Nov. 14, 1967 J. FRANCIS ETAL 3,353,127

MULTIPOLE CIRCUIT BREAKER WITH INDIVIDUAL BREAKERS COUPLED BY SLIDES THEREBETWEEN

Filed June 7, 1965 3 Sheets-Sheet 1

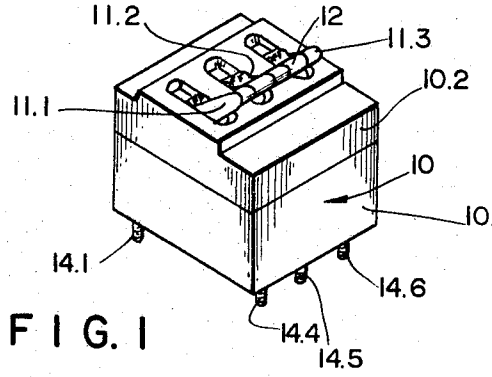


FIG. 1

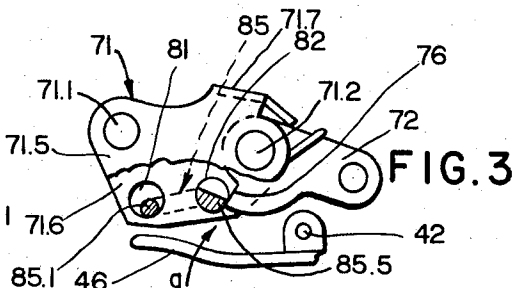


FIG. 3

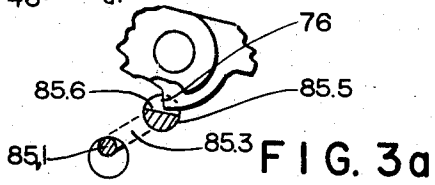


FIG. 3a

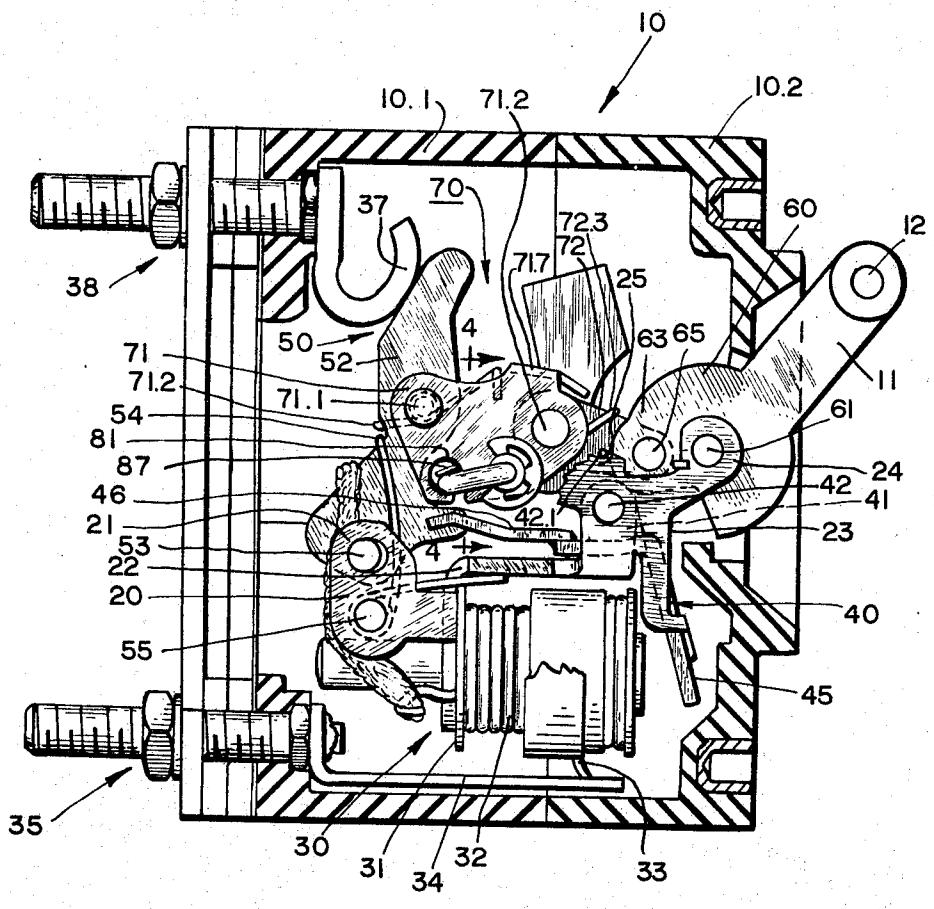


FIG. 2

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Filed June 7, 1965 3 Sheets-Sheet 2

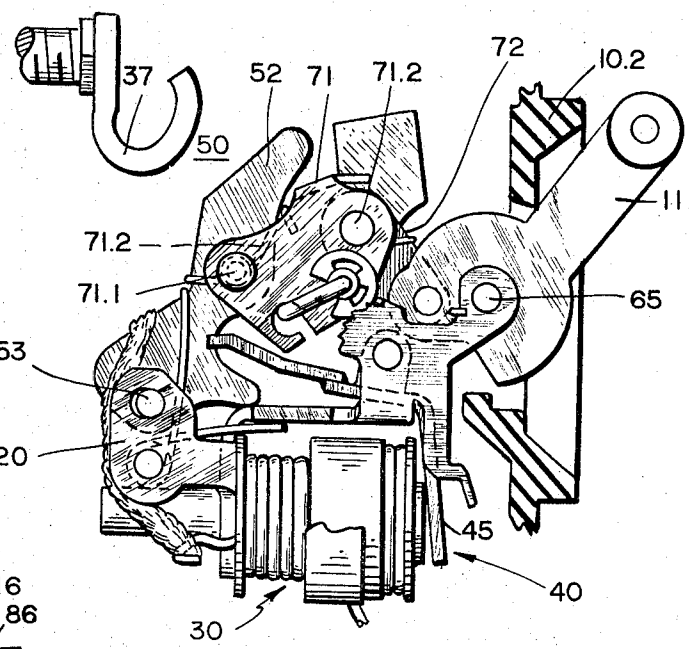


FIG. 2a

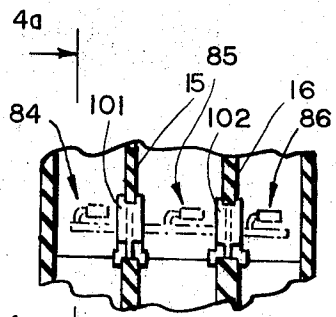


FIG. 4

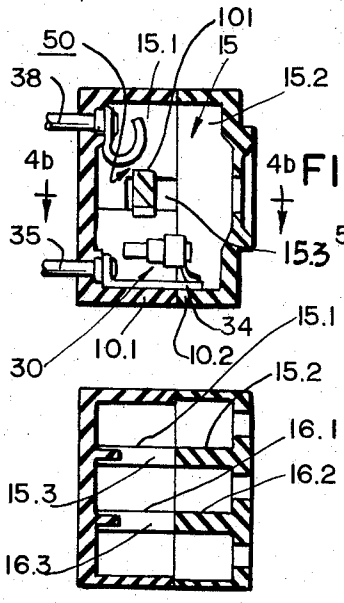


FIG. 4b

FIG. 4a

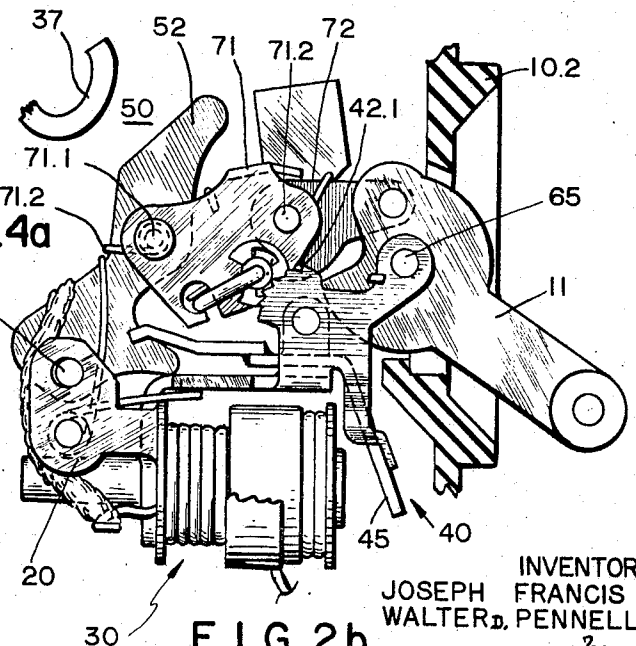


FIG. 2b

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Filed June 7, 1965 3 Sheets-Sheet 3

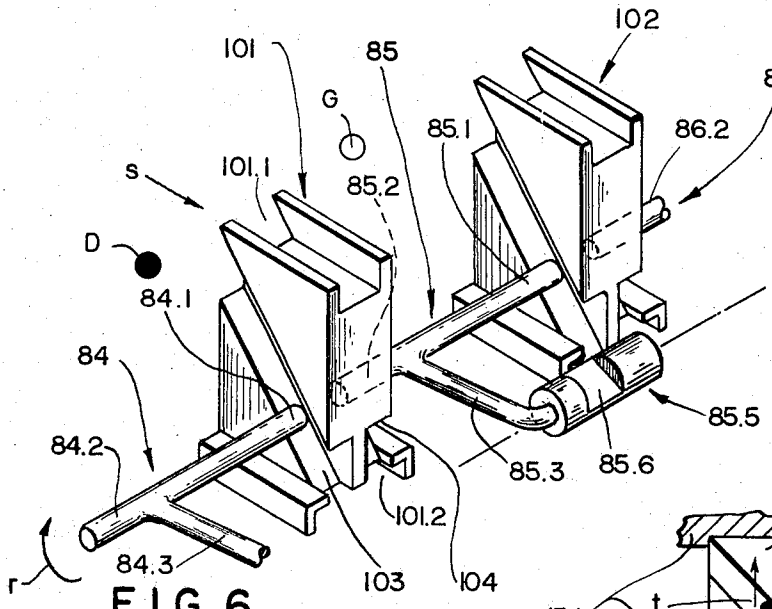


FIG. 6

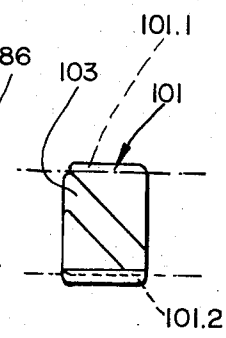


FIG. 5

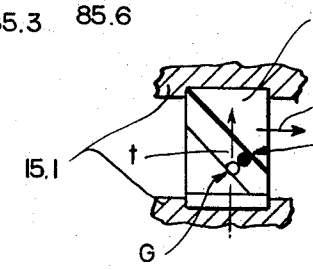


FIG. 7d

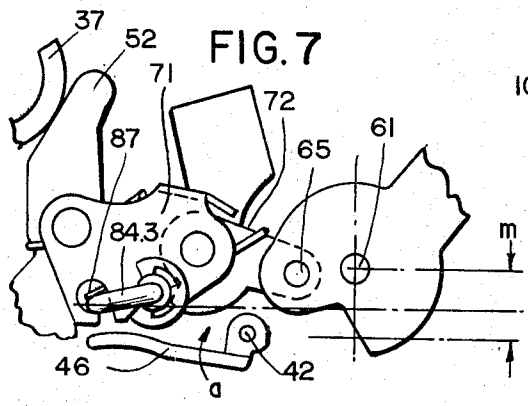


FIG. 7

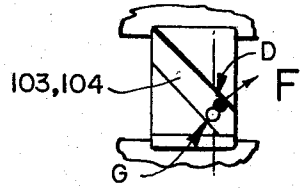


FIG. 7c

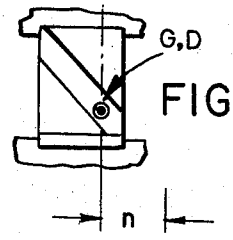


FIG. 7b

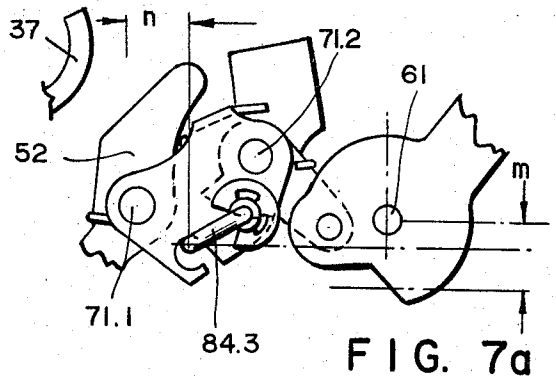


FIG. 7a

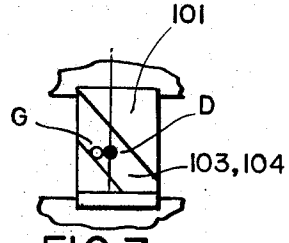


FIG. 7e

United States Patent Office 3,353,127
Patented Nov. 14, 1967

3,353,127

MULTIPOLE CIRCUIT BREAKER WITH INDIVIDUAL BREAKERS COUPLED BY SLIDES THEREBETWEEN

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Filed June 7, 1965, Ser. No. 461,637
6 Claims. (Cl. 335—9)

The field of the present invention is that of multipole circuit breakers of the so-called "trip free" type, which after automatically opening caused by a faulty circuit condition cannot be reclosed so long as the fault exists.

Objects of the invention are to provide multipole circuit breaker units of the above type which utilize conventional single cricuit breaker constructions without essential modification; to provide for asembly in a partitioned housing of single breakers by means of linking instrumentalities essentially forming part of the partitions; to provide multipole circuit breakers wherein single breakers are correlated for tripping the entire unit from any one thereof but each being moved by its own driving power; to provide such breakers wherein an emergency unlatching and circuit opening component of any one single breaker affects the corresponding component of each other breaker without the intervention of other components of the single breaker or of linking structures extending through the entire breaker unit; to provide circuit breakers for any desirable number of poles which require only identical linking components, the linking structure being independent of the number of poles; to provide multipole circuit breaker units composed of standard single breakers which are linked by optimally simple mass production molded parts which can be very easily assembled and do not require appreciable modification of the basic breaker movement construction; and to provide a multipole trip free circuit breaker which is simple, comparatively inexpensive in manufacture and assembly, and rugged and reliable in operation.

The substance of the invention can be shortly stated as follows.

Known circuit breaker mechanisms contain rotatable locking mechanisms such as the latches of conventional toggle movements which normally lock the toggle linkage in spread position but cause it to collapse for opening the contacts, when a latch element is caused to rotate by an element of the breaker's safety device responding to an abnormal condition such as overcurrent. According to the invention, the rotary, toggle unlocking motion of such a latch element of one single breaker is transferred to the corresponding latch elements of one or more additional breakers by means of a grooved transfer body that is slidingly supported on a partition which divides the housing for the multipole unit into compartments for the single breakers, and engages the latch elements of adjacent single breakers.

In the herein described typical and preferred embodiment, the rotatable latch element is yoke-shaped and has a catch cylinder rotatable on a toggle link, a crank arm, and a yoke pin that can rotate about the catch cylinder and extends laterally from the toggle. One or both ends of the yoke pin reach into a groove on a respective side of the transfer body that slides in guides formed on a housing partition. Each groove, appropriately inclined to the sliding direction, transfers the movement of its pin end to a similar groove on the other side of the transfer body, also referred to as slide, which second groove moves its pin end of the yoke of the next breaker which is rotated, rotates its catch cylinder and thus unlocks the toggle of that adjacent breaker which promptly opens its contacts. If the initially tripped breaker is in an intermediate position, both ends of the yoke pin move their respective slides. The pin of an emergency tripped end breaker moving its slide thus turns the next yoke pin that in turn rotates its cylinder tripping the second breaker; the opposite end of the second yoke pin of the second breaker moves the second slide which in turn trips the third movement and so on if more than three single breakers are combined.

According to an important practical aspect of the invention, the ends of the yoke pins fit their grooves loosely causing an inertial blow originating in the spring forces of the breaker movement and enhancing the transfer from one breaker to the next. In another aspect, the guide structure for the sliding transfer bodies is formed by windows of partition walls which can be divided to permit easy assembly.

The description refers to drawings wherein:

FIG. 1 is an isometric view of a triple pole breaker according to the invention;

FIGS. 2, 2*a* and 2*b* are similar longitudinal sections near a wall of the housing showing a single breaker in elevation in three different significant positions, namely "closed," "trip free opened," and "manually opened";

FIGS. 3 and 3*a* are fragmentary elevations of the toggle lock in latched and unlatched conditions, respectively;

FIG. 4 is a section on 4—4 of FIG. 2, showing the connecting slides;

FIG. 4*a* is a section on 4*a* of FIG. 4;

FIG. 4*b* is a section on 4*b* of FIG. 4*a*;

FIG. 5 is a side elevation of a slide;

FIG. 6 is an isometric view of two slides, a complete intermediate latch yoke, and the end portions of two end yokes of triple pole breaker; and

FIGS. 7 to 7*e* are schematic illustrations of the operation of a breaker according to the invention.

FIG. 1 shows the exterior of a three-pole circuit breaker according to the invention, but it should be understood that its principles are applicable to two-pole breakers as well as to breakers with more than three poles. A conventional insulating housing **10** encloses three single breakers, each with a handle **11.1**, **11.2** and **11.3**. The handles are connected for joint operation by a bar **12** which is also shown in FIG. 2. The housing is conveniently divided into two halves **10.1** and **10.2**. FIGS. 1 and 2 also show the terminal screws **14.1** to **14.6**, two for each single breaker, which here also serve for holding the fixed breaker contact **37** and the movement and magnet support **30**. As especially shown in FIGS. 4, 4*a*, 4*b*, the housing has two partitions **15**, **16** which are split similarly to the housing proper as shown at **15.1**, **15.2** and **16.1**, **16.2**. The partition halves **15.1** and **16.1** have cut-outs **15.3** and **16.3** which together with **15.2** and **16.2** form rectangular windows wherein slide the slide blocks **101** and **102**, forming transfer bodies which will be described below.

In the following description, the complete multipole circuit breaker will be referred to for short as breaker unit or unit, whereas each individual single pole switch will be referred to as single breaker or simply breaker. Each of the two or more breakers of a unit is or at least can be of identical construction, their interrelation being accomplished by elements whose configuration is independent of the construction, whether or not conventional, of each breaker. An individual breaker will now be described by describing one of them, here by way of example the intermediate one between partitions **15**, **16**, with reference to FIGS. 2 to 3*a*.

The breaker movement to be described is of conventional construction such as for example dealt with in Patent No. 2,360,922 of Oct. 24, 1944 to K. W. Wilckens.

It will be understood that deviations from this conventional construction, involving progress in fabrication as well as performance can be applied, and have been applied to the present basic construction; such improvements however are not part of the present invention.

The breaker movement is supported by a toggle frame **20** which has on the left-hand side of FIG. 2 two parallel switch blade ears **21** leading into a common bridge **22**. On the other side of the frame **20** are two parallel armature and handle supporting ears **23**. Each of these has a handle pivot extension **24** and a tightening sector **25** for the armature spring **42.1**. The toggle frame **20** is carried on an armature structure **30** with a coil form **31**. The magnet structure **32** is supported by means of its coil tail **33** on the terminal bar **34** which is fastened to the housing with terminal screw **35**. The fixed contact **37** is similarly fastened to the housing at **38**.

An armature **40** is pivoted by means of two ears **41** (behind the ears **23**) on a pintle **42** fastened to the frame ears **23**. The L-shape armature has an anchor **45** and an actuator **46**.

The switch **50** has the above-mentioned fixed contact **37** and a movable switch blade **52** which is at **53** pivoted with a round pintle in oblong perforations of the frame switch ears **21**. A spring **54** is wound around a pin **55** in a second pair of perforations of the frame ears **21** and biases the switch blade **52** into open position, compare FIGS. 2*a* and 2*b*.

The handle hub **60** is pivoted on a pintle **61** inserted into opposed perforations of the ears **24** of the frame. On the other side of the grip **11**, **12** (FIG. 1) are two toggle link engaging ears **63** for a toggle pintle **65**.

The toggle movement proper **70** has a blade link **71** with two walls **71.5**, **71.6** connected by a bridge **71.7** and a handle link **72**. The blade link is pivotally joined to the blade **52** with a pintle **71.1** which carries an assist spring **71.2** that enhances the effect of contact main spring **54**. The handle link **72** is pivoted to the blade link with toggle pintle **71.2** and to the handle at **65**. The toggle pintle **71.2** carries a toggle spring **72.3**.

The toggle trigger mechanism **80** which is also shown in FIGS. 3 and 3*a* is arranged within the two walls **71.5** and **71.6** (FIG. 3) of the blade link **71**. Each of these walls has four perforations, two each for the switch blade pivot **71.1** and the toggle pivot **71.2** respectively, and two each, indicated at **81** and **82** (FIG. 3) for the trigger crank yoke **85** that is completely shown also in FIG. 6. The latch tooth **76** of the handle link **72** extends between the two walls of the switch blade link **71**. The trigger yoke **85** (FIG. 6) has a yoke stem **85.1**, a stub **85.2**, a crank arm **85.3** and catch head **85.5** with a flat **85.6**. A spring **87**, wound on part of head **85.5**, tends to keep the yoke **85** in the position of FIG. 3. With the switch in closed position and parts **37**, **52** contacting, the latch tooth **76** of the handle link **72** is outside of the flat **85.6**, and engages the full or convex region of the head **85.5**, as shown in FIG. 3. The toggle is then firmly locked in the position of FIG. 2. The diameter of perforation **81** is larger than that of the stem **85.1** which can swing in that perforation whereas the head **85.5** fits its pivot perforation **82**. When the actuator **46** of the armature **40** turns in the direction of arrow *a*, due to attraction of the anchor **45** by the core of coil **32**, it touches the crank arm **85.3**, rotates it in the same direction and with it the head **85.5** and its flat **85.6**. The tooth **76** can now enter the flat and the above mentioned rigid locking connection of the two links **71** and **72** is opened, as shown in FIG. 3*a*. The stem **85.1** and the stub **85.2** rotate on the head **85.5**, the stem moving within perforation **81**. When the toggle linkage collapses, the main and auxiliary biasing springs **54** and **71.2** quickly break contact at **50**.

If it is attempted to close contact by turning handle **11** after the toggle linkage is triggered by a persistent abnormal condition and opened into the condition of FIG. 2*a*, the two links **71** and **72** will merely rotate relatively to each other; the contacts will remain open and the handle moved back on being released. This is commonly referred to as "trip free" operation.

For manually breaking contact, the handle **11** is rotated downwardly as shown in FIG. 2*b* and this moves the two links **71** and **72** which remain rigidly joined, towards the right thus moving contact **52** in the same direction.

It will be observed from FIG. 3 that the trigger lock at tooth **76** and flat **85.6** can be loosened either by applying a force to arm **85.3** or by lifting stem **85.1** or stub **85.2**. The stub is not required for single pole operation, but necessary for purposes of the present invention. It will be appreciated that this modification is very slight and insignificant so far as cost is concerned.

For multipole circuit breaker units according to the invention, there are provided one or more transfer bodies, also referred to as blocks or slides. In the present triple pole embodiment, two slides are present which are identical and designated **101** and **102** in FIGS. 4 to 7*e*. Each one of these slides has guide grooves **101.1** and **102.2** which slide in the ledges or sides of the window openings **15.3**, **16.3** of the partitions **15.1**, **15.2** of the housing, which are described with reference to FIGS. 4, 4*a*, 4*b*.

Each slide block has on opposite sides two oblique transfer grooves **103**, **104**. Into **103** reaches a stem and into **104** a stub of a respective yoke, as clearly shown in FIG. 6 at **84.1** and **84.2**, respectively. It will be evident that upwardly rotational movement of stem or stub will be translated into a lateral movement of the respective slide block, as indicated by arrows *r* and *s*.

As an important feature of the invention, the grooves **103**, **104** are considerably wider than the diameters of the stems and studs which they engage, for the purpose to be explained below. In a satisfactory practical embodiment, the stem and stub diameter is .062±.001 inch, the groove width .110±.003 inch, and the groove inclination 45°. The grooves **101.1**, **101.2** slide easily on the edges of their respective partition windows, with a clearance of .003 to .004 inch on each side. The slides are at this time preferably made of a high quality polycarbonate.

The operation of the above described multipole circuit breaker unit will now be explained, particularly with reference to FIGS. 6 and 7 to 7*e*. For purposes of this explanation it is important to distinguish between the single breaker movement which is tripped by its magnet or equivalent safety device on the one hand, and the single breaker movement or movements which break circuit not on initiation by their respective safety device or devices but by way of mechanical transmission from the actually tripped single breaker. For the purpose of simplifying the explanation it may be assumed that the toggle locking yoke **84** at the left-hand side of FIG. 6 is that of the single breaker movement which is initially tripped by its armature actuator **46**, and that the yokes **85** and **86** are not thus affected by their safety devices. In FIG. 6, the end face of stem **84.1** of yoke **84** which engages the groove **103** of slide block **101** is designated D and indicated in FIGS. 6 to 7*e* as a full circle or dot, and the end face of the stub **85.2** of the next yoke **85**, which engages the other groove **104** of the slide **101** is designated G and indicated as an open circle. Needless to say, the faces of one and the same yoke will always have the same positions relative its axis of rotation, that is, the axis of heads **85.5** (FIGS. 3, 3*a*).

Under normal closed circuit conditions with the contacts closed as shown in FIGS. 2 and 7, the slides **103** and **104** and the end faces D, G are at rest in the positions shown in FIG. 7*b*. It should now be remembered that, as described above, the yoke stem and stub ends fit loosely in their grooves, with considerable clearance such as for example .020 inch on each side. If now the breaker movement that is associated with yoke **84** is tripped, due to overcurrent, by the actuator **46** of the magnet armature **40** turning in clockwise direction and

contacting arm 84.3, the stem face D of 84 will move in clockwise direction *r* until it hits the upper edge of the groove 103. The stub end 85.2 (G) of the next yoke 85 remains stationary at that point, and this condition is indicated in FIG. 7*c*. Upon D of yoke 84 having hit the upper edge of the groove 103, the slide begins to move towards the right as indicated in FIG. 7*d* by arrow *s*, and the lower edge of the other groove 104 reaches face G of the 85.2 stub of yoke 85. Up to now the toggle yoke 84 is still in the condition shown in FIG. 3, apart from a slight rotation. Immediately however, when its latch tooth 76 slips over the flat 85.6, the toggle of yoke 84 collapses and moves quickly into the position shown in FIGS. 3*a* and 7*a* with a rotatory as well as linear movement, taking along the slide 101 in direction *s*. The stub face G of yoke 85 has begun to move upwardly as indicated by arrow *t* in FIG. 7*d*. This causes clockwise rotation of the yoke 85 on its head 85.5 and therefore rotation of the latch flat 85.6. This position is indicated in the diagram portion of FIG. 7*a*.

Thus the slides not only transmit the rotatory motion of the toggle locking yoke but also a transitory one as apparent from FIGS. 7 and 7*b*, where the respective positions are related to the fixed handle pivot 61. Dimensions *m* and *n* are equal in both instances indicating the total displacement of the latch pins with their faces D and G. This assists in the rotation of the latch flat 85.6 (FIGS. 3, 3*a*) which is especially important if the tripping motion has to be translated from an end breaker when rotation might otherwise be lost so as not to unlock the latch tooth at the other end.

Upon restoration of normal conditions and reclosing of the breaker unit, the situation of FIG. 7*b* is again present.

It will now be evident that reliable "trip free" operation is in no way impeded by the slide coupling according to the invention and that all the breakers of the unit will remain open even if the handles 11, joined by the bar 12, are forcibly moved into circuit closing position.

It will also be evident that the tripping movement is transferred from any one single breaker yoke to the adjacent single breakers, either through a slide on each side of the intermediate yoke 85, or through two slides on one side of an emergency tripped end yoke 84 or 86.

Due to the above described looseness of the stub and stem ends in their respective grooves, inertial impacts are present during trip transfer, which provides sufficient energy to translate reliably the tripping action even from an end breaker to the two others. Proper choice of the widths and inclinations of the slide grooves permit such amplification of the spring forces imparted by the initially tripped yoke to the subsequently tripping yokes, and optimal selection of the frictional parameters, in order to assure toggle collapse with absolute certainty.

It should be understood that the present disclosure is for the purpose of illustration and that this invention includes all modifications which fall within the scope of the appended claims.

We claim:

1. A multipole circuit breaker unit having a plurality of juxtaposed single pole breakers of the type wherein a linkage mechanism is locked to maintain contact closure until it is manually operated or automatically unlocked by tripping with an emergency actuator, comprising:

in each of said single pole breakers a trigger yoke having a tripping latch head and fastened thereto for rotation thereabout pin means extending laterally at least at one side of its breaker and being in substantial alignment with each other in closed contact position, for tripping the linkage mechanism upon rotation of the head by the pin means when moved by said actuator;

partition means for separating said single pole breakers; and

transfer means slidingly mounted on said partition means, and having on opposite sides facing adjacent single breakers transfer surfaces for engaging the ends of said aligned pin means extending towards each other from the adjacent breakers, the surfaces being inclined to the path of the respective pin means upon tripping, rotation of the pin means of one single breaker upon tripping thereof causing sliding of the transfer means that engages the tripped pin means, causing rotation of the opposite pin means of the adjacent single breaker engaged by the same transfer means, causing tripping of such breaker and opening of the respective contacts.

2. Circuit breaker according to claim 1, further comprising:

housing means for enclosing said single pole breakers and carrying said partition means; and

windows in said partition means having two parallel edges for supporting said transfer means and being longer than the transfer means to permit guided sliding thereof.

3. Circuit breaker according to claim 1 wherein said transfer surfaces are the sides of grooves which are wider than said ends of the pin means.

4. A multipole circuit breaker unit having within a housing between one or more partitions two or more circuit breakers with linkage mechanisms that open their contacts by tripping, in response to an abnormal condition, a normally locked catch by rotating latch means which projects laterally of its breaker, with the latch means of adjacent breakers extending towards each other, comprising:

guide frames constituted by opposite ledges of an aligned window in a respective partition; and

a transfer block sliding on said ledges, said block including guide grooves slidingly engaging said ledges, and obliquely thereto on opposite sides of the block, transfer grooves engaging respective adjacent latch means, such that rotation of the latch means upon tripping causes movement of the transfer block, rotation of the adjacent latch means and opening of its contacts.

5. Circuit breaker according to claim 4 wherein said transfer grooves are essentially radial to the path of said rotating latch means.

6. Circuit breaker according to claim 4 wherein said transfer block is rectangular with guide grooves at opposite sides and said transfer grooves diagonally recessed therein.

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