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2,431,886

OVER-CURRENT AND UNDER-CURRENT PROTECTIVE SWITCH

Filed May 29, 1942

3 Sheets-Sheet 1

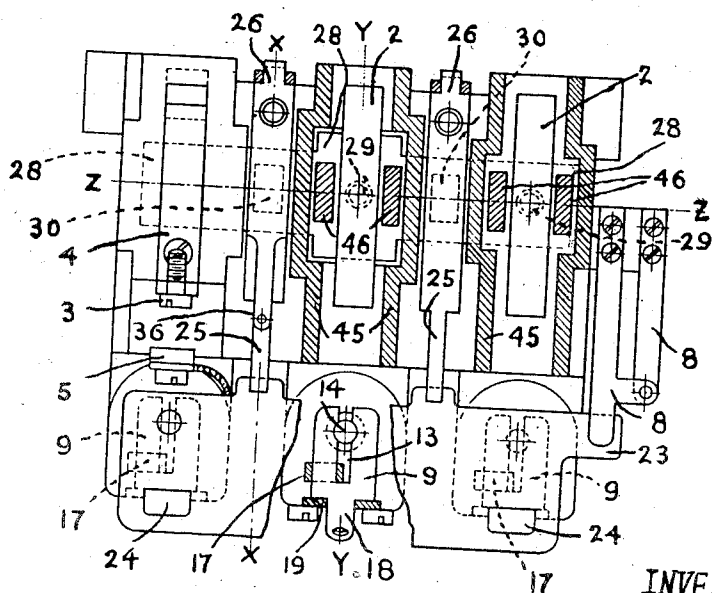
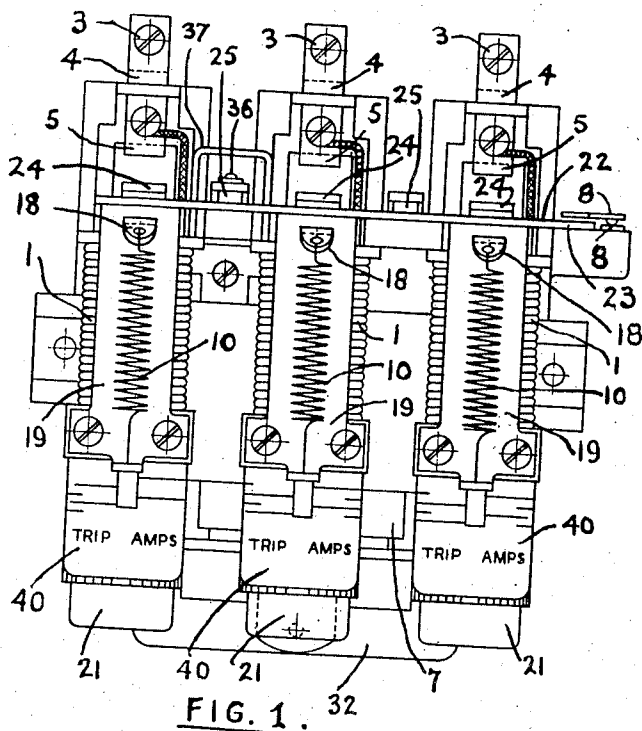


FIG. 2.

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3 Sheets-Sheet 2

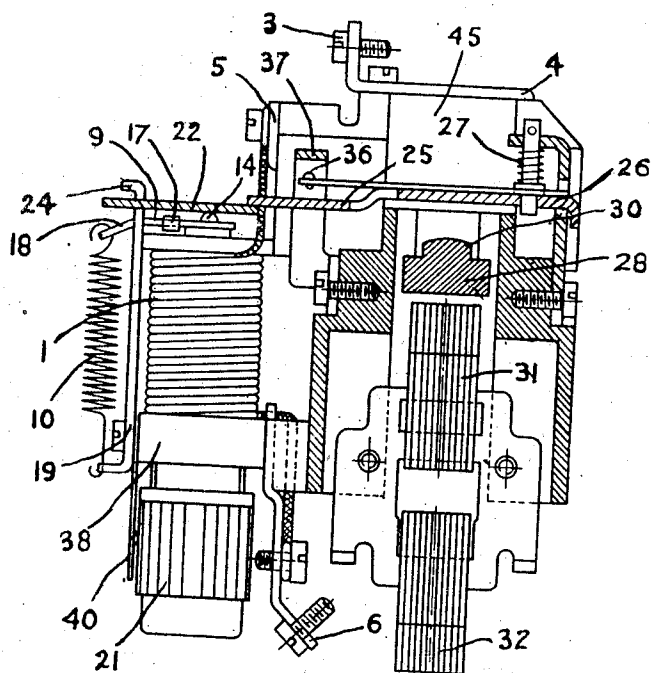


FIG. 3.

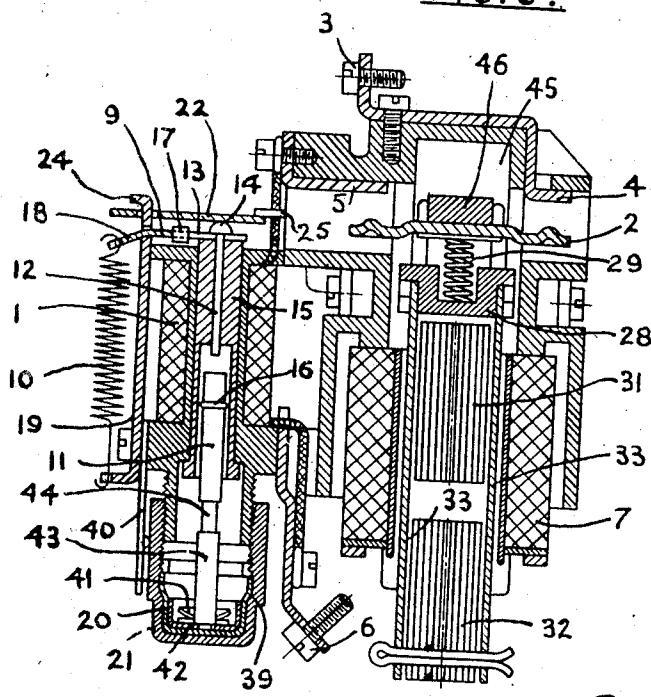


FIG. 4.

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3 Sheets-Sheet 3

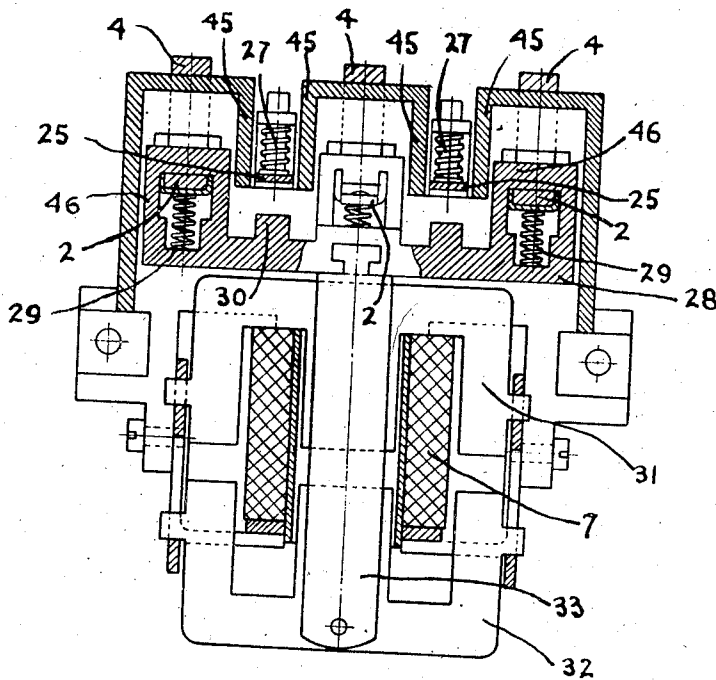


FIG. 5.

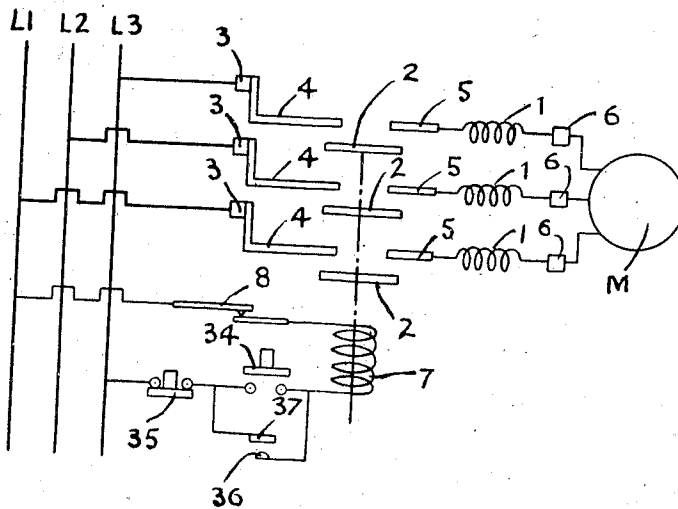


FIG. 6.

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## UNITED STATES PATENT OFFICE

2,431,886

OVER-CURRENT AND UNDER-CURRENT  
PROTECTIVE SWITCH

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Application May 29, 1942, Serial No. 444,998  
In Great Britain June 13, 1941

15 Claims. (Cl. 175—294)

1

This invention relates to devices for protecting electric circuits.

The primary object of the invention is the provision of an improved device whereby protection of a circuit against both over-current and no-volt or under-current conditions will be obtained in a simpler manner than heretofore.

Other objects and advantages will appear hereinafter.

The invention consists broadly in the arrangement that a common winding operates both as an over-current and as an under-current or no-volt winding.

In order that the invention may be the more clearly understood a three phase electric motor starter having incorporated therein a protection device in accordance with the invention which will now be described, reference being made to the accompanying drawings, wherein:

Figure 1 is a front elevation of said starter.

Figure 2 is a plan of the same shown partly in section.

Figure 3 is a sectional side elevation of the same taken on the line X—X of Figure 2.

Figure 4 is a sectional side elevation of the same taken on the line Y—Y of Figure 2.

Figure 5 is a front elevation of the same shown partly in section on the line Z—Z of Figure 2.

Figure 6 is a diagram showing the circuit connections.

Referring to the drawings, the three phase motor starter comprises three vertical coils 1 adapted to be connected in the three phases of the motor circuit and to act both as under-current coils and as over-current coils.

The circuit of a motor M is completed through these three coils 1 when respective bridging contacts 2 are lifted, the circuit of each phase being traced, as shown in Figures 4 and 6, from a terminal 3 adapted to be connected to the respective line, through a stationary contact 4, the bridging contact 2, a stationary contact 5, the coil 1 and a terminal 6 adapted to be connected to the respective terminal of the motor. The bridging contacts 2 are adapted to be lifted to their closing position upon energisation of a common winding 7, and the coils 1 upon the occurrence of either over-current or under-current are adapted to deenergise said winding 7 by disengaging a pair of contacts 8 which are connected in the circuit of said winding. Additional manually operated switch means, to be hereinafter described, will also be connected in the circuit of the winding 7 in series with the contacts 8

2

for starting and stopping the motor under normal conditions.

In order that the coils 1 shall function as stated both as over-current coils and as under-current coils, each of said coils has an under-current armature 9 which is adapted to be attracted downwardly to the upper end of the coil and is biased upwardly by means of a spring 10 to its non-attracted position, an over-current plunger 11 within the coil adapted to be moved upwardly upon the occurrence of over-current, and an actuating rod 12 adapted to be raised, to disengage the contacts 8, by upward movement either of the under-current armature 9 or of the over-current plunger 11.

Said actuating rod 12 is located vertically within the upper portion of the coil 1 above the over-current plunger 11. The lifting of this actuating rod 12 by the over-current plunger 11 takes place by direct abutment of the upper end of said over-current plunger with the lower end of said actuating rod. The lifting of said actuating rod 12 by said under-current armature 9 takes place owing to the fact that said actuating rod passes through an opening 13 in said under-current armature, as shown in Figure 2, and is formed with an enlarged head 14 above said under-current armature which cannot pass through said opening. In normal operation therefore with said under-current armature 9 at the down or attracted position this enlarged head 14 rests thereon. Should over-current conditions occur the over-current plunger 11 will rise and thereby lift the actuating rod 12 independently of the under-current armature to the actuating position, and should under-current occur, the under-current armature 9 will rise under the influence of its spring 10 to the non-attracted position, thereby lifting said actuating rod 12 independently of said over-current plunger.

Each coil 1 has a fixed core 15 located therein and extending throughout its entire length. The lower half of this core is drilled out axially as shown so that a tube or skirt portion is formed in which the over-current plunger 11 moves. The upper half of said core 15 has a small axial bore hole through which said tripping rod 12 passes. The over-current plunger 11 is fitted with a ring 16 of non-magnetic material near its upper end whereby sticking between said plunger and the tube portion of the core 15 is prevented.

Each under-current armature 9 takes the form of a pivoted plate which at the attracted position shown is horizontal and flush against the upper end of the core 15, and at the non-attracted po-

3  
sition is upwardly tilted. The opening 13 therein for the actuating rod 12 takes the form of a slot as shown, bifurcating said armature at right angles to its axis of oscillation. One of the prongs of bifurcation has mounted upon it a silencing coil 17 in the form of a single turn of copper strip.

The pivotal mounting of each under-current armature is effected by providing it with an extending lug 18 which passes through an opening 19 in a fixed vertical plate 19 located alongside the respective coil 1. Each aforesaid spring 19 for biasing the respective under-current armature to the non-attracted position is a tension spring and is secured at one end to the lug 18 and at the other end to the bottom end of the plate 19.

The plate 19 is of magnetic material and is of about the same length as the core 15 and it will be appreciated that, with said core extended completely through the coil 1 as described, said core together with the plate 19 and the armature 9 forms a fairly efficient magnetic circuit. This is important as the release under-currents must be of the order of 20% to 25% of the full load current of the motor. At the same time the arrangement gives a fairly wide range of adjustment for the over-current settings.

The over-current plunger 11 at its lower end carries the plunger 20 of a dash pot 21 whereby the upward movement of said over-current plunger is retarded. Thus, actuation will not take place in response to a momentary over-current unless this is of very great intensity.

The opening of the contacts 8 in response to the lifting of any or all of the rods 12 is effected through the medium of an actuating plate 22. This actuating plate 22 overlies, and normally rests on, the heads 14 of the actuating rods 12, and it has an extension 23 which lies underneath one of the contacts 8, (Figure 2,) so that when any or all of the actuating rods 12 are lifted said actuating plate 22 is lifted and thereby lifts the said contact 8 out of engagement with its neighbour. Said actuating plate 22 is pivotally mounted on the top of the three plates 19 each of which has a reduced lug 24 at its upper end which extends through an opening in said actuating plate, as shown in Figure 4, to provide such pivotal mounting.

In order that the actuating rods 12 and actuating plate 22 shall not be lifted by the under-current armatures 9 while the coils 1 are de-energised owing to the starter not being in operation, said actuating plate 22 is positively held at the down position, with sufficient force to prevail over the springs 19, so long as the main bridging contacts 2 are down, and subsequently to said main bridging contacts being lifted to the closed position and thereby energising the coils 1, said actuating plate 22 is released for response to over-current or under-current as described. To this end two levers 25 are provided pivotally mounted about horizontal axes at 26 and downwardly biased by means of springs 27 so that their extremities normally bear down upon the actuating plate 22, as shown in Figure 3, and thereby hold it at the attracted position. The lifting of the bridging contacts 2 is effected through the medium of a common contact carrier 28 upon which said contacts are mounted by means of springs 29, and, after said bridging contacts have bridged their stationary contacts 4 and 5, said contact carrier 28 continues to move upwards, as permitted by said springs 29, until

upward projections 30 thereon engage said levers 25 and lift them clear of the actuating plate 22.

For lifting the contact carrier 28 upon energisation of the winding 7, said winding 7 is provided with an upper stationary E-shaped magnet frame 31 and a corresponding lower movable E-shaped magnet frame 32. Said lower magnet frame 32 is linked to said contact carrier 28 by means of links 33, and when, upon energisation of the winding 7, said lower magnet frame 32 is attracted upwards to said upper magnet frame 31 said contact carrier is also lifted.

The aforesaid manually operated switch means for starting and stopping the motor under normal conditions comprise a normally open start push button switch 34 and a normally closed stop push button switch 35 both in series with the winding 7 and the contacts 8. One of the levers 25 carries a contact 36 which, when said lever is lifted engages a fixed contact 37. These contacts 36, 37 are connected in parallel with the start push button switch 34 and thus operate to maintain the winding 7 energised after momentary depression of the start push button switch has initiated its energisation. Momentary depression of the stop push button switch 35, or momentary opening of the contacts 8 by over-current or under-current conditions, will then terminate the energisation of said winding 7 and open the bridging contacts 2 and said winding 7 can only be again energised by depression of the start push button switch 34. It should be noted that, when the circuit breaker is tripped, contacts 36, 37 will open before the levers 25 reclose the contacts 8.

It is obvious that in place of the push button, 34, a simple contacting device could be provided on the unit structure itself for momentarily closing the circuit of the winding 7, and that, in place of the stop push button 35, means could be provided for momentarily opening the contacts 8. Again the arrangement could be such that contacts equivalent to the contacts 8 are normally latched at the closed position, and are unlatched when the actuating plate 22 is lifted, and a single reset-and-stop member adapted to return said contacts to the latched position could, when moved beyond the latched position, be adapted momentarily to open said contacts for de-energising the winding 7 and stopping the motor.

The dash pots 21 may be as described and claimed in prior British Specification No. 461,900 modified according to prior British Specification No. 480,805. That is to say, the bobbin 38 of each winding 1 is made of moulded insulating material and so also is the dash pot cylinder 21 save for a metal lining 39. Said dash pot cylinder is in screwed relation on an extension of said bobbin as shown so that it is axially adjustable relative to the coil 1 for varying the position of the over-current plunger 11 within said coil and therefore the degree of over-current at which said plunger will respond. Also a stationary calibrated plate 40 is mounted alongside each dash pot cylinder so that said position of said cylinder can be read against said plate in terms of the amperes required to effect tripping.

Also, as in said prior British Specification No. 480,805, the dash pot plunger 20 has a hole in it and a dished washer 41 rests on said plunger, said dished washer being adapted to tilt in the event of a heavy over-current and close said hole so that the plunger rises at a rate determined by the

5

clearance surrounding it. In the case of a very severe over-current the plunger of course rises substantially instantaneously. Again, as in prior British Specification No. 480,805, in order that the effective size of the hole in the plunger can be adjusted a flat washer 42 is interposed between the plunger 20 and the dished washer 41, said flat washer having a number of holes in it of different sizes and being angularly adjustable around the stem 43 so that any selected one of said holes may register with the hole in the plunger 20. The stem 43 and the hole in the flat washer 42 are hexagonal so that the flat washer will remain in any of six adjusted positions. The stem 43 is reduced at 44 so that the flat washer 42 may be raised and turned for adjusting it.

With regard to the constructional details of the starter, the parts heretofore described are all supported and united by means of a frame of insulating material whose somewhat complicated form is deemed sufficiently clear from the drawings. It will be seen that this frame embodies partitions 45 which shroud the three bridging contacts 2 from one another and from the levers 25. The contact carrier 28 also is of insulating material and is formed with rectangular loop like portions 46 which embrace the bridging contacts 2 as shown and serve to limit their upward movement relative to said contact carrier.

Other structural details are deemed sufficiently clear from the drawings.

What I claim and desire to secure by Letters Patent is:

1. A circuit protecting device for a three phase alternating current circuit comprising three coils connected respectively in the three phases, over-current armatures associated respectively with said coils and adapted to move to an attracted position upon occurrence of over-current conditions in the respective phases, under-current armatures associated respectively with said coils and yielding urged to a non-attracted position upon occurrence of under-current conditions in the respective phases, a circuit interrupter connected in the circuit of two of the three phases, a member extending relative to the three coils and adapted to actuate the circuit interrupter to circuit opening position by the movement of any one of said over-current armatures to its attracted position and by the movement of any one of said under-current armatures to its non-attracted position, and means normally positioned to engage and prevent actuation of said member and retain all three of said under-current armatures in attracted position despite the deenergization of the coils.

2. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with said coil and adapted to move to an attracted position upon occurrence of over-current conditions in the coil, an under-current armature associated with the coil and yielding urged to a non-attracted position upon occurrence of under-current conditions in the coil, an electromagnetically actuated switch having its contacts connected in the circuit to be protected and its actuating coil connected in a local circuit, a circuit interrupter connected in said local circuit and normally assuming circuit closing position and causing actuation of the switch to circuit closing position, means operative to actuate said circuit interrupter to circuit opening position and arranged to be operated by the movement of the over-current armature to its attracted position and by the movement of

6

the under-current armature to its non-attracted position to actuate the circuit interrupter to circuit opening position and cause the switch to assume circuit opening position, and means normally positioned to engage and prevent operation of the circuit interrupter actuating means and retain the under-current armature in its attracted position despite the deenergization of the coil when the circuit is open.

3. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with the coil and adapted to move to an attracted position upon occurrence of over-current conditions in the coil, an under-current armature associated with the coil and yielding urged to a non-attracted position upon occurrence of under-current conditions in the coil, a circuit interrupter connected in a local circuit and normally in circuit closing position, means operative to actuate the circuit interrupter to circuit opening position by the movement of the over-current armature to attracted position and by the movement of the under-current armature to non-attracted position, a switch having its contacts connected in the circuit to be protected, an electromagnet connected in the local circuit of the circuit interrupter and adapted to actuate the switch to circuit closing position upon energization thereof, means for actuating said switch to circuit opening position upon de-energization of the electromagnet, and means actuated by the switch opening means to retain the under-current armature in attracted position when the switch is in circuit opening position despite the de-energization of the coil.

4. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with the coil and adapted to move to an attracted position upon occurrence of over-current conditions in the coil, an under-current armature associated with the coil and yielding urged to a non-attracted position upon occurrence of under-current conditions in the coil, a circuit interrupter connected in a local circuit and normally in circuit closing position, means operative to actuate the circuit interrupter to circuit opening position and arranged to be operated by the movement of the over-current armature to attracted position and by the movement of the under-current armature to non-attracted position to actuate the circuit interrupter to circuit opening position, a switch having its contacts connected in the circuit to be protected, an electromagnet connected in the local circuit of the circuit interrupter and having a movable core member connected to the switch and adapted upon de-energization of the electromagnet by the opening of the local circuit to effect opening of said switch, and means normally positioned to engage and retain the circuit interrupter actuating means in inoperative position and actuated to position out of engagement with the circuit interrupter actuating means by the circuit closing movement of the switch whereby said switch when in the circuit opening position prevents actuating of the circuit interrupter to circuit opening position despite the de-energization of the coil.

5. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with the coil and adapted to move to an attracted position upon occurrence of over-current conditions in the coil, an under-current armature associated with said coil and yielding urged to a non-attracted po-

7  
 sition upon occurrence of under-current conditions in the coil, a circuit interrupter connected in a local circuit and normally in circuit closing position, means operative to actuate the circuit interrupter to circuit opening position by the movement of the over-current armature to attracted position and by the movement of the under-current armature to non-attracted position, a switch having its contacts connected in said circuit to be protected, an electromagnet connected in the local circuit of the circuit interrupter and having a movable core member connected to the switch and adapted upon de-energization of the electromagnet by the opening of the local circuit to effect opening of the switch, auxiliary maintaining contacts yielding urged to circuit opening position and actuated to circuit closing position by the circuit closing movement of the switch, said auxiliary maintaining contacts being connected in the local circuit to maintain energization of the electromagnet after the initial energization of the electromagnet, and means normally engaging the circuit interrupter actuating means to prevent actuation of the circuit interrupter to circuit opening position and operated by the movement of the switch to circuit closing position out of engagement with the circuit interrupter actuating means to permit actuation of the circuit interrupter to circuit opening position.

6. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with the coil and adapted to move to an attracted position upon occurrence of over-current conditions in said circuit, an under-current armature associated with the coil and yielding urged to a non-attracted position upon occurrence of under-current conditions in said circuit, a switch having its contacts connected in the circuit to be protected, an electromagnet connected in a local circuit and having a movable core member connected to the switch and adapted upon de-energization of the electromagnet to effect opening of the switch, a circuit interrupter connected in the local circuit of the electromagnet and normally closing said circuit and adapted to be actuated to circuit opening position upon movement of the over-current armature to attracted position and upon movement of the under-current armature to non-attracted position, and auxiliary maintaining contacts yielding urged to circuit opening position and actuated to circuit closing position by the circuit closing movement of the switch, said auxiliary maintaining contacts being connected in the local circuit of the electromagnet to maintain energization of the electromagnet after the initial energization of the electromagnet.

7. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with the coil and adapted to move to an attracted position upon occurrence of over-current conditions in the coil, an under-current armature associated with the coil and yielding urged to a non-attracted position upon occurrence of under-current conditions in the coil, a circuit interrupter connected in a local circuit and normally in circuit closing position and adapted to be actuated to circuit opening position upon movement of the over-current armature to attracted position and upon movement of the under-current armature to non-attracted position, a switch having its contacts connected in the circuit to be protected, an electromagnet connected in the local circuit of the circuit

circuit interrupter and having a movable core member connected to the switch and adapted upon de-energization of the electromagnet to effect opening of the switch, and a mechanical interlock actuated by the opening of the switch through the de-energization of the electromagnet to hold the under-current armature at attracted position.

8. A circuit protecting device comprising a coil connected in the circuit to be protected, an over-current armature associated with the coil and adapted to move to an attracted position upon occurrence of over-current conditions in said circuit, an under-current armature associated with the coil and yielding urged to a non-attracted position upon occurrence of under-current conditions in said circuit, a switch having its contacts connected in said circuit to be protected, an electromagnet connected in a local circuit and having a movable core member connected to the switch and adapted upon de-energization of the electromagnet to effect opening of the switch, a circuit interrupter connected in the local circuit of the electromagnet and normally in circuit closing position, means to actuate the circuit interrupter to circuit opening position operative by movement of the over-current armature to attracted position and by the movement of the under-current armature to non-attracted position, auxiliary maintaining contacts connected in the local circuit of the electromagnet and normally in circuit opening position and actuated to circuit closing position by the circuit closing movement of the switch, and a mechanical interlock between the switch and the actuating means for the circuit interrupter whereby when the switch is in circuit opening position the circuit interrupter actuating means is held against movement and the under-current armature is retained in attracted position, and said auxiliary contacts in circuit closing position maintaining the electromagnet energized after the initial energization of the electromagnet.

9. A circuit protecting device comprising a coil connected in the circuit to be protected and having a core arranged with a bore of different diameters at the opposite end portions, an over-current plunger reciprocable axially in the portion of largest diameter of the bore of the coil core and adapted to be moved to an attracted position upon occurrence of over-current conditions in said circuit, an under-current armature pivotally mounted at one end of the coil and yielding urged to move to a non-attracted position upon occurrence of under-current conditions in said circuit, and an actuating rod having a head at one end and slidably mounted in the bore portion of smallest diameter of the coil core above the over-current plunger and adapted to be lifted by the movement of the over-current plunger to attracted position and passing through an opening in said under-current armature with the head resting on said under-current armature whereby the rod is lifted by the under-current armature assuming non-attracted position.

10. A circuit protecting device as claimed in claim 9, a ring of non-magnetic material fitted on the over-current plunger to prevent sticking of said plunger in the core.

11. A circuit protecting device comprising a coil connected in the circuit to be protected and having a core arranged with a bore of different diameters at the opposite end portions, an over-current plunger reciprocable axially in the bore portion of largest diameter of the coil core and

adapted to be moved to an attracted position upon occurrence of over-current conditions in said circuit, a fixed plate extending alongside of said coil, an under-current armature pivotally mounted on said fixed plate at one end of the coil and yieldingly urged to a non-attracted position upon occurrence of under-current conditions in the circuit, an actuating rod having a head at one end and slidably mounted in the bore portion of smallest diameter of the coil core above the over-current plunger and adapted to be lifted by the movement of the over-current plunger to attracted position and passing through an opening in the under-current armature with the head resting on the under-current armature whereby movement of the under-current armature will lift the actuating rod, and said core, fixed plate and under-current armature forming a magnetic circuit.

12. A circuit protecting device comprising a coil connected in the circuit to be protected and having a core arranged with a bore of two diameters at the opposite end portions, an over-current plunger reciprocable axially in the bore portion of largest diameter of the coil core and adapted to be moved to an attracted position upon occurrence of over-current conditions in the circuit, an under-current armature comprising a bifurcated plate pivotally mounted at one end of said coil and yieldingly urged to a non-attracted position upon occurrence of under-current conditions in the circuit, an actuating rod having a head at one end and slidably mounted in the bore portion of smallest diameter of the coil core above the over-current plunger and adapted to be lifted by the movement of the over-current plunger to attracted position and passing through the bifurcation of the under-current armature plate at right angles to its pivotal axis with the head resting on the under-current armature plate whereby the rod is lifted by the movement of the under-current armature plate to non-attracted position, and a silencing coil mounted upon one of the bifurcation legs of the under-current armature plate.

13. A circuit protecting device comprising a coil connected in the circuit to be protected and having a core arranged with a bore of different diameters at the opposite end portions, an over-current plunger reciprocable axially in the bore portion of greatest diameter of the coil core and adapted to be moved to an attracted position upon occurrence of over-current conditions in said circuit, an under-current armature pivotally mounted at one end of the coil and yieldingly urged to a non-attracted position upon occurrence of under-current conditions in said circuit, a switch having its contacts connected in the circuit to be protected, an electromagnet connected in the circuit to be protected and having a movable core connected to the switch to close the switch upon energization of the electromagnet and open the switch upon de-energization of the electromagnet, an actuating rod having a head at one end and slidable in the bore portion of smallest diameter of the coil core above the over-current plunger and adapted to be lifted by the movement of the over-current plunger to attracted position and passing through an opening in the under-current armature with the head resting on the under-current armature whereby the rod is lifted by the movement of the under-current armature to non-attracted position, auxiliary maintaining contacts connected in the circuit of the electromagnet and yieldingly urged to circuit

opening position and actuated to circuit closing position by the movement of the electromagnetically actuated switch to circuit closing position, a mechanical interlock extending between the electromagnetically actuated switch and the actuating rod and yieldingly urged to hold the rod against movement when the electromagnet is de-energized despite the de-energization of the coil, and the auxiliary contacts maintaining the energization of the electromagnet after the initial energization of the electromagnet.

14. A circuit protecting device for a three phase alternating current circuit comprising three coils connected respectively in the three phases, over-current armatures associated respectively with said coils and adapted to move to an attracted position upon occurrence of over-current conditions in the respective phases, under-current armatures associated respectively with said coils and yieldingly urged to a non-attracted position upon occurrence of under-current conditions in the respective phases, a three pole switch having its contacts connected in the three phases, an electromagnet connected in the circuit of two of the three phases and having a movable core member connected to the movable contact makers of the three pole switch and adapted upon de-energization of the electromagnet to effect opening of said switch, a circuit interrupter connected in the circuit of the electromagnet and normally in circuit closing position, a member extending relative to the three coils and adapted to actuate the circuit interrupter to circuit opening position by the movement of any one of the over-current armatures to its attracted position and by the movement of any one of the under-current armatures to its non-attracted position, and a mechanical interlock extending between the electromagnetically actuated switch and said member and yieldingly urged to engage said member and hold the under-current armatures in attracted position when the electromagnetically actuated switch is in circuit opening position.

15. An electric circuit protecting device adapted to be interposed in the circuit to be protected, comprising switch means connected in the circuit to be protected normally assuming circuit opening position, electromagnetically operated means connected in a local electric energizing circuit adapted upon closing of said local circuit to energize the same and actuate said switch means to circuit closing position and connect the electromagnetically operated means in and maintain said circuit to be protected closed, a circuit interrupter interposed in the local circuit of the electromagnetically operated means and normally urged to circuit closing position, means operative to actuate said circuit interrupter to circuit opening position, a coil connected in the circuit to be protected, an armature movable into and outwardly of one end of said coil and normally assuming a position outwardly of the coil, said armature upon an occurrence of an over-current condition in the circuit to be protected being attracted to and movable into the coil to operate the interrupter actuating means to actuate the interrupter to circuit opening position, a second armature supported to have movement toward and away from the opposite end of the coil and yieldingly urged in a direction away from the coil to operate the circuit interrupter actuating means to actuate the circuit interrupter to circuit opening position and attracted to the coil upon the closing of the circuit to be protected

and energization of said coil, and means automatically operative upon the opening of the circuit to be protected and de-energizing of the electromagnetically operated switch actuating means to actuate the switch to circuit opening position and engage the circuit interrupter actuating means and retain the second armature in its attracted position even though the coil is de-energized whereby the interrupter is in its normal circuit closing position when the electromagnetically operated switch actuating means is de-energized and the switch is in circuit opening position.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

| Number    | Name          | Date          |
|-----------|---------------|---------------|
| 986,708   | Greene -----  | Mar. 14, 1911 |
| 1,764,374 | White -----   | June 17, 1930 |
| 1,800,256 | Keller -----  | Apr. 14, 1931 |
| 1,890,993 | Keller -----  | Dec. 13, 1932 |
| 2,189,591 | McShane ----- | Feb. 6, 1940  |

FOREIGN PATENTS

| Number  | Country             | Date         |
|---------|---------------------|--------------|
| 370,122 | Great Britain ----- | Apr. 7, 1932 |