

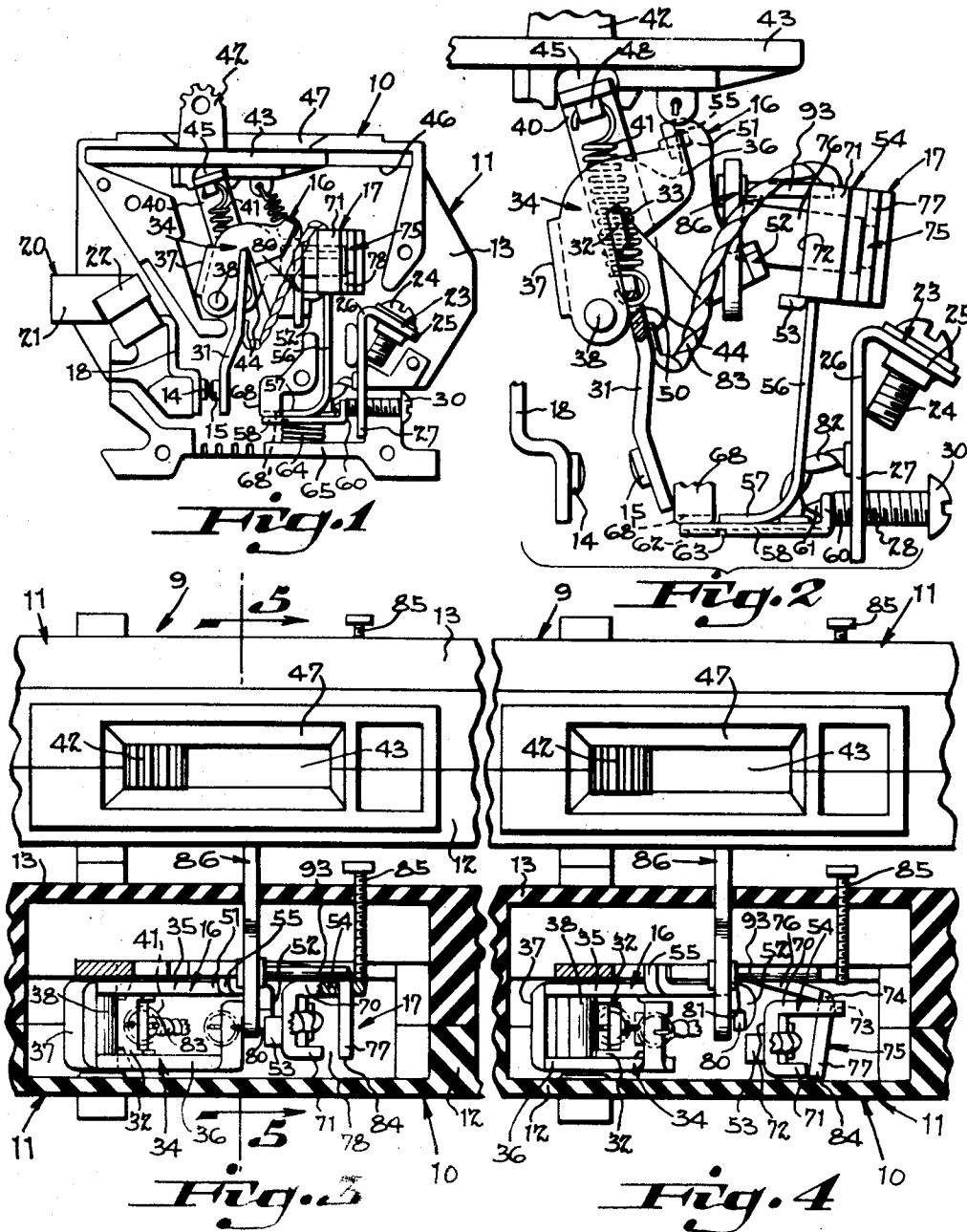
Oct. 11, 1960

W. H. MIDDENDORF
MULTIPOLE CIRCUIT BREAKER

2,956,133

Filed July 16, 1958

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

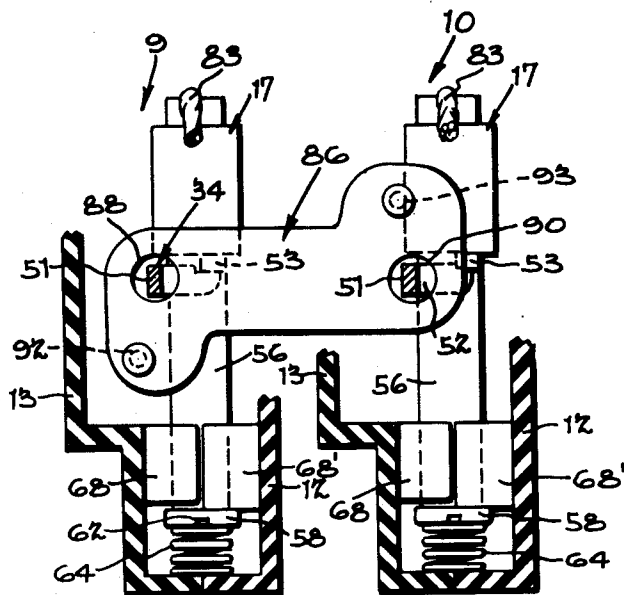


Fig. 5

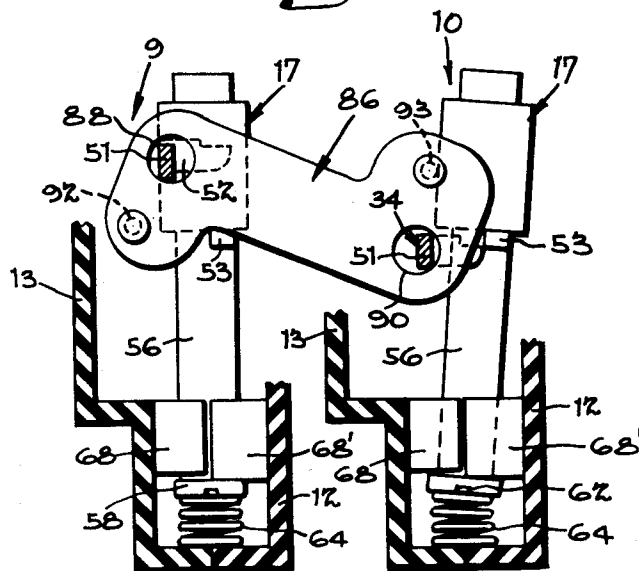


Fig. 6

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3 Sheets-Sheet 3

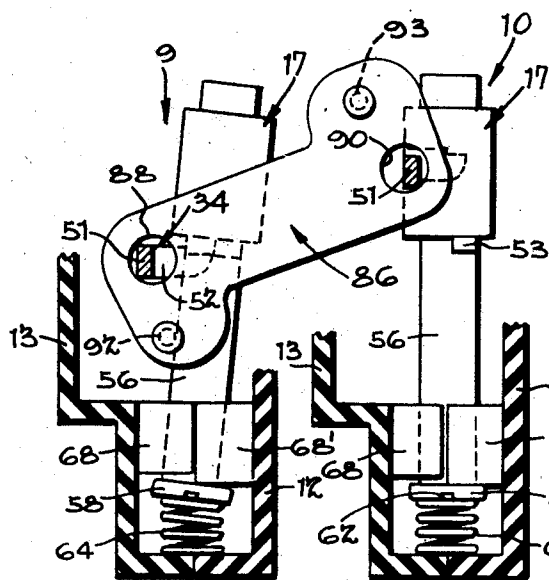


Fig. 7

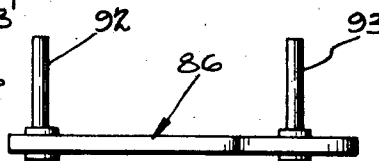


Fig. 9

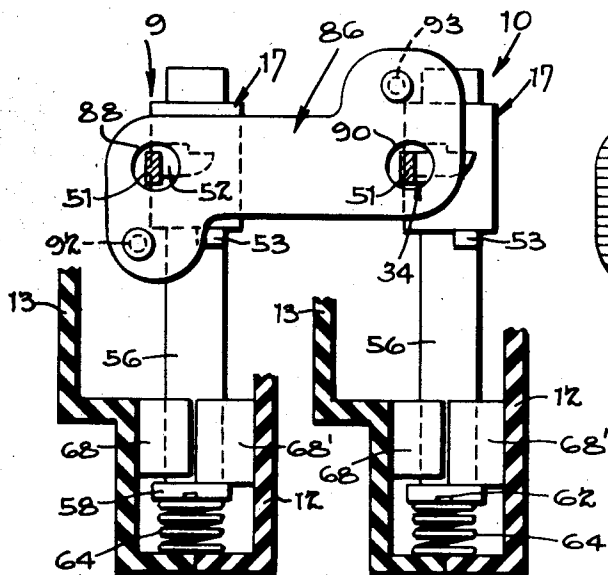


Fig. 8

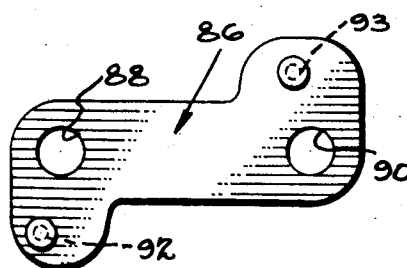


Fig. 10

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2,956,133

MULTIPOLE CIRCUIT BREAKER

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Filed July 16, 1958, Ser. No. 748,941

14 Claims. (Cl. 200—88)

This invention relates to circuit breakers and is particularly directed to a multipole circuit breaker comprising paired single-pole circuit breakers each of which is opened in response to an overload in its circuit, and a tripping device which is common to the single-pole circuit breakers for mechanically effecting the release of all of the breakers when any one of the breakers of the assembly is opened.

The principal object of the present invention is to provide a multipole circuit breaker comprising a plurality of component single-pole circuit breakers of standard construction and having a common tripping device for tripping all of the poles upon the occurrence of an overload in the circuit of any one of the poles.

The present application is a continuation-in-part of my copending patent application Serial No. 601,783 for "Circuit Breaker," filed August 2, 1956, now Patent No. 2,848,577. That application discloses and claims a novel single-pole circuit breaker which is uniquely adapted to be assembled with other like breakers to provide a multipole breaker in the manner herein disclosed. Essentially, the single-pole circuit breaker disclosed in my copending application is adapted for use in household-distribution circuits, or the like, to protect against fire hazards resulting from overheating of the circuit conductors as a consequence of overloading or short circuiting. While single-pole breakers of this type are adequate for many installations, there are other places where it is necessary or desirable for safety reasons to provide independently operable circuit breakers in each of the legs of a single or multiple phase circuit so that each leg will be protected individually.

In the past, various multipole circuit breakers have been proposed for such service. However, the multipole circuit breakers of the type heretofore available have been of relatively specialized design and frequently have not been readily available for home service. These special multipole breakers have also been disadvantageous since their size and shape frequently requires special accommodations at the panel board.

The present invention contemplates a multipole circuit breaker which is assembled from a plurality of identical single-pole circuit breakers which are readily installed in the panel boards conventionally provided in residential construction and which are mechanically interconnected for multipole cooperation by means of a simple common tripping element.

One advantage of the present multipole unit is that it is economical to produce since the component single-pole circuit breakers are identical with one another and can be economically mass produced; while the common tripping elements interconnecting the breakers are extremely simple members which are also very inexpensively produced. Moreover, construction of the tripping members and component breakers is such that they may quickly and easily be assembled into a multipole unit of any size to protect as many legs of a circuit as required.

A further advantage of the present construction is that

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the bimetallic strip is not flexed either during movement of the magnetic tripping elements of the circuit breaker, during release of the breaker in response to the tripping of an adjacent breaker, or during resetting of the breaker.

- 5 Consequently, even a heavy duty circuit breaker requires but a minimum force to trip the operating mechanism. This facilitates the provision of a circuit breaker in which the contacts are rapidly opened at a substantially smaller overload current than was previously practicable. Moreover, the bimetallic strip is not subjected to any distort-
10 ing force which might cause it to become permanently bent or warped with the result that the circuit breaker would become desensitized or decalibrated.

- One preferred form of component circuit breaker constructed in accordance with the present invention com-
15 prises a spring actuated contact operating mechanism and a tripping mechanism including an elongated bimetallic strip which thermally flexes in one direction to release the operating mechanism and carries a magnetic core
20 which is adapted to be shifted transversely to the plane of flexure of the bimetallic strip to effect release of the operating mechanism. The bimetallic strip is not rigidly mounted in the breaker housing but rather is mounted upon a movable support plate. The support plate is
25 spring urged against suitable abutment elements so that the support plate holds one end of the bimetallic strip stationary during bending of the strip under thermal stresses but is free to pivot in a plane transverse to the plane of bimetallic flexure when the magnetic core is
30 energized.

- In one form of the invention the bimetallic strip also carries a latching surface disposed to cooperate with a member of the operating mechanism. This latching sur-
35 face is thus disengaged from the operating mechanism in one direction in response to thermal action of the bimetallic strip and in a second direction at right angles in response to the actuation of the magnetic core.

- The single-pole circuit breakers are adapted for multi-
40 pole service by means of a common trip element adapted to be secured to the operating mechanisms of two adjacent breakers and to pivot upon the tripping of one of the breakers. The cooperating member is provided with abutments adapted to engage an element associated with the latching surface, such as the bimetallic strip,
45 and to shift that surface in substantially the same direction that it is shifted by its associated magnetic elements to effect release of the operating mechanism.

- These and other objects and advantages of the present invention will be more readily apparent from a considera-
50 tion of the following detailed description of the drawings illustrating a preferred embodiment of the invention.

In the drawings:

- Figure 1 is a vertical elevational view of a component
55 circuit breaker constructed in accordance with the present invention, with the front housing removed.

- Figure 2 is an enlarged elevational view of the circuit
breaker showing details of the tripping and operating
mechanism.

- Figure 3 is a top plan view of a pair of single-pole cir-
60 cuit breakers equipped for multipole service in accordance with the present invention, the top portion of one of the breakers being broken away to show the carrier in its latched position.

- Figure 4 is a top plan view partially broken away,
65 similar to Figure 3, showing the manner in which the carrier is released by action of the magnetic core and armature.

- Figure 5 is a cross-sectional view taken along line 5—5
70 of Figure 3 showing the two circuit breakers in a latched position.

Figure 6 is a cross-sectional view similar to Figure 5

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showing the movement of the common trip element at the moment when the left hand breaker has become tripped in response to an overload.

Figure 7 is a cross-sectional view similar to Figure 5 showing the movement of the common trip member at the moment when the right hand circuit breaker has been tripped in response to an overload condition.

Figure 8 is a cross-sectional view similar to Figure 5 showing both circuit breakers in unlatched position.

Figure 9 is a top plan view of the common trip member.

Figure 10 is an elevational view of the common trip member.

One preferred form of multipole breaker constructed in accordance with the present invention includes two or more component circuit breakers of the type disclosed and claimed in my copending application Serial No. 601,783 for "Circuit Breaker," filed August 2, 1956. The single-pole circuit breaker disclosed in that application will first be described in detail in order to provide a better understanding of the manner in which two such breakers are interconnected by a common tripping member to provide a multipole circuit breaker.

As is best shown in Figures 1-4, a preferred form of circuit breaker 10 comprises a housing 11 formed of two mating sections 12 and 13 constructed of molded insulating material such as "Bakelite," or the like. The housing encloses a stationary contact 14, a movable contact 15, an operating mechanism 16 for shifting the movable contact into and out of engagement with the stationary contact, and a latching mechanism 17 for releasably holding the operating mechanism.

The stationary contact 14 is welded or otherwise rigidly secured to a conducting strip 18. This strip, which is of an irregular configuration, is seated in a multiple angular slot provided in the housing and is secured at its outer end to terminal connecting means 20, preferably in the form of two spaced outwardly extending contact jaws 21. The jaws are adapted to receive a contact blade or other conductive element and are spring urged into contact with such an element by means of a U-shaped spring clip 22. At the opposite end of the housing 11 is a terminal 23 including a screw 24 threadably engaging an opening in arm 25 of conductor strip 26. This strip includes a leg 27 rigidly supported in a suitable groove formed in the housing walls. Leg 27 is provided with a threaded opening 28 adapted to receive calibrating screw 30, the function of which is explained in detail below.

Movable contact 15 is welded or otherwise rigidly secured to the free end of switch arm 31. This switch arm is provided with two legs 32 disposed at its upper end, the legs being pivotally supported in recesses 33 formed in carrier member 34. Switch arm 31 and carrier 34 constitute two elements of operating mechanism 16 for shifting the movable contact between an open and closed position. Carrier member 34 includes two spaced parallel arms 35 and 36 joined by a cross strip 37. The arms are provided with aligned openings for receiving a pin 38 which extends across the housing and is journaled in suitable openings provided in the opposite housing sections.

In addition to switch arm 31 and carrier 34, operating mechanism 16 includes an operating lever 40, a main operating spring 41, a handle 42 and a plate 43 integral with the handle. Operating lever 40 is mounted adjacent to wall 11 of the housing between that wall and carrier 34. The lower end of this lever is pivotally supported by an arcuate shoulder 44 provided in the housing wall. The upper end of the lever is received within a recess 45 formed in the under surface of plate 43. The plate is adapted for reciprocating movement within the housing and is guided in its movement by guideways 46 formed in the housing walls. Handle 42, formed integrally with the plate, extends outwardly through an opening 47 formed in the front face of the housing and provides a

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ready means for shifting the plate and operating lever. The upper end of the operating lever is provided with a tang 48 adapted to engage one end of the spring 41, the other end of the spring being secured to the upper end of switch arm 31 in any suitable manner, as by passing the end of the spring through a suitable opening 50 formed in that arm. It will be appreciated that spring 41 functions as an over center spring effective to urge switch arm 31 to an open or closed position depending upon the position of the operating lever and carrier.

One of the arms 36 of carrier member 34 is provided with an extension 51 adapted to function as a release arm. This release arm includes a transversely extending flange 52 adapted for engagement with latching finger 53 of magnetic core 54, as explained below. This same arm of the carrier also includes a lug 55 adapted for cooperative engagement with operating lever 40, so that the operating lever is effective to shift the carrier member during manual closing of the contacts as explained below.

Tripping mechanism 16 comprises, in addition to magnetic core 54, an elongated bimetallic strip 56 including a foot 57 which is welded or otherwise secured to a support member 58. In the embodiment shown, support member 58 is in the form of an elongated plate having upturned arm 60 formed on the outer end thereof. This arm is provided with a groove, preferably disposed centrally of the arm for receiving the tip 61 of calibrating screw 30. The undersurface of support member 58 is provided with a longitudinal groove 62 and a transverse groove 63. These grooves function to accurately position the point at which the floating support member is engaged by mounting spring 64. This coil spring is compressed between support member 58 and a bottom wall 65 of the breaker housing. The end of mounting spring 64 in engagement with plate 58 includes a first segment extending diametrically across the spring and a second segment 67 extending at right angles to the first segment. This second segment of the spring also preferably extends slightly upwardly in the direction of the axis of the spring, for the reasons explained below.

In its assembled position, the first, or diametrical segment resides in engagement with longitudinal groove 62 of the support member; and the second segment of the spring resides in engagement with the portion of transverse groove 63 which is remote from the release arm of carrier 34. The end of support member 58 remote from the calibration screw is forced by the spring into engagement with abutments 68, 68' respectively formed on housing members 12 and 13. Abutment member 68' is shown by dotted lines and is preferably provided with a flat horizontal face which extends outwardly from housing section 12 to a point substantially in alignment with the end of calibrating screw 30. Abutment member 68' differs from abutment 68 only in that its lower surface is below that of abutment 68. This difference in the lower surfaces permits unhampered sideways rotation of support member 58 about its longitudinal axis. Longitudinal sliding movement of the support plate is prevented in one direction by engagement of arm 60 with the conical tip of calibrating screw 30. In the other direction, sliding movement of plate 58 is restrained by the engagement of the end of bimetallic strip 56 with abutment member 68. The end of the bimetallic strip is preferably rounded to facilitate pivotal movement of plate 58 about the abutment member.

The free end of bimetallic strip 56 carries magnetic core 54. This core, formed of ferro magnetic material, is generally U-shaped and includes a support arm 70, a second arm 71 extending parallel to support arm 70 and being appreciably shorter than that arm and a connecting segment 72. The connecting segment is welded or otherwise permanently secured to the surface of the bimetallic strip facing carrier member 34. Support arm 70 is provided with a slot 73 adapted to receive a narrow

band 74 formed on armature 75. Armature 75, also formed of magnetically permeable material, is of generally right angular configuration and includes a wall engaging pivot arm 76 and a segment 77 adapted to be attracted to the core. Arm 76 and segment 77 are joined by band 74 which is loosely received within aperture 73 in the support arm of core member 62. The relative sizes of band 74 and aperture 73 are such as to permit pivotal movement of the armature relative to the core.

In normal operation, pivot arm 76 of the armature is disposed closely adjacent to the inner wall of section 13 of the housing; and extends substantially parallel thereto. However, as explained below, when core 54 is energized, arm 71 of the core attracts segment 77 of the armature, causing it to close air gap 78. This causes the armature to pivot about the end of arm 76 in engagement with the housing and in turn forces the core and upper end of the bimetallic strip to shift transversely of the housing. This latter movement is effected by rotation of the support 58 about its longitudinal axis. Transverse pivotal movement of plate 58 and bimetallic strip 56 are resisted by segment 67 of support spring 64 which exerts a small torsional force on the bottom of the plate.

Core 54 also includes a latching finger 53 extending outwardly from the undersurface of connecting segment 72 of the core toward the carrier member. This finger is adapted to reside in notch 80 formed on the outer end of the release arm, the notch having shoulder 81 effective to limit the amount finger 53 extends over the release arm.

When the contacts are closed, current flows through the circuit breaker from jaws 21, through conductor strip 18, across contacts 14 and 15, through switch arm 31, and flexible conductor 83 welded to the switch arm, to bimetallic strip 56, the current then passes through bimetallic strip 56, plate 58, flexible conductor 82 and conductor strip 27 to terminal 23.

In order to close the contacts of the breaker after tripping, the operating handle is shifted from its left hand position shown in Figure 1 to a position at the right hand end of the slot. During its movement, handle 42 causes operating lever 40 to pivot clockwise about shoulder 44. The operating lever in turn carries the upper end of spring 41 in a clockwise direction. The operating lever during its pivotal movement also engages projecting lug 55 formed on arm 36 of the carrier member and thereby forces the carrier member to rotate clockwise about transverse pin 38. Near the end of its clockwise movements, flange 52 of release arm 51 engages latching finger 53 of the core. The outer end of flange 52 is of arcuate configuration to provide a camming surface which forces the core and the upper end of bimetallic strip 56 to move in a transverse direction. This causes support member 58 to pivot on its longitudinal axis about calibrating screw 30 and abutment member 68. As the operating handle nears its extreme right hand position, finger 53 is forced outwardly beyond flange 52 and as carrier member 34 is pivoted downwardly an additional amount, the finger slides into notch 80 in flange 52. The finger is urged into the slot under the influence of segment 67 of mounting spring 64 which urges plate 58 to rotate in a direction effective to force the core towards wall 13. It should be noted that during the latching of the carrier member bimetallic strip 56 is not flexed in any way.

After the carrier member is latched, the operating handle is then returned to its left hand position shown in Figure 1 to effect manual closing of movable contact 15. Movement of the handle in this direction causes counterclockwise pivotal movement of operating lever 40 and causes counterclockwise movement of over center spring 41 secured to the lever. As the operating handle approaches its extreme left hand position, the spring is moved beyond its over center position forcing switch arm 31 in a clockwise direction about its pivot points in re-

cesses 33 of the carrier member. Movable contact 15 is thus brought into engagement with stationary contact 14.

The tripping mechanism releasably holds carrier 34 in its position with contacts 14 and 15 closed until the occurrence of an overload condition. Tripping mechanism 17 is adapted to release carrier 34 in the event of a continuing overload of moderate magnitude by means of thermally responsive bimetallic strip 56. The breaker is also effective in response to a heavy overload, that is one of an order of magnitude several times that of the rated capacity of the breaker, to immediately release the carrier through magnetically responsive means including core 54 and armature 75.

More particularly, upon the occurrence of a moderate current overload of continuing magnitude, bimetallic strip 56 becomes heated and since the high expansion side of the element is disposed toward the carrier member, the free end of the bimetallic strip deflects away from the carrier, to the right. If the moderate overload continues for a sufficient period of time, the free end of the bimetallic element is shifted to the right a sufficient distance to disengage latching finger 53 of the core from flange 52 of the carrier member. As soon as the carrier member is released from engagement with the core, it is urged counterclockwise by main operating spring 41. Movement of the carrier member in this direction shifts the upper end of switch arm 31, which is pivoted in recesses 33 of the carrier member, to a position in which spring 41 is shifted beyond an over center position causing rapid counterclockwise rotation of switch arm 31 separating contact 15 from stationary contact 14.

When a short circuit, or heavy overload condition, causes a current flow of more than a predetermined magnitude through the breaker, the current in flexible conductor 83 and bimetallic strip 56 energizes core member 54 causing the establishment of a strong magnetic field around the core. The effect of this magnetic field is to cause the attraction of free end 84 of armature 75 to arm 71 of the core. As the free end of the armature moves toward the core, the armature pivots about aperture 73 in support arm 70 of the core. This movement forces pivot arm 76 of the armature against the inner surface of base wall 13 of the housing which in turn forces the core away from the housing wall to the position shown in Figure 4. Movement of the core in this direction is accomplished without bending the bimetal since the foot of the bimetal pivots with support plate 58, that plate turning about its longitudinal axis between calibrating screw 30 and abutment member 68. Before core 54 reaches its extreme unlatching position shown in Figure 4, finger 53 slides off the end of flange 52, thereby releasing arm 51 and freeing the carrier for counterclockwise movement as explained above. The operating mechanism is thus tripped to open contacts 15 and 14 in the same manner as before.

It will be noted that while support spring 64 exerts a restoring force upon support strip 58 tending to rotate the bimetallic strip and core toward base wall 13, the restoring force exerted by this spring is not sufficient to impede rapid tripping of the release arm when a sufficiently large current flows to energize core 54. Also, it is to be understood that the upward component of force exerted by spring 64 along center groove 63 of plate 58 is of sufficient magnitude to hold the plate firmly against calibrating screw 30 and abutment 68, throughout the operation of the device including flexing of bimetallic strip 56.

Two separate calibrating means are provided in the breaker, one for calibrating the thermally responsive element and one for calibrating the magnetically responsive element. These two calibrating means function completely independently of one another and the adjustment of one in no way affects the adjustment, or setting, of the other. More specifically, calibrating screw 30 pro-

vides means for adjusting the thermally responsive means of the breaker. By threading this screw in and out relative to arm 60 of plate 58, this end of the plate is raised or lowered as the plate shifts on a transverse axis about abutment 68. Adjustment of the angulation of the plate in turn causes the bimetallic strip to move in its plane of expansion so that the amount that finger 53 extends over flange 52 is readily controlled. Obviously, if the core is positioned so that when the bimetallic strip is cold, this finger extends only part way over the flange, the finger will become disengaged from the flange when the bimetallic element has moved a shorter distance than would be the case if the flange were initially positioned to extend a substantial distance over the finger. It will be appreciated that the calibration of the thermally responsive element depends upon the taper of screw 30, the size of groove in arm 60, and other dimensions which can be controlled accurately. Consequently, a number of breakers can be uniformly calibrated by making the same number of turns in screw 30.

Separate means in the form of an adjustable abutment element such as set screw 85 are provided for calibrating the magnetically responsive release mechanism. As shown in Figures 3 and 4, screw 85 threadably engages a suitable opening provided in base wall 13 and is disposed for abutment with support arm 70 of core 54. This set screw is effective to shift the core perpendicular to the path of bimetallic strip movement inwardly and outwardly relative to flange 52. As the magnetic core is shifted, armature 75 assumes a position in which a greater or lesser air gap 78 is established between the armature and core. As this air gap is decreased, the magnetic flux set up by a given current increases. The air gap is decreased when this core is shifted away from housing section 13. Decreasing the air gap increases the magnetic force and lessens the distance finger 53 must move to release flange 52 thereby reducing the tripping time of the breaker at high overloads.

This much of the circuit breaker is disclosed in my above identified copending application Serial No. 601,783. To adapt single-pole circuit breakers of this type for use as a multipole circuit breaker two or more circuit breakers, such as circuit breakers 9 and 10, are mounted in side by side relationship in any suitable manner as indicated in Figures 3-8. The operating handles 42 of the circuit breakers may be tied together for movement in unison in the usual manner. Additionally a common trip 86 is provided for interconnecting the carrier members of each pair of single-pole circuit breakers. The trip member 86 is effective in consequence of movement incidental to the release of either carrier to cause disengagement of latching finger 53 from cooperating flange 52 of the other circuit breaker of the pair by shifting the latching finger in a transverse direction, that is, in a direction generally lateral to the plane of flexure of the bimetallic strip associated with latching member 53.

As best shown in Figures 5-8, common trip member 86 extends transversely between circuit breakers 9 and 10, passing through suitable apertures provided at the side walls of the circuit breakers. A preferred form of common trip member comprises an electrically insulative stamping made of high rag content fiberboard, or the like. The common trip member mechanically engages carriers 34 of circuit breakers 9 and 10. More particularly, the common trip member is provided with two enlarged bores 88 and 90 formed adjacent to opposite ends of the member. Bore 88 receives extension 51 of one arm of carrier 34 closely adjacent to latching flange 52. In a similar manner, bore 90 receives a similar extension 51 formed on an arm of carrier 34 of breaker 9. As is apparent from Figure 5, each of the bores is substantially larger than the extensions received within the bores for reasons subsequently explained.

Common trip member 86 further comprises two projections 92 and 93. In the preferred embodiment, these

projections are in the form of elongated pins secured to the common trip member in any suitable manner such as by means of rivets, or the like. As is apparent from Figure 3, the projections or pins 92 and 93 extend transversely of the common trip member and longitudinally of the individual circuit breaker housings. Each of the projections is vertically offset from the adjacent bore formed in member 86, projection 92 being disposed beneath bore 88 and projection 93 being disposed above bore 90.

The function of cross member 86 is to trip the second breaker of a pair irrespective of the current condition in the leg of the circuit protected by the breaker, in response to the tripping of the first breaker of the pair. In accordance with the present invention, common trip member 86 accomplishes this by pivotally shifting the latch carrying element, i.e., the bimetallic strip in the embodiment shown, in a transverse direction parallel to the direction in which the bimetallic strip is shifted in response to actuation of its own magnetic core.

It is to be understood that while in these drawings two single-pole circuit breakers are shown in assembled relationship, as many circuit breakers as are desired can be assembled in the manner shown by interconnecting the carrier members of adjacent circuit breakers by common tripping members similar to tripping member 86.

When the circuit breakers of a multipole pair are both latched, the cross strap is in the position shown in Figure 5. Let it now be assumed that an overload condition occurs in the circuit leg containing the left hand circuit breaker 9 as shown in Figure 6. When the left hand circuit breaker is tripped either by the thermal bending of its bimetallic strip or by the action of its magnetic core, in the manner explained above, the carrier member 34 of the left hand member rotates about the axis of pin 33 in a counterclockwise direction. When the carrier member rotates in this direction, latching flange 52 and the adjacent portions of the carrier member are raised. This raises the left end of common trip member 86. However, since the right hand circuit breaker 10 at this moment remains untripped, the right end of member 86 does not rise but rather the common trip element pivots about bore 90 which embraces the carrier member of the right hand breaker. It is to be understood that in this embodiment each of the carrier members pivots in a vertical plane but is not shiftable in a horizontal plane transversely of the circuit breaker housings. As the common trip member 86 pivots about the carrier member 34 of the right hand circuit breaker 10, the projecting pin 93 of the common trip member engages the core, or other suitable element associated with the bimetallic strip of circuit breaker 10, and causes the bimetallic strip to pivot in a clockwise direction to the right as shown in Figure 6. When the bimetallic strip is shifted in this direction, the latch finger 53 carried by that strip is shifted sideways from engagement with the cooperating flange 52 of the carrier member 34. Consequently, the carrier member of circuit breaker 10 is released and the contacts of breaker 10 are opened. Thus, the upward movement of the left hand side of common trip member 86 is effective to exert a sideways unlatching force of the right hand circuit breaker so that the circuit breaker trips almost simultaneously with the tripping of the left hand circuit breaker.

A similar release is effected when the right hand circuit breaker 9 trips from an overload condition, while the left hand circuit breaker remains latched. This condition is illustrated in Figure 7. When the right hand circuit breaker 10 is tripped, the carrier of that circuit breaker pivots to raise that portion of the breaker adjacent to latching flange 52. This in turn causes the right hand end of the common trip member to be raised, the trip member pivoting about bore 88 embracing the car-

rier member 34 of the left hand circuit breaker. When the common trip member is thus pivoted, projection 92 on the left hand edge of the common trip member engages the bimetallic strip of circuit breaker 9 and pivots that strip to the right as shown in Figure 7. The shifting of this bimetallic strip in a transverse direction causes the latching finger 53 carried by the strip to become disengaged from the cooperating flange 52 of the carrier member of the left hand breaker. The carrier member of this breaker is thus released and is pivoted in a counterclockwise direction about a pivot pin 38 to open the contacts of the breaker in the manner explained above.

When both breakers are tripped, the common trip member 86 assumes the position shown in Figure 8. The two circuit breakers can readily be reset by actuating the interconnected handles 42 in the manner explained above.

It is to be understood that the principles of the present invention may be utilized in conjunction with circuit breakers differing in details from the circuit breakers shown in the present disclosure. It is believed that from the foregoing disclosure of the general principles of the present invention and the above detailed description of a preferred embodiment, those skilled in the art will readily comprehend many different modifications of the present invention. Thus, for example, it is contemplated that a bimetallic strip can be spring mounted in the manner shown in the enclosed drawings to effect thermal release in one direction and magnetic release in a second direction, but the magnetic circuit can be mounted within the housing rather than on the bimetallic strip. In a further modification, a latching finger, such as member 53, can be mounted upon a pivoted spring urged element which is not in itself a bimetallic strip but which is shifted by a separate bimetallic strip to effect thermal release and is shifted in the second direction by a magnetic core assembly. Moreover, it is contemplated that the common latching member can be mounted for rotation about a support provided on the housing rather than upon each of the carrier members.

Having described my invention, I claim:

1. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers comprising a housing, relatively movable contacts disposed within said housing, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising a thermally responsive bimetallic strip adapted to flex in a first plane and thereby cause release of said operating means, and a magnetic means including a magnetically permeable member carried by said bimetallic strip and effective to cause movement of said bimetallic strip in a second plane and thereby effect release of said operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in said second plane to release said operating means in response to the release of the operating means of the other breaker.

2. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers comprising a housing, relatively movable contacts disposed within said housing, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising a latching surface disposed for engagement with a cooperating element of said operating means, a thermal current responsive element adapted to shift said latching surface in a first direction to release said operating mechanism, and a magnetic current responsive element adapted to shift said latching surface in a second direction to release said operating means, and means interconnecting said breakers for shifting the bimetallic strip

of either breaker in said second direction to release said operating means in response to the release of the operating means of the other breaker.

3. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having relatively movable contacts, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising an elongated bimetallic strip, a yieldable support member, one end of said bimetallic strip being mounted on said support member, a magnetic core mounted on the free end of the bimetallic strip, a latching surface carried by the free end of the bimetallic strip and adapted for engagement with a cooperating element of the operating means, a magnetic armature disposed adjacent to and in normally spaced relationship from a portion of said core, said bimetallic strip being adapted upon flexing to shift said latching surface in one direction to release said operating means, the magnetic core and armature cooperating when energized to shift the latching surface in a direction transverse to the direction of bimetal movement to effect release of the operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a direction transverse to the direction of bimetallic movement to release said operating means in response to the release of the operating means of the other breaker.

4. A multiple circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having relatively movable contacts, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising a thermally responsive bimetallic strip adapted upon flexing to cause release of said operating means, and a magnetic means including a magnetically permeable member carried by said bimetallic strip and effective to release said operating means by movement in a direction perpendicular to the direction of bimetallic flexing, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a direction perpendicular to the direction of bimetallic flexing to release the operating means of said breaker in response to the tripping of the other breaker of said pair.

5. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having relatively movable contacts, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising a latching surface disposed for engagement with a cooperating element of said operating means, a thermal element adapted to shift said latching surface in a first direction to release said operating mechanism, and a magnetic element adapted to shift said latching surface in a direction perpendicular to the first direction to release said operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a direction perpendicular to the direction of bimetallic flexing to release the operating means of said breaker in response to the tripping of the other breaker of said pair.

6. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having movable contacts, and spring urged operating means for opening and closing said contacts, the improvement which comprises current responsive tripping means effective to releasably latch the operating means and to release the operating means in response to an

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overload current, said tripping means comprising an elongated bimetallic strip, a support member, one end of said bimetallic strip being mounted upon said support member, a compression spring engaging the opposite side of said support member from said bimetallic strip, stationary abutment members in engagement with said support member, said abutment members and spring cooperating to hold said support member stationary during flexure of said bimetallic strip but permitting pivotal movement of said support member in a plane transverse to the plane of flexure of said bimetallic strip, a magnetic core mounted on the free end of the bimetallic strip, a latching surface carried by the bimetallic strip and adapted for engagement with a cooperating element of the operating means, a magnetic armature disposed adjacent to and in normally spaced relationship from a portion of said core, said bimetallic strip being adapted upon flexing to shift the latching surface in the direction of bimetallic flexure to release said operating means, the magnetic core and armature cooperating when energized to pivot the bimetallic strip and support member about the abutment members to shift the latching surface in a direction transverse to the direction of bimetallic flexure and effect release of the operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a direction transverse to the direction of bimetallic flexing to release the operating means of said breaker in response to the tripping of the other breaker of said pair.

7. A pair of single-pole circuit breakers each having cooperable contacts, releasable operating means for opening the respective contacts, and current responsive means for releasing said operating means, said current responsive means including a latching member engageable with a cooperating element of said operating means and disengageable therefrom by movement in a first plane and by movement in a second plane, a common trip member, means pivotally mounting said common trip member, means interconnecting said common trip member with each of said operating mechanisms and with said latching members, said common trip member being rotated in said second plane upon the release of the operating mechanism of one of said breakers and being effective to cause movement of the latching member of the other of said breakers in the second plane thereby effecting disengagement of said last named latching member from its associated operating mechanism.

8. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having movable contacts, spring urged operating means for opening and closing said contacts, current responsive tripping means effective to releasably latch the operating means and to release the operating means in response to an overload current, said tripping means comprising an elongated bimetallic strip, a support plate, one end of said bimetallic strip being mounted upon the upper surface of said support plate, stationary abutment members in engagement with said support member, the undersurface of said plate including a central longitudinal groove and a transverse groove, a compression spring engaging the lower surface of said support plate and urging said plate into engagement with said abutment members, said spring including a diametral segment disposed within said longitudinal groove and a second segment in engagement with said transverse groove, said abutment members and spring cooperating to hold said support plate stationary during flexure of said bimetallic strip but permitting pivotal movement of said support plate in a plane transverse to the plane of flexure of said bimetallic strip, the second segment of said spring tending to resist said pivotal movement, a magnetic core mounted on the free end of the bimetallic strip, a latching surface carried by the bimetallic strip and adapted for engagement with a cooperating element of the operating means, a magnetic armature disposed adjacent to

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and in normally spaced relationship from a portion of said core, said bimetallic strip being adapted upon flexing to shift the latching surface in the direction of bimetallic flexure to release said operating means, the magnetic core and armature cooperating when energized to pivot the bimetallic strip and support plate about the abutment members to shift the latching surface in a direction transverse to the direction of bimetallic flexure and effect release of the operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a direction transverse to the direction of bimetallic flexing to release the operating means of said breaker in response to the release of the operating mechanism of the other breaker of said pair.

9. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having movable contacts, and spring urged operating means for opening and closing said contacts, current responsive tripping means effective to releasably latch the operating means and to release the operating means in response to an overload current, said tripping means comprising an elongated bimetallic member, a support plate, one end of said elongated bimetallic member being mounted upon the upper surface of said support plate, stationary abutment members in engagement with said support plate, the undersurface of said plate including a central longitudinal groove and a transverse groove, a compression spring engaging the lower surface of said support plate and urging said plate into engagement with said abutment members, said spring including a diametral segment disposed within said longitudinal groove and a second segment in engagement with said transverse groove, said abutment members and spring cooperating to hold said support plate stationary against pivotal movement in a longitudinal plane but permitting pivotal movement of said support plate in a transverse plane, the second segment of said spring tending to resist said pivotal movement in said transverse plane, a magnetic core mounted within said breaker, a latching surface carried by the elongated member and adapted for engagement with a cooperating element of the operating means, a magnetic armature disposed adjacent to and in normally spaced relationship from a portion of said core, said bimetallic member being adapted upon flexing to shift the latching surface in the longitudinal direction to release said operating means, the magnetic core and armature cooperating when energized to pivot the support plate about the abutment members to shift the latching surface in a transverse direction and effect release of the operating means, and means interconnecting said single-pole circuit breakers for shifting the elongated member of either breaker in a transverse direction to release the operating means of said breaker in response to the release of the operating mechanism of the other breaker of said pair.

10. A multipole circuit breaker comprising a pair of single-pole circuit breakers each having cooperable contacts, releasable operating means including a rotatable member for opening the respective contacts, current responsive means for releasing said operating means, said current responsive means including a latching member engageable with a cooperating element of said operating means and disengageable therefrom in a longitudinal direction in the plane of rotation of said rotatable member and in a transverse direction, a common trip member, means pivotally mounting said common trip member, means interconnecting said common trip member with the rotatable member of each of said operating mechanisms, said common trip member having abutment portions in engagement with each of said latching members, said common trip member being rotated upon the release of the operating mechanism of one of said breakers and being effective to cause transverse movement of the latching member of the other of said breakers in said transverse direction thereby effecting disengagement of said last

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named latching member from its associated operating mechanism.

11. A multipole circuit breaker comprising a pair of single-pole circuit breakers each having cooperable contacts, releasable operating means including a pivotally mounted carrier member for opening the respective contacts, and current responsive means for releasing said operating means, said current responsive means including a latching member engageable with a cooperating element of said carrier and disengageable therefrom in a longitudinal direction in the plane of movement of said carrier and in a transverse direction angulated with respect to the plane of movement of said carrier, a common trip member, said common trip member having two spaced apertures and abutments disposed adjacent to each of said apertures, each of said apertures embracing a carrier member of one of said breakers, each of said abutment members being disposed for engagement with one of said latching members, said common trip member being rotated upon the release of the operating mechanism of one of said breakers and being effective to cause transverse disengagement of the latching member of the other of said breakers from its associated operating mechanism.

12. A multipole circuit breaker comprising a pair of single-pole circuit breakers each having cooperable contacts, releasable operating means including a pivotally mounted carrier member for opening the respective contacts, and current responsive means for releasing said operating means, said current responsive means including a latching member engageable with a cooperating portion of said carrier and disengageable therefrom in a longitudinal direction in the plane of movement of the carrier member and in a transverse direction angulated with respect to the plane of movement of the carrier member, a common trip member comprising a flat plate of an insulating material, said common trip member having enlarged bores adjacent to each end thereof, abutment pins extending transversely of said common trip member, one of said pins being vertically spaced from each of said bores, each of said bores receiving a portion of one of said carrier members, and each of said abutment pins engaging one of said latching members, said common trip member being rotated upon the release of the operating mechanism of one of said breakers and being effective to cause transverse disengagement of the latching member of the other of said breakers from its associated operating mechanism.

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13. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers comprising a housing, relatively movable contacts disposed within said housing, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising a thermally responsive bimetallic strip adapted to flex in a first plane and thereby cause release of said operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a second plane to release said operating means in response to the release of the operating means of the other breaker.

14. A multipole circuit breaker comprising a pair of single-pole circuit breakers, each of said single-pole circuit breakers having relatively movable contacts, spring urged operating means for opening said contacts, current responsive tripping means effective to releasably latch said operating means and to release said operating means in response to an overload current, said tripping means comprising an elongated bimetallic strip, a yieldable support member, one end of said bimetallic strip being mounted on said support member, a magnetic core mounted on the free end of the bimetallic strip, a latching surface carried by the free end of the bimetallic strip and adapted for engagement with a cooperating element of the operating means, said bimetallic strip being adapted upon flexing to shift said latching surface in one direction to release said operating means, and means interconnecting said single-pole circuit breakers for shifting the bimetallic strip of either breaker in a direction transverse to the direction of bimetallic movement to release said operating means in response to the release of the operating means of the other breaker.

References Cited in the file of this patent

UNITED STATES PATENTS

1,955,327	Dorfman	Apr. 17, 1934
2,263,208	Getchell	Nov. 18, 1941
2,692,926	Cole	Oct. 26, 1954
2,797,277	Dorfman	June 25, 1957
2,824,191	Christensen	Feb. 18, 1958