Sept. 28, 1954 K. W. WILCKENS 2,690,486

CIRCUIT BREAKER

Filed June 26, 1951

Fig. 1.

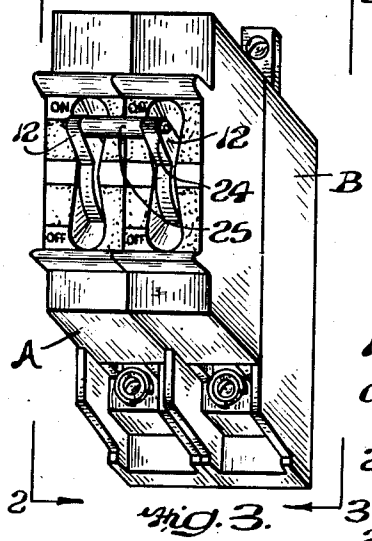


Fig. 2.

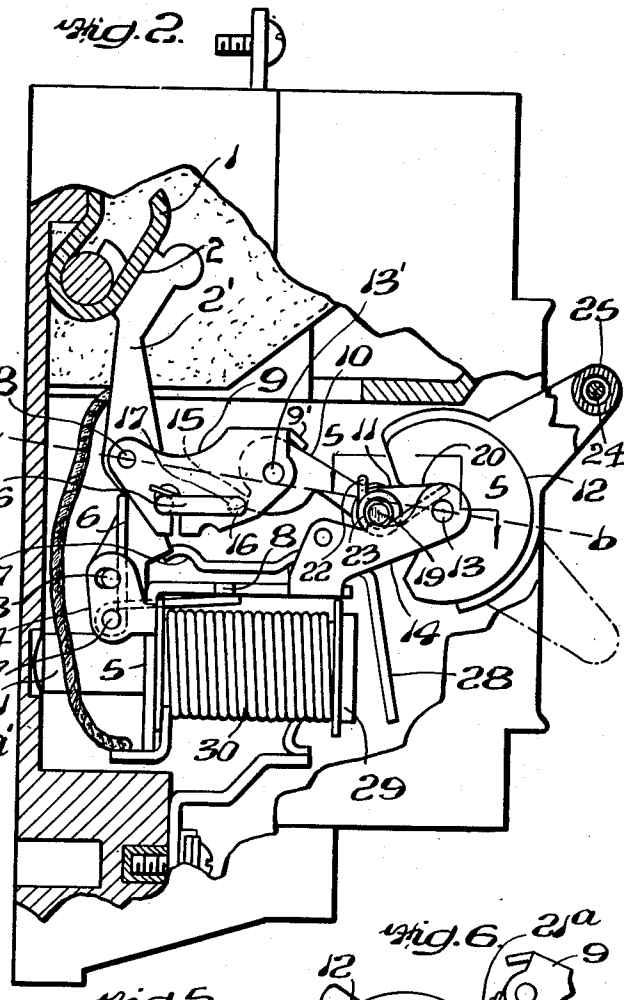


Fig. 3.

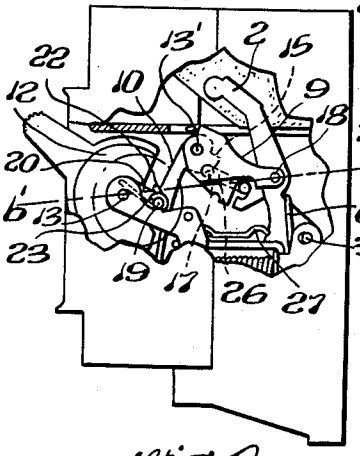


Fig. 4.

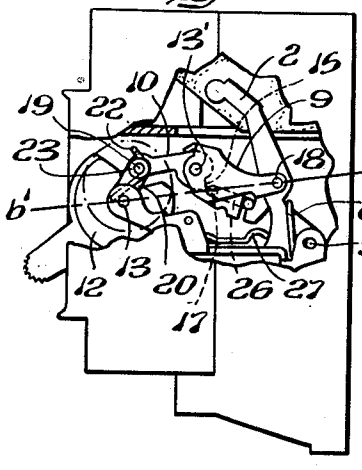


Fig. 5

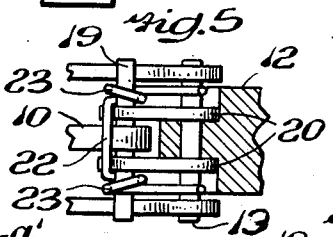


Fig. 6.

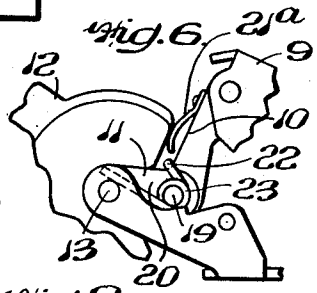


Fig. 7.

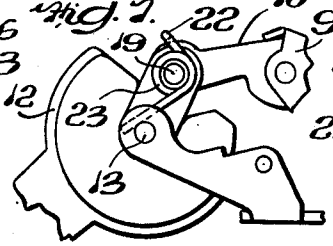
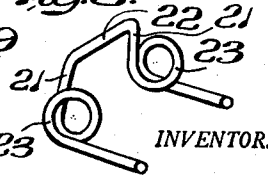


Fig. 8.



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Patented Sept. 28, 1954

2,690,486

UNITED STATES PATENT OFFICE

2,690,486

CIRCUIT BREAKER

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Application June 26, 1951, Serial No. 233,551

13 Claims. (Cl. 200—89)

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My invention relates primarily to trip-free circuit breakers and is designed to automatically apply force to the handle of such a circuit breaker tending to move the handle toward "off" position after, but not before, the movement of a contact to interrupt an overload which causes tripping of a linkage or toggle connecting the handle with a movable contact.

The principal object of my invention is the avoidance of the application, to the handle, of torque tending to open the breaker contacts, but the automatic application, to the handle, of sufficient torque to do useful work after the contacts have been opened as a result of an overload. Such work may be the movement of any load, as for instance the movement of an indicator, but my invention primarily contemplates the utilization of the torque applied to one handle for turning a handle or handles of one or more additional breakers to "off" position so as to interrupt the circuit or circuits controlled by such breakers without "tripping" the linkage or toggle mechanism through which the respective handles are connected with respective movable contacts.

By coupling together the handles of two or more breakers embodying my improvements, a multi-pole breaker may be built up from standard units each usable as a single pole breaker. All of the circuits controlled by such a built-up multi-pole breaker will be interrupted upon the tripping of the linkage or toggle mechanism of any one of them, and all of the circuits may be reclosed simultaneously by a single movement.

My improvements are particularly applicable to circuit breakers of the types referred to in my Letters Patent of the United States Nos. 2,360,922 and 2,427,998 wherein a contact-carrying lever is connected, through pivotally connected, collapsible links, with an oscillating operating handle, and my improvements provide actuating means for straightening the links and moving the handle to "off" position after tripping, but without any tendency to cause the movement of the handle when the linkage or toggle is in position for transmitting force between the handle and lever, or vice versa.

In its preferred form the actuating means comprises a spring which is subjected to momentary compression or loading as a result of the angular movement of a link and the inertia of the handle during tripping. The expansion of the spring exerts sufficient force to straighten the link and rock the handle past a dead center line against substantial resistance. The resultant movement of the handle may be transmitted through coupling bolts or a common shaft to the other handles whose movement opens other contacts without tripping the linkage associated therewith.

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The principles of my invention, and the best mode in which I have contemplated applying such principles, will further appear from the following description and the accompanying drawings in illustration thereof.

In the drawings, Fig. 1 is a perspective view of a pair of single pole breakers embodying my invention, the breakers being arranged in tandem with their cases bonded together and their handles coupled to form a multi-pole breaker; Fig. 2 is an enlarged side elevation looking in the direction of the line 2—2 of Fig. 1, with parts broken away to show the operating mechanism of one of the breakers incorporating my improvements, with the handle and contacts in the "on" position; Fig. 3 is a side elevation, looking in the direction of the line 3—3 of Fig. 1, with parts broken away to show the operating mechanism of the other circuit breaker the handle and contacts being in positions occupied by them after the linkage connecting the handle and movable contact has been collapsed as a result of an overload but before the inertia of the handle has been overcome to shift it to "off" position; Fig. 4 is a broken side elevation similar to Fig. 3 but with the handle moved to "off" position and the linkage straightened ready for re-closing of the contacts; Fig. 5 is an irregular transverse sectional view taken on the line 5—5 of Fig. 2; Fig. 6 is a fragmentary view showing the compression of the handle-actuating spring resulting from the collapse of the links and the inertia of the handle of the parts shown in Fig. 2 and also showing a supplementary spring on the linkage; Fig. 7 is a fragmentary view illustrating the release of the handle-actuating spring from compression and the freedom of the handle from torque when the handle is in the "off" position; and Fig. 8 is a perspective view of a handle-actuating spring.

In the embodiment of my invention illustrated in the drawings, a pair of single pole circuit breakers have their cases A and B bonded together in any suitable manner. Each of the cases contains a fixed contact 1 and a movable contact 2 carried by a conducting lever or blade 2', which is shiftably mounted on a shiftable fulcrum pin 3 seated in slotted ears 4 of a magnetically permeable frame 5. The switch blade 2' is normally biased away from the contact 1

by a strong spring 6 having a bight engaging the switch blade and legs wound around a pin 7 and anchored beneath the legs 8 of the frame 5.

The switch blade 2' is manually reciprocable to move the contact 2 toward and from the contact 1 through linkage comprising jointed links 9 and 10 pivotally connected with an oscillating handle 12 fulcrumed on a pintle 13 seated in the outer ends of ears 14 of the frame 5.

The links 9 and 10 are pivotally connected with one another by a pintle 13' and are provided with complementary latching members consisting of the tooth 15 and rocking shaft 16 having a cut-away portion 17, so that the links 9 and 10 are rigidly connected when the tooth 15 engages the periphery of the shaft 16. The links 9 and 10 collapse when the shaft 16 is turned to bring the recess 17 into registration with the tooth 15. The latching mechanism may, however, be omitted and the links 9 and 10 straightened far enough to move the pintle 13' past dead center position. The extent of the movement of the links beyond dead center position may be limited by the adjustable lip 9' overlying the top of the link 10. Several types of usable linkage are shown in my Patents Nos. 2,072,932, 2,200,109, and 2,360,922.

The end of the link 9 is connected by a pintle 18 with the switch lever or blade 2' above the bight of the spring 6 and the end of the link 10 is pivotally connected by a pintle 19 with a boss 11 of the handle 12. The boss 11 preferably consists of a metal insert journaled on the pintle 13 and seated in the socket 20 of the handle 12 so that the inset 11 is held in fixed relation to and forms part of the insulating handle 12. If desired the boss 11 may be made integral with the handle 12.

In accordance with my invention, a spring 21 (Fig. 8) has a bight 22 overlying the link 10 and legs 23 coiled around opposite ends of the pintle 19 and resting on the pintle 13. The legs 23 have sections extending transversely to one another on opposite sides of the coils therein, so that when the extremities of the legs 23 rest upon the pintle 13, the link 10 may lie beneath the bight 22 without having any pressure exerted thereon when the links are latched together and regardless of whether the switch lever 2' and handle 12 are in their closed positions shown in Fig. 2 or in their open positions shown in Figs. 4 and 7.

But when the links 9 and 10 are unlatched, and the linkage collapses, the switch lever 2' is moved by its spring 6 toward open position, while the handle 12 may remain in closed position, as shown in Figs. 3 and 6. The collapse of the linkage causes the link 10 to move at an angle to the link on 11 and engage the bight 22 and compress the coils of the legs 23. The spring 6 is of considerable greater strength than the spring 21, so that the lever 2' is moved to its full open position notwithstanding any resistance resulting from the compression of the spring 21 by the movement of the link 10.

The tendency of the compressed or loaded spring 21 to expand exerts a pressure on the link 19 tending to straighten the links 9 and 10 and lift the axis of the pintle 19 past the dead center line *a*—*b* (Fig. 2) connecting the axes of the pintles 13 and 18.

The straightening of the links and the thrust of the spring 21 applies torque to the handle 12 at the pivot 19 so as to turn the handle 12 about the axis of the pintle 13 with sufficient force to do useful work as well as turn the handle to "off" position.

The force exerted on the handle by the spring 21 may be supplemented by the expansion of a leaf spring 21a riveted to the link 10 and compressed between such link and the handle upon the collapse of the linkage and the thrust of the spring 6. In some cases, the spring 21a may be used in substitution for the spring 21.

The handles of the several breakers are coupled rigidly together by a bolt 24 and spacing bar 25. Hence the overload tripping of one breaker and the movement of its handle about the axis of its pintle to its "off" position turns all handles of breakers connected therewith to their "off" positions and opens contacts connected with such handles without collapsing the linkage of the latter breakers.

When the handles are all moved to "'off" position, the respective linkages return to force-transmitting position and all of the contacts may be simultaneously closed by moving the bar 25 or any one of the handles 12 to "on" position. If overload persists on any of the breakers, the overloaded breaker will instantly trip despite the holding of the coupling or handle, so that the trip free characteristics of the breakers are not impaired by my improvements.

The automatic tripping of a breaker on overload may be effected by collapsing its linkage by any current responsive means. As illustrated in the drawings, such means comprise a spring-pressed arm 26 on the shaft 16. This arm 26 lies in the path of movement of a non-magnetic arm 27 of a pivoted armature 28. The armature 28 is attracted toward the pole piece 29 of a solenoid 30 whenever the flow of current through the solenoid coil creates a magnetic flux sufficient to attract the armature, immediately in case of a short, or after a time delay in case of an overload causing the movement of a core (not shown) in the dash pot 31, as more fully explained in my patents above referred to.

It will be understood that multi-pole breaker having any number of poles may be assembled from units such as above described and that they will operate as a multi-pole breaker by merely rigidly coupling their handles by means of a bolt or by rigidly mounting all the handles on a common pintle or shaft 13 extending across all the breakers. For example, four units may be assembled and coupled together to provide protection for a three phase hookup and to permit remote control of all of the breakers by an auxiliary circuit having a conductor forming the solenoid coil of the fourth breaker. Or two or three circuit breaker units may be coupled together to form a two pole breaker or a three pole breaker. Or the units may be used individually for each protecting a single circuit and the actuated movement of the handle to "off" position utilized for the operation of an indicator, target or other auxiliary device, or merely to insure the movement of the handle to the "off" position to reset the breaker for reclosing. In all instances, a strong torque is applied to the handle to move its point of connection with the linkage past the center line *a*—*b* and past the center line *a'*—*b'* after the breaker has been tripped by an overload and its linkage or toggle has collapsed, but neither the actuating spring 21 nor 21a has any tendency to cause movement of the handle to "off" posi-

tion or to cause the opening of the contacts, as a result of vibration or otherwise.

From the foregoing, it will be seen that when the links 9 and 10 are rigidly latched together, as shown in Fig. 2, force is transmissible therethrough from the pivotally mounted handle 12 to the load presented by the movement of the lever 2' (and vice versa) to close or open the contact 2, without any participation of the spring 21 and/or spring 21a in the operation, and without the exertion of any force by the spring 21, which is fully expanded so long as the links are latched together. But when the linkage is collapsed by an overload (as a result of turning the cut-away portion 17 of the shaft 16 into the path of the tooth 15) the spring 6 applies force to turn the links 9 and 10 on their pivots 18, 13' and 19 (Fig. 3). This turning of the link 10 on its pivot 13', loads the spring 21 by winding the bight 22 around the axis of the pintle 19 against the resistance of the spring legs resting on the pintle 13. The coils 23 are thereby placed under stress. This stress tends to move the links 10 and 11 until the stress is relieved; thereby moving the pintle 19 past the line a'—b' and turning the handle 12 to fully open position, where it is free from any stress from the spring 21.

Having described my invention, I claim:

1. The combination with a plurality of sets of contacts, of handles each operatively associated with a contact of a set aforesaid for moving such contact to closed or open position, articulated linkages effecting such associations and each connecting one of said handles with its associated contact, each of said linkages including a pair of pivotally connected links permitting the collapse of such linkage, the links of each linkage being movable into position by transmitting force between a handle and its associated contact, a coupling connecting said handles with one another, and a spring loaded by the collapse of one of said linkages and imparting torque to one of said handles upon such collapse of its associated linkage and the opening of its associated contact and thereby rocking another handle through said coupling to move the contact associated with said last named handle without collapsing its associated linkage.

2. The combination with a plurality of switch units each comprising a set of contacts, of handles each operatively associated with a contact of a set aforesaid for moving such contact to closed or open position, each unit including linkage connecting its handle and movable contact to effect such operative association, the linkage of at least one of said units having pivotally connected links collapsible to permit the movement of its associated contact independently of movement of its associated handle, said last named unit also having a handle-actuator applying torque to said handle upon collapse of said links only, and a coupling connecting said handles and transmitting torque therethrough to open a contact of another unit without collapsing the linkage associated with the last named contact.

3. The combination with a plurality of switch units each comprising a movable contact, of handles each operatively associated with one of said movable contacts, each of said units having articulated linkage connecting its handle with its movable contact to effect such operative association, each of said linkages comprising collapsibly connected links, a spring connected with each of said linkages and loaded by the collapsing movement thereof to impart torque to the handle connected with the collapsed linkage, said spring being unloaded when said linkages are operatively positioned for movement of said contacts by said handles, said handles being coupled to one another independently of said linkage and the movement of said handle connected with the collapsed linkage also moving the other handle to open the contact connected with the latter without collapsing the linkage between said last named contact and handle.

4. The combination with complementary contacts and a handle for moving one of said contacts to open or closed position, of articulated linkage connecting said handle with the last named contact, said linkage comprising links connected by a joint permitting the collapse thereof, one of said links being pivotally connected with said handle, and a spring in the path of movement of one of said links, said spring being substantially unloaded when said linkage is positioned to transmit force from said handle to said movable contact, or vice versa, but being increasingly loaded by the collapsing movement of said last named link upon the collapse of said linkage to impart torque to said handle.

5. The combination with complementary contacts and a handle for moving one of said contacts relatively to the other, of linkage for transmitting force between said handle and last named contact in one position of said linkage, said linkage including a pair of links with a joint between them permitting the collapse of such linkage, and a spring in the path of movement of one of said links, said spring being substantially unloaded when said contacts are closed and being increasingly loaded by the collapse of said linkage to impart torque to said handle.

6. The combination with complementary contacts and handle movable about an axis, of articulated linkage having a link pivotally connected with one of said contacts and a link pivotally connected with said handle at a point movable past a dead center line intersecting the axis of said handle and the pivotal connection of said first named link with said contact, the links of said linkage being movable into position for transmitting force between said handle and contact and movable into collapsed position preventing transmission of force between said handle and contact, and a handle-actuator actuated by the collapsing movement of said linkage and applying torque to said handle only when one of said links is in collapsed position.

7. The combination with a load and a handle movable about an axis, of a link pivotally connected with said handle, a second link pivotally connected with said first link and with said load, said load being movable by said handle through said links when the latter are in force transmitting position, said links being collapsible to prevent transmission of force from said handle to said load, and a spring operatively associated with said handle and in the path of movement of one of said links, said spring being increasingly loaded by the collapsing movement of said links to move said handle about its axis.

8. The combination with a load and source of power of collapsible linkage having pivotally connected links respectively connected with said source of power and with said load, said linkage being movable into position for transmitting force from said source to said load, means for collapsing said linkage, and an anchored spring in the path of movement of one of said links dur-

ing the collapse of said linkage and loaded by the impact thereof, said spring being operatively associated with said source of power and applying force thereto when loaded.

9. The combination with a load and a source of power, of collapsible linkage having links connected together through a joint, one of said links having a pivotal connection with said source and the other of said links being connected with said load, said links being movable into positions for transmitting force between said source and load and also being collapsible, and an anchored spring having a section coiled around the axis of said pivotal connection and a section in the path of movement of one of said links upon collapse of said linkage, said spring being loaded by the collapsing movement of said last named link and being operatively associated with said source to apply force thereto when said spring is loaded.

10. The combination with complementary contacts and a handle associated with one of said contacts for moving it to closed or open position, of linkage connecting said handle and contact to transmit a force between them in one position of said linkage, a pintle connecting one end of said linkage with said handle, and a spring wound around said pintle and having a bight overlying said linkage when the latter is in force-transmitting position, said bight being engaged by said linkage and loaded by the movement thereof to impart torque to said handle only upon the collapse of said linkage.

11. The combination with a pivotally mounted handle and a load reciprocable thereby, of articulated linkage connecting handle and load and through which force is transmissible in one position thereof, said linkage being collapsible to prevent transmission of force between said handle and load, and a spring carried by said linkage which is substantially unloaded when said linkage is in force-transmitting position, said spring being increasingly loaded by the collapsing movement of said linkage and imparting torque to said handle.

12. The combination with a pivotally mounted member and a reciprocal load member, of linkage pivotally connected with the respective members and through which force is transmissible from one member to the other member in one position of said linkage, said linkage being collapsible to prevent transmission of force from one of said members to the other, a spring having a bight in the path of said linkage upon the collapse thereof and an anchorage adjacent to the pivotal mounting of said first named member, said spring having a coil adjacent to the connection of said linkage with said pivotally mounted member first named, said spring being loaded upon the collapse of said linkage and imparting torque to turn said pivotally mounted member on its axis.

13. In a circuit breaker, the combination with a switch blade and an operating handle, links connecting said handle and switch blade and movable into and out of position for transmitting stress between said handle and switch blade, means for applying force to one of said collapsed links and thereby moving said links toward stress transmitting position, said links being free of such force when in stress transmitting position, and means responsive to current controlled by said switch blade for initiating the collapse of said links independently of said means first named.

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