# United States Patent [19]

**Harper**

[11] **3,786,380**

[45] **Jan. 15, 1974**


[54] **MULTI-POLE CIRCUIT BREAKER**


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[73] Assignee: **Airpax Electronic, Inc.,** Cambridge, Md.



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[21] Appl. No.: **333,296**

[52] **U.S. Cl.** ..... **335/9,** 335/10, 335/201

[51] **Int. Cl.** ..... **H01h 73/02**

[58] **Field of Search** ..... 335/8, 9, 10, 201; 200/153 H, 50 C



[56] **References Cited**

UNITED STATES PATENTS

3,444,488 5/1969 Harper ..... 335/10



*Primary Examiner*—Harold Broome
*Attorney*—LeBlanc & Shur



[57] **ABSTRACT**

A multi-pole circuit breaker is disclosed which allows selective manual making and breaking of contacts within the breaker and automatic simultaneous breaking of all breaker contacts whenever a current overload condition occurs at any of the poles of the circuit breaker. The selective and automatic breaking function is accomplished by an interlocking trip shoe assembly comprised of a number of trip levers associated, one each, with a pole of the circuit breaker. Each trip lever is cammed by the movement of the movable contact associated with one of the poles in response to an overload condition at this pole to actuate the armatures associated with the other of the poles to open all other breaker contacts. When the circuit breaker switch associated with one of the poles is moved to an "off" position, a camming member is shifted to a cut away portion of the trip lever such that the trip lever is not cammed when the movable contact swings away from the fixed contact. This permits the breaking of the contacts of one pole without breaking of the contacts associated with the other of the poles. The breaker is provided with vent channels for venting arcing gases and a fine mesh screen in front of the vent channels which acts as a flame arrestor to prevent explosions.


**18 Claims, 6 Drawing Figures**

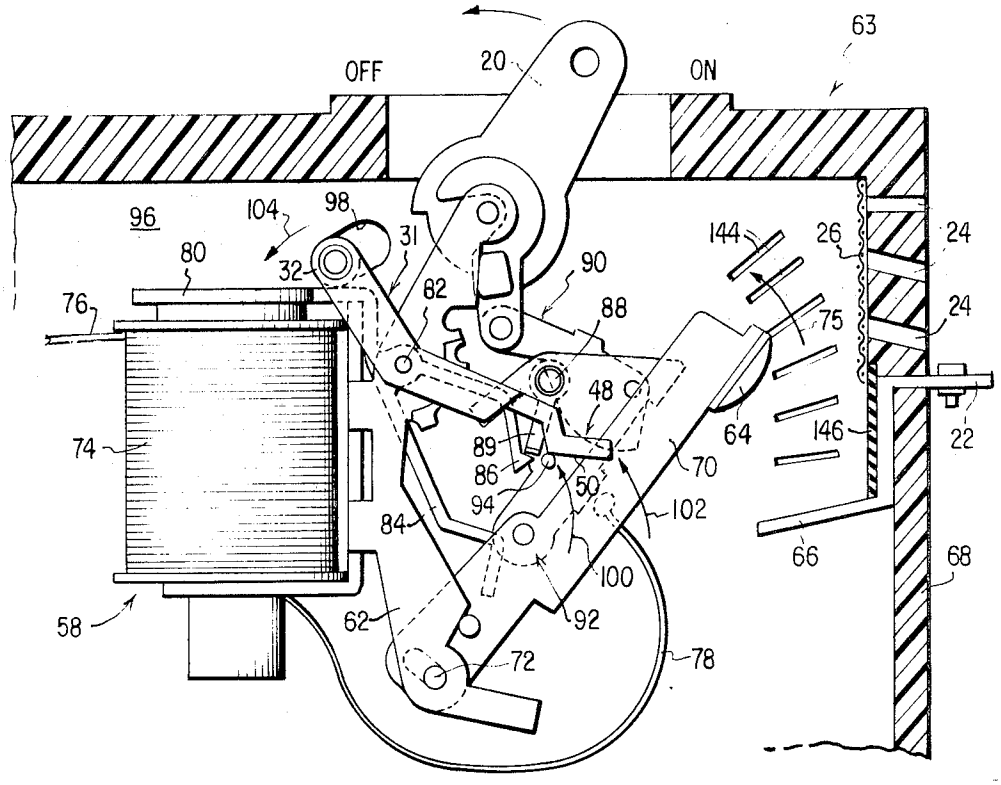


FIG. 1

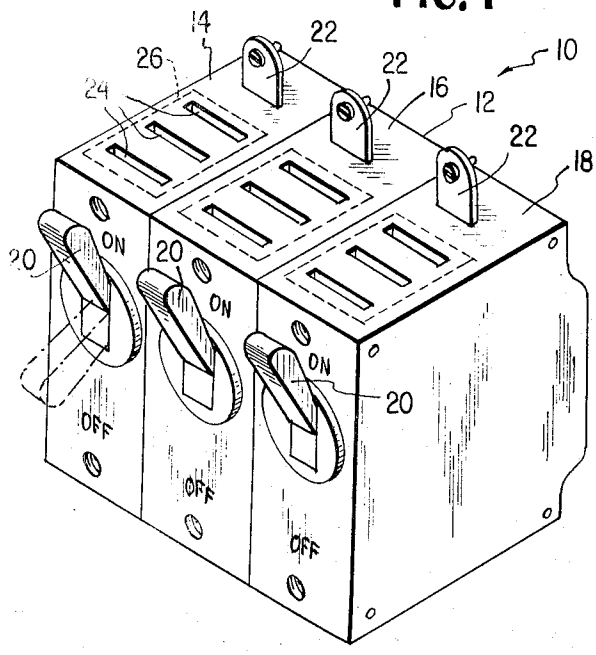
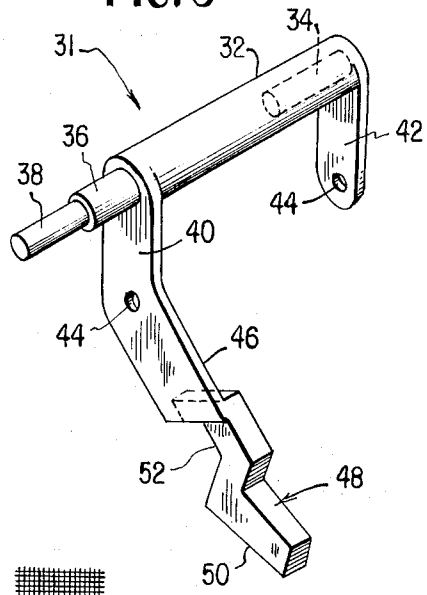



FIG. 3



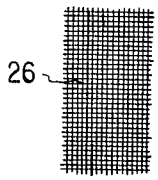




FIG. 2

FIG. 4

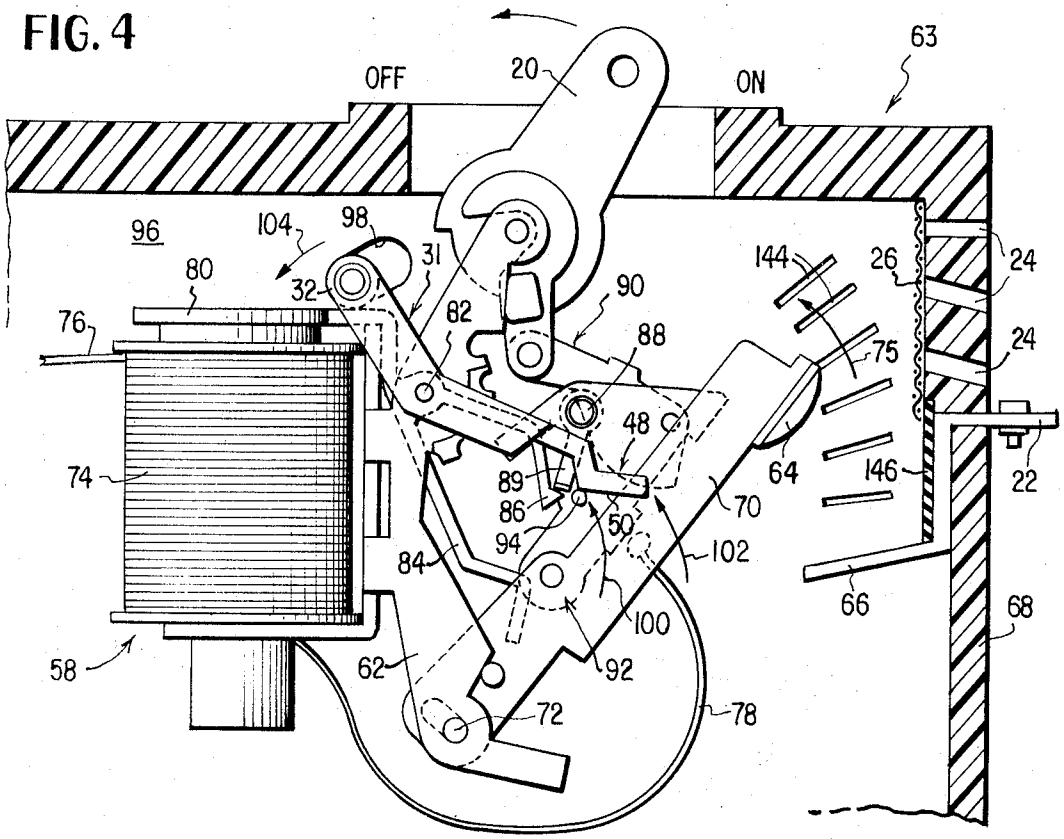


FIG. 5

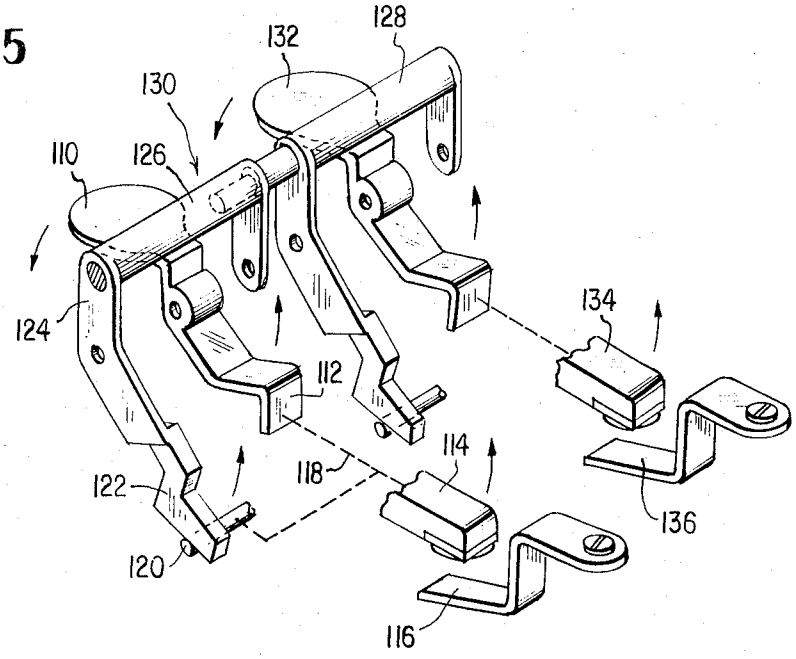

128
132
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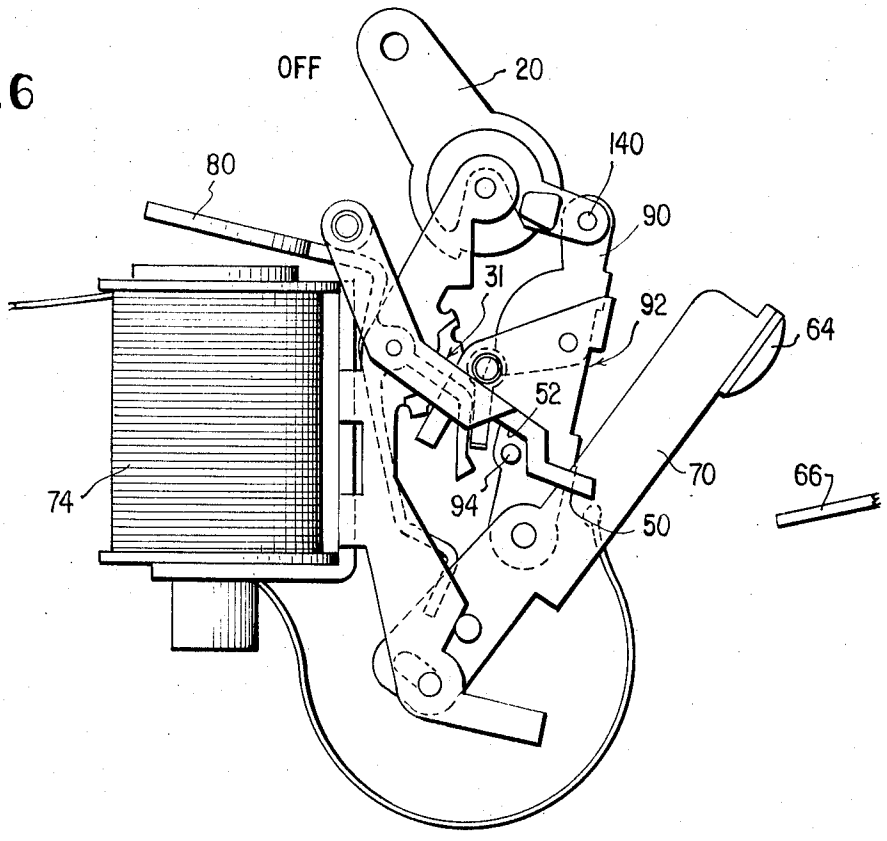
FIG. 6


OFF
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# MULTI-POLE CIRCUIT BREAKER

This invention relates to a high performance multi-pole electrical circuit breaker and more particularly to an interlocked tripping mechanism for use with a multi-pole circuit breaker, which provides that any number of single poles or combinations of poles may be manually turned "on" or "off" without effecting the other poles, while an overload at any one pole will cause all poles to open. Additionally, the high performance electrical circuit breaker includes flame arresting apparatus so that the high performance electrical circuit breaker can be used in highly explosive environments.

Multi-pole circuit breakers of all sizes and ratings have had considerable application not only in conventional power delivery systems but also in specialized applications in which the selective interruption of the conductivity path of one of a plurality of transmission lines is desirable. Selective interruption of a conductivity path is necessary when, for, instance, the conductivity path between two points is to be checked absent the effects of any return conductivity path. A return conductivity path can be provided in a number of ways, but most typically when machinery remains connected to the transmission line. More generally, however, it is desirable to provide a multi-pole breaker of such versatility that selective opening of the poles may be achieved on a manual basis with all poles of the multi-pole circuit breaker being opened automatically in response to a current overload condition

It is also desirable to provide a multi-pole breaker in modular form in which poles may be added as the need arises without the necessity of gaining access to the interior of the circuit breaker housing. Additionally, it is desirable to provide a multi-pole circuit breaker with fewer moving parts so that the construction thereof is made less expensive and so that the reliability of the circuit breaker may be increased.

As described in U.S. Pat. No. 3,444,488 issued to George S. Harper on May 13, 1969 and assigned to the assignee hereof, prior to the Harper patent, multi-pole circuit breakers can be divided into three categories. First are the units having the handles of all poles tied together with a rigid pin. In this case all poles turn "on" and "off" together manually. An overload at any pole causes all poles to turn "off" simultaneously. Second, there are units in which the handles of a breaker are not tied together with a rigid pin, but are connected with a mechanism such that all poles must be turned "on" together manually. Turning one pole "off" manually turns "off" all other poles. Similarly, an overload at any one pole causes all poles to turn "off" simultaneously. Third, there are units having the handles of a breaker not tied together with a rigid pin, but built with a mechanism such that any combination of poles can be turned "on" together manually or any combination of poles can be turned "off" together manually. However, an overload at any single pole or combination of poles does not turn the other poles off. In the Harper patent a fourth category of breakers is described in which selective actuation and automatic deactivation responsive to an overload condition is described. In the Harper patent selective actuation of the poles is made possible by a unitary cross trip stretching between the poles and a trip shoe assembly involving a number of moving parts. Because of the unitary cross trip, the multi-pole breaker of the required number of poles is assembled at the factory.



However, it is oftentimes desirable to construct a multi-pole circuit breaker in modular form in which a number of poles is provided by merely connecting together the required number of circuit breaker modules. This capability permits increased flexibility, since a number of modules may be carried to the installation location and simply connected together as the installation requirements demand without the necessity of opening the circuit breaker case or housing.

In the present invention an easily assembled modular multi-pole circuit breaker is provided which allows selective manual making and breaking of the pole contacts and automatic simultaneous breaking of the pole contacts under circuit overload conditions by means of an interlocking trip shoe assembly. The interlocking trip shoe assembly is comprised of a number of trip levers associated, one each, with the poles of the multi-pole breaker. Each trip lever is carried in a separate module and each trip lever is adapted to mate with the trip lever of an adjoining module. Moreover, each trip lever is cammed by the movement of a movable contact within its module when an overload condition occurs. When one trip lever is cammed the armatures in other modules are actuated by corresponding trip lever movement. When the circuit breaker switch associated with one of the poles is moved to an "off" position, a camming member associated with the movable contact is shifted to a cut away portion of the trip lever such that the trip lever is not cammed when the movable contact swings away from the fixed contact. This permits the breaking of the contacts associated with one pole without the breaking of the other contacts.

As was mentioned, because of the wide applicability of multi-pole circuit breakers, and especially those which may be made in modular form and assembled conveniently in the field, there is a need for providing multi-pole circuit breakers with flame-arresting apparatus so that the multi-pole breakers may be utilized in hostile and potentially explosive environments. As is well known, the making and breaking of electrical contacts may often be accompanied by an electrical arc across the contacts. Electrical arcing increases the heat and the pressure within the circuit breaker housing which is particularly severe when the contacts are opened in response to relatively large currents flowing through the breaker when an overload condition exists. Although there has been provided a number of means to minimize arcing such as, so-called arc chutes, arc chutes do not completely eliminate breaker arcing and therefore heat and pressure may continue to build up within the breaker if the breaker is of the sealed variety.

Because of the inability to completely eliminate breaker arcing many circuit breakers are provided with vents which provide channels for venting the gases generated within the circuit breaker to the atmosphere. This not only releases the gas generated in the arc chambers of the circuit breakers but also helps to more rapidly dissipate heat from the breaker. It will be appreciated, however, that while the vented circuit breakers provide for gas and heat release, thereby increasing the lifetime of the breaker, these circuit breakers are not suitable for use in environments containing explosive material. Explosive atmospheres exist for example, in the bilge areas of marine vessels in which gasoline va-

pors are trapped. When multi-pole circuit breakers having vent channels are utilized, gasoline vapors may be ignited when the excessive pressures of the circuit breaker accompanying the electrical arc across a circuit breaker causes a small flame to be actually vented or blown out of the circuit breaker through the vent channels. It has been proposed that circuit breakers for use in a bilge area be completely sealed. However, as noted, excessive amounts of heat and pressure due to contact arcing generally causes circuit breakers to present very poor electrical circuit characteristics in that the contacts and operative mechanisms therein deteriorate rapidly.

The present invention overcomes these and other problems by providing a high performance modular circuit breaker which can be used under adverse conditions, and in particular provides a breaker which can be used in explosive atmospheres. Thus, a modular circuit breaker is provided which can be universally utilized not only under normal conditions but also where explosive atmospheres prevent the use of a high performance circuit breaker. In one embodiment of the present invention a fine wire mesh screen is positioned between the contacts and the vent channels to act as a flame arrestor for permitting the arc gases and the excessive heat and pressure accompanying them to vent to the atmosphere while at the same time preventing the venting of flame. In particular it has been found that a screen should have openings no larger than **30** mesh and a single layer of 60 mesh screen is preferred. If multiple layers of screen are used, larger mesh size (lower mesh number) may be employed.

It is accordingly an object of the present invention to provide a multi-pole circuit breaker which is more versatile than those in existence.

It is also an object of the present invention to provide a modular multi-pole circuit breaker which may be economically and readily produced.

It is a further object of this invention to provide an interlocking trip lever assembly permitting the ready connection of any number of modules to form a multi-pole circuit breaker.

It is a still further object of this invention to provide a multi-pole circuit breaker allowing selective manual making and breaking of pole contacts and automatic simultaneous breaking of the pole contacts under a current overload condition at any one of the poles.

It is yet another object of this invention to provide an interlocking trip lever assembly which permits the addition of breaker modules to provide a multi-pole circuit breaker and which allows selective manually instigated pole breaking without interruption or breaking of any other of the poles in the multi-pole circuit breaker.

It is yet another object of the present invention to provide an improved high performance multi-pole circuit breaker, which may be utilized under adverse conditions.

It is a still further object of the present invention to provide a modular high performance circuit breaker usable in a potentially explosive atmosphere such as the bilge of a marine vessel.

It is yet another object of the present invention to provide a modular circuit breaker incorporating a flame arrestor and vent channel for the circuit breaker arc chamber.

These and further objects and advantages of the invention will be more apparent upon reference to the following specification, claims and appended drawings, wherein:

FIG. **1** is a perspective view of a multi-pole circuit breaker constructed in accordance with this invention;

FIG. **2** is a plan view of the flame arresting screen of FIG. **1**;

FIG. **3** is a perspective view of one of the interlocking trip levers utilized in conjunction with the circuit breaker of FIG. **1**;

FIG. **4** is a plan view in partial cross section of a circuit breaker assembly utilizing the subject trip lever with the breaker in a tripped condition, and indicating the placement of the flame arresting screen of FIG. **2**;

FIG. **5** is a perspective view of interlocking trip levers indicating the simultaneous interruption or breaking of the pole contacts with the sensing of an overload condition at one of the poles; and

FIG. **6** is a plan view of the subject circuit breaker in an "off" position indicating the position of a camming member free of engagement with the cam follower portion of the subject trip lever.

Referring to the drawings, the novel high performance multi-pole circuit breaker of the present invention is generally indicated at **10** of FIG. **1** as including housing **12**, generally formed of mating modules **14, 16** and **18** each associated with a "pole" of the circuit breaker. In general, each module includes a single pole switch which is actuated by overcurrent through the switch to open the associated pole contacts. This interrupts the conduction path between the terminals connected by the switch and the conduction state of the module is thus determined by the conduction state of the single pole switch. Although this invention will be described as if there were only one single pole switch per module and only one set of contacts, it will be appreciated that each module can be provided with any number of switches and contacts.

Each module includes a housing which is preferably molded from black colored phenolic material. After the operating mechanism of the breaker is mounted in the module, the modules are joined to other modules in a conventional manner by screws or the like to form a single modular housing structure **12.** Projecting from each of the modules is a toggle switch handle **20** which controls the conduction state of the module by controlling the conduction path between module terminals. In FIG. **1** only one terminal **22** per module is illustrated, it being understood that there are at least two terminals per module. Handles **20** have two positions, an "on" position and an "off" position as indicated.

As will be described, the switch contacts associated with one of the poles in the multi-pole circuit breaker can be broken by the positioning of the associated toggle switch handle in the "off" position as illustrated in phantom. This interrupts the conduction path through one module while the conduction paths through the other modules remain uninterrupted.

Each of the modules **14, 16** and **18** is provided with a plurality of vent channels **24** which communicate with the interior of the module. At the point of communication, a fine mesh screen illustrated and best seen at **26** in FIG. **4,** is provided to permit venting of the aforementioned gases while at the same time preventing flame associated with the making and breaking of contacts to emerge from the module housing. As illustrated, portions of this screen are visible through the vent channels **24** in FIG. **1.**

The positioning of screen **26** will be discussed hereinafter in connection with FIG. **4.** In general, however, screen **26** is a rectangular mesh screen such as that illustrated in FIG. **2.** The screen **26** is preferably of conventional woven wire mesh construction and in the preferred embodiment has mesh openings corresponding to a conventional mesh size of 60. It has been found that the fine wire mesh screen **26** acts as a flame arrestor so that the circuit breaker is suitable for use in potentially explosive atmospheres such as marine bilges where gasoline vapors tend to collect and otherwise might be exploded by flame blowing out through the vent channels **24.** It has been found that openings in the single layer wire mesh **26** can have a mesh size no larger than approximately 30 as previously indicated. If multiple layers of screen material are used for the screen **26,** then larger mesh sizes (lower mesh numbers) can be used, but in any event, the effective opening formed by the multiple layers should be the equivalent of a 30 mesh size or smaller.

Referring now to FIG. **3,** a trip lever **31,** sometimes referred to as a "cross trip," is illustrated. The interlocking of a number of these trip levers makes possible the above mentioned modular construction, as will be described. Trip lever **31** also provides a single unitary device which permits the manual breaking of selected pole contacts in the multi-pole breaker of FIG. **1** and automatic breaking of all pole contacts in the event of an overload condition.

Turning now to FIG. **3,** trip lever **31** is illustrated as including a cylindrical bar **32** having a bore or recess **34** at one end. On an opposite end cylindrical bar **32** is stepped to form a projection or linkage member **36** of cylindrical form and of reduced diameter. Linkage member **36** carries an interlocking pin **38** coaxial therewith and of still further reduced diameter for insertion into and/or friction fit within a corresponding bore in an adjacent trip lever when two modules are secured together in an interlocking relationship. The pin and linkage for an end module is clipped off or otherwise removed as required.

Depending from either end of cylindrical bar **32** are support arms **40** and **42,** each having bores **44** through which an armature pin is inserted, and about which the trip lever is pivoted. The support arm **40** includes an extension **46** on which is carried a cam follower **48.** Cam follower **48** has a cam following surface **50** adapted to coact with a camming member which moves with the movable contact arm of a breaker mechanism, as will be described in connection with FIG. **4.** When the cam follower is cammed, the trip lever **31** is rotated about the aforementioned armature pin.

Cam follower **48** is also provided with a cut away portion **52** adjacent the cam following surface **50.** The purpose of the cut away portion **52** is to prevent the actuation of breaker armatures with the movement of a toggle switch handle to the "off" position. This operation will be described in detail in connection with FIG. **6.**

One type of electromagnetic circuit breaker with which the trip lever **31** may be utilized is illustrated in FIG. **4.** The circuit breaking mechanism is generally indicated by the arrow **58** and can be of a type similar to that described in the aforementioned U.S. Pat. No. 3,444,488 issued to G. S. Harper. It will be appreciated with respect to the electromagnetic breaker illustrated in FIG. **4** that much of the mechanical linkage utilized in the actuation of the movable contact has been omitted for the sake of clarity, armature-actuated sear pin tripping assemblies being conventional.

Referring now to FIG. **4,** frame **62** is mounted within one of the modules, a portion of which is shown at **63.** Mounted on frame **62** are the operating elements of the circuit breaker which rotate a movable contact **64** into and out of engagement with a fixed contact **66** which extends through a walled portion **68** of the module to form the aforementioned terminal **22.**

The movable contact **64** is secured to a contact bar or arm **70** which is pivotally and slidably mounted on frame **62** by pin **72.** Arm **70** is spring biased such that upon release, arm **70** carrying contact **64** moves in the direction of arrow **75** away from contact **66.**

Also mounted on frame **62** is an electromagnet **74,** having a winding, one end of which, **76,** is connected to one or more terminals (not shown) of the breaker module. The other end of the winding of electromagnet **74** is connected directly to arm **70** by cable **78** such that electromagnet **74** is connected in series with arm **70** and contacts **64** and **66** when these two contacts mate.

An armature **80** is pivoted about an armature pin **82** and is spring biased in an upward direction by a leaf spring portion **84.** A trip bar **86** extends from the armature **80,** which when the armature is moved in a downward direction, moves upwardly to force sear pin **88** extension **89** in a direction which releases a detent (not shown) collapsing the toggle links **90** and **92** holding contact **64** in mating engagement with contact **66.** The release of the detent permits upward movement of contact **64** as shown by arrow **75.**

Under an overload condition, electromagnet **74** is energized to attract armature **80** to pivot trip bar **86** into contact with the sear pin extension **89,** which causes the sear pin to rotate. By a camming and release process described in the aforementioned Harper patent the linkages, generally illustrated by the reference characters **90** and **92,** collapse allowing the spring biased arm **70** to move upwardly.

Arm **70** is connected to linkage **92** which carries a pin **94** which serves as the camming member for the trip lever **31** of FIG. **3.** Trip lever **31** is mounted on frame **62** via armature pin **82** such that cylindrical bar **32** rests on the top surface of the armature **80.** A slot **98** is provided in the sidewall **96** of the module housing through which the interlock pin and linkage members of an adjacent trip lever may extend for insertion into the cylindrical bar **32** of the trip lever.

Trip lever **31** is so mounted that, in the tripped position shown, camming surface **50** coacts with pin **94.** Upon upward movement of arm **70** as indicated by arrow **75,** pin **94** moves upwardly as shown by the arrow **100** and coacts with cam following surface **50** to move the end of cam follower **48** in the direction shown by the arrow **102.** This causes the opposite end of trip lever **31** to rotate in the direction shown by the arrow **104.**

The interlocking operation of two trip levers is illustrated in FIG. **5.** Because of the interlocking nature of the trip shoe assembly, as diagrammatically illustrated in connection with FIG. **5,** the downward actuation of an armature **110** associated with one pole of a breaker provides an upward movement of trip bar **112** which through sear pin action (not shown) causes a movable contact **114** associated with one module to move upwardly out of contact with a stationary contact **116.**

The mechanical connection is illustrated by the dotted line **118.** Simultaneously with the breaking of contacts **114** and **116** a pin **120** carried by the toggle of movable contact **114** cams trip lever portion **122** in an upward direction, causing portion **124** and a cylindrical bar **126** to move downwardly as indicated. A cylindrical bar **128** of a second trip lever associated with another module is connected through pin and linkage **130** to cylindrical bar **126.** When cylindrical bar **126** moves downwardly, cylindrical bar **128** moves downwardly and serves as a cam for camming armature **132** of an adjacent circuit breaker assembly to effect release of a contact **134** from a further stationary contact **136.** This provides the aforementioned automatic operation such that when an overload current is sensed at one of the poles of the multi-pole breaker, the movement of one trip lever actuates all armatures via the interlocked trip levers.

It will be appreciated that the trip lever configuration directly senses the movement of the moving contact arm without complicated intermediate levers or actions. The trip lever provides both a cam following surface, e.g., surface **50** and a camming surface which is the cylindrical member thereof. Thus a single pivot point is provided for the actuation of this trip mechanism, e.g., the armature pin.

Referring now to FIG. **6,** the position of the various parts of the electromagnetic circuit breaker of FIG. **4** are illustrated when the handle **20** is in the "off" position. It will be appreciated that like elements have been labelled with like reference characters with respect to the correspondence between FIGS. **4** and **6.** As illustrated in FIG. **6,** in the "off" position arm **70** is rotated away from contact **66.** Since the toggle links do not collapse, pin **94** is made to clear camming surface **50** and rests within cut away portion **52** of trip lever **31.** Thus, even with arm **70** in an up position, trip lever **31** remains untripped and does not actuate the armature of any of the breakers. The reason that pin **94** comes to rest within the cut away portion **52** is that in the "off" position linkage **92** is pulled up by the bell crank mechanism generally illustrated at **140,** such that pin **94** misses camming surface **50** when toggle switch handle **20** is moved manually to the "off" position.

In this manner moving one of the toggle switches on one of the modules illustrated in FIG. **1** to the "off" position does not in and of itself trip any of the armatures, thereby permitting selective interruption of the conduction path through any of the modules of the multi-pole breaker unit.

Referring again to FIG. **4** and as mentioned in connection with FIG. **1,** adjacent contacts **64** and **66** is an area in which arcing occurs. This area is referred to as the arc chamber and lies generally in that vicinity of contacts **64** and **66.** Arcing may be controlled within this area by the utilization of arc chutes **144.** However, as mentioned hereinbefore arc chutes do not completely prevent arcing and there is therefore a need for a flame arrestor. In the present invention the flame arresting action is provided by means of screen **26** which is mounted adjacent the arc chutes **144** and closes off the openings of the vent channels **24** through the housing **63** The mounting can be in any conventional manner as by cementing, the use of a slotted housing, clamping, etc. Screen **26** is insulated by an electrical insulating member **146** between the contact **66** and the screen. As can be seen, the lower two vent channels are slanted in a downward direction so as to improve flame suppression. The uppermost channel being furthest away from the site of the arc production is made horizontal and wider than the other two channels to improve venting.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and desired to be secured by United States Letters Patent is:

**1.** A trip lever for use with a multi-pole circuit breaker comprising:

a bar having a recess partially therethrough at one end; a support secured to said bar; means for pivoting said support about a predetermined axis; a cam follower located on said support at an end opposite that secured to said bar, said cam follower having a portion thereof cut away; and a linkage carried by said bar, a portion of said linkage adapted to engage a similar trip lever through its recess.

**2.** The apparatus according to claim **1** wherein said bar is an elongated cylinder and wherein said support includes a pair of arms secured at one end to opposite ends of said cylinder, said arms each having a bore centered about the intersection of said predetermined axis with the arm, one of said arms carrying said cam follower at its extremity.

**3.** The apparatus according to claim **2** wherein said portion of the linkage means adapted to engage a similar trip lever includes a pin coaxial with said cylinder and extending from said cylinder a distance sufficient to engage the recess of an adjacent trip lever.

**4.** In a modular multi-pole electronic circuit breaker assembly having an individual switch to manually control the conduction state of an associated module, of the type in which each module includes circuit breaking apparatus having an arm carrying a movable contact which is moved away from a corresponding fixed contact responsively to an overcurrent condition, apparatus in each module for automatically tripping the circuit breaking apparatus in the other modules responsively to an overcurrent condition and for permitting manual control of the conduction state of one module without affecting the conduction states of the other modules comprising:

a camming member moving with said arm; a trip lever including a bar coacting with said circuit breaking apparatus to trip said apparatus, a separable interlocking linkage member carried by said trip lever adapted to engage a second trip lever of an adjacent module and to coact with said second trip lever for tripping the adjacent circuit breaking apparatus by imparting to said second trip lever a like movement to that of said first mentioned trip lever, a support having an end secured to said bar and having a cam follower at the other end, and means for pivotally mounting said trip lever such that when said switch provides for conduction of said module the associated camming member is in a position to coact with the associated cam follower to rotate said trip lever about its pivot, said

cam follower having a cut away portion positioned such that when said switch manually provides for the nonconduction of said module, said camming member is out of engagement with said cam follower, thereby preventing coaction.

5. The apparatus according to claim 4 wherein said circuit breaking apparatus includes electromagnetic means for sensing current overload.

6. The apparatus according to claim 5 wherein said interlocking linkage member includes a pin extending from said bar, said bar having a bore adapted to receive a pin from an adjacent trip lever.

7. The apparatus according to claim 6 wherein said bar, support and cam follower are of unitary construction.

8. The apparatus according to claim 4 and further including a vent channel through each module adjacent the module contacts and a flame arresting mesh screen positioned at said vent channel for preventing the venting of flame through said vent channel.

9. The apparatus according to claim 8 wherein the effective mesh size of said screen is no larger than 30.

10. The apparatus according to claim 9 wherein said mesh size is 60.

11. The apparatus according to claim 8 wherein said mesh screen closes off the interior end of said vent channel and further including means for electrically insulating said screen from said module.

12. The apparatus according to claim 4 and further including a plurality of vent channels through each module adjacent the module contacts, selected vent channels closest to said contacts when said contacts are in a mating condition being sloped downwardly and flame arresting means positioned at said vent channels for preventing the venting of flame from said channels in the event of contact arcing.

13. In a multi-pole circuit breaker of the type including a plurality of modules having circuit breaking means including a pair of contacts which are opened responsively to the sensing of an overload current by the movement of an armature and means for normally opening and closing said contacts, the improvement for use with selected modules comprising:

a trip lever including a bar having a recess and linkage means secured to said bar adapted to engage the trip lever of an adjacent module through its recess, said bar coacting with said armature to actuate it; a support having an end secured to said bar; a cam follower at the end of said support opposite the end secured to said bar, said cam follower having a cut away portion; a camming member moving with one of said contacts; and means for pivoting said support about a predetermined axis and for locating said cam follower with respect to said camming member such that when said contacts are manually opened, said camming member lies within said cut away portion out of engagement with said cam follower for preventing actuation of the armatures in any of the modules, and such that when said contacts are manually closed and when said contacts are opened responsive to overload current therethrough, said camming member coacts with said cam follower to move said trip lever for actuation of the armatures in other modules.

14. The circuit breaker according to claim 13 wherein each module includes a housing having a vent channel through one of the housing walls and a spark arresting mesh screen positioned so as to partially occlude said vent channel.

15. A multi-pole circuit breaker comprising:

a plurality of modules, each of said modules including a pair of terminals, switch means for connecting said terminals, means for sensing an overload current through said switch means, an armature movable responsively to the sensing of said overload current, means for opening said switch means responsive to the movement of said armature, a camming member carried by said switch opening means, and a trip lever; selected trip levers including: a bar coacting with an armature for the actuation thereof, a linkage member secured to said bar and adapted to engage the trip lever of an adjacent module; a support having an end secured to said bar, a cam follower at the end of said support opposite the end secured to said bar, said cam follower having a cut away portion; means for manually opening and closing said switch means; and means for pivoting said support about a predetermined axis and for locating said cam follower with respect to said camming member such that when said switch means is manually opened, said camming member lies within said cut away portion out of engagement with said cam follower for preventing actuation of the armatures in any of the modules, and such that when said switch means is manually closed and when said switch means is opened responsively to overload current, said camming member coacts with said cam follower to move said trip lever for actuation of the armatures in other modules.

16. The apparatus of claim 15 wherein said bar is an elongated cylinder and wherein said support includes a pair of arms secured at one end to opposite ends of said cylinder, said arms each having a bore centered about the intersection of said predetermined axis with the arms, one of said arms carrying said cam follower at its extremity.

17. The apparatus according to claim 16 wherein said cylinder includes a bore and wherein said linkage member includes a pin coaxial with said cylinder and extending from said cylinder a distance sufficient to engage the bore of an adjacent trip lever.

18. A multi-pole circuit breaker comprising:

a plurality of modules, each of said modules including a housing having an interior chamber, a pair of terminals passing through said housing, switch means carried within said housing for connecting said terminals, said housing having a vent channel communicating with said chamber adjacent said switch means and a screen positioned at said vent channel for preventing flame from exiting said vent channel, means for sensing an overload current through said switch means; an armature movable responsively to the sensing of said overload current, means for opening said switch means responsive to the movement of said armature; a camming member carried by said switch opening means, and a trip lever; selected trip levers including: a bar coacting with said armature, a linkage member secured to said bar and adapted to engage the trip lever of an adjacent module, a support secured to said bar, a cam follower at the end of said support opposite the portion secured to said bar, said cam follower having a cut away portion; means for man-

ually opening and closing said switch means; and means for pivoting said support about a predetermined axis and for locating said cam follower with respect to said camming member such that when said switch means is manually opened said camming member lies within said cut away portion out of engagement with said cam follower for preventing actuation of the armatures in any of the modules, and such that when said switch means is manually closed and when said switch means is opened responsively to overcurrent therethrough, said camming member coacts with said cam follower to move said trip lever for actuation of the armatures in the other of said modules.

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# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,786,380 Dated January 15, 1974

Inventor(s) George Sullivan Harper

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The name of the assignee should read --Airpax Electronics Inc.--.

In Col. 1, line 20, "for, instance," should read --for instance,--.

Signed and sealed this 17th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

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