wall of the housing are provided with openings 15 through which the leads (not shown) for the relay extend into the housing. It will be understood that a suitable closure member may be provided for closing the open upper end of the housing, and this may comprise a removable cover member, or a wall of a motor frame or the like which the relay is to control. It is to be understood that the housing 10 and the relay therein is associated with the motor in a manner so that the operation of the relay in starting of the motor is controlled by vibration produced by the motor. Any suitable mounting means for the housing 10 may be provided and it can be mounted either externally or inside the motor frame as required by the expediency of the situation to which the motor is to be put.

The relay indicated generally at 18 comprises a substantially rectangular base 19 of insulating material, and which base is formed with a rib 20 integral therewith extending lengthwise thereof and of the housing 10, and intermediate the front and rear edges of the base member 19 so that the rib 20 lies vertically in alignment with the partition 11 of the housing. The end walls 12 of the housing 10 are formed with shoulders 22 over which the end edges of the base member 19 extend providing an overlap of the base member 19 therewith to insulate the leads extending through the openings 15 of the housing from the parts of the relay positioned in the housing between the bottom wall 13 and the base member 19. A core frame member 23 substantially of E-shape, as viewed in plan (Figure 2) is secured to the base member 19 by a pair of bolts 24 which extend through the rib 20 and into the partition 11 of the housing 10. The outer leg elements 26 and 27 of the core frame member 23 provide core sections for a pair of coils 29 and 30, respectively, to support the coils 29 and 30 to extend with their axes in parallel relation with each other and lengthwise of the housing 10. The core 27 and coil 30 comprise parts of electromagnetic means 32 which, as will hereinafter appear, serves to cut out the relay 18 entirely upon a continued overload on the supply line, and the electromagnetic means comprising the core 26 and coil 29 comprise an electromagnetic means 33 which is for the purpose of cutting out the starting winding of the motor after it has reached a predetermined speed, as will be described in detail hereinafter.

A plurality of terminals 35, 36, 37, 38 and 39 are carried by the base member 19 along the margins of its front and rear edges providing for connection of the electromagnets 32 and 33 with a source of current supply and to leads of the motor to be controlled. These terminal members are all of like construction, and the terminal 35, as below described, is typical of the construction of all of them. As shown in Figures 3 and 5, it will be observed that the terminal 37 comprises a substantially U-shaped clip 42 which snugly fits over an edge of the base member 19 and the leg portion thereof inwardly of the housing 10, is formed with a pair of up struck ears 44 which have threaded engagement with a bolt 46 having a head 47 at one end thereof provided with the usual kerf for rotating the same with a screw driver or like implement. The electrical connections are made between the terminals and the several leads of the electromagnetic means 32 and 33 by securing such leads as by soldering to the clip members 42. The leads from the motor and the current supply source are adapted to be made between the bolt heads of the several terminals and the outer legs of the clips. The terminals 35 and 36 provide for connection of the relay 18 with a source of current supply, and it will be observed from Figures 3 and 5 that a lead 48 extends from the terminal 35 to one end of the coil 30 of the electromagnetic means 32. A lead 49 (Figure 3) extends from the other end of the coil 30 to a terminal 50 formed by a clip 42, as previously described. This terminal is

not adapted to have connection with any outside lead and simply provides for electrical connection of the lead 50 from the coil 30 to a metal heater strip member 53 one end of which is connected to the clip. The heater strip member 53 is connected at its other end to the inturned ear 54 of a substantially C-shaped bracket 55, the other ear or leg 56 of which is suitably secured to the base member 19 by a bolt 57. A bolt 58 having threading engagement with the leg 56 of the bracket 55 engages the other leg or ear 54 of the bracket. A leaf spring 59 of bi-metal is suitably connected at one end to the ear 54 of the C-shaped bracket 55 and at its other or free end carries a contact 60. The contact 60 has normally closed engagement with a contact 61 carried by an armature 62 which armature is adapted to be attracted upon energization of the coil 30 of the electromagnetic means 32. The armature 62 comprises a first metal arm member 64 riveted at one end to a thin metal strip 65 which is fixed as by riveting at its other end to an ear 66 formed at the free end of the intermediate leg 25 of the core frame member 23. The free end of the arm 64 is bent substantially at right angles to form the extension or armature bar 68 which is adapted to be attracted upon energization of the coil 30. An arm 67 is riveted at one end to ear 66 of the leg 25 and at its free end carries a bolt 71 which has threaded engagement with the leg 25 of the core frame member 23 and provides for adjustment of the armature 62 by flexing of ear 66. The leg 25 of the core frame member 23 has a bracket 74 suitably secured at one end thereto, the other end of which has a laterally extending ear 75 which overlies the extension or bent end 68 of the arm 64 of armature 62 to limit the upward movement of the armature when the coil 30 is deenergized. As shown in Figure 3, the partition 11 of the housing 10 is formed with a substantially triangular recess 77 for accommodating the bracket 74. A bolt 79 extends through the free end of bracket 74 and has threading engagement with the leg 25 which provides for adjustment of the ear 75 of the bracket relative to the extension 68 of the armature 62.

Referring now more particularly to Figure 1, it will be observed that the electromagnetic means 33 has an armature 85 associated therewith which comprises an armature metal bar member 86 secured at one end as by a rivet to a thin spring steel reed 87 the other end of which is connected as by a rivet to an ear 88 of the leg 25 of the core frame member 23 extending laterally opposite the ear 66. An arm 89, like arm 67, is riveted at one end to ear 88 and it also is provided with a bolt 92 at its free end having threading engagement with the leg 25 for adjustment of the armature by flexing of ear 88. The bar 86 of the armature 85 carries a contact 90 adjacent its free end. A thin metal flexible contactor arm member 91 is fixed at one end to a C-shaped bracket 93, like the bracket 55 previously described, and it is suitably fixed to the base member 19 by a bolt 94. A bolt 95 has threading engagement with the leg 96 of the bracket 93, and the end of the bolt is adapted to engage the other leg 97 of the bracket 96 providing for adjustment of the position of the metal contactor arm 91. The spring arm 91 at its free end carries a contact 98 in a position to be engaged by the contact 90 of the armature 95. The contacts 90 and 98 are normally open. As shown more clearly in Figure 1 the terminal 39 is connected by a suitable lead 100 to a bracket 101 fixed at one end as by riveting to the base member 19 and carrying a contact 102 at its other end. The contact 102 has normally closed engagement with the contact 103 carried by contact arm 104 which is connected at its end opposite the contact 103 with the free end of the core leg 26 of the core frame member 23.

A lead 107 extends from the core frame member 23 to the clip 42 of terminal 37. A lead 108 extends from one end of the winding of coil 29 to the terminal 38, and the C-shaped bracket 93 has a lead 109 extending from the end of leg 96 thereof to the other end of the winding coil member 29.

Any suitable electrical connection is provided between the terminals 36 and 38, and upon reference to Figure 7 it will be observed that a manually operable switch 110 has been interposed between a lead 109 connecting the terminals 36 and 38. This switch structure is not shown in Figures 1 through 6. The incorporation of such switch however, may be readily made by a skilled workman and may be disposed in any suitable position and provides for opening or closing of the circuit between the terminals 35 and 36 to cut the relay in and out of circuit with a supply line.

Referring now to Figure 7, we have shown the electrical circuit of the relay above described in connection with Figures 1 through 6, and the several parts and leads of the relay are indicated by like reference numerals. Figure 7 in addition shows the connection of the terminals 37, 38 and 39 of the relay of our present invention with the windings of an electric motor. The electric motor is indicated by the reference numeral 120 and it comprises a starting winding 121 and a running winding 122. The starting and running windings are arranged in parallel and have connection with the terminal 38 by a conductor 123, with the other end of the running winding 122 being connected by the lead 124 with the terminal 37 of the relay above described. The other end of the starting winding 121 is connected by a conductor 125 to terminal 39 of the previously described relay.

With the circuit connections of the relay being made as described with the electric motor 120, shown in Figure 7, the operation of the device is as follows:

The terminals 35 and 36 are connected to current supply leads 130 and 131, respectively, and the leads 123, 124 and 125 are connected to terminals 38, 39 and 37, respectively, as previously described. From terminal 35 the current is conducted by the lead 48 to the coil 30 of the electromagnetic means 32 therethrough and from the conductor 49 to the terminal 50, and from the latter to the heater bar 53. The bracket 55 provides an electrical connection of the heater bar 53 with the bi-metal spring member 59, thence through normally closed contacts 60 and 61, armature 62 to leg 25 of the core frame member 23. The leg 25 of the core frame member 23 serves as a conductor and from which the lead 107 extends to terminal 37. The conductor 124 extends from terminal 37 to one end of running winding 122, the other end of which is connected by lead 123 to lead 109, switch 110 and terminal 36 to complete the circuit through the running winding. The flexible carrier member 104 also has connection with the terminal 37 through leg 26 of core frame member 23 and the contact 103 carried by member 104 has nor-

mally closed contacting engagement with the contact 102, which is connected by the bracket 101 and lead 100 to the terminal 39 from which lead 125 extends to one end of the starting winding 121. The other end of the starting winding is connected by the conductor 123 to the terminal lead 109, switch 110, and terminal 36. When the switch 110 between the terminals 36 and 38 is closed the electromagnetic means 32 is energized attracting the armature 62 which flexes the bi-metal element 58 downwardly with the armature to maintain pressure contact between the normally closed contacts 61 and 60 to permit current flow through the running winding 122 and the starting winding 121 of the motor to start the same. The contacts 90 and 98 are normally open and therefore upon closing of switch 110, the electromagnetic means 33 is not energized. Now, when the motor reaches a predetermined speed so that it sets the reed 87 of the armature 86 to vibrate in resonance to a predetermined frequency, the reed will vibrate with sufficient amplitude to close the normally open contacts 90 and 98. This closing of the contacts 90 and 98 energizes the coil 29 of the electromagnetic means 33 which attracts the armature 85 engaging the spring contactor arm 91 which then engages flexible member 104 and moving the contact 103 carried thereby away from the contact 102, and opening the circuit of the starting winding so that the motor continues to run on the running winding only. Thereafter the electromagnetic means 33 will maintain the starting circuit open until the main control switch 110 is opened or the normally closed contacts 60 and 61 of the cutout relay are caused to be separated. If the main control switch 110 is opened the coil 29 of the electromagnetic means 33 is deenergized releasing the armature 86 and the switch is set for another starting cycle.

The electromagnetic means 32 provides a safety cutout mechanism for the relay and it will be observed in the physical arrangement of parts as shown in Figure 3 that if a load is placed upon a line or a short circuit occurs the bi-metal element 59 will heat up causing it to snap away from the armature 62 to thereby separate the contacts 62 which in its attracted position is maintained substantially in lengthwise alignment with the axis of coil 30 and 61 from each other which opens the circuit between the terminals 35 and 36. When this condition occurs it will deenergize the electromagnet 32 and open the circuit through the windings of electric motor 120. After the bi-metallic element 59 has cooled it will again return to the position shown in the drawings wherein the contacts 60 and 61 are reengaged to again establish a circuit through the running and starting windings which, after the motor has reached a predetermined speed, the normally closed contacts 102 and 103 are opened, and the normally open contacts 90 and 98 are closed to open the circuit of the starting winding.

In Figure 8 we have shown a modified form of relay and circuit arrangement therefor. In this modified embodiment of the relay and of circuit arrangement the electromagnetic means 33' comprises a coil 29' connected by conductor 108' to the lead 109. The electromagnetic means 33' also includes a series coil winding 132 connected in series by leads 133 and 134 with the running winding 122. Now when heavy currents pass through the running winding 122, such as occur during momentary overloads on the line, the series coil 132 will partially neutralize the electromagnet means 33' causing the armature 86 to be released and thereby close contacts 102 and 103 so that the starting winding 121 is again cut into circuit. When the overload is removed and the motor again attains its predetermined speed the starting winding 121 will be cut out in the manner previously described. For purposes of illustration the series coil 132 has been shown spaced away from the coil 29' of the electromagnet means 33', but it will be understood that in the preferred embodiment of the form of our invention that the series coil 132 is wound around the coil 29'.

While we have shown what we consider to be the preferred embodiments of our invention, it will be understood that various modifications and rearrangements may be made therein without departing from the spirit and scope of the invention.

We claim:

1. A device for use with an electric motor having a running winding and a starting winding comprising contact means adapted to be connected in circuit with said starting winding, electromagnetic means including a tuned reed armature, said tuned reed armature being adapted to vibrate responsive to vibration of said motor at a predetermined speed of rotation thereof, said tuned reed armature upon vibration thereof effecting energization of said electromagnetic means, said electromagnetic means when energized being adapted to attract said tuned reed armature, and said tuned reed armature in its attracted position providing for opening said normally closed contacts.

2. The combination with an electric motor having a running winding and a starting winding, of a relay comprising normally closed contacts adapted to be connected in the circuit of said starting winding, an electromagnet, a tuned reed armature for said electromagnet, said tuned reed armature being adapted to vibrate responsive to vibration of said motor at a predetermined speed of rotation thereof, said tuned reed armature upon vibration thereof effecting energization of said electromagnet, said electromagnet when energized being adapted to attract said tuned armature and said tuned reed armature in its attracted position providing for opening said normally closed contacts of said relay.

3. The combination with an electric motor comprising a running winding and a starting winding, of a relay comprising normally closed contacts adapted to be connected in the circuit of said starting winding, electromagnetic means including a tuned reed armature and normally open contact means opening the circuit of said electromagnetic means, said tuned reed armature being adapted to vibrate responsive to vibration of said motor at a predetermined speed of rotation thereof, said tuned reed armature upon vibration thereof being adapted to effect closing of said normally open contacts to energize said electromagnetic means, said electromagnetic means when energized being adapted to attract said tuned reed armature, and said tuned reed armature in its attracted position providing for opening said normally closed contacts.

4. The combination with an electric motor having a running winding and a starting winding, of a relay comprising normally closed contacts adapted to be connected in circuit with said starting winding, an electromagnet, and a tuned armature adapted to be attracted by said electromagnet, normally open contacts associated with said

armature and electromagnet, said armature being responsive to a predetermined speed of rotation of said motor to close said normally open contacts and thereby energize said electromagnet, said armature upon being attracted by said electromagnet causing opening of said normally closed contacts and thereby open the circuit of said starting winding.

5. A starting relay for use with an electric motor having a running winding and a starting winding connected in parallel relation comprising, an electromagnet adapted to be connected in parallel with said windings and having normally open contacts whereby said electromagnet is normally de-energized, a tuned reed armature adapted to be attracted by said electromagnet upon energization of the latter, said tuned reed armature being adapted to vibrate responsive to vibration of said motor at a predetermined speed of rotation thereof, said tuned reed armature upon vibration thereof effecting closing of said normally open contacts for energizing said electromagnet, normally closed contacts adapted to be connected in the circuit of said starting winding, and said tuned reed armature in its attracted position providing for opening of said normally closed contacts to open the circuit of said starting winding.

6. A relay for use with an electric motor having a running winding and a starting winding comprising, an electromagnet having a pair of coils, one of said coils being adapted to be connected in closed series relation with said running winding, and the other of said coils being adapted to be connected in parallel relation with said running winding, normally open contact means between said other of said pair of coils and said running winding, normally closed contact means adapted to be connected in the circuit of said starting winding, and means responsive to a predetermined speed of rotation of said motor for closing said normally open contacts to energize said other coil of said electromagnet in parallel with said running winding causing opening of said normally closed contacts and thereby opening the circuit of said starting winding.

7. A relay for use with an electric motor having a running winding and a starting winding comprising, an electromagnet having a pair of coils, one of said pair of coils being adapted to be connected in closed series relation with said running winding, and the other of said pair of coils being adapted to be conntected in parallel relation with said running winding, normally open contact means between said other of said pair of coils and said running winding, normally closed contact means adapted to be connected in the circuit of said starting winding, and means responsive to a predetermined speed of rotation of said motor for closing said normally open contacts to energize said other coil of said electromagnet causing opening of said normally closed contacts and thereby open the circuit of said starting winding, said one coil of said electromagnet upon overload current flow in said running winding rendering the magnetic effect of said other coil ineffective whereby said normally closed contacts when opened are re-closed to re-establish said starting winding circuit.

8. In a relay for use with an electric motor having a running winding and a starting winding, an electromagnet comprising a pair of coils one being adapted to be connected in series relation and the other in parallel relation with said running winding, a tuned armature for said electromagnet, normally open contact means adapted to be connected in the circuit of said other coil, normally closed contact means adapted to be connected in the circuit of said starting winding, said tuned armature being responsve to a predetermined speed of rotation of said motor for closing said normally open contacts to energize said other coil of said electromagnet and attract said armature, said armature in its attracted position causing opening of said normally closed contacts of the circuit of said starting winding to deenergize the latter.

9. In a relay for use with an electric motor having a running winding and a starting winding, an electromagnet comprising a pair of coils one being adapted to be connected in series relation and the other in parallel relation with said running winding, a tuned spring metal armature for said electromagnet, contact means in the circuit of said other coil and associated with said electromagnet and said armature and normally maintained in open relation by said armature in its released position, normally closed contact means adapted to be connected in the circuit of said starting winding, said armature being responsive to a predetermined speed of rotation of said motor for closing said first contact means to energize said other coil of electromagnet, said armature in its movement to its attracted position causing opening of said normally closed contact means and thereby opening the circuit of said starting winding, said one coil of said electromagnet upon an overload thereon and on said running winding neutralizing the magnetic effect of said other coil and permitting said armature to return to its released position whereby said normally closed contacts are reclosed to re-establish said starting winding circuit.

10. A relay for use with an electric motor having a running winding and a starting winding comprising, an electromagnet adapted to be connected in circuit with said running winding, a tuned spring metal armature, normally open contact means comprising a pair of contacts one of which is carried by said armature, a flexible contactor arm fixed at one end and carrying the other of said pair of contacts, contact means comprising a pair of normally closed contacts adapted to be connected in the circuit of said starting winding, a spring contact arm carrying one of said normally closed contacts, said flexible contactor arm being arranged to lie between said armature and said spring contact arm, said armature being responsive to a predetermined speed of rotation of said motor to vibrate with sufficient amplitude to close said normally open contacts carried by said armature and said flexible contactor arm whereby said electromagnet is adapted to be energized, said armature in its movement to its attracted position engaging said flexible contactor arm with said spring contact arm to separate the normally closed contact carried thereby from the other closed contact and open the circuit of said starting winding.

11. The relay of claim 10 characterized by the electromagnet comprising a coil adapted to be connected in parallel relation with the running winding of the motor.

12. The relay of claim 10 characterized by the electromagnet comprising a pair of coils one being adapted to be connected in series relation and the other in parallel relation with said running winding.

13. The relay of claim 5 characterized by the provision of a second electromagnet, an armature

therefor, a bi-metal member, and normally closed contacts carried by said armature and said bi-metal member for connecting said second electromagnet in series relation with said first electromagnet and the windings of the motor, said bi-metal member upon overload current passing therethrough being adapted to flex away from said last named armature to separate said last named normally closed contacts.

14. The relay of claim 8 characterized by the provision of a second electromagnet, an armature therefor, a bi-metal member, and normally closed contacts carried by said armature and said bi-metal member for connecting said second electromagnet in series relation with said first electromagnet and the windings of the motor, said bi-metal member upon overload current passing therethrough being adapted to flex away from said last named armature to separate said last named normally closed contacts.

15. The combination with an electric motor having a running winding and starting winding, of a relay comprising normally closed contact means adapted to be connected in the circuit of said starting winding, and electromagnet means adapted to be energized upon a predetermined speed of rotation of said motor for opening said contact means and thereby open the circuit of said starting winding, a second electromagnet means comprising an armature and a bi-metal member, normally closed contacts carried respectively by said armature and bi-metal member for connecting said second electromagnet means in series relation with the first mentioned electromagnet means and the windings of the motor, said bi-metal member being connected in series with said normally closed contacts and upon overload current passing therethrough being adapted to flex away from said last named armature to separate said normally closed contacts.

16. In a device for use with an electric motor having a running winding and a starting winding comprising, normally closed contact means adapted to be connected in circuit with said starting winding, an electromagnet adapted when energized to open said normally closed contact means, normally open contact means in circuit with said electromagnet, a tuned reed associated with said normally open contact means adapted upon a predetermined speed of rotation of said motor to effect closing of said normally opened contact means to energize said electromagnet, said electromagnet when energized being adapted to attract said tuned reed to maintain said normally closed contacts open.

17. In a device for use with an electric motor having a running winding and a starting winding comprising, normally closed contact means adapted to be connected in circuit with said starting winding, an electromagnet adapted when energized to open said normally closed contact means, normally open contact means in circuit with said electromagnet, a tuned reed associated with said normally open contact means adapted upon a predetermined speed of rotation of said motor to effect closing of said normally open contact means to energize said electromagnet, said electromagnet when energized being adapted to attract said tuned reed to maintain said normally closed contacts open, and said electromagnet having means adapted upon predetermined overload current flow in said running winding for releasing said tuned reed whereby said normally closed contacts when opened are reclosed to reestablish said starting winding circuit.

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