May 25, 1965 D. E. CAIN 3,185,791

CIRCUIT BREAKER WITH PANCAKE TYPE OPERATING MECHANISM AND IMPROVED FORCE TRANSMISSION MEANS

Filed April 18, 1963 5 Sheets-Sheet 1

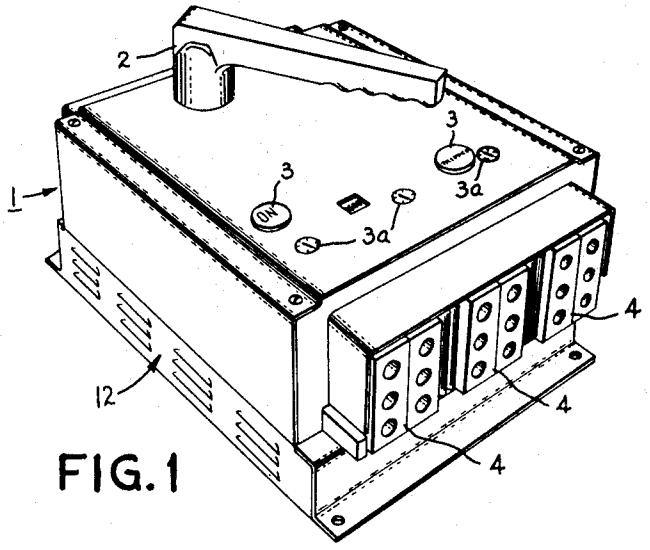

FIG. 1

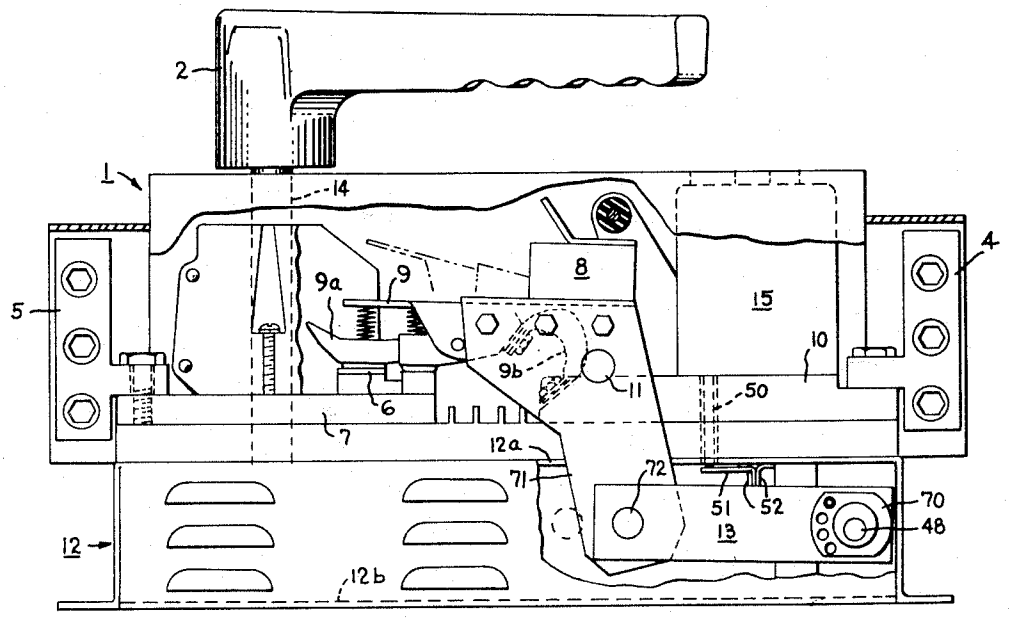

FIG. 2

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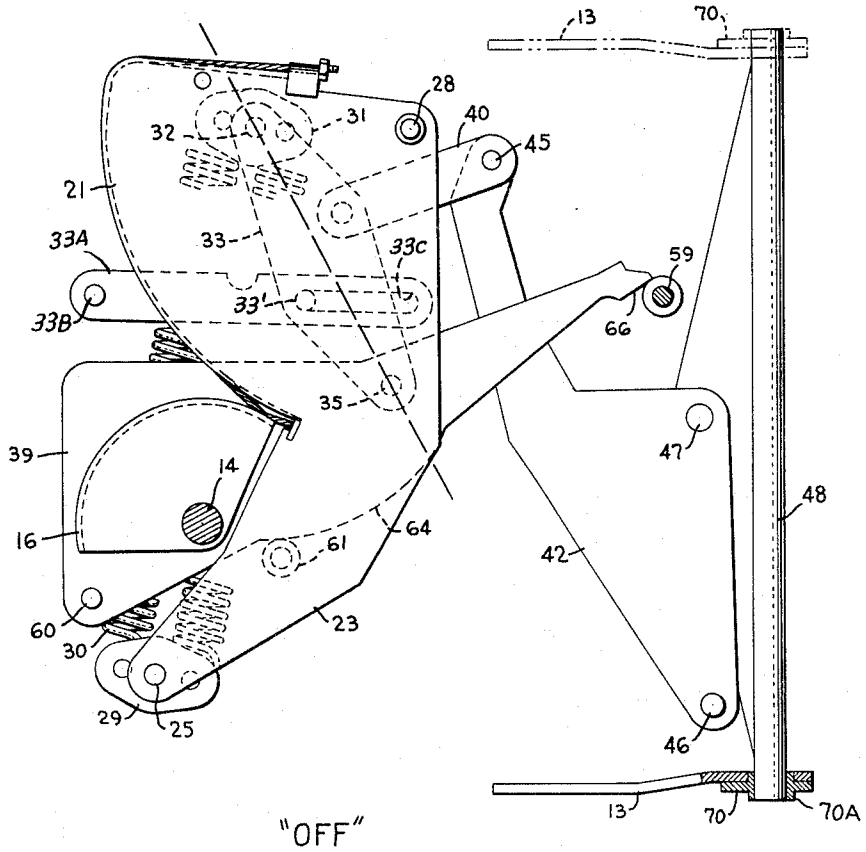

"OFF"

FIG.5

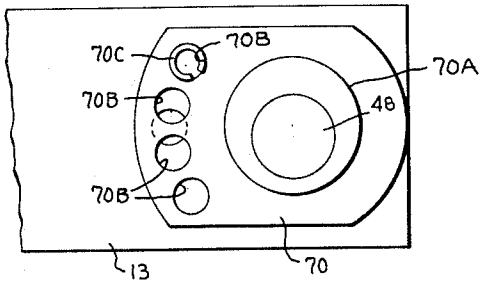

FIG.3

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May 25, 1965 D. E. CAIN 3,185,791

CIRCUIT BREAKER WITH PANCAKE TYPE OPERATING MECHANISM AND IMPROVED FORCE TRANSMISSION MEANS

Filed April 18, 1963 5 Sheets-Sheet 3

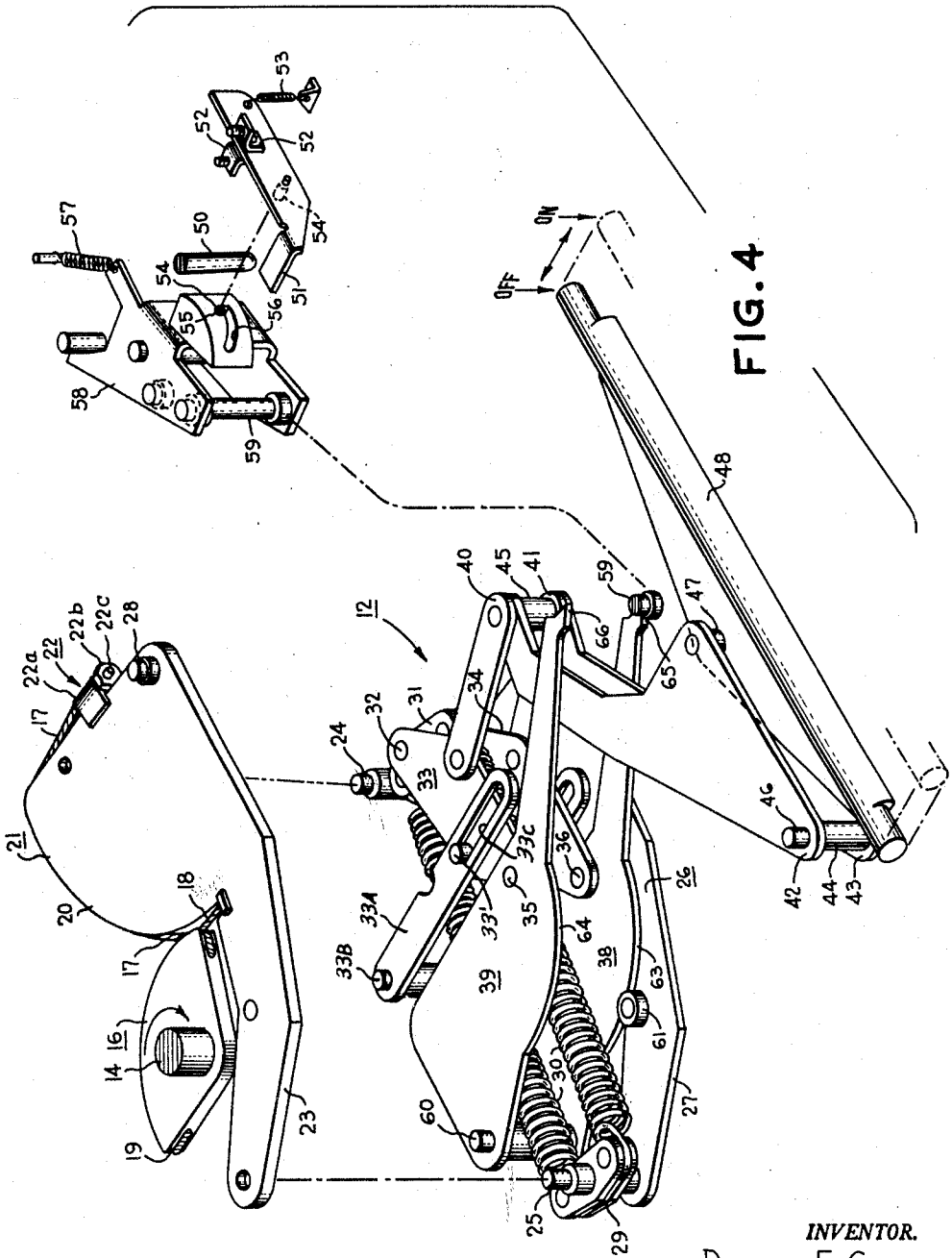

FIG. 4

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May 25, 1965 D. E. CAIN 3,185,791

CIRCUIT BREAKER WITH PANCAKE TYPE OPERATING MECHANISM AND IMPROVED FORCE TRANSMISSION MEANS

Filed April 18, 1963 5 Sheets-Sheet 4

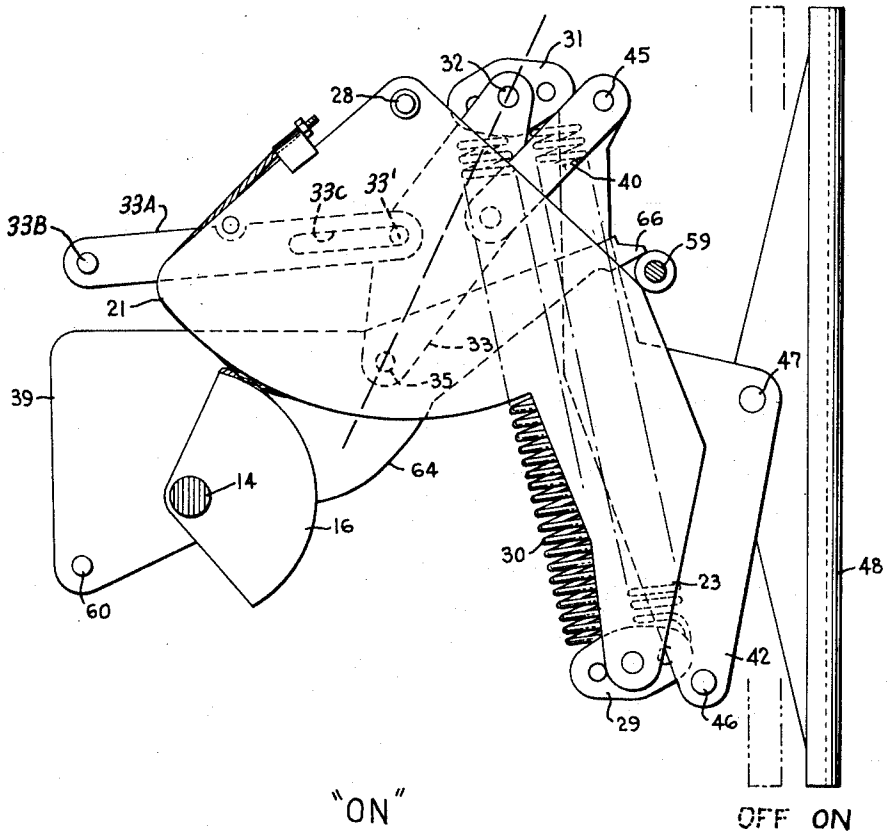

FIG. 6

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CIRCUIT BREAKER WITH PANCAKE TYPE OPERATING MECHANISM AND IMPROVED FORCE TRANSMISSION MEANS

Filed April 18, 1963 5 Sheets-Sheet 5

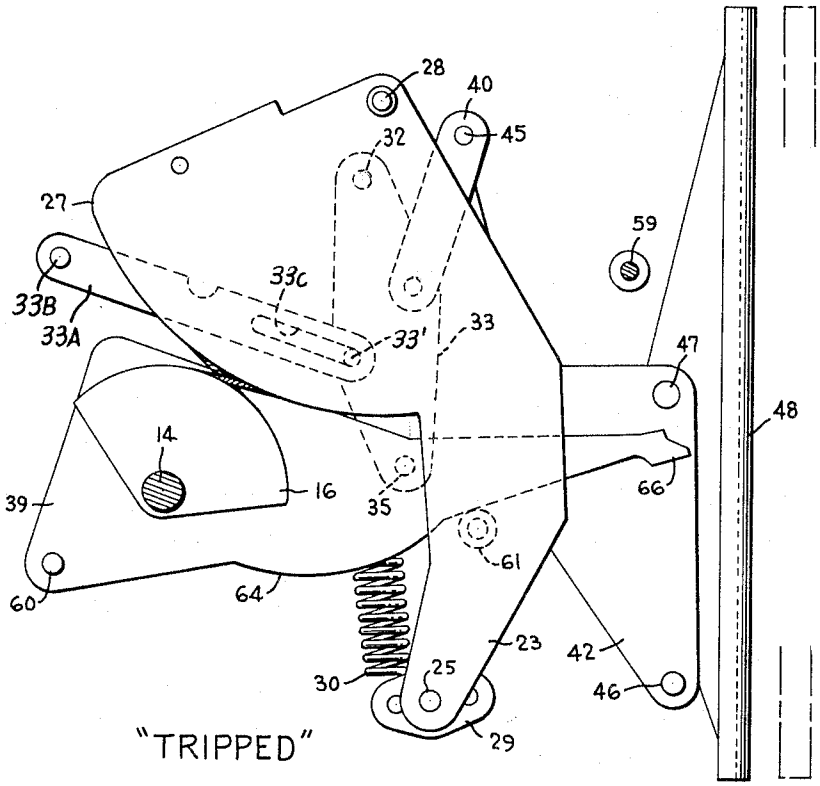

FIG. 7

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United States Patent Office 3,185,791 Patented May 25, 1965

3,185,791

CIRCUIT BREAKER WITH PANCAKE TYPE OPERATING MECHANISM AND IMPROVED FORCE TRANSMISSION MEANS

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Filed Apr. 18, 1963, Ser. No. 273,955
5 Claims. (Cl. 200—106)

This invention relates to electric circuit breakers, and more specifically, to electric circuit breakers of the type utilizing a flat or so-called "pancake" operating mechanism.

Circuit breakers of the type referred to have contacts positioned within an upper chamber in the circuit breaker housing and a flat operating mechanism which lies below that chamber parallel to and adjacent the bottom wall of the housing. Also within the upper chamber of the housing, a trip unit is provided to open the circuit breaker contacts in the event of an overload.

The "pancake" construction has the advantage of permitting use of larger current-carrying contacts in a housing of smaller overall size since the flat "pancake" mechanism permits much more efficient utilization of space than conventional operating mechanisms. When use of such "pancake" type operating mechanisms in high-ampere-rated circuit breakers is attempted, however, certain problems arise relating to force transmission. Specifically, problems are encountered in transmitting force from the operating mechanism, which has elements all moving in parallel planes, to the contact carrying cross-arm, which is in a plane above the operating mechansm and which moves in a plane perpendicular to the operating mechanism. For instance, if the circuit breaker is of the multi-pole variety, uniform pressures must be exerted on each of the contact pairs for proper operation of the circuit breaker. If the contacts are not closed with uniform presure, contact resistance will vary resulting in improper operation of the circuit breaker. Furthermore, any unbalance of torque on the cross-arm may result in uneven wear on bearing surfaces causing shorter life and possible failure of the circuit breaker.

Accordingly, it is an object of this invention to provide a circuit breaker having an improved linkage for transmitting force from a "pancake" type operating mechanism to a cross-arm which will convert forces parallel to the operating mechanism into forces perpendicular to the operating mechanism for use in operating the contact-carrying cross-arm.

It is another object of this invention to provide a circuit breaker having a linkage for coupling forces from a "pancake" type operating mechanism to a cross-arm so as to effect closing of the contacts with uniform pressures.

It is a further object of this invention to provide a circuit breaker having a linkage for transmitting force from a "pancake" type operating mechanism to a cross-arm so as to result in balanced torque on the cross-arm with resultant even wear on bearing surfaces.

It is still a further object of this invention to provide a circuit breaker having an improved operating mechanism including an improved arrangement for driving the elements thereof.

In accordance with the invention, in one form thereof, there is provided an electric circuit breaker having a generally planar "pancake" type operating mechanism and a contact-carrying cross-arm mounted thereabove. For transmitting force from an operating handle to a toggle portion of the operating mechanism, a pair of cam sectors connected in a driving relationship by a pair of cables are employed. There is provided a force equalizing member which is specially designed to apply equal forces to opposite ends of the cross-arm. In addition, the linkage also converts forces which are parallel to the operating mechanism into forces perpendicular to the operating mechanism for use in driving the cross-arm.

More specifically, there is provided a force equalizing member which is pivotally connected at its mid-point to an output lever of the operating mechanism. The ends of the force equalizing member are linked to the ends of the cross-arm so as to supply the cross-arm with a balanced pair of forces. This insures uniform contact pressures and proper cross-arm operation.

For the purpose of this application, the term "circuit breaker" will be defined as any device which opens and closes an electric circuit, whether by manual or automatic means, or both.

Other objects and features of this invention will become apparent when the following specification is considered in combination with the annexed drawings, in which:

FIGURE 1 is a perspective view of an electric circuit breaker embodying the invention;

FIGURE 2 is a side view of the circuit breaker of FIGURE 1 with portions broken away to show underlying elements;

FIGURE 3 is a fragmentary elevational view of a portion of the mechanism of the circuit breaker;

FIGURE 4 is an exploded perspective view showing the relationship of different elements of the operating mechanism;

FIGURE 5 is a top plan view of the operating mechanism and portions of the linkage in the "off" position;

FIGURE 6 is a top plan view of the operating mechanism and the linkage in the "on" position, and

FIGURE 7 is a top plan view of the operating mechanism and a portion of the linkage in the tripped position.

Referring now to FIGURE 1, there is provided a circuit breaker having a generally rectangular housing **1** formed from molded plastic or other suitable material. Alternatively, a metallic housing could be provided; however, suitable insulating means, such as a coating of insulating material must then be used to prevent the housing from coming in contact with any of the electrically energized components of the circuit breaker. An operating handle **2** is mounted on a suitable control shaft **14** (shown in FIGURE 2) which protrudes through housing **1**. Suitable indicia **3** are also positioned on the front face of housing **1** to enable the operator to determine whether the circuit breaker is in the "off," the "on," or the "tripped" position, respectively. Also, on the front face of housing **1** there may be provided suitable adjusting elements *3a* for varying the overload setting of a trip unit. At one end of the circuit breaker are output terminals **4** to which load conductors may be connected.

Turning now to FIGURE 2, the basic components of the circuit breaker may be seen. Input terminals **5** are provided for securing input conductors to the circuit breaker, a portion of the housing being removable to permit this. Input terminals **5** are electrically connected to stationary contacts **6** by line contact straps **7**. A cross-arm **8** is provided for carrying the movable contacts and for moving these contacts between "open" and "closed" positions. As most clearly shown in FIGURE 2, movable arms are mounted on the cross-arm **8** in spaced relation along the cross-arm **8**. Contacts *9a* are mounted on the movable arms **9** and are electrically connected to output terminals **4** by means of flexible braids *9b* and load contact straps **10**.

In order to actuate cross-arm **8**, which is pivoted on axle **11**, there is provided an operating mechanism of the flat or "pancake" variety which is disposed beneath

the contacts and cross-arm, as is indicated generally at numeral 12. The operating mechanism is entirely contained within the space between parallel plates 12*a* and 12*b* and all its elements move in planes parallel to plates 12*a* and 12*b*. The plate 12*a* generally divides the housing into two compartments, a lower one containing the operating mechanism 12 and an upper one containing the cross-arm, contacts and related elements. The operating mechanism 12 to be described, imparts a horizontally reciprocating motion to a cross-arm 48 in a direction perpendicular to its longitudinal axis, between positions corresponding to "on" and "off" positions of the circuit breaker contacts, as indicated by the dotted line portions and arrow in FIGURE 4.

Horizontal reciprocating motion of the arm 48 is translated into rotary reciprocating movement of the movable contact assembly comprising contact cross-arm 8 and contact arms 9, which assembly is pivotally supported on the base 12 by means of depending support members 71, one at each end of the cross-arm 8 (only one shown). The support members 8 are pivotally supported on pins 11 carried by the base 12 by suitable means, not shown, and each member 71 is pivotally connected by a pin 72 to the end of one of the links 13.

Horizontal reciprocating motion of the arm 48 therefore causes generally horizontal lengthwise reciprocating movement of the links 13, and rotary reciprocating motion of the support members 71, carrying with them the contact cross-arm 8 and the movable contact arms 9.

Within the housing adjacent the contacts and cross-arm, is a trip unit 15 to sense over-currents and actuate the operating mechanism to trip the circuit breaker contacts in the event thereof.

Turning now to FIGURE 4, the "pancake" operating mechanism may be seen in greater detail. Input forces are imparted to the mechanism by way of a torque which is exerted manually on operating shaft 14 which is rotatably mounted on plate 12A and includes a portion extending upwardly through the housing 1 and carrying a manual operating handle 2. Operating shaft 14 carries cam sector 16 which has cables 17 and 18 affixed to opposite ends of its cam surface. The cam surface may be grooved as shown at 19 to receive cables 17 and 18 or flanges may be provided to prevent the cables slipping off the edges of the cam surface. The cables are crisscrossed with opposite ends affixed to the ends of a second cam surface 20 which is a part of cam sector 21. Cable 17 is connected to run from one end of cam sector 16 to the nonadjacent end of cam sector 21 and the other cable 18 is connected to run from the other end of cam sector 16 to opposite end of sector 21. The cables may be anchored in the cam sectors by balls seated in corresponding slots or by any conventional means; however, one cable at one end is preferably affixed by adjustable means 22 for adjusting tension in the cables.

As is shown in FIGURE 4, adjustable means 22 may consist of a bracket 22*a* and a nut 22*b* abutting the bracket and engaging a threaded rod 22*c* secured to the end of cable 17. Adjustable means 22 may be used not only to supply initial tension to the cables, but may also subsequently be used to take up slack caused by wear on the cam surfaces and stretching of the cables. Cables 17 and 18 may be steel cables of the aircraft control variety or any other type of flexible cable having suitable strength and flexibility. It will be understood that means other than cables 17 and 18 could be used to provide the driving relationship between cam sectors 16 and 21. For instance, cam sectors 16 and 21 could have teeth milled on the surfaces thereof for engagement with each other in a gear driving relationship. The geared sectors modification, however, has several disadvantages which are overcome by the cable driven arrangement. For instance, the gear teeth may wear or become broken necessitating replacement of the entire sector. Any wear or breakage in the cable arrangement can be repaired by simply replacing an inexpensive cable. In addition, the initial cost of the assembly is reduced due to the elimination of an expensive gear milling process.

As shown, the operating mechanism consists of a number of pairs of spaced flat parts, with a driving spring moving therebetween. For ease of understanding, the mechanism will be described first by reference only to the upper set of such parts, since the lower set of parts is a substantial duplicate thereof.

Integral with and extending from cam sector 21 is drive arm 23 for shifting the base of an overcenter spring assembly to be described. Member 21 is pivotally supported on a stationary pivot pin 28 carried by the base 12A.

Stud 25 is mounted on arm 23 and carries a hanger 29 that anchors one end of each of the coil springs 30. The opposite ends of springs 30 are anchored to hanger 31 which is supported by a stud 32 mounted on a link or toggle lever 33. The toggle lever 33 is pivotally supported on a releasable member 39 by pivot pin 35.

When the drive arm 23 is rotated so as to carry the line of action of the springs 30 past the pivot 35 of the toggle lever 33, the toggle lever 33 moves overcenter with a snap action, such as from the position shown in FIGURE 5 to the position shown in FIGURE 6.

This motion of the lever 33 causes reciprocal horizontal movement of the arm 48 by means of the interconnection provided by levers 40 and 42. Lever 42 is mounted at one end on a stationary pivot pin 46, and is connected at about its midpoint by means of pin 47 to the midpoint of the arm 48. The member 48 is therefore driven at its midpoint and consequently equal forces are transmitted at the ends of the member 48 which therefore acts as a force equalizing member. These forces are transmitted through links 13 to the ends of cross-arm 8 as shown in FIGURE 2 and previously described. As previously stated, the mechanism comprises in addition to the part just described, an essentially duplicate set of parts spaced therefrom, with the operating springs 30 moving between the two. Thus the lower set comprises a cam sector member 26 (corresponding to 21) pivotally mounted on stationary pivot pin 28 and having a drive arm 27 (corresponding to 23). The springs 30 also act between arm 27 and a toggle lever 34 (corresponding to 33) pivotally carried by a releasable support 38 (corresponding to 39). The lever 34 is connected to operate an arm 43 (corresponding to 42) by a link 41 (corresponding to link 40). The arm 43 is also connected to the arm 48 by the pin 47.

In the embodiment shown, only one drive cam sector 16 is utilized, that is, only member 26 is directly driven by the handle, the plate 26 being moved by its interconnection with plate 21.

Also forming part of the operating mechanism and supported between the plates 12*a* and 12*b* is a latch mechanism shown at the upper right hand portion of FIGURE 4. This latch mechanism releases the releasable members 38 and 39 so as to open the circuit breaker contacts in the event of actuation of the trip unit 15. The trip unit 15 may comprise any suitable current-responsive means delivering an output motion in response to a predetermined intensity of current therethrough. Such devices may be magnetic, such as a solenoid, or thermal, such as a bimetallic strip. A bimetallic member of the type referred to is shown for example in prior Patent 2,863,023, R. N. Rowe. Combined thermal and magnetic trip means which may readily be adapted for use with the invention are shown also in prior Patent 2,844,497, H. M. Steven et al. More specifically, if an overcurrent should occur, trip unit plunger 50 is depressed by the trip unit to contact release lever 51. Release lever 51 which is normally pivoted about supports 52 is biased in an upward position by spring 53. When the trip plunger strikes, lever 51 is depressed against the

biasing force of spring 53 to push lock pin 54 out of the restraining portion 55 of slot 56. This permits spring 57 to rotate stop assembly 58 in a counterclockwise direction so as to move stop bar 59 of the assembly 58 away from the ends of releasable members 38 and 39. When this occurs, releasable members 38 and 39, which support springs 30 through toggle levers 33 and 34, move under the force of springs 30 in a clockwise direction about pivotal support 60 as viewed in FIGURE 6.

For the purpose of assisting the automatic opening operation upon release of the members 38 and 39, a pair of spaced parallel guide links 33A are provided, pivotally supported on the base 12 by stationary pivot pin 33*b*. The links 33A have aligned slots 33C, receiving pins 33' carried by the toggle links 33, respectively.

When the members 38, 39 rotate clockwise from the latched position of FIGURE 6, the pivot pin 35 of links 33 moves downwardly and slightly to the right as viewed, and therefore it moves farther away from the stationary pin 33B supporting the guide links 33A.

Because of the engagement of pins 33' with the outer ends of slots 33C, however, the intermediate part of links 33 are restrained from proportionately equal movement in a similar direction. This causes conuterclockwise movement of the links 33 about their pivotal support on the members 38, 39. By means of the connecting links 40, this movement causes counterclockwise movement of the levers 42, moving the force-equalizing bar 48 to the left as viewed. This causes opening of the contacts in the manner previously described. This causes output levers 42 and 43 to be driven in a counterclockwise direction about their pivot pin 46, which action causes immediate opening of the circuit breaker contacts in the manner described above, through links 13.

To reset the mechanism, operating shaft 14 is turned in a counterclockwise direction to cause clockwise rotation of cam sectors 21 and drive member 26. As shown more clearly in FIGURE 7, this permits rollers 61 on drive arms 23 and 27 to contact the arcuate lower surfaces 63 and 64 of releasable members 38 and 39, thereby raising these members in a counterclockwise direction until ends 65 and 66 are retained behind stop bar 59. This movement occurs when the operating shaft is turned toward the off position. When the operating shaft has been turned all the way to the off position, the circuit breaker is completely reset and may be once again turned to the on position.

In order to better understand the relative positions of the elements of the operating mechanism when the mechanism is in the off, the on, or the tripped positions, reference may be had to FIGURES 5–7. Considering first the mechanism in its FIGURE 5 configuration, it may be seen that operating shaft 14 is turned to the extreme counterclockwise position. This results in like movement of cam sector 16 with consequent pivoting of drive arm 23 about axis 28 to the extreme clockwise position. In this position spring hanger 29 lies to the left of the axis of toggle levers 33 and 34 indicated by the dashed line, with the result that the toggle levers assume a stable position with respect to the springs at the limit of their counterclockwise travel. In this position, toggle links 40 and 41 are moved to the limit of their travel to the left with the result that output levers 42 and 43 are pivoted to their limit in the counterclockwise direction. Stud 47, therefore, is in its extreme left position with the result that force equalizing member 48 is also moved to the left. Force equalizing member 48 is connected at its ends to connecting links 13 as shown in FIGURES 2 and 5. These connecting links are secured at one end to force equalizing member 48 by eccentric adjustable means 70. The opposite ends of the links are pivotally affixed to depending support portions 71 at the ends of cross-arms 8 by pins 72. Thus, it may be seen that when the mechanism is in the position shown in FIGURE 5, with force equalizing member 48 in its extreme left position, cross-arm 8 has been pivoted about axle 11 in a clockwise manner and movable contacts 9 are separated from stationary contacts 6.

The application of force from the pivoted force equalizing member 48 to the ends of the cross-arm 8 assures a uniform pressure on the spaced contacts. It also avoids uneven application of force to the cross-arm. Although the connection from the force equalizing member to the cross-arm is conveniently arranged at the ends of the cross-arm, as shown in FIGURE 3, it will be apparent that the desired result could also be achieved by connecting the force equalizing member to the cross-arm at other points equally spaced from the center of the cross-arm.

The effective length of the arms 13 may be varied within a predetermined range to vary the "on" position of the contact arms 9. For this purpose, each end of the force equalizing member 48 is received in eccentric relation in the hub portion 70A of the adjusting member 70. The hub 70A is rotatably received in the arm 13. Rotation of the member 70 in the arm 13 therefore moves the end of the member 48 eccentrically in the hole receiving hub 70A, thus varying the distance between the end of member 48 and the pivot 72. The member 70 may be locked in a selected one of four angular positions by setting it so that a desired one of the holes 70B in the member 70 registers with the hole 13A in the arm 13, and inserting a resilient locking pin 70C therein, see FIGURE 3.

Turning to FIGURE 6, it may be seen that a clockwise rotation of operating shaft 14 will cause similarly rotating sector 16 to drive the drive arms 23 and 27 to the extreme counterclockwise position. As springs 30 pass the axis of toggle levers 33 and 34, indicated by the dashed line, the levers will snap overcenter and toggle in combination with toggle links 40 and 41 to the position shown in FIGURE 6. In this position output levers 42 and 43 are driven in a clockwise direction moving force equalizing member 48 to the position shown by solid lines. This position is to the right of the "off" position which is indicated by dotted lines. In this position force equalizing member 48 drives cross-arm 8 in a counterclockwise direction, as viewed in FIGURE 2, closing contacts 6 and 9.

Referring now to FIGURE 7, the elements of this operating mechanism may be seen in the tripped configuration. When stop bar 59 is caused to move to the right by the trip unit to the position shown in FIGURE 7, releasable members 38 and 39 are released and move under the influence of springs 30 clockwise into the position shown in FIGURE 7. As releasable members 38 and 39 move under the influence of springs 30, toggle levers 33 and 34 also collapse, as do toggle links 40 and 41. This results in a counterclockwise movement of output levers 42 and 43 which causes a movement of force equalizing member 48 to the left and results in opening of the circuit breaker contacts in the same manner as when the force equalizing member moves to the left due to the mechanism being set in the off position, as shown in FIGURE 5.

In order to reset the mechanism from the tripped position shown in FIGURE 7, control shaft 14 is merely rotated counterclockwise to the off position which results in clockwise pivoting of drive arms 23 and 27 causing rollers 61 to be drawn over the arcuate surfaces 63 and 64 of releasable members 38 and 39, thereby raising the trip bars for engagement by stop bar 59.

Thus, it may be seen that there is provided a circuit breaker having a "pancake" type operating mechanism together with a specially designed linkage which transform forces in the plane of the operating mechanism into forces perpendicular to that plane for application to a contact-carrying cross-arm. In addition, the linkage provides an equal pair of forces which may be applied to spaced points on the cross-arm to insure balanced operation of the cross-arm and its associated contacts. Moreover, an improved and easily adjustable cable drive is provided for effective operation of the mechanism.

While only a single embodiment of this invention has been shown, it will be apparent that many modifications

thereof may readily be made by those skilled in the art and it is therefore intended by the appended claims to cover all such modifications as fall within the true spirit and scope of this invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electric circuit breaker comprising:
(*a*) a support,
(*b*) a plurality of relatively stationary contacts mounted on said support,
(*c*) a plurality of relatively movable contacts,
(*d*) an elongated contact cross-arm pivotally supported on said support for movement about its longitudinal axis between open and closed circuit positions,
(*e*) means connecting said contact cross-arm to said relatively movable contact to move said relatively movable contacts between open and closed circuit positions in response to rotational movement of said contact cross-arm about said longitudinal axis between said open and closed circuit positions,
(*f*) snap-acting operating mechanism for operating said contact cross-arm between said open and closed circuit positions, the principal parts of said operating mechanism moving in planes parallel to each other and parallel to said axis of said contact cross-arm,
(*g*) said operating mechanism including a force-equalizing rod movable reciprocally by said operating mechanism in a plane parallel to said axis of said contact cross-arm, and
(*h*) means connecting the ends of said force-equalizing rod to the corresponding ends of said contact cross-arm, said connecting means being disposed and arranged to translate said reciprocal movement of said force equalizing member into reciprocal rotational movement of said contact cross-arm about said axis to move said movable contacts between said open and closed circuit positions.

2. An electric circuit breaker as set forth in claim 1 wherein said means connecting said ends of said force equalizing member and said ends of said contact cross-arm includes adjustable means for varying the relative normal position of said contact cross-arm and said force equalizing member.

3. An electric circuit breaker comprising:
(*a*) a generally planar supporting base having a front surface and a back surface,
(*b*) a plurality of relatively stationary contacts supported on said front surface of said supporting base,
(*c*) an elongated contact cross-arm pivotally supported on said front surface of said base and extending substantially parallel to said supporting base,
(*d*) a plurality of relatively movable contacts movable between open and closed circuit positions with respect to said relatively stationary contacts,
(*e*) said contact cross-arm being movable about a longitudinal axis of rotation between open and closed circuit positions,
(*f*) means connecting said contact cross-arm to said relatively movable contacts to cause movement of said relatively movable contacts between open and closed circuit positions upon rotational movement of said contact cross-arm between said open and closed circuit positions respectively,
(*g*) operating mechanism mounted on said supporting base adjacent said back surface, comprising a plurality of parts movable in planes parallel to each other and parallel to the plane of said supporting base,
(*h*) said operating mechanism including an elongated force-equalizing member extending generally parallel to said cross-arm, said force-equalizing member being movable bodily in a direction parallel to said plane of said supporting base reciprocally between open and closed circuit positions, and
(*i*) rigid link means interconnecting the ends of said contact cross-arm with the ends of said force-equalizing member, whereby operating force generated by said operating mechanism is applied to said contact cross-arm substantially equally at opposite ends thereof.

4. An electric circuit breaker comprising:
(*a*) a generally planar supporting base having a front surface and a back surface,
(*b*) a plurality of relatively stationary contacts supported on said front surface of said supporting base,
(*c*) a plurality of relatively movable contacts movable into and out of engagement with each of said stationary contacts respectively,
(*d*) an elongated contact cross-arm supported on said front surface of said supporting base in parallel relation thereto for rotation about its longitudinal axis between open and closed circuit positions,
(*e*) means connecting said relatively movable contacts to said contact cross-arm for movement of said movable contacts between open and closed circuit position in response to movement of said contact cross-arm between open and closed circuit positions respectively,
(*f*) operating mechanism mounted on said supporting base adjacent said back surface, said operating mechanism comprising a plurality of parts movable in planes parallel to each other and parallel to the plane of said supporting base, said parts comprising: a releasable member, a first operating member pivotally supported on said releasable member, and overcenter operating spring means connected to said first operating member and movable across the pivot point of said first operating member on said releasable member to move said first operating member between open and closed circuit positions with a snap-action,
(*g*) an elongated force-equalizing member extending substantially parallel to the plane of said supporting base, said force-equalizing member being movable bodily in a plane parallel to said plane of said supporting base,
(*h*) means connecting said first operating member to said force-equalizing member at a point substantially equally spaced from the opposite ends of said force equalizing member, and
(*i*) means connecting the ends of said force equalizing member to the corresponding ends of said contact cross-arm, said connecting means being disposed and arranged to translate said bodily movement of said force-equalizing member into rotational movement of said contact cross-arm.

5. An electric circuit breaker comprising:
(*a*) a support,
(*b*) at least one stationary contact mounted on said support,
(*c*) at least one relatively movable contact supported on said support,
(*d*) a releasable member pivotally supported on said support,
(*e*) means releasably latching one end of said releasable member to retain said releasable member in a predetermined first position with respect to said support,
(*f*) a first switch operating member pivotally supported on said releasable member intermediate the pivot of said releasable member and said latched end thereof,
(*g*) spring-supporting means pivotally supported on said support,
(*h*) an elongated tension-type operating spring interconnecting said spring-supporting means and said first switch operating member, whereby movement of said spring supporting means between open and closed circuit positions moves said tension spring

across the pivot of said first switch operating member to move said switch operating member between open and closed circuit positions with a snap-action,

(*i*) a first pulley sector supported on said support,

(*j*) a manually operable member supported on said support and connected to said first pulley sector,

(*k*) said spring supporting member having an integral second pulley sector, and

(*l*) a flexible tensile force-transmitting member having one end thereof connected to one end of said first pulley sector and having the other end connected to the opposite end of said second pulley sector, whereby rotational movement of said first pulley by said manually operable member tends to wind said tensile force-transmitting member onto said first pulley sector and off of said second pulley sector to move said spring-supporting member between said open and closed circuit positions.

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ROBERT K. SCHAEFER, *Examiner.*