Oct. 14, 1952 B. C. ROGERS 2,614,191

HIGH-VOLTAGE BREAKER AND RECLOSER

Filed May 11, 1949 2 SHEETS—SHEET 1

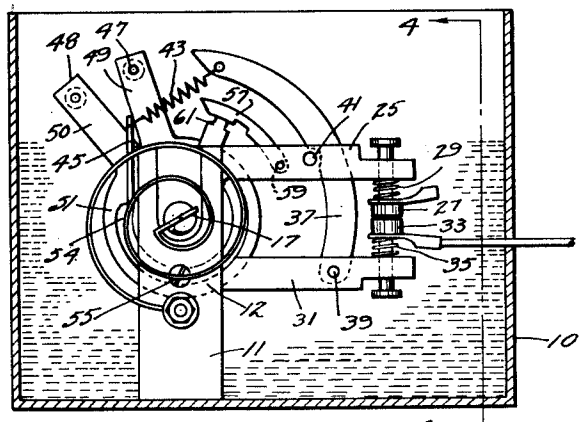

FIG. 1.

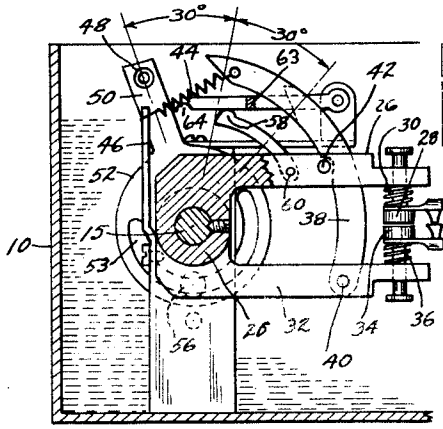

FIG. 2.

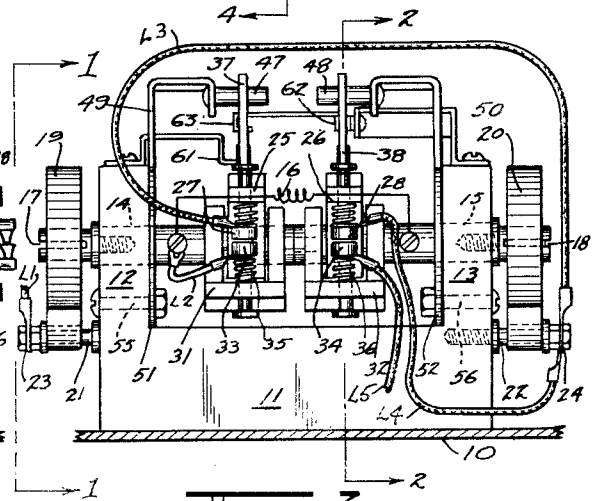

FIG. 3.

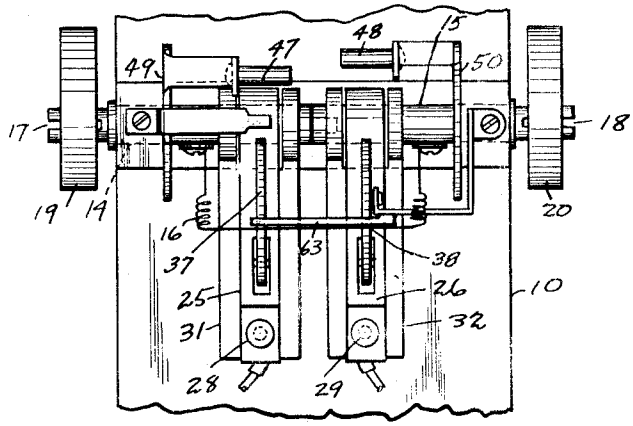

FIG. 4.

INVENTOR.
Bertram C. Rogers.
BY W. B. Harpman
ATTORNEY.

Oct. 14, 1952 B. C. ROGERS 2,614,191

HIGH-VOLTAGE BREAKER AND RECLOSER

Filed May 11, 1949 2 SHEETS—SHEET 2

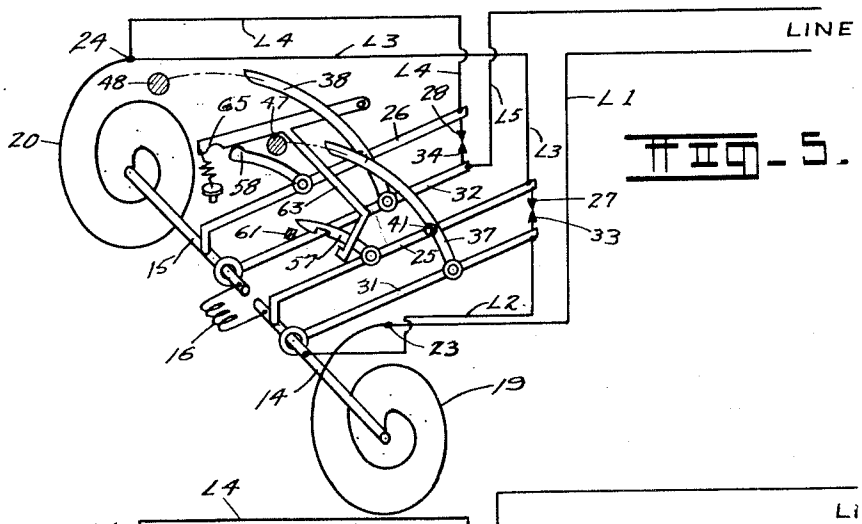

FIG. 5.

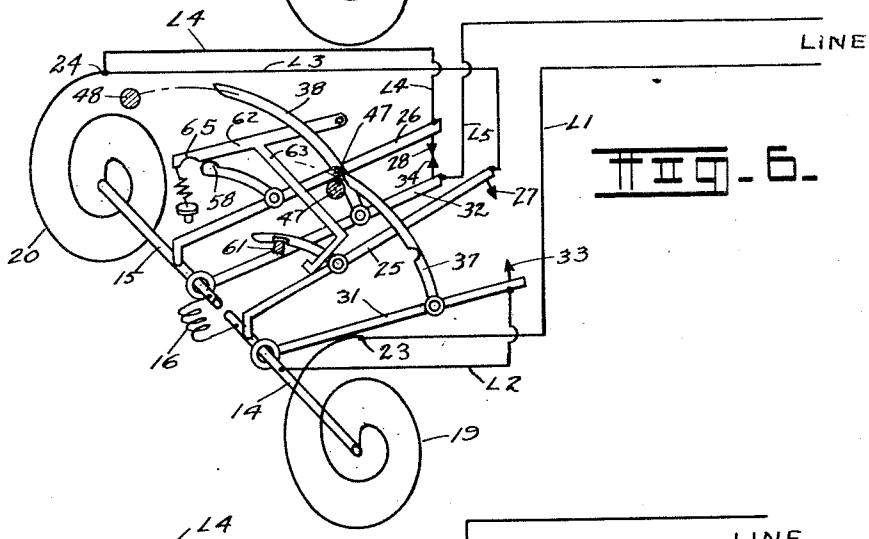

FIG. 6.

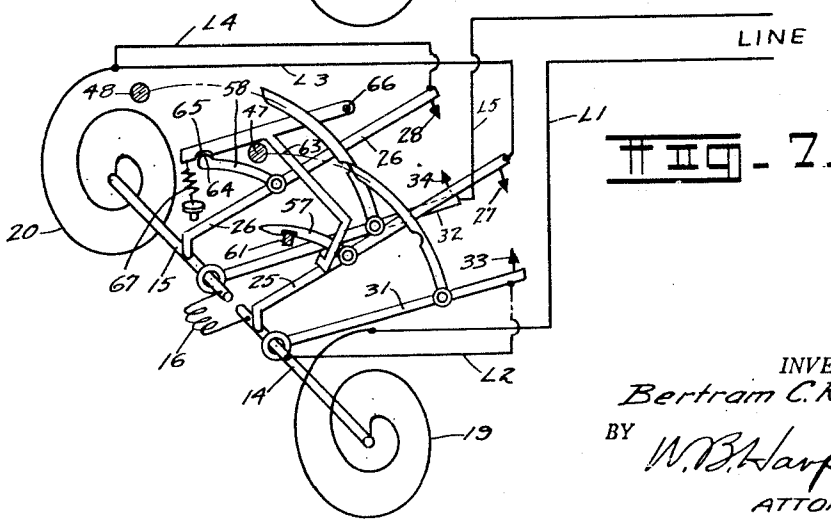

FIG. 7.

INVENTOR.
Bertram C. Rogers.
BY W. B. Harpman
ATTORNEY.

Patented Oct. 14, 1952

2,614,191

UNITED STATES PATENT OFFICE

2,614,191

HIGH-VOLTAGE BREAKER AND RECLOSER

Bertram C. Rogers, Sharon, Pa.

Application May 11, 1949, Serial No. 92,662

5 Claims. (Cl. 200—116)

1

This invention relates to circuit breakers and more particularly to automatically reclosing circuit breakers for high voltage circuits.

The principal object of the invention is the provision of a high voltage circuit breaker and recloser which will operate to open and subsequently reclose a high voltage circuit line at such time as an excessive current occurs thereon.

A further object of the invention is the provision of a high voltage circuit breaker and recloser which may be simply and economically constructed and which is particularly adapted for the protection of the high voltage transformers.

A still further object of the invention is the provision of a high voltage circuit breaker and recloser which is entirely automatic in operation and which will operate to continuously open and reclose an overloaded high voltage circuit until such time as the overloaded condition is eliminated and without damage to the circuit breaker itself or the transformer or other devices protected by its operation.

A still further object of the invention is the provision of an automatic thermally controlled high voltage circuit breaker that will open without arcing upon being overloaded and reclose without arcing upon completion of a predetermined timing cycle and repeat the opening and reclosing cycle as long as the overload condition exists or until locked out by auxiliary locking means which can be incorporated in the construction.

A still further object of the invention is the provision of an automatic high voltage circuit breaker and reclosing circuit incorporating thermal responsive means as a prime mover for the operating mechanism thereof, impedance creating means in the high voltage circuit controlled and heat storing means for the thermal control and timing of the operating cycle of the circuit breaker and recloser.

A still further object of the invention is the provision of a high voltage circuit breaker and recloser incorporating means responsive to an overload in the said circuit for introducing impedance means in the said circuit and breakers for the said circuit responsive to thermal action of the said impedance means for breaking the said circuit and subsequently reclosing the same.

The high voltage circuit breaker and recloser disclosed herein is particularly adapted for protective use in connection with high voltage circuits and may be incorporated in high voltage transformers in the high side thereof for protecting the same upon short-circuits or overloads.

2

The device may obviously be used in connection with the protection of other high voltage equipment and is capable of operating automatically and indefinitely without manual attention or resetting as it is designed to protect itself as well as the associated equipment in the high voltage circuit supervised.

The device is intended to be enclosed in an oil filled housing and may obviously be enclosed in the same housing as the coolant provided in high voltage transformers and the like.

With the foregoing and other objects in view which will appear as the description proceeds, the invention resides in the combination and arrangement of parts and in the details of construction hereinafter described and claimed, it being understood that changes in the precise embodiment of the invention herein disclosed can be made within the scope of what is claimed without departing from the spirit of the invention.

The invention is illustrated in the accompanying drawing, wherein:

Figure 1 is a side view of the circuit breaker and recloser.

Figure 2 is a cross sectional view of the circuit breaker and recloser.

Figure 3 is a front plan view of the circuit breaker and recloser.

Figure 4 is a top plan view of the circuit breaker and recloser.

Figure 5 is a symbolic view of the circuit breaker and recloser and electrical circuits in connection therewith in normal closed circuit position.

Figure 6 is a symbolic view of the circuit breaker and recloser and electrical circuits in connection therewith showing the first stage of operation of the device responsive to an overload.

Figure 7 is a symbolic view of the circuit breaker and recloser and electrical circuits in connection therewith showing the circuit opened.

By referring to the drawings and Figures 1 to 4 in particular it will be seen that a high voltage circuit breaker and recloser has been illustrated which comprises a mechanism preferably enclosed in a housing 10 capable of retaining cooling liquid such as oil so that the mechanism of the circuit breaker is immersed therein. The mechanism itself includes an insulating frame 11 having a pair of spaced upwardly extending arms 12 and 13 and the arms carry a pair of shafts 14 and 15 journaled therein for rotary movement. The inner ends of the shafts 14 and 15 are movably engaged one upon the other and electrically

connected one to the other by means of a flexible conductor 16.

Each of the shafts 14 and 15 extend outwardly beyond the sides of the arms 12 and 13 and each has a slot 17 and 18, respectively, which serve to position and retain the ends of a pair of spirally wound bimetallic conductors 19 and 20. The outermost ends of the spirally wound bimetallic conductors 19 and 20 are secured to pins 21 and 22, respectively, which are in turn engaged in the insulating frame 11. The pins 21 and 22 serve to hold the ends of the spirally wound bimetallic conductors 19 and 20 in fixed position with respect to the insulating frame 11. Each of the pins 21 and 22 has a line terminal 23 and 24, respectively, formed thereon. Each of the shafts 14 and 15 has a contact arm 25 and 26, respectively, secured thereto and extending outwardly therefrom on a plane above the center thereof as best shown in Figures 1 and 2 of the drawings. The arms 25 and 26 are formed of insulating material and have floating contacts 27 and 28, respectively, positioned on their outermost ends, as best shown in Figures 1 and 2 of the drawings. The contacts 27 and 28 are normally spaced with respect to the outermost ends of the arms 25 and 26 by coil springs 29 and 30, respectively.

The shafts 14 and 15 also pivotally support a pair of secondary arms 31 and 32, the outermost ends of which lie directly in under the outermost ends of the arms 25 and 26. Floating contacts 33 and 34 are positioned on the upper surfaces of the ends of the arms 31 and 32 for normal registry with the contacts 27 and 28 heretofore referred to. The contacts 33 and 34 are spaced with respect to the arms 31 and 32 by coil springs 35 and 36. Each of the arms 25 and 26 has a vertical opening inwardly from their outermost ends and each of the arms 31 and 32 has an arcuate latch 37 and 38, respectively, pivoted thereto as at 39 and 40. The arcuate latches 37 and 38 extend upwardly from the arms 31 and 32 and pass through the vertical openings in arms 25 and 26 and are notched along their inner surfaces so that they will register with latch pins 41 and 42 positioned in the arms 25 and 26, respectively, and transversely of the openings therein through which the arcuate latches 37 and 38 are positioned.

It will thus be seen that the arm 31 is held in fixed spaced relation with respect to the arm 25 by the latch member 37 engaged upon the pin 41 and thereby holding the contacts 27 and 33 in engagement to complete an electrical circuit therethrough. The arcuate latch 38 holds the arms 32 and 26 in spaced fixed position thereby positioning the contact members 28 and 34 in engagement and closing a circuit therethrough. The arcuate latches 37 and 38 are normally held in engagement with the pins 41 and 42 by a pair of coil springs 43 and 44 which are connected between the uppermost ends of the arcuate latches 37 and 38 and a pair of vertical supports 45 and 46 which are secured to the rearmost portions of the arms 31 and 32, respectively. It will thus be seen that any rotating motion imparted to the shafts 14 or 15 by the spiral bimetallic conductors 19 or 20 will lift the arms 25 and 26 and the arms 31 and 32 by reason of the connection of the arcuate latches 37 and 38.

In order that the arcuate latches 37 and 38 may be released upon predetermined movement of the arms 25 and 26 and the arms 31 and 32 released from their fixed spaced position with respect thereto, a pair of release pins 47 and 48 are positioned in the path of the arcuate latches 37 and 38 and spaced with respect to the end thereof 30° and 60°, respectively. Positioning of the release pins 47 and 48 is adjustable as they are carried on extensions 49 and 50 of disc-like members 51 and 52, each of which is pivotally positioned on the shaft 14 and 15 and is provided with a radial slot 53 and 54, respectively, through which bolts 55 and 56 positioned through transverse openings in the arms 12 and 13 are engaged so that the release pins 47 and 48 may be adjusted by loosening the bolts 55 and 56 and rotating the disc-like members 51 and 52.

Still referring to Figures 1 and 2 of the drawings it will be seen that each of the upper ends of the latches 37 and 38 is provided with a cam surface for slidable engagement with the release pins 47 and 48 whereby the latches 37 and 38 may be lifted so as to disengage the same from the latch pins 41 and 42 heretofore described. Such action frees the arms 31 and 32 from their latched engagement from the arms 25 and 26 and permits the same to drop. Secondary latches are formed on each of the arms 25 and 26 and comprise latch members 57 and 58 pivoted as at 59 and 60 to the arms 25 and 26, respectively, and adapted to be releasably engaged upon secondary latch pins 61 and 62 which in turn are carried by the body members 51 and 52.

In Figures 3 and 4 of the drawings an interconnecting latch releasing arm 63 is arranged to release the secondary latch arm 57 upon the predetermined release of the secondary latch arm 58 as hereinafter described.

By referring now to Figures 5, 6 and 7 of the drawings symbolic illustrations of the high voltage circuit breaker and reclosed may be seen in connection with the wiring diagrams and showing the normal closed circuit and circuit opening action of the device.

In Figure 5 of the drawings the high voltage line supervised is indicated by the legend "line" and it will be observed that one side thereof is connected by means of a conductor L1 with the terminal 23 on the fixed end of the spirally wound bimetallic conductor 19, the current normally flowing through the terminal 23, the spirally wound bimetallic conductor 19 and the shaft 14 and through a conductor L2 to the contact 33 on the outermost end of the arm 31 which is normally in registry with the contact 27 on the outermost end of the arm 25. A conductor L3 connects the contact 27 with the terminal 24 on the fixed end of the spirally wound bimetallic conductor 20 and a conductor L4 connects the terminal 24 with the contact 28 on the outermost end of the arm 26. The contact 28 is normally closed with the contact 34 on the outer end of the arm 32 and a conductor L5 connects the contact 34 with the other side of the line. It will thus be seen that the normal flow of the current through the high voltage circuit breaker and recloser as shown in Figure 5 of the drawings is by way of the line L1, the bimetallic conductor 19, the shaft 14, the conductor L2 and through the contacts 33 and 27, through the conductor L3 and L4, through the contact points 28 and 34 and conductor L5 to complete the circuit. At such time as an overload or short exists on the line supervised, the additional flow of current through the conductor 19 will heat the same and cause the operation illustrated symbolically in Figure 6 of the drawings.

By referring to Figure 6 of the drawings it will

be seen that the heating of the bimetallic conductor 19 has caused the same to rotate the shaft 14 so as to lift the arm 25 which in turn lifts the arm 31 by reason of the arcuate latch 37 until the arm 25 has moved through 30° at which time the latch 37 will strike the release pin 41 and release the arcuate latch 37 from the latch pin 41 and permit the arm 31 to drop thereby breaking the circuit between the contacts 33 and 27.

It will be obvious to those skilled in the art that ordinary line fluctuations will not sufficiently heat the bimetallic conductor 19 to cause it to rotate the shaft 14 through the 30° of motion necessary to effect the unlatching of the arcuate latch 37 and that the circuit breaker and recloser remains inoperative during such ordinary line fluctuations, the arms 25 and 31 rising and falling responsive to the thermal action of the spiral bimetallic conductor 19 which is in the normal circuit.

When the hereinbefore described releasing action does occur, as responsive to an overload or short in the supervised line, the current then flows through the conductor L1, the bimetallic element 19, the shaft 14, the connection 16, the shaft 15 and the bimetallic conductor 20 and from the bimetallic conductor 20 through the conductor L4, the contacts 28 and 34 and the conductor L5. The current flowing through the spiral bimetallic conductor 20 will heat the same and cause the shaft 15 to revolve and when the same has revolved through 60° the end of the arcuate latch 38 will strike the release pin 48 and release the arm 32 which will then drop and open the contacts 34 and 28 thereby breaking the circuit. This action is illustrated in Figure 7 of the drawings wherein both pairs of contacts 33 and 27 and 34 and 28 are shown in open position.

In Figures 5, 6 and 7 of the drawings there are also shown schematic arrangements of the secondary arms 57 and 58 together with the latch releasing arm 63. The secondary arms 57 and 58 and latch releasing arm 63 function to first hold the arms 25 and 26 in elevated relation and then simultaneously release the same so that the contacts 23, 27, 24 and 28 will simultaneously reclose the circuit through the device. As heretofore explained, the secondary arm 57 is adapted to latch on the secondary latch pin 61 when the arm 25 is moved 30° from normal horizontal position by the action of the spiral bimetallic conductor 19 with the result that the arm 25 is held in elevated relation by the secondary latch pin 61, as shown in Figure 6 of the drawings.

At such time as the arm 26 rises through 60°, the secondary arm 58, and more particularly a raised outer end portion 64 thereof, engages a socket 65 formed in a right angle extension of the latch releasing arm 63. The other end of the right angle extension of the latch releasing arm 63 is pivoted as at 66 to the framework of the device and the free end is urged against the secondary arm 58 by a tensioning spring 67 which is adjustably connected to the frame of the device. Thus, at such time as the circuit breaker has operated to break the circuit, the cooling of the spiral bimetallic conductor 20 will tend to rotate the shaft 15 clockwise and at such time as sufficient energy is developed the secondary arm 58 will disengage the socket 65 by pulling outwardly therefrom, which action will elevate the latch releasing arm 63 and simultaneously lift the secondary arm 57 from its engagement with the secondary latch pin 61. This action frees both the arms 25 and 26 and permits them to drop and

simultaneously reclose the contacts 33, 27, 34 and 28 and thus re-establish the circuit in its normal path through the device.

It will occur to those skilled in the art that the reclosing of the circuit controlling contacts simultaneously avoids arcing which would otherwise occur if one of the pairs of contacts closed in advance of the other. The operation of the device is such that it is particularly adaptable to adjustment as for timing the cycling action, which adjustment is made by varying the winding of the spiral bimetallic conductors 19 and 20 with relation to their attachment to the ends of the shafts 14 and 15, respectively.

It will thus be seen that in operation the high voltage circuit breaker and recloser operates on a definite predetermined cycle and provides for varying line load conditions and current fluctuations which would ordinarily tend to cause the circuit breaker and recloser to operate.

In the present device the ordinary and permissible variations are anticipated by the construction and operation of the device as, for example, the operation of the spiral bimetallic conductor 19 which is always in circuit with the line and heating of which will lift the arms 25 and 31. This action does not start the cycle of operation of the circuit breaker and recloser until such time as a predetermined movement of the bimetallic conductor 19 moves the arms 25 and 33 through 30° from normal horizontal position. Once this movement occurs and attains the 30° elevation from normal, the arm 25 is lifted in elevated position by the secondary arm 57 and the arm 31 is unlatched and dropped to cause the current to travel through the spiral bimetallic conductor 20, heat the same and elevate the arm 26 to 60°, at which point the arm 32 is released and the circuit broken.

The reclosing cycle of the device is controlled by the time it takes the spiral bimetallic conductor 20 to cool sufficiently to overcome the tension of the adjustment spring 67 and disengage the secondary arm 58 from its latched position. Upon such occurrence, both the secondary arms 57 and 58 are unlatched and the arms 25 and 26 are free to reclose the circuit controlling contacts.

It will thus be seen that an action novel in the art of circuit breakers and reclosers has been incorporated in the device disclosed herein in that the actual opening of the circuit is performed by mechanical means (the spiral bimetallic conductor 20) which is, in effect, shunted into the circuit upon the opening of the contact arms controlled by the bimetallic conductor 19. Both of the spiral bimetallic conductors produce energy from the thermal action of the current flowing therethrough and the spiral bimetallic conductor 20, in addition to serving as a prime mover, creates desirable impedance in the circuit immediately prior to the opening of the circuit to the end that arcing is very substantially reduced if not eliminated.

It will be obvious to those skilled in the art that the device is adaptable to the automatic control of relatively high voltages by merely increasing the proportionate size and length of the various component parts to the end that their normal closed circuit and operating cycle open circuit positions are sufficient to avoid arcing between the several current carrying parts. It will also occur to those skilled in the art that if desired an arcing point may be added to the construction of the contacts 27, 33, 28 and 34,

although the same are apparently not necessary at voltages up to and including 2400 volts.

It will thus be seen that the high voltage breaker and recloser disclosed herein meets the several objects of the invention.

Having thus described my invention, what I claim is:

1. A circuit breaker and recloser having two pairs of series connected separable contacts, a pair of latch mechanisms interconnecting said separable contacts and normally holding said contacts in closed circuit position, a thermally responsive element in said circuit arranged to move one of one of said two pairs of separable contacts in response to overload current therethrough, a secondary thermally responsive element connected in a shunt circuit around said first pair of separable contacts and arranged to move one of the other one of said two pairs of separable contacts responsive to current flow therethrough, and means engageable with one of the said latch mechanisms upon predetermined movement of said first mentioned pair of separable contacts to unlatch said latch mechanisms to permit said first mentioned pair of separable contacts to open and means engageable with the other of said latch mechanisms to unlatch the second mentioned pair of separable contacts responsive to movement thereof occasioned by said secondary thermally responsive element, and secondary latch means for holding said movable contacts in open position and responsive in releasing action to reverse motion of said thermally responsive elements as occasioned by the cooling thereof.

2. The circuit breaker and recloser set forth in claim 1 and wherein the thermally responsive elements comprise spiral bimetallic elements.

3. The circuit breaker and recloser set forth in claim 1 and wherein the two pairs of separable contacts are positioned on two pairs of arms and wherein one of each of said two pairs of arms is affixed to a rotatable shaft and wherein said thermally responsive elements comprise spiral bimetallic conductors arranged to rotate said shafts, and wherein the other one of each of said two pairs of arms is pivotally mounted on one of said shafts and wherein the shunt circuit around the said first pair of separable contacts comprises a shunt interconnecting said rotatable shafts.

4. The circuit breaker and recloser set forth in claim 1 and wherein each of the two pairs of separable contacts includes spring means normally biasing said pairs of contacts toward each other.

5. The circuit breaker and recloser set forth in claim 1 and wherein the means engageable with said latch mechanisms comprise stationary structural elements positioned in the path of said latch mechanisms.

BERTRAM C. ROGERS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,071,848	Lindstrom	Feb. 23, 1937
2,199,622	Dorfman	May 7, 1940
2,361,221	Ludwig et al.	Oct. 24, 1944
2,436,909	Werner	Mar. 2, 1948
2,462,244	Wise	Feb. 22, 1949