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CIRCUIT INTERRUPTER TRIP DEVICE

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This invention relates to circuit interrupters and more particularly to circuit interrupters embodying electromagnetic tripping means for tripping the interrupter in response to overload currents above a predetermined value.

An object of the invention is to provide a circuit interrupter having instantaneous and time delay trip mechanism with improved means for adjusting the instantaneous tripping characteristics of the interrupter.

Another object of the invention is to provide a circuit interrupter having instantaneous and time delay trip mechanism with improved adjusting means for adjusting, over a wide range, the instantaneous tripping characteristics of the interrupter.

Another object of the invention is to provide a circuit interrupter with an improved electromagnetic trip means with a fixed core and a movable armature wherein the armature is adjustable relative to the core to vary the minimum tripping current required to instantaneously trip the interrupter over a wide range of current values.

Another object of the invention is to provide a circuit interrupter with an electromagnetic trip device, a plurality of parallel magnetic flux circuits wherein one element of said electromagnetic trip device is adjustable to vary the minimum overload current value for instantaneously tripping the interrupter.

Another object of the invention is to provide a circuit interrupter with an improved electromagnetic trip device comprising a movable armature and a fixed core structure disposed to produce a differential pull on said armature, wherein the armature is adjustable relative to said core structure to vary the differential pull of the electromagnet, the minimum tripping current required to instantaneously trip the interrupter being selectively determined by varying the differential pull of the electromagnet.

Another object of the invention is to provide a circuit interrupter with an improved electromagnetic trip device comprising an armature and a fixed core structure disposed to produce a differential pull on said armature wherein means is provided for adjusting the armature relative to the fixed core to adjust the instantaneous tripping characteristics of the interrupter and the adjusting means is adjustable for calibrating said trip device.

The novel features that are considered characteristic of the invention are set forth in particular in the appended claims. The invention

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itself, however, both as to structure and operation, together with additional advantages thereof, will be best understood from the following detailed description thereof when read in conjunction with the accompanying drawing, in which:

Figure 1 is a vertical sectional view of a circuit interrupter embodying the principles of the invention;

Fig. 2 is a sectional view on an enlarged scale of the trip device; and

Fig. 3 is a horizontal sectional view of the electromagnetic trip devices for two adjacent poles of the interrupter taken on line III—III of Fig. 2, showing the adjustment of the movable armature and the adjustment of the armature adjusting means for one of the poles. The adjusting device for the pole shown in the upper part of the figure has been omitted to more clearly illustrate the magnet structure.

Referring to Fig. 1 of the drawing, the circuit interrupter is of the three pole type and comprises a base 7 of molded insulating material, a cover 9 also of molded insulating material secured to the base by means of bolts (not shown), operating mechanism indicated generally at 11 and a trip device indicated generally at 13 having a separate electroresponsive tripping means for each of at least two of the poles of the interrupter. Each pole of the breaker is provided with a stationary contact 15 mounted on the lower end of a conductor 17 of the corresponding pole of the breaker, the conductor being suitably secured to the base 7.

The movable contact structures of the several poles are the same, for which reason only the movable contact structure for the center pole has been shown and will be described. The movable contact 19 for the center pole is secured to a contact arm 21 which is loosely supported on a channel-shaped switch arm 23. The three channel-shaped switch arms of the three poles are rigidly fastened for unitary movement by means of a metal tie bar 25 which extends transversely across all of the poles of the breaker. The tie bar 25 is fastened to the switch arms 23 adjacent the pivoted ends thereof by means of metal straps 27 looped about the tie bar and clinched thereagainst. The tie bar is surrounded by an insulating tube 29 in order to insulate and prevent short circuiting of the poles of the interrupter. By means of the tie bar 25, all of the switch arms 23 are mechanically interconnected so that all three of the switch arms are operated by a single operating mechanism, which is hereinafter described. The channel-shaped

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switch arm 23 for the center pole is pivotally supported on a pin 31 mounted in a U-shaped main frame 33 secured to the base 7 by means of screws 35. The pivot pin 31 forms the common pivot for the three mechanically connected switch arms 23.

Each of the contact arms 21, to which the movable contacts 19 are secured, is attached to its corresponding channel-shaped switch arm 23 by means of a headed adjusting bolt 37 which threadedly engages the switch arm and is locked in adjusted position by a lock nut 39. The head (not shown) of the bolt 37 loosely engages in a recess in the contact arm and is retained therein by an inwardly flanged portion of the contact arm. Contact pressure is provided by a compression spring 41 having one end seated in a cup-shaped spring seat 43 mounted on the switch arm 23 near its upper end and the other end bearing against the contact arm 21. The spring 41, in the open contact position of the switch arm 23, biases the contact arm 21 counterclockwise about the head of the bolt 37, the movement being limited by a tail portion of the contact arm 21 striking the channel-shaped switch arm 23.

The upper end of a flexible conductor 45 is electrically and mechanically connected to the lower end of the contact arm 21 by means of a clamp 47 and the lower end of the flexible conductor is connected by means of a screw 49 to a conductor 51 which forms the energizing means for the corresponding pole of the trip device 13. The conductor 51 has its lower end connected by means of a bolt 53 and nuts 55 to a terminal connector 57. The upper end of the conductor 17 is similarly connected to a terminal connector. The circuits for the two outer poles are the same as the circuit for the center pole, consequently, only the circuit for the center pole will be traced. This circuit extends from the upper terminal 57 through the bolt 53, the conductor 17, stationary contact 15, movable contact 19, contact arm 21, flexible conductor 45, the trip device 13 energizing conductor 51 and the lower bolt 53 to the lower terminal connector 57.

The movable contact structure comprising the channel shaped switch arms 23, the tie bar 25 and the contact arms 21 for all three poles of the breaker, is adapted to be operated to open and closed positions to open and close the circuit of the interrupter by the single operating mechanism 11. This operating mechanism comprises a carrier or support member 59 pivotally mounted by means of a pin 61 on the main frame 33, a pair of toggle links 63 and 65 interconnecting the carrier 59 and the center pole switch arm 23, a U-shaped operating lever 67, overcenter springs 69 for connecting the operating lever 67 to the knee pivot pin 71 of the toggle links 63 and 65, and an insulating operating handle 73 for the operating lever.

The toggle link 63 is pivotally connected by means of a pin 75 to the carrier 59, while the toggle link 65 is pivotally connected by means of a pin 77 to the channel-shaped switch arm 23 for the center pole of the interrupter. The two legs of the operating lever 67 are disposed adjacent the inner sides of the main frame 33 and are pivotally supported on pins 79 projecting inwardly from the sides of the frame. The operating handle 73 projects through an opening 81 in the cover 9 and has an arcuate protective portion 83 having side portions 85 integral with the portion 83. The side portions 85 of the operating handle straddle the main frame 33 and

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are secured to the two legs of the operating lever 67 by means of screws 87 which threadedly engage the respective legs of the operating lever 67. The connecting portion of the operating lever is provided with a formed over portion 89. The portion 89 of the operating lever is for the purpose of engaging and resetting the carrier 59 to its latched position by movement of the operating handle as far as it will go in opening direction, in order to reset the mechanism following a tripping operation of the interrupter. The carrier 59 is normally restrained in latched position as shown in Fig. 1 by a latch 91 of the trip device, which engages a latching portion 93 of the carrier.

The operation of the circuit interrupter operating mechanism is as follows: with the parts in the position shown in Fig. 1, in which position all of the contact means are closed and the carrier 59 is held in latched position; if the operating handle 73 is moved in a clockwise direction from the position shown to the opposite end of the slot 81 thus rotating the operating lever 67 in a clockwise direction, the overcenter spring 69 will snap overcenter below the line 71—75 and cause the toggle links 63—65 to collapse, thereby causing simultaneous movement of all of the channel-shaped switch arms 23 and the movable contacts 19 to the open-circuit position with a snap action. To reclose the interrupter, the operating handle is moved in the opposite direction back to the position shown in Fig. 1. This movement of the handle causes the overcenter springs to snap overcenter in the opposite direction and move the toggle to the intoggle position to simultaneously close all of the contact means with a snap action.

The circuit interrupter is opened automatically in response to overload currents occurring in the circuit of any pole of the breaker, by operation of the trip device 13. When the latch 91 is released by the trip device in response to an overload current, it frees the carrier 59 and permits the springs 69 to rotate the carrier in a counterclockwise direction, thus causing collapse of the toggle 63—65 and movement of the channel-shaped switch arms and the movable contacts for all three poles of the breaker to the open circuit position. The breaker cannot be closed after a tripping operation until the handle is moved to the fully opened position in order to reset and relatch the carrier 59 with the latch 91. After the carrier has been relatched, the operating handle may then be moved to the closed circuit position to effect closing of the contacts.

The trip device comprises an insulating base or support member 95 (Fig. 2) secured by means of rivets 97 or other suitable means to an angle bracket 99 which is, in turn, secured to the base 7 of the interrupter by means of the screws 49. A cover 100 of insulating material encloses the trip device. The electroresponsive tripping means for the three poles are the same therefore only the one for the center pole will be described. The energizing conductor 51 of each pole has a loop 101 therein, the upper leg of the loop being disposed adjacent to the base 95 and secured by suitable means to the underside of the base 95. A bimetal element 105 has one end secured by means of rivets 107 or other suitable means to the lower leg of the loop near the base of the loop. The rivets 107 also serve to rigidly secure both the lower loop of the heater element 51 and the bimetal element 105 to a support bracket 119 to which is also secured the electromagnetic trip means to be later described.

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The bimetal element 105 extends toward the right (Fig. 2) substantially parallel to and adjacent the lower leg of the loop 101. The free end of the bimetal is disposed adjacent an adjusting screw 109 mounted in an insulating trip bar 111. The trip bar is pivotally mounted by pins 113 supported in the trip bar engaging bearing projections 115 (Figs. 2 and 3) extending downwardly from the bracket 99 through openings in the base 95. In the normal position of the trip bar 111, a latch member 112 (Fig. 2) thereon engages a latch portion 114 of a latch member 116 to restrain this latch in latching position. When the bimetal element 105 is heated a predetermined amount in response to overload currents, it deflects downwardly to engage the adjusting screw 109 and rocks the trip bar clockwise about its pivot 113. This movement of the trip bar disengages the latch 112 from the latch portion 114 of the latch 116 thus freeing the latch member 116 which, in turn, frees the latch 91 causing an opening operation of the breaker mechanism in the previously described manner.

The latch member 91 is pivotally and slidably supported on a pin 92 mounted in the side members of the bracket 99. The latch 116 is pivotally supported on a pin 118 mounted in one side member of the bracket 99 and a portion 120 of the bracket formed parallel to the side members from the connecting portion of the bracket. The latch members 91 and 116 are biased to latching position by means of a spring 123 coiled about the pin 92. The bight 124 of the spring 123 engages and biases the latch 91 in a counterclockwise direction to latching position. One end 129 of the spring 123 engages an opening in an ear 131 on the latch member 116 and biases this latch to latching position. The other end 133 of the spring engages the connecting portion of the bracket 99 to provide tension for the spring. A roller latch 135 carried by the latch member 116 maintains the latch 91 in latching position as long as the latch 112 on the trip bar 111 engages latch portion 114 and maintains the latch 116 in the position shown in Fig. 2.

Referring to Fig. 1, it will be seen that the overcenter springs 69, in the closed position of the interrupter, acting through the toggle link 63 biases the releasable member 59 in a counterclockwise direction. Movement of the member 59 is normally prevented by engagement of the latch end 93 thereof with the latch member 91.

When the trip bar 111 (Fig. 2) is actuated by the bimetal element 105 as previously described, or by the electromagnetic tripping means to be hereinafter described, the latch element 112 is disengaged from the latch portion 114 of the latch member 116. The force of the overcenter springs 69 (Fig. 1) overcomes the spring 123 and moves the latch member 116 clockwise, which movement disengages the roller latch from the latch 91 permitting the latter to rotate in a clockwise direction to release the carrier 59 thereby effecting opening operation of the interrupter. As soon as the latch portion 93 of the carrier 59 is free of the latch 91, the spring 123 acts to restore the latch 91 counterclockwise to its latching position and also to restore the latch 116 counterclockwise to its latching position. The counterclockwise movement of the latch members 91 and 116 is limited by portions of each latch member engaging a stop 137 bent inwardly from the bracket 99. When the latch 116 is biased against the stop 137, the latch portion 114 thereof is slightly beyond latching posi-

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tion to permit movement of the latch 112 to latching position.

As previously set forth, the interrupter cannot be closed following an automatic opening operation until the carrier 59 is reset and relatched. This is accomplished by movement of the handle to the fully open position. During the clockwise or resetting movement of the carrier 59, the latch end thereof engages the latch 91 and, since this latch cannot rotate due to the engagement of the latch roller 135 therewith, it is slid downwardly between the latch roller and the limit stop 137. When the carrier 59 has moved to the left (Fig. 2) of the latch 91, the spring 123 acts to slide the latch upwardly to latching position. The interrupter may now be closed by counterclockwise movement of the handle to the closed position.

It will be noted that the latch 116 restrains the latch 91 with a large moment arm and that the latch 112 restrains the latch 116 with a large moment arm thereby effecting a large mechanical advantage and an extremely light latch load.

The trip device is also provided with electromagnetic means for at least two poles of the breaker operable in response to overload currents above a predetermined value, or in response to short circuits to instantaneously actuate the trip bar 111 to cause automatic opening of the interrupter. Each electromagnet comprises a fixed U-shaped core member 117 fixedly mounted on the bracket 119 and a movable armature 125. The bracket 119 is of nonmagnetic material and is suitably secured by means of rivets 127 to a projection (not shown) molded integral with the base 95. The rivets 127 extend through openings in the base 95, the bracket 119 and the core member 117 thereby rigidly securing the bracket and the core member 117 to the base.

The armature 125 is threadedly mounted on one end of a horizontally disposed rod 151 and is locked in place by a set screw 153. The rod 151 is slidably mounted in an opening in a formed over portion 155 of the nonmagnetic bracket 119 and the armature is biased to retracted position against the bracket by means of a spring 157 compressed between the portion 155 of the bracket and a collar 159 secured on the rod 151. At its right hand end (Figs. 2 and 3) the rod projects through an open slot 161 in the trip bar 111 and is provided with a head 165 which, upon movement of the armature to attracted position, engages and operates the trip bar to trip the interrupter.

The core member 117 is of laminated construction and the ends of the outer lamination 121 (Figs. 2 and 3) are bent at right angles and lie adjacent the ends of the other laminations of the fixed core member. Projections 162 of the outer lamination 121 extend to the right (Fig. 3) and are bent inwardly toward each other to form small auxiliary pole pieces 163 which, when the magnet is energized, exert a back pull on the armature 125. The purpose of the projection 162 and the auxiliary pole pieces 163 is to provide a limited path for at least a portion of the magnetic flux to thereby provide a differential pull on the armature 125 which may be varied according to the adjustment of the armature relative to the core member 117 and the auxiliary pole pieces 163.

The armature 125 is adjusted by means of an eccentric cam 167 (Fig. 3) which engages the back face of the armature. The cam 167 is

formed on one end of an adjusting lever 169 pivotally mounted on a pivot pin 171 supported on a plate 173; and having a handle 174 thereon extending through an opening (not shown) in the cover 100. The plate 173 is pivotally mounted on a screw 175 threadedly engaging an opening in an ear 177 formed at right angles to the lower one (Fig. 3) of the auxiliary pole pieces 163. The plate 173 at its upper end as shown in Fig. 3 is provided with an elongated slot through which projects a screw 179 which threadedly engages an ear 181 formed at right angles to the upper one of the auxiliary pole pieces 163. This permits adjustment of the support plate 173 and of the pivot 171 of the lever 169 relative to the armature 125 in order to calibrate the trip device. By loosening the screw 179 and moving the plate 173 about the pivot screw 175, the initial position of the lever 169 and the cam 167 may be varied.

Referring to Fig. 3, it will be seen that the instantaneous trip magnet shown at the bottom of the figure is adjusted to trip the interrupter in response to overload currents of high value. In this adjusted position, the armature 125, biased by the spring 157 against the cam 167, occupies the position of greatest retraction permissible by adjustment of the lever 169. This position of the armature 125 provides the greatest air gap between the armature and the core member 117 and the smallest air gaps between the armature 125 and the auxiliary pole pieces 163. This decreases the pull of the magnet for a given value of overload current and increases the value of the current required to operate the trip magnet and trip the interrupter. Movement of the adjusting lever 169 in a clockwise direction from the Fig. 3 position through the action of the cam 167 moves the armature 125 toward the left thereby decreasing the main air gap. This has the effect of increasing the pull of the magnet on the armature in tripping direction and of decreasing the back drag opposing movement of the armature in tripping direction. When the device is adjusted to a position below the highest position to which it is capable of adjustment, the trip device will be actuated in response to overload currents of lesser magnitude to trip the interrupter. The adjusting lever 169 is retained in adjusted position by engagement with a series of holes 163 in the plate 173 which is spring biased toward the adjusting lever by means of a spring washer 185.

By way of example, assuming that the breaker is rated to carry a normal load indefinitely without actuating the trip device, the bimetal may be calibrated to trip the breaker with an inverse time delay in response to overloads of say between 100% and 300% of the normal rated current. The electromagnetic trip device may be calibrated and adjusted to instantaneously trip the breaker on overloads of, for instance, between 300% and 1100% of rated current depending on the setting of the lever 169 and the corresponding adjustment of the movable armature 125. Assuming that the trip device is calibrated to the above arbitrary values, then with the device set to the "low" position, the electromagnet will operate to instantaneously trip the breaker upon the occurrence of an overload current of 300% or more of normal. If the lever 169 is moved to the "high" position to correspondingly adjust the armature 125, the armature will not be attracted until the occurrence of an overload current of 1100% of normal. By adjusting the lever 169 to any point between the maximum and minimum settings, 75

the magnet will function to instantaneously trip the breaker in response to an overload current of a minimum value corresponding to the particular setting of the device. Thus the device may be set to cause instantaneous tripping of the breaker in response to a minimum overload of, for instance, 300%, 500% or 700%, etc., up to 1100% of normal rated current. It will be understood that if the device is adjusted to instantaneously trip out at a minimum overload of, for instance, 700% of normal, the bimetal element 105 will function to trip the breaker after a time delay upon the occurrence of overload currents of any value between 100% and 700%, or between 100% and the particular minimum current value between 300% and 1100% to which the magnet is adjusted.

The time delay tripping may be adjusted by rotating the screw 109 in the trip bar 111 to vary the distance of the end of the screw from the bimetal element.

The high instantaneous trip setting is determined by the small air gap between the armature 125 and the auxiliary pole pieces 163 of the core member, and by the air gap between the core member 117 and the armature. The low instantaneous trip setting is determined by the initial force of the spring 157. The initial tension of the spring 157 may be varied by backing out the set screw 153 and turning the rod 151 into or out of the armature to increase or decrease the tension of the spring. This varies the low instantaneous tripping current required to trip the breaker when the adjustable armature is set to the "low" position.

From the foregoing description, it will be seen that the invention provides a circuit breaker having an improved trip device wherein the electromagnet trip means is provided with two parallel magnetic flux circuits and corresponding air gaps disposed to produce a differential pull on the armature so that a wide range of adjustment is obtained, the minimum current value required to trip the breaker being selectively determined by varying the air gaps to thereby vary the differential magnetic pull on the armature.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts thereof may be made without departing from some of the essential features of the invention. It is desired, therefore, that the language of the appended claims be given as reasonably broad interpretation as the prior art permits.

We claim as our invention:

1. A trip device for a circuit interrupter comprising a tripping armature, a pole structure comprising a main fixed pole member disposed in front of said armature and a plurality of fixed auxiliary pole members disposed back of said armature to cause said pole structure to produce a differential pull on said tripping armature, an energizing winding traversed by the current of the circuit of the interrupter for energizing said pole structure, manual means for moving said tripping armature relative to said pole structure to vary the differential pull of said pole structure on said armature, a pivoted plate supporting said manual means, and means for adjustably positioning said plate to vary the initial setting of said manual means.
2. The combination of an energizing winding normally energized by current of predetermined

value, an armature cooperating therewith, a unitary pole structure comprising a fixed main pole member and a plurality of fixed auxiliary pole members integral with said main pole member and energized in response to the abnormal currents in said winding for operating said armature, said auxiliary pole members being disposed to produce a back drag on said armature, manual means for moving said armature relative to said main pole member and said auxiliary pole members to vary the magnetic pull on said armature for operating said armature and for varying the back drag on said armature to thereby selectively determine the magnitude of overload current required to instantaneously operate said armature, a support member for said manual means, and adjusting means for adjustably positioning said support member to thereby vary the initial setting of said manual means.

3. The combination of an energizing winding, an armature cooperating therewith, a fixedly mounted pole structure comprising a main pole member disposed on one side of said armature and a pair of auxiliary pole members disposed on the opposite side of said armature, said pole structure producing a differential pull on said armature, manual means for selectively adjusting said armature relative to said pole structure to vary the differential pull thereof on said armature, support means for said adjusting means, and means for adjusting said support means for said adjusting means to vary the initial setting of said manual means.

4. The combination of an energizing winding normally energized by current of predetermined value, an armature cooperating therewith, a fixedly mounted pole structure comprising a main pole member disposed on one side of said armature providing a main magnetic flux circuit and a pair of spaced auxiliary pole members integral with said main pole member and disposed on the opposite side of said armature, said auxiliary pole members providing a secondary magnetic flux circuit, said pole structure producing a differential pull on said armature, manual means for adjusting said armature relative to said pole structure to thereby vary the minimum overload current value required to operate said armature, a movable support on which said manual means is mounted, and adjusting means for varying the position of said support to vary the initial setting of said manual means.

5. A circuit interrupting device comprising a winding, a movable armature attracted by the field thereof for movement to circuit interrupting position, a fixed pole structure magnetized by said winding, a part of said fixed pole structure being disposed to produce a magnetic force for restraining said armature against movement by said attraction except for field strengths above a predetermined value, manual means for adjusting said armature relative to said pole structure to selectively determine the field strength required to effect circuit interrupting movement of said armature against said restraining force, pivot means for said manual means, and adjusting means for moving said pivot relative to said armature to calibrate said device.

6. A circuit interrupter comprising a magnet winding, a tripping armature cooperating therewith, means for producing a magnetic back drag normally restraining tripping movement of said armature by the field of said winding, manual means for adjusting said armature to selectively vary the effective magnitude of said magnetic

back drag and to vary the magnitude of the attraction of said field required to operate said armature, a support member for said manual adjusting means and said support member being adjustable to vary the initial setting of said manual means.

7. A trip device for a circuit interrupter comprising an electromagnet having a movable armature operable to effect opening of said interrupter, a fixed U-shaped core structure disposed on one side of said armature to operate said armature upon energization of said electromagnet in response to overload currents of predetermined value, spaced auxiliary core members integral with said fixed core structure and disposed on the other side of said armature to restrain said armature against operation in response to overload currents below said predetermined value, manual means comprising a pivoted lever having a cam surface thereon for engaging and adjusting said armature relative to said fixed core member and said auxiliary core members to vary the minimum overload current required to operate said armature, and a pivoted support member on which said lever is pivotally mounted, said pivoted support member being adjustable to calibrate said trip device.

8. A trip device for a circuit interrupter comprising an electromagnet having an armature operable to effect opening of said interrupter, a U-shaped main core member having a pair of pole pieces disposed on one side of said armature, said main core members being operable upon energization of said electromagnet in response to overload currents above a predetermined value to operate said armature, auxiliary core members extending from the pole pieces of said main core member and disposed to restrain said armature against operation in response to overload currents below said predetermined value, adjusting means for said armature comprising a cam member operable to move said armature relative to said main core member and said auxiliary core member to selectively determine the minimum overload current required to operate said armature, an adjustable support member for pivotally supporting said cam member, and means for adjusting said support member to vary the initial setting of said cam member.

9. A trip device for a circuit interrupter operable to effect opening of said interrupter comprising an armature, a U-shaped magnetic core energizable in response to overload currents to operate said armature, said magnetic core having a portion disposed in front of said armature to produce a forward pull on said armature, said U-shaped magnetic core having pole faces at the ends thereof slanting inwardly toward the center of the U and having substantially parallel extensions at the outer edges of the U extending beyond said slanting pole faces, the outer ends of said extensions being formed inwardly and disposed back of the end portions of said armature for producing a back pull on said armature, said armature having slanting pole faces cooperating with the slanting pole faces on said magnetic core, said slanting pole faces of the armature terminating in a corner at each end of the armature of small area for reducing the lateral flux leakage to said extensions and enhancing the back pull on said armature, manual means operable to move said armature relative to said front portion and said back portion of said magnetic core to vary both the forward pull and the back pull on said armature, a support member

for said manual means, and said support member being adjustable to vary the initial setting of said manual means.

10. A trip device for a circuit interrupter operable to effect opening of said interrupter comprising an electromagnet comprising an armature, a fixed core member having an extension beyond the end of said armature and having pole portions positioned oppositely on each side of the armature to provide a main air gap on one side of the armature and a secondary air gap on the other side of said armature producing a differential pull on said armature, the pole portion for one of said air gaps being slanted at an angle relative to the pole portion of the other air gap, said armature having a slanting end portion facing said slanting pole portion and providing an end of reduced section for reducing the lateral flux leakage to said extension of said core, manual means for adjusting said armature relative to said core member to vary said main and secondary air gaps to thereby vary the differential pull on said armature, a member supporting said manual adjusting means, and means for adjusting said supporting member for said manual adjusting means to vary the initial setting of said manual adjusting means and said armature.

11. A trip device for a circuit interrupter operable to effect opening of said interrupter including an electromagnet comprising an armature, a fixed core member having a fixed extension beyond the end of said armature and having pole portions positioned a fixed distance apart oppositely on each side of said armature to provide a main air gap on one side of said armature and a secondary air gap on the other side of said armature producing a differential pull on said arma-

ture, the pole portion of one of said air gaps being slanted at an angle relative to the pole portion of the other air gap, said armature having a slanting end portion facing said slanting pole portion providing an end of reduced section for reducing the lateral flux leakage to said extension of said core, manual means for adjusting the position of rest of said armature relative to said fixed core member to simultaneously vary both said main and secondary air gaps to thereby vary the differential pull on said armature, and a member adjustably supporting said manual means.

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