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CIRCUIT BREAKER WITH PLUG-IN TYPE TERMINAL STRUCTURE

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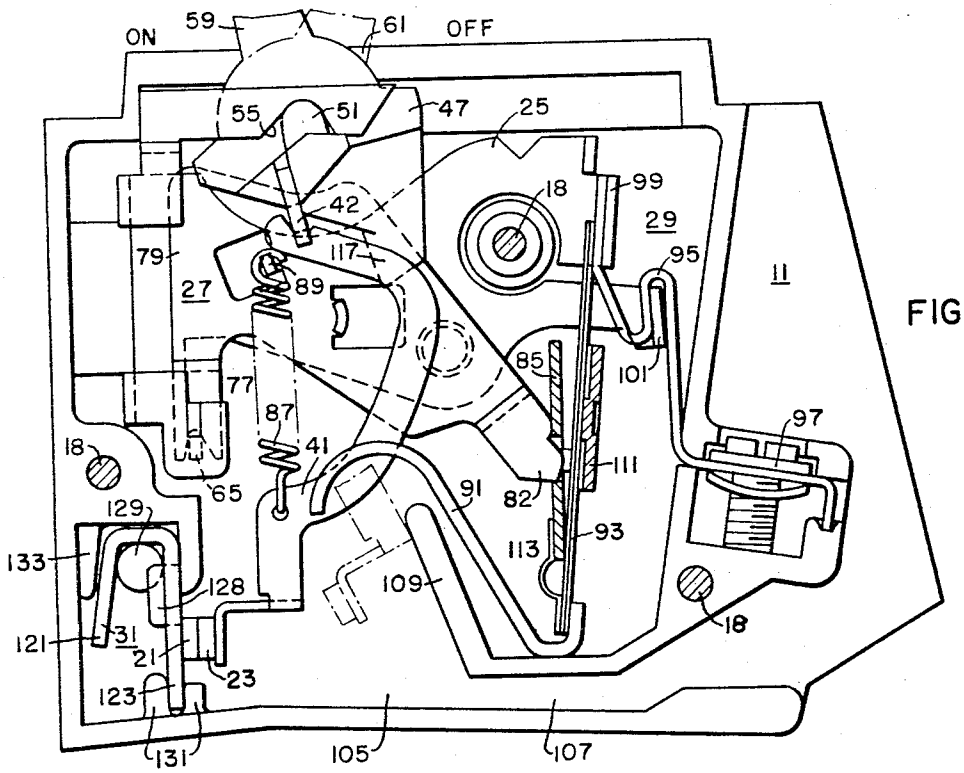

FIG. 1

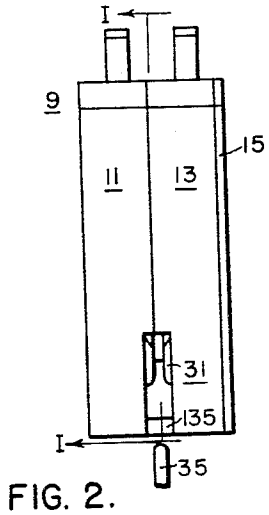

FIG. 2.

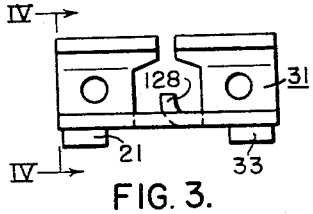

FIG. 3.

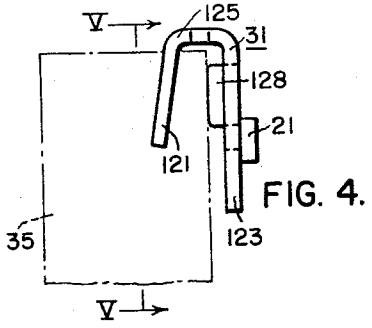

FIG. 4.

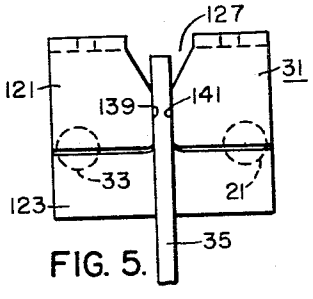

FIG. 5.

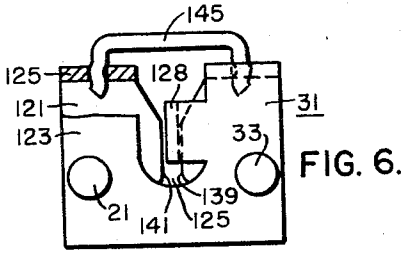

FIG. 6.

WITNESSES

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CIRCUIT BREAKER WITH PLUG-IN TYPE TERMINAL STRUCTURE

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This invention relates to circuit breakers of the type comprising a plug-in terminal structure, and more particularly to plug-in type terminal structures for use with molded-case type circuit breakers.

For certain panelboard or load-center installations circuit breakers are constructed with plug-in type line terminals that can be plugged onto bus-bar conducting stabs to electrically connect the circuit breakers with bus bars. These plug-in type terminals or sockets are generally resilient sheet-metal conductors that are mounted in the circuit breakers in such a way that the bus bar stabs will engage spaced flat side surfaces of the conductors to force the side surfaces apart flexing the generally resilient conductors to provide contact pressure in the mounted position. It is sometimes desirable to use an additional spring means to bias the flat side surfaces against the conducting stab. It is considered that this type of terminal structure does not always provide the most efficient and effective means for effecting contact pressure.

Accordingly, an object of this invention is to provide a circuit breaker with an improved plug-in type terminal structure constructed to more efficiently provide contact pressure in the mounted position.

Another object of this invention is to provide a circuit breaker with an improved plug-in type sheet metal terminal structure constructed for end-type contact with a conducting stab.

Another object of this invention is to provide an improved double-type circuit breaker comprising two circuit-breaker mechanisms and an improved plug-in type terminal structure that can be mounted onto a common conducting stab to electrically connect the two mechanisms to the conducting stab.

The novel features that are considered characteristic of this invention are set forth in particular in the appended claims. The invention, both as to structure and operation, together with additional objects and advantages thereof, will be best understood from the following detailed description when read in conjunction with the accompanying drawings.

In said drawings:

FIGURE 1 is a side sectional view taken generally along the line I—I of FIG. 2 with the plug-in type terminal structure being shown in side elevation;

FIG. 2 is an end view, on a smaller scale relative to FIG. 1, of the double-type circuit breaker of FIG. 1 and part of a bus-bar stab;

FIG. 3 is a top plan view of the plug-in type terminal structure of FIGS. 1 and 2;

FIG. 4 is a view taken along the line IV—IV of FIG. 3;

FIG. 5 is a view of the terminal structure of FIG. 4 taken along the line V—V of FIG. 4 with the bus-bar stab being shown in elevation; and

FIG. 6 is a front elevational view, with parts broken away, of the plug-in type terminal structure of FIGS. 3–5 with an additional spring biasing member connected to the terminal structure.

The general operation and certain parts of the circuit breaker disclosed herein are described more specifically in the patent to Earl Bullis, Jr. Patent No. 3,200,217, issued Aug. 10, 1965.

Referring to FIG. 2 of the drawings, a double-type circuit breaker **9** is shown therein comprising an insulating housing that is composed of two molded insulating parts, **11** and **13**, forming two compartments. Each of the parts **11** and **13** comprises a back portion molded integral with four sides forming an open front. The open front of the part **11** is covered by the back portion of the part **13** which serves as an insulating barrier between the two compartments, and the open front of the part **13** is covered by a molded insulating cover **15**. The three molded insulating portions **11**, **13** and **15** of the housing are held rigidly together by three rivets **18** (FIG. 1).

The housing parts **11**, **13** and **15** form two insulating compartments housing two circuit breaker mechanisms which are identical in construction and operation, each of which mechanisms operates independently of the other. For this reason, only the mechanism enclosed by the housing part **11** will be specifically described, it being understood that, unless otherwise mentioned, the description applies to both of the mechanisms of the double-type circuit breaker.

The circuit-breaker mechanism, which is enclosed by the housing part **11** and the back portion of the housing part **13**, comprises a stationary contact **21**, a movable contact **23**, a supporting metal frame **25**, an operating mechanism **27** and a trip device **29**.

The stationary contact **21** is welded, or otherwise rigidly secured, to a line terminal structure **31** that will be hereinafter more specifically described. A stationary contact **33** (FIG. 3) for the circuit breaker mechanism that is housed in the housing part **13** (FIG. 2) is also welded, or otherwise rigidly secured, to the line terminal structure **31**.

The line terminal structure **31** is constructed to cooperate with a rigid load-center or panelboard conducting stab **35** in a manner to be hereinafter more specifically described.

Referring to FIG. 1, the stationary contact **21** cooperates with the movable contact **23** that is welded or otherwise rigidly secured to a generally C-shaped contact arm or switch arm **41**. A bearing member **42** is provided with a slot that is complementary with a slot in the upper part of the contact arm **41**, and the bearing is provided with two upper leg portions that fit into suitable slots in a molded insulating operating member **47**. The bearing **42** transmits motion from the operating member **47** to the movable contact arm **41** when the breaker is manually operated, and, as will be hereinafter explained, from the movable contact arm **41** to the operating member **47** when the breaker is tripped automatically in response to an overload current condition.

The operating member **47** is a molded insulating member having an arcuate trunnion **51** molded at each side thereof. The trunnions **51** fit and rotatably ride on two arcuate surfaces **55** that are formed on the metallic supporting frame **25**. The operating member **47** is supported between the surfaces **55** of the frame **25** and the bearing **42** which is supported by the contact arm **41**. The operating member **47** has a handle part **59** molded integrally therewith, which handle part extends through an opening **61** in the insulating housing to permit manual operation of the circuit breaker. Arcuate surfaces on opposite sides of the handle **59** substantially close the opening **61** in all positions of the operating member **47**.

The frame **25** supports an insulating pivot **65**. A metallic trip member **79** is pivotally supported at one end **77** thereof on the pivot **65**. The other end **82** of the trip member **79** is latched on a ledge in an opening in an armature **85**. The armature **85** is part of the trip device **29** which will be hereinafter specifically described. The ends **77** and **82** of the trip member **79** are offset and dis-

posed in a plane that is parallel to the plane in which the main body portion of the trip members **79** is disposed. An overcenter spring **87** is connected, under tension, at one end in an opening in the contact arm **41** and at the other end in a slot in a projection **89** extending from the trip member **79**.

The movable contact arm **41** is connected by means of a flexible conductor **91** to the free end of a bimetal **93** that is attached at its other end to a load terminal conductor **95**. A load terminal connecting screw **97**, which is externally accessible, is provided at the outer end of the conductor **95** to enable connection of the circuit breaker in an electric circuit. The load terminal conductor **95** is welded or otherwise attached to a projection **99**, extending out from the supporting frame **25**. The terminal conductor **95** is given additional support by being looped over and welded to another projection **101** extending out from the supporting frame **25**.

The closed electric circuit through the circuit-breaker mechanism extends from the line terminal structure **31** through the stationary and movable contacts **21, 23**, the contact arm **41**, the flexible conductor **91**, the bimetal member **93**, the load terminal conductor **95**, to a conducting wire that would be electrically connected to the conductor **95** by means of the screw **97** when the circuit breaker is in operating position. Since the movable contact arm **41** extends downward from its pivot, the arc is established adjacent the bottom of the housing in an arc chute **105**, one end of which is connected by a vent passage **107** to an opening in the end of the housing beneath the load terminal screw **97**.

The circuit breaker is manually operated to open and close the contacts **21, 23** by operation of the insulating handle **59**. Movement of the handle **59** clockwise from the full-line "on" position to the "off" position in which it is shown in dot-and-dash lines, carries the upper end of the contact arm **41** to the left of the line of action of the spring **87** whereupon the spring acts to move the contact arm **41**, with a snap action, to the open position shown partially in dot-and-dash lines. A projection **109**, molded integral with the housing part **11**, acts as a stop to limit opening movement of the contact arm **41**. Movement of the operating handle **59** in a counterclockwise direction from the "off" to the "on" position moves the upper end of the movable contact arm **41** to the right of the line of action of the spring **87** whereupon the spring operates to move the contact arm to the closed position seen in FIG. 1.

The trip device **29** is provided to effect automatic opening of the circuit breaker upon the occurrence of overload current conditions. The trip device **29** comprises the magnetic armature **85**, the bimetal **93**, a U-shaped magnetic member **111** that is secured to the bimetal **93** with the free ends thereof facing in the direction of the magnetic armature **85** and a spring **113**. The upper end of the bimetal **93** is welded or otherwise suitable secured to the terminal conductor **95** which is secured to the projection **99** on the metal frame **25**. The flexible conductor **91** is welded or otherwise suitably secured to the lower or free end of the bimetal **93**, and it (the conductor **91**) electrically connects the bimetal **93** with the movable contact arm **41**. The armature **85** is movably mounted on the bimetal **93** by means of the spring **113** that is secured at the lower end thereof to the bimetal **97** and at the upper end thereof to the armature **85**.

Upon the occurrence of an overload current below a predetermined value, the bimetal element **93** is heated, and when it is heated a predetermined amount, it deflects, with a time delay, to the right as seen in FIG. 1 to effect a thermal tripping operation. The armature **85**, which is supported on the bimetal **93** by means of the spring **113**, is carried to the right with the bimetal to release the trip member **79**. When the trip member **79** is released, the spring **87** acts to rotate the trip member clockwise about the pivot **65** to a tripped position. During this movement, the line of action of the spring **87** moves to the right of the pivot **42** of the contact arm **41** whereupon the spring biases the contact arm in an opening direction and moves the contact arm so that the line of action of the force exerted by the spring on the operating member **47** shifts across the pivot **51** whereupon the spring **87** actuates both the contact arm **41** and the operating member **47** to a tripped position. In order to provide a visual indication that the breaker has been automatically tripped open, movement of the operating member **47** is stopped in an immediate position when a projection **117**, molded integral with the operating member **47**, strikes the projection **89** that exetends from the trip member **79**. The circuit breaker is trip-free in that the breaker will trip upon the occurrence of an overload even if the handle **59** is held in the "on" or closed position.

Before the contacts can be closed following an automatic opening operation, it is necessary to reset and relatch the mechanism. This is accomplished by moving the operating handle **59** clockwise from the intermediate or tripped position to the full "off" position. During this movement, due to the engagement of the projection **117** of the operating member **47** with the projection **89** of the trip member **79**, the trip member is moved counterclockwise about the pivot **65** until the latch end **82** is again supported in the latched position on the armature **86**. Thereafter, the circuit breaker can again be manually operated in the same manner hereinbefore described.

The circuit breaker is magnetically tripped automatically and instantaneously in response to overload currents above the predetermined value. Upon the flow of current through the bimetal **93**, a magnetic flux, which is induced around the bimetal, takes the path of least reluctance through the magnet **111**, across an air gap and through the armature **85**. When an overload current above the predetermined value occurs, the pull of the magnetic flux is of such strength that the armature **85** is attracted to the magnet **111** whereupon the spring **113** fluxes permitting the armature to move, relative to the bimetal **93**, to the right. This movement releases the trip member **79**, and the contacts are opened in the same manner hereinbefore described with respect to the thermal tripping operation.

The line terminal **31** comprises a sheet-metal type generally resilient member of conducting material. The member **31** is a flat member having oppositely disposed large-surface-area flat face surfaces and small-surface-area end surface means between the faces or face parts. The member **31** is formed as a generally U-shaped member (FIG. 4) comprising opposite leg parts **121** and **123** connected by means of a bight part **125**. The terminal member **31** is formed with a slot **127** (FIG. 5) therein, which slot extends through the length of the leg part **121** (FIG. 4), through the bight part **125**, and downward a little more than half of the length of the leg part **123** (FIG .6). A projection **128** is bent-over from the leg part **123** to form a stop to position the terminal **31** relative to the conducting stab **35**. As was previously described, the two contacts **21** and **33** are welded or otherwise suitably secured to one of the sides or faces of the leg part **123** of the terminal **31**. Each of the contacts **21** and **33** cooperates with a different one of the stationary contacts of the two circuit breaker mechanisms of the double-type circuit breaker **9**. The terminal **31** is mounted in the circuit breaker housing **11, 13, 15** during assembly of the circuit breaker. During the assembly operation, the terminal **31** is moved into position when the compartment of the circuit breaker part **11** is open. The member **31** fits over a projection **129** (FIG. 1) that is molded as an integral part of the housing part **11**, and the leg **123** of the member **31** fits in a slot in another projection **131** that is also molded as an integral part of the housing part **11**. A third projection **133** that is molded as an integral part of the

housing part **11** is provided to engage and position the short leg **121** of the terminal **31**. When the terminal **31** is in the position seen in FIG. 1, the housing part **13** (FIG. 2) is moved into position and the cover **15** is then moved to cover the open housing part **13**. Thereafter, the parts are secured together by means of the rivets **18** (FIG. 1). The back wall of the housing part **13** has an opening in the lower back corner thereof to permit positioning of the terminal **31** in the breaker housing. As can be seen in FIG. 2, the back corner at the line terminal end of the circuit breaker housing **11, 13, 15** is provided with a slot or opening **135** therein to receive the stab **35** when the circuit breaker is moved into the mounted position.

When it is desired to mount the circuit breaker in a panelboard or load-center, the circuit breaker is moved into position to connect the terminal **31** with the conducting stab **35**. During this movement, a connecting part of the rigid flat conducting stab **35** moves between two facing end parts **139** and **141** (FIG. 5) of the end surface means of the terminal **31**. The dimension between the facing end parts **139** and **141** is less than the thickness of the conducting stab **35** so that as the terminal **31** is forced onto the stab **35** the facing end surfaces **139, 141** are biased apart spring charging the generally resilient terminal member **31** to provide contact pressure between the facing end surfaces **139, 141,** and the opposite sides of the stab **35**. The member **31** is generally rigid with regard to forces applied in an endwise direction. Thus, it can be understood that as the member **31** is forced onto the stab **35** the member **31** flexes with a torsion or twisting action to provide a torsion-type or twisting-type spring bias of the facing end surfaces **139, 141** against the conducting stab **35**. This torsion action serves to provide effective contact pressure between the facing end surfaces **139, 141** and the conducting stab **35**. As can be seen in FIG. 4, when the terminal **31** is moved into position on the stab **35** the projection or stop portion **128** on the member **31** serves to position the member **31** relative to the stab **35**.

If it is desired to further increase the contact pressure between the facing end surfaces **139, 141** and the conducting stab **35** an additional spring member **145** (FIG. 6) can be mounted on the terminal **31** to provide an additional force biasing the facing end surfaces **139, 141** against the stab **35**. As can be seen in FIG. 6, the spring **145** is a generally U-shaped member with the end parts thereof mounted in suitable openings in the bight part **125** of the terminal **31**.

It is to be noted that the terminal member **31** is supported in the housing **11, 13** and **15**; but that the terminal does not cooperate with the insulating housing in order to provide the biasing force for effecting contact pressure between the facing end surfaces **139, 141** and the stab **35** as would be the case, for example, if a spring member were positioned against part of the housing and the member **31** in order to provide contact pressure. Thus, if the insulating housing is distorted or relieved to some extent because of heat that may be generated in the circuit-breaker mechanism under excessive switching and short circuit conditions, this distortion of the insulating housing will not affect the contact pressure between the terminal **31** and the stab **35**.

For some applications, only one circuit-breaker mechanism may be utilized in only one compartment. In these cases, only one contact need be welded to the contact-supporting leg **123**.

While the invention has been disclosed in accordance with the provisions of the patent statutes, it is to be understood that various changes in the structural details and arrangement of parts may be made without departing from some of the essential features of the invention. It is desired, therefore, that the language of the appended claims be given as reasonably broad an interpretation as is permitted by the prior art.

We claim as our invention:

1. A circuit breaker comprising a pair of contacts operable to open and close an electric circuit, a plug-in type terminal structure in electrical series with said contacts, said plug-in type terminal structure comprising a sheet-metal type member of generally resilient conducting material, said sheet-metal type member comprising oppositely disposed flat face surfaces and end surface means between said flat face surfaces, said sheet-metal type member comprising facing end parts of said end surface means which facing end parts are positioned to receive a conducting stab therebetween when said circuit breaker is plugged onto the conducting stab, said plug-in type terminal structure constructed to cooperate with a conducting stab having a connecting part that has a thickness greater than the dimension between said facing end parts whereby when said plug-in type terminal structure is forced onto said connecting part said facing end parts are forced apart with a torsion action of said plug-in type terminal structure to spring charge said plug-in type terminal structure to effect a bias of said facing end parts against said connecting part of said conducting stab.

2. A circuit breaker constructed in accordance with claim **1**, wherein said sheet-metal type member comprises a one-piece member having a slot therein to form said facing end parts at opposite sides of said slot.

3. A circuit breaker constructed in accordance with claim **1**, wherein said sheet-metal type member comprises an inverted generally U-shaped member comprising a first leg and a second leg, said first leg formed with a slot therein to form said facing end parts at opposite sides of said slot, and means connecting said second leg in electrical series with said contacts.

4. A circuit breaker constructed in accordance with claim **3**, wherein one of said contacts is supported on a flat face surface of said second leg.

5. A circuit breaker constructed in accordance with claim **1**, wherein said sheet-metal type member comprises a member having a slot therein to form said facing end parts at opposite sides of said slot, and separate spring means engaging said member on opposite sides of said slot to bias said facing end parts against said conducting stab.

6. Control apparatus comprising a circuit breaker, a conducting stab comprising a connecting part having a thickness,

said circuit breaker comprising a pair of contacts operable to open and close an electric circuit, a plug-in type terminal structure in electrical series with said contacts, said plug-in type terminal structure comprising a sheet-metal type member of generally resilient conducting material, said sheet-metal type member comprising oppositely disposed flat face surfaces and end surface means between said flat face surfaces, said sheet-metal type member formed such that said end surface means comprise facing end parts having a dimension therebetween that is less than said thickness of said connecting part of said conducting stab when said plug-in type terminal structure is not connected to said conducting stab,

said circuit breaker removably connected to said conducting stab with said plug-in type terminal structure forced onto said connecting part of said conducting stab, said facing end parts of said plug-in type terminal structure positioned on opposite sides of said connecting part and forced apart by said connecting part to spring charge said plug-in type terminal structure to effect a bias of said facing end parts against said connecting part.

7. Control apparatus according to claim **6**, said sheet-metal type member comprising a one-piece member having a slot therein to form said facing end parts at opposite sides of said slot.

8. Control apparatus according to claim 6, said sheet-metal type member comprising an inverted generally U-shaped member comprising a first leg and a second leg, said first leg formed with a slot therein to form said facing end parts at opposite sides of said slot, and means connecting said second leg in electrical series with said contacts.

9. Control apparatus according to claim 8, one of said contacts supported on a flat face surface of said second leg.

10. Control apparatus according to claim 6, said sheet-metal type member comprising a member having a slot therein to form said facing end parts at opposite sides of said slot, and separate spring means engaging said sheet-metal type member on opposite sides of said slot to provide an additional bias of said facing end parts against said connecting part of said conducting stab.

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