CIRCUIT BREAKER AND SAFETY INTERLOCK FOR MODULAR POWER SUPPLY


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ABSTRACT

A circuit breaker assembly with a pivotally mounted indicator flag and latch member adapted to engage and releasably lock a manual control handle of the circuit breaker in an open position. The handle in the closed position shields from view the indicator flag and in the open position exposes the indicator flag to view, thereby providing a visual indication of when the circuit breaker is open. An output terminal strip of the circuit breaker has a cover positioned with respect to the handle so that it can be removed only when the handle is in the open position. The circuit breaker is mountable adjacent to a power supply module and mechanically interlocks therewith so that the module cannot be removed from the frame in which it is carried prior to removal of the terminal cover and thus prior to opening of the circuit breaker.

15 Claims, 8 Drawing Figures
This invention relates to electrical circuit breakers and more particularly to a circuit breaker for a modular power supply system.

Objects of this invention are to provide a circuit breaker for a modular power supply which (1) provides a purely mechanical highly visible indicator that the breaker is open, (2) automatically locks in the open position so that the breaker cannot be accidentally closed, (3) preserves its associated power supply module from being removed from its frame while the circuit breaker is closed thereby providing a safety interlock, and (4) has only a few comparatively simple component parts which can be readily molded or cast and hence is of economical construction and assembly and is relatively maintenance free.

These and other objects, features and advantages of this invention are disclosed in this specification and the accompanying drawings in which:

FIG. 1 is a front elevational view of a plurality of circuit breakers and their associated power supply modules mounted in stacked arrays in a frame to provide a modular power supply system.

FIG. 2 is a fragmentary front elevational view on an enlarged scale of a circuit breaker and associated power supply module illustrating the way in which the module is carried by the frame.

FIG. 3 is a fragmentary sectional view on line 3—3 of FIG. 2 illustrating some of the details of construction of the circuit breaker assembly with a handle shown in the closed position in solid lines and in the open position in phantom.

FIG. 4 is a fragmentary sectional view similar to FIG. 3 showing the handle of the circuit breaker in the open position in solid line and intermediate the open and closed positions in phantom.

FIG. 5 is a fragmentary front elevational view of the circuit breaker assembly of FIG. 2 with the terminal cover panel removed and the circuit breaker handle in the open position thereby exposing the indicator flag and latch member to plain view.

FIG. 6 is a perspective view of the indicator flag and latch member of the circuit breaker assembly.

FIG. 7 is a sectional view on line 7—7 of FIG. 6 showing the cross-sectional configuration of the indicator flag and latch member.

FIG. 8 is a fragmentary sectional view on line 8—8 of FIG. 2 showing the interlocking of the power supply module with the terminal cover panel.

Referring to the drawings:

FIG. 1 illustrates a modular power supply system designated generally as 10 with a frame 12 adapted to slideably receive and carry a plurality of individual power supply modules 14. A circuit breaker assembly 16 is associated with each power supply module 14. Power supply modules 14 and circuit breakers 16 are arranged in frame 12 in three vertically extending columns each containing seven modules and seven circuit breakers. A panel 18 with an air vent 20 is attached to the side of frame 12 and encloses the control circuitry for the three columns of power supply modules 14.

As shown in FIG. 2, each power supply module 14 has a front spilt cover 22 with vents 24 therein secured by screws 26 to a chassis or carriage 28 with two generally parallel spaced-apart opposed vertically extending shoulders 30 thereon (only one of which is shown in FIG. 2). Each power supply module 14 is carried by and slides into and out of frame 12 on a pair of ways 32 secured to frame 12 and underlying shoulders 30 of chassis 28. Each pair of ways 32 are generally in opposed spaced-apart parallel relationship and extend horizontally substantially throughout the full depth of frame 12.

As shown in FIGS. 2, 5 and 8, circuit breaker assembly 16 has a mounting panel 34 secured to frame 12 as by two screws 35 (FIG. 5) and such additional screws (not shown) as required. Mounting panel 34 has a lower generally rectangular
has a generally U-shaped cross section and extends through a U-shaped opening 106 (FIG. 4) in sidewall 108 of cover 44 with flange 104 engaging the interior of sidewall 108. Since the lower screw 46 and hence cover 44 cannot be removed unless breaker 48 is open, module 14 cannot be removed from frame 12 until circuit breaker 48 has been opened. The present invention also contemplates a mechanical interlock directly between module 14 and handle 54 to open circuit breaker 48 when module 14 is removed from frame 12. This can be achieved by fixing a rod or shaft (not shown) to module 14 so that it extends generally horizontally between handle 54 and mounting panel 34. Although the illustrated embodiment is preferred, both arrangements provide safety interlocks which reduce the risk of electrical shock and injury to service and maintenance personnel.

In operating circuit breaker assembly 16, when handle 54 is in the down or solid line position (shown in FIG. 4) the contacts of circuit breaker 48 are open. Due to the force of gravity indicator and latch member 60 assumes the position shown in FIG. 4 with flag portion 70 extending vertically downward with its free edge overlying and in close proximity to abutments 62 of module 14. When flag 70 is in this position, it provides a latch cooperating with abutment 62 to lock handle 54 in the down position and thus prevent the contacts of circuit breaker 48 from being closed. As shown in FIG. 5, when handle 54 is in the down position flag 70 is exposed to view from the front of mounting panel 34 and thus gives a visual indication that the circuit breaker is open and hence its associated power supply module is turned off or not operating. If desired flag 70 can be colored a bright red and terminology as indicated in FIG. 5 added to further assist in determining when module 14 is off. The ability to promptly determine when a power supply module 14 is off or inoperative is particularly important in modular power supply systems because such systems are designed so that the remaining power supply modules automatically can, under certain conditions, assume the load which was in part carried by a module that becomes inoperative.

To close the contacts of circuit breaker 48 pressure is manually applied in the direction of the arrow in FIG. 4 to the underside of tab 72 of indicator and latch member 64 to swing the free edge of flag 70 counterclockwise and out of latching engagement with abutments 62 of handle 54 and then handle 54 is moved generally counterclockwise to the upward position shown in solid line in FIG. 3 to close the contacts of circuit breaker 48. As shown in FIG. 4, once flag 70 disengages from abutments 62 and handle 54 is moved slightly upward cam surface 92 engages the underside of flag 70 and cams the flag 70 to the close position in which case flag 70 can be moved upward without further interference by flag 70. As handle 54 nears the end of its upward stroke flag 70 is cammed counterclockwise by bottom wall 82 of handle 54 (as shown in solid line in FIG. 3). As shown in FIGS. 2 and 3, when handle 54 is in the fully upward position it completely overlies and shields flag 70 so that it cannot be viewed from the front of circuit breaker assembly 16. Thus indicator or flag 70 is only visible when handle 54 is in the down position so that the contacts of circuit breaker 48 are open and its associated module 14 is off.

The handle 54, flag and latch member 60, terminal cover panel 44, and mounting panel 34 of circuit breaker assembly 16 can all be molded of an ABS self-extinguishing plastic material and thus are of economical construction. To further facilitate the economy of construction and assembly terminal block 42 can be integrally molded with mounting panel 34 and a standardized commercially available circuit breaker 48 can be utilized in manufacture and assembly of the circuit breaker apparatus of this invention.

**Claim:**

1. A circuit breaker assembly comprising: an electric circuit breaker having at least one pair of contacts and at least one arm movable to a first position wherein said contacts are open and to a second position wherein said contacts are closed, a handle connected adjacent one end thereof to said arm and movable therewith to corresponding first and second positions to open and close said contacts, and an interlock means movably mounted in said circuit breaker assembly and operative to releasably lock said arm in said first position, said flag means comprising a shaft mounted in said circuit breaker assembly for rotary movement about its longitudinal axis and a generally rectangular panel connected to said shaft and extending generally axially thereof and radially therefrom, at least one abutment on said handle adjacent one end thereof adapted to be engaged by said flag means to releasably lock said arm in its first position, said handle being arranged and constructed to overlie said flag means to shield said flag means from view from a front side of said assembly when said arm and said handle are in their respective second positions and to expose said flag means to view from said front side of said assembly when said arm and said handle are in their respective first positions, and wherein said handle has a pocket therein adapted to receive at least a portion of said flag means when said handle is in its said second position.

2. The circuit breaker assembly set forth in claim 1 wherein said handle has a cam surface adjacent said abutment on said one end of said handle, said cam surface being adapted to engage and rotate said panel when said handle moves from its first to its second position.

3. The circuit breaker assembly set forth in claim 1 wherein said handle is arranged to move in an upward direction from its said first position to its said second position and in a downward direction from its said second position to its said first position, and wherein said shaft is pivotally mounted in said circuit breaker assembly above said arm and adjacent said handle so that said handle engages said panel to retain said panel in a raised position when said handle is in its said second position and so that said panel is free to pivot downwardly due to gravity when said handle is moved to its said first position.

4. The circuit breaker assembly set forth in claim 1 wherein said shaft is mounted in said circuit breaker assembly so that its longitudinal axis is transverse to the direction of movement of said handle, said panel has a free edge remote from said shaft adapted to engage said abutment to releasably lock said handle in its first position and said panel is arranged to be pivoted out of engagement with said abutment so that said handle is free to be moved to its second position.

5. A circuit breaker assembly comprising: an electric circuit breaker having a housing, at least one pair of contacts and actuator means, said actuator means having handle means operable from a front face of said housing and movable to a first position to open said contacts and to a second position to close said contacts, and wherein said combined means is disposed in its first position to engage said actuator means and restrain movement of said handle means from its first position to its second position, said combined means is further disposed in its first position to provide a visual indication of said contacts are open when said handle means is in its first position, and said combined means is disposed in its second position in the space between said front face portion and said shield portion when said handle means is in its second position so as to be hidden from view.

6. The assembly set forth in claim 5 wherein said combined indicator and latch means comprises a panel pivotally mounted in said circuit breaker assembly for rotation about an axis that is generally parallel to said front face, said panel having a free edge remote from said axis adapted to rotate to a position engaging said actuator means to restrain movement of said handle means from its first position to its second position.
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7. The circuit breaker assembly set forth in claim 5 wherein said handle means is mounted to pivot in an upward direction from said first position to said second position and in a downward direction from said second position to said first position, and wherein said combined indicator and latch means comprises a panel pivotally mounted in said circuit breaker assembly adjacent said handle means for rotation about an axis that is transverse to the direction of movement of said handle means, said panel being disposed so that said handle means engages said panel to retain said panel in a raised position when said handle means is in its second position and so that said panel is free to pivot downwardly due to gravity when said handle means is moved to said first position.

8. The circuit breaker assembly set forth in claim 7 wherein said panel engages said actuator means when said handle means is in its first position to restrain movement of said handle means from its first position to its second position, and wherein said combined indicator and latch means further comprises a tab accessible when said panel is in engagement with said actuator means and operatively connected to said panel so that said panel can be disengaged from said actuator means by moving said tab.

9. The circuit breaker assembly set forth in claim 7 wherein the pivotal mounting for said panel comprises a shaft and said panel has a free edge remote from said shaft adapted to engage an abutment on said handle means when said handle means is in its first position thereby releasably locking said handle means in its first position and wherein said panel is arranged to be pivoted out of engagement with said abutment so that said handle means is free to be moved to its second position.

10. The circuit breaker assembly set forth in claim 5 further comprising electrical terminal means for connection to electrical wiring, said terminal means being accessible from the front of said circuit breaker assembly to facilitate connection of said wiring, a movable cover enclosing said terminal means to prevent access to said terminal means when said cover is in a closed position, releasable fastener means for releasably locking said cover in its closed position, said fastener means being located in the space between said front face portion and said handle means when said handle means is in its second position with said handle means overlying said fastener means to prevent access thereto when said handle means is in its second position.

11. In combination, a frame having a plurality of openings therein adapted to slideably receive and support a plurality of power supply modules, a plurality of power supply modules disposed in respective openings in said frame, a plurality of circuit breaker assemblies mounted on said frame with each assembly disposed adjacent a front end of a respective associated module, each of said modules being adapted to be removed from said frame by sliding motion relative to its associated circuit breaker assembly, each of said circuit breaker assemblies comprising a housing, at least one pair of contacts and actuator means, said actuator means having handle means operable from a front face of said housing and movable to a first position to open said contacts and to a second position to close said contacts, terminal means in said circuit breaker assembly, electrical wiring connecting said terminal means in each circuit breaker assembly to its respective associated module and adapted to supply power thereto when said contacts are closed and releasable mechanical interlock means interengaging each circuit breaker assembly and its respective associated module to restrain removal of said associated module from said frame and wherein said interlock means includes means for disengaging said interlock means when said handle means is moved to its first position.

12. The combination set forth in claim 11 wherein each circuit breaker assembly further comprises a movable cover overlying said terminal means to prevent access thereto when said cover is closed and permit access to said terminal means when said cover is opened, and wherein each module interlock means comprises said cover and a rigid member interengaged between a module and said cover of an associated circuit breaker assembly when said cover is closed to restrain motion of said rigid member, said rigid member being adapted to be disengaged when said cover is opened.

13. The combination set forth in claim 12 wherein said means for disengaging said mechanical interlock means comprises releasable fastener means for holding said cover in its closed position and thereby maintain said interlock means engaged, and wherein said handle means is arranged and constructed so that when said handle means is in its second position said handle means covers said releasable fastener means to prevent access thereto.

14. The combination set forth in claim 12 wherein said rigid member comprises a conduit for said electrical wiring between a module and said terminal means in its associated circuit breaker assembly.

15. A circuit breaker assembly comprising: an electric circuit breaker having a housing, at least one pair of contacts and actuator means, said actuator means having handle means operable from a front face of said housing and movable to a first position to open said contacts and to a second position to close said contacts, terminal means in said circuit breaker assembly, electrical wiring connecting said terminal means in each circuit breaker assembly to its respective associated module and adapted to supply power thereto when said contacts are closed and releasable mechanical interlock means interengaging each circuit breaker assembly and its respective associated module to restrain removal of said associated module from said frame and wherein said interlock means includes means for disengaging said interlock means when said handle means is moved to its first position.