April 7, 1959

C. I. CLAUSING

2,881,283

MAGNETIC LATCH CALIBRATION SYSTEM

Filed April 28, 1958

FIG. 1

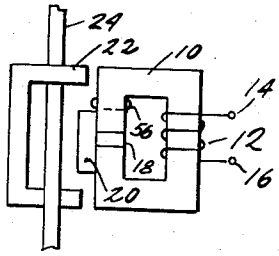



FIG. 6

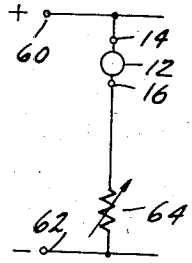



FIG. 7

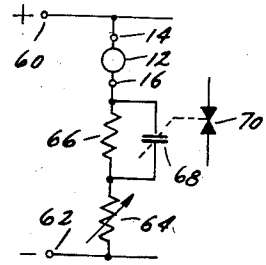



FIG. 3

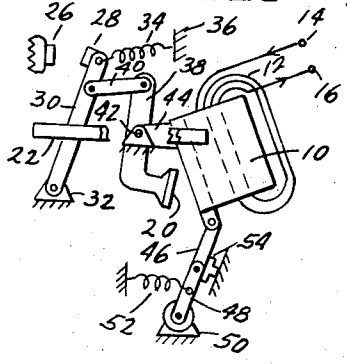



FIG. 2

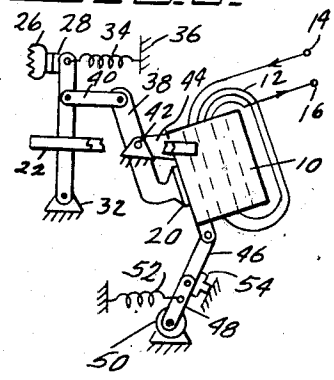



FIG. 4

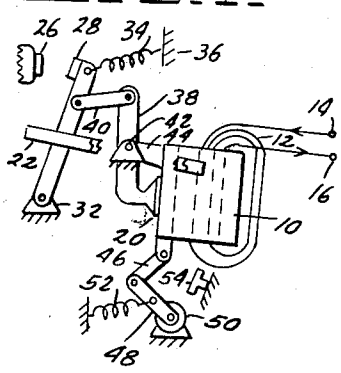
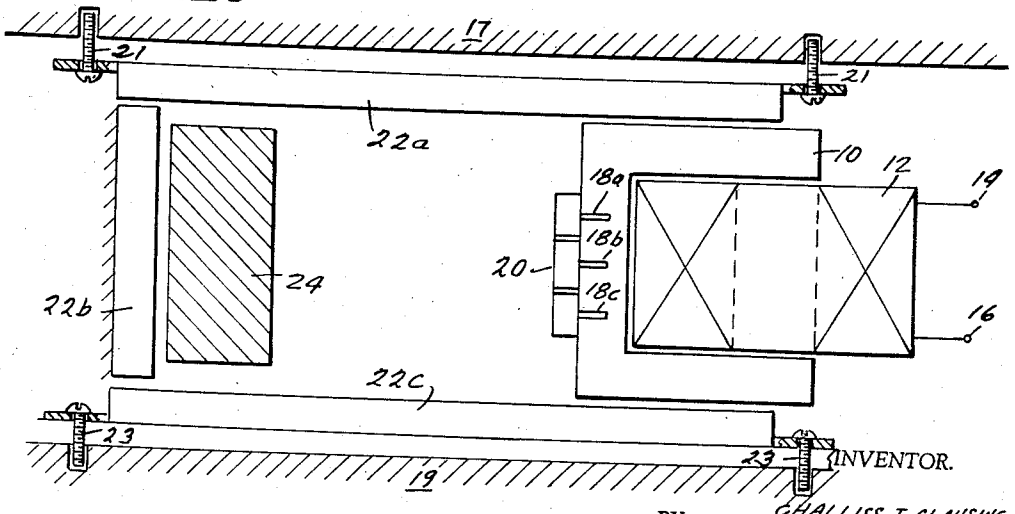



FIG. 5




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# MAGNETIC LATCH CALIBRATION SYSTEM

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Application April 28, 1958, Serial No. 731,346

6 Claims. (Cl. 200—93)

My invention relates to a novel calibration system for magnetic latches of the type set forth in my copending application Serial No. 719,067, filed March 4, 1958, entitled Magnetic Latch System for High Speed Circuit Breakers, and assigned to the assignee of the instant invention.

Magnetic latch systems for circuit breakers as described in my above noted copending application are comprised of a magnetic structure which is provided with controlling windings for energization of the magnetic structure so that it may seal an armature which is movable with respect to the magnetic structure. The armature is operatively connected to a movable circuit breaker contact whereby the circuit breaker contact will move to a disengaged position when the armature is moved away from its cooperating magnetic structure. When the armature is sealed to the magnetic structure, the circuit breaker contact operatively connected to the armature will be positioned and held in the engaged position.

In order to control the energization of the magnetic structure, a polarizing coil generates a magnetomotive force which is sufficient to maintain the armature sealed to the magnetic structure. A second winding which conducts the current of the circuit breaker is magnetically coupled with the polarizing coil so that responsive to a predetermined current condition of the circuit breaker, the second winding or so called "bucking bar" will generate a magnetomotive force to buck down the magnetomotive force of the polarizing coil so that the armature will be released from the magnetic structure and the circuit breaker contacts may be disengaged.

In order to calibrate the magnetic latch so that the armature will be released under a predetermined bucking bar current condition, it has been the practice to adjust the reluctance of the magnetic structure and thereby effect the cooperation between the magnetomotive forces generated by the polarizing coil and the bucking bar. However, since the magnetic latch structure is normally connected to one terminal of the circuit breaker, it is normally necessary to isolate the circuit breaker from the source in order to make adjustments in the tripping characteristics of the latch since physical access to the latch is required. Furthermore, the adjustment of the reluctance of the circuit is relatively inaccurate and it is difficult to set it to close tolerances.

The principle of my invention is to provide an adjustable impedance means in the polarizing coil circuit which operates in cooperation with the control of the reluctance of the magnetic circuit to achieve adjustable calibration of the magnetic latch tripping characteristics. More specifically, the reluctance of the magnetic circuit is first adjusted while the circuit breaker is isolated from its source to set the latch at some upper calibration level. Thereafter, calibration is achieved through control of the polarizing coil ampere-turns by means of the variable impedance which could be a rheostat. Accordingly, when it is necessary to recalibrate the magnetic latch tripping characteristics, the circuit breaker need not be isolated



from the source and the variable impedance may be operated from some conveniently located position to control the tripping point of the circuit breaker.

In view of the foregoing, the primary object of my invention is to provide a novel calibration system for magnetic latches.

Another object of my invention is to provide a novel calibration system for magnetic latches which may be safely operated while the circuit breaker is closed.

A further object of this invention is to provide a novel and simple calibration system for magnetic latches associated with high speed circuit breakers which is simple in construction and may be remotely operated while the circuit breaker is still energized.

A further object of this invention is to provide a calibration system for high speed circuit breaker magnetic latches wherein the reluctance of the magnetic latch structure is initially adjusted to set the upper limit of the calibration required and the calibration is thereafter achieved by control of the polarizing coil ampere-turns.

These and other objects of my invention will become apparent from the following description taken in conjunction with the drawings in which:

Figure 1 schematically illustrates the type of magnetic latch to which my invention may be applied.

Figure 2 shows the magnetic latch structure in conjunction with a schematically illustrated circuit breaker with the circuit breaker in its closed position.

Figure 3 is similar to Figure 2 and illustrates the latch with the circuit breaker in its tripped position.

Figure 4 is based on Figures 2 and 3 where the magnetic latch is reset after the automatic operation shown in Figure 3.

Figure 5 is a top view of the magnetic latch structure and specifically illustrates the manner in which calibration by control of the magnetic circuit reluctance is achieved.

Figure 6 illustrates a first embodiment of my novel invention.

Figure 7 illustrates a second embodiment of my novel invention.

Referring now to Figure 1, the general latch structure is comprised of a magnetic structure **10** having a polarizing coil **12** thereon which is energized from a D.-C. energizing source connected to terminals **14** and **16**. The magnetic circuit of magnetic structure **10** includes a gap of relatively high reluctance **18** and armature member **20** positioned across the gap **18**. Note that this high reluctance path is obtained in Figure 5 by means of slots **18***a*, **18***b* and **18***c*.

The flux due to polarizing coil **12** is normally sufficient to maintain the armature **20** sealed thereto in the absence of any other flux source. However, a second flux source is provided by magnetic structure **22** which contains a so-called bucking bar **24** therein which carries the load current of the circuit breaker, or some portion of the load current of the circuit breaker.

Figure 5 more accurately shows the magnetic armature **22** as comprising legs **22***a*, **22***b* and **22***c*. Legs **22***a* and **22***c* are adjustably supported from support means **17** and **19** by pairs of screws **21** and **23** respectively whereby the air gaps between the legs **22***a* and **22***c* with respect to magnetic structure **10** and leg **22***b* is controlled.

The bucking bar **24** will generate a magnetic flux in core **22** which will operate to normally aid the flux in that portion of the magnetic structure **10** which includes armature **20**. However, when there is a fault on the system and the current through bucking bar **24** reverses, the flux through the portion of the magnetic circuit including armature **20** will be bucked down or shifted so that the armature **20** will be released.

Similarly, this system can apply to forward current tripping. That is, the current in the bucking bar is always in a tripping direction and actual tripping occurs when the current reaches a predetermined value.

One application of this type of magnetic latch system is set forth in the circuit breaker device of Figures 2, 3 and 4. The circuit breaker is comprised of a stationary contact 26 and movable contact 28. Movable contact 28 is carried by a conductive contact arm 30 which operates as bucking bar 24 which is pivoted at pivot point 32 and is biased to a contact disengaged position by opening spring 34 which is connected to the contact arm 30 at one end and to a fixed point 36 at its other end. Contact arm 30 is then connected to a walking beam 38 through connecting link 40 where the walking beam 38 is pivotally supported at pivot 42. The lower end of walking beam 38 then supports the armature 20 as described in Figure 1.

The magnetic structure 10 is provided with a protruding support arm 44 which is pivotally connected to the same pivot 42 that supports walking beam 38. The lower end of magnetic structure 10 is connected to the upper end of the toggle linkage including toggle links 46 and 48. The lower end of toggle link 48 is rotatably driven by motor 50 in the manner set forth in my copending application Serial No. 660,970, filed May 22, 1957, entitled High Speed Circuit Breaker, and assigned to the assignee of the instant invention, to drive the toggle linkage 46 and 48 against its normal bias to break to the left as caused by biasing spring 52, while the right-hand motion of the toggle linkage is limited by the stop member 54.

As was described in connection with Figures 1 and 5, the polarizing coil 12 operates as a first flux source for magnet 10 of Figures 2, 3 and 4 while the second flux source, as best seen in Figure 5, includes magnetic legs 22*a*, 22*b* and 22*c* which surround the movable contact arm 24 which generates a flux in the structure 22.

In operation, when the armature 20 is sealed to magnetic structure 10, as shown in Figure 2, the circuit breaker movable contact arm 30 will be rigidly positioned to the left to maintain movable contact 28 in engagement with fixed contact 26 against the opening force of opening spring 34. If, however, the current through contact arm 30 reverses, the net flux in magnetic structure 10 at the area where armature 20 is sealed will be shifted or bucked so that the armature 20 will be released, as seen in Figure 3, to thereby unlatch movable contact arm 30 which is pulled to the right by opening spring 34.

This operation then allows the toggle including links 46 and 48 to be broken to the left, as shown in Figure 4, whereby the magnet 10 rotates about pivot point 42 and is brought into engagement with armature 20, at which time the armature will again seal itself to the magnetic structure. After such sealing, the motor 50 may be energized to drive toggle link 48 clockwise whereby the complete magnet assembly including magnet 10 and armature 20 will be driven counterclockwise so as to drive contact arm 30 to the left and into engagement with stationary contact 26 against the biasing force of spring 34.

In order to calibrate the tripping point of the magnetic latch, it has been the practice to adjust the position of legs 22*a* and 22*c* to thereby adjust the reluctance of the magnetic circuit which includes the bucking bar 24. As previously described, it is necessary to disengage the circuit breaker from the source when this adjustment is to be made since the presence of bucking bar 24 would expose operating personnel to substantial danger during the adjusting operation.

In accordance with the instant invention, the reluctance of the magnetic circuit is preadjusted when the circuit breaker is disconnected from the source of some maximum calibration level. Calibration of the magnetic latch system, while the circuit is engaged, is then achieved by adjusting the ampere-turns of the polarizing coil.



Thus, as is seen in Figure 6, a D.-C. circuit having terminals 60 and 62 is connected in series with terminals 14 and 16 of polarizing coil 12 and in series with a rheostat 64. The rheostat 64 may be positioned at any convenient point so as to be readily available for adjustment.

Accordingly, while the circuit breaker contacts are still closed, the trip level of the magnetic latch may be made more sensitive by increasing the resistance of rheostat 64 or less sensitive by decreasing the resistance of rheostat 64.

The second embodiment of my invention is set forth in Figure 7 in which components similar to those of Figure 6 are given similar identifying numerals. More specifically, the embodiment of Figure 7 illustrates my novel invention in combination with the magnetic latch control system of my above noted copending application Serial No. 719,067. In the circuit of Figure 7, an additional resistor 66 is added in series with polarizing coil 12 where the resistor 66 has a normally closed relay contact 68 associated therewith. Relay contact 68 is schematically indicated by the dotted line as operatively connected to the schematically illustrated circuit breaker contacts 70 so that contact 68 will open only after the circuit breaker contacts 70 close.

Accordingly, prior to closure of the circuit breaker contacts, the ampere-turns of polarizing coil 12 will be relatively high so that a relatively large seal-in force is available to seal the armature of the magnetic latch to its cooperating magnetic structure. When the circuit breaker contacts 70 are closed, however, relay contacts 68 open to thereby place resistor 66 in series with polarizing coil 12 so as to decrease the ampere-turns of polarizing coil 12 to a relatively low holding value.

Clearly, in the circuit of Figure 7, the rheostat 64 will operate in the manner set forth in Figure 6 for precisely adjusting the level of ampere-turns of polarizing coil 12 while the circuit breaker contacts 70 are engaged so as to accurately adjust the calibration of the magnetic latch in any desired manner.

In the foregoing, I have described my invention only in connection with preferred embodiments thereof. Many variations and modifications of the principles of my invention within the scope of the description herein are obvious. Accordingly, I prefer to be bound not by the specific disclosure herein but only by the appending claims.

I claim:

1. In a high speed magnetic latch system for a circuit breaker; a magnetic structure, an armature, and a first and second winding for generating magnetomotive force in said magnetic structure; said armature being movable into and out of a magnetically sealed position with respect to said magnetic structure; said first winding being connected to a source of D.-C. voltage for supplying a first magnetomotive force to said magnetic structure; said second winding conducting a current functionally related to the current carried by said circuit breaker and supplying a second magnetomotive force to said magnetic structure; said second magnetomotive force being directed to oppose said first magnetomotive force in at least the area of said magnetic structure receiving said armature; said magnetic structure having adjustable components for adjusting the reluctance of at least a portion of said magnetic structure, the adjustment of said reluctance of said magnetic structure adjusting the relative effectiveness of said first and second windings in maintaining said armature sealed to said magnetic structure; said first winding and said source of D.-C. voltage having an adjustable impedance means connected in circuit relation therewith; adjustment of said impedance means controlling the ampere-turns supplied to said first winding and further adjusting the relative effectiveness of said first and second

windings in maintaining said armature sealed to said magnetic structure.

2. In a high speed magnetic latch system for a circuit breaker; a magnetic structure, an armature, and a first and second winding for generating magnetomotive force in said magnetic structure; said armature being movable into and out of a magnetically sealed position with respect to said magnetic structure; said first winding being connected to a source of D.-C. voltage for supplying a first magnetomotive force to said magnetic structure; said second winding conducting a current functionally related to the current carried by said circuit breaker and supplying a second magnetomotive force to said magnetic structure; said second magnetomotive force being directed to oppose said first magnetomotive force in at least the area of said magnetic structure receiving said armature; said magnetic structure having adjustable components for adjusting the reluctance of at least a portion of said magnetic structure, the adjustment of said reluctance of said magnetic structure adjusting the relative effectiveness of said first and second windings in maintaining said armature sealed to said magnetic structure; said first winding having an adjustable resistor connected in series therewith; adjustment of said adjustable resistor varying the ampere-turns of said first winding to thereby provide calibration adjustment for said magnetic latch system independently of said adjustment of the reluctance of said magnetic structure.

3. In a high speed circuit breaker; a relatively fixed contact and a relatively movable contact movable into and out of engagement with said relatively fixed contact; a magnetic latch means for latching said circuit breaker contacts in engagement; said magnetic latch means including a magnetic structure, an armature, a polarizing coil and a bucking coil; said polarizing coil and said bucking coil being wound on said magnetic structure; said armature being movable into and out of a magnetically sealed position with respect to said magnetic structure; said armature being operatively connected to said circuit breaker movable contact to latch said contact in its engaged position when said armature is sealed to said magnetic structure, and to unlatch said contact when said armature is moved away from its said sealed position; said polarizing coil having an energizing circuit associated therewith; said energizing circuit being constructed to energize said polarizing coil to cause said polarizing coil to generate a relatively large number of ampere-turns to circulate from said magnetic structure to said armature when said armature is being moved towards its said magnetically sealed position and said movable circuit breaker contact is moved toward its said engaged position; said energizing circuit decreasing the number of ampere-turns generated by said polarizing coil after said armature is in its said magnetically sealed position to a level sufficient to normally maintain said armature in said magnetically sealed position; said bucking coil being operable responsive to fault conditions to buck down the ampere-turns sealing said armature to said magnetic structure to thereby unlatch said movable circuit breaker contact; said energizing circuit further having an adjustable resistor associated therewith to adjust the ampere-turns supplied to said polarizing coil when said circuit breaker contacts are closed.

4. In a high speed circuit breaker; a relatively fixed contact and a relatively movable contact movable into and out of engagement with said relatively fixed contact; a magnetic latch means for latching said circuit breaker contacts in engagement; said magnetic latch means including a magnetic structure, an armature, a polarizing coil and a bucking coil; said polarizing coil and said bucking coil being wound on said magnetic structure; said armature being movable into and out of a magnetically sealed position with respect to said magnetic structure; said armature being operatively connected to said circuit breaker movable contact to latch said contact in its engaged position when said armature is sealed to said magnetic structure, and to unlatch said contact when said armature is moved away from its said sealed position; said polarizing coil having an energizing circuit associated therewith; said energizing circuit being constructed to energize said polarizing coil to cause said polarizing coil to generate; ampere-turns to circulate from said magnetic structure to said armature for magnetically sealing said armature to said magnetic structure and maintain said circuit breaker movable contact in its engaged position; said bucking coil being operable responsive to fault conditions to buck down the ampere-turns sealing said armature to said magnetic structure to thereby unlatch said movable circuit breaker contact; said energizing circuit further having an adjustable resistor associated therewith to adjust the ampere-turns supplied to said polarizing coil when said circuit breaker contacts are closed.



5. In a magnetic latch structure for circuit breakers; said magnetic latch structure including a first magnetic structure, a second magnetic structure, an armature, a polarizing winding for said first magnetic structure and a circuit breaker current responsive winding for said second magnetic structure; said armature being movable into and out of magnetically sealed relationship with respect to said first magnetic structure at a predetermined portion thereof; said polarizing winding having a first source of ampere-turns associated therewith for generating a magnetomotive force in said first magnetic structure for sealing said armature to said predetermined portion of said first magnetic structure; said second magnetic structure being positioned to include said predetermined portion of said first magnetic structure in its magnetic circuit; said circuit breaker current responsive winding generating a magnetomotive force in the magnetic circuit of said second magnetic structure to normally aid said magnetomotive force of said first magnetic structure in sealing said armature to said first magnetic structure, reversal of current in said circuit breaker current responsive winding operating to decrease the net magnetomotive force sealing said armature to said first magnetic structure; a variable resistance; said variable resistance being connected in circuit relation with said polarizing coil to control the ampere-turns supplied to said polarizing coil by said source of ampere-turns; adjustment of said variable impedance adjusting the point at which said armature will be released from said first magnetic structure responsive to reversal of current in said circuit breaker current responsive winding.

6. In a magnetic latch structure for circuit breakers; said magnetic latch structure including a first magnetic structure, a second magnetic structure, an armature, a polarizing winding for said first magnetic structure and a circuit breaker current responsive winding for said second magnetic structure; said armature being movable into and out of magnetically sealed relationship with respect to said first magnetic structure at a predetermined portion thereof; said polarizing winding having a first source of ampere-turns associated therewith for generating a magnetomotive force in said first magnetic structure for sealing said armature to said predetermined portion of said first magnetic structure; said second magnetic structure being positioned to include said predetermined portion of said first magnetic structure in its magnetic circuit; said circuit breaker current responsive winding generating a magnetomotive force in the magnetic circuit of said second magnetic structure to normally aid said magnetomotive force of said first magnetic structure in sealing said armature to said first magnetic structure, reversal of current in said circuit breaker current responsive winding operating to decrease the net magnetomotive force sealing said armature to said first magnetic structure; said magnetic circuit of said second magnetic structure having an adjustable member therein for adjusting the reluctance of said magnetic circuit; a variable resist-

ance; said variable resistance being connected in circuit relation with said polarizing coil to control the ampere-turns supplied to said polarizing coil by said source of ampere-turns; adjustment of said variable impedance adjusting the point at which said armature will be released from said first magnetic structure responsive to reversal of current in said circuit breaker current responsive



winding; said reluctance of said magnetic circuit being adjusted while said circuit breaker associated with said magnetic latch is disconnected from its source; said variable resistance being adjustable while said circuit breaker is connected to its source.

No references cited.