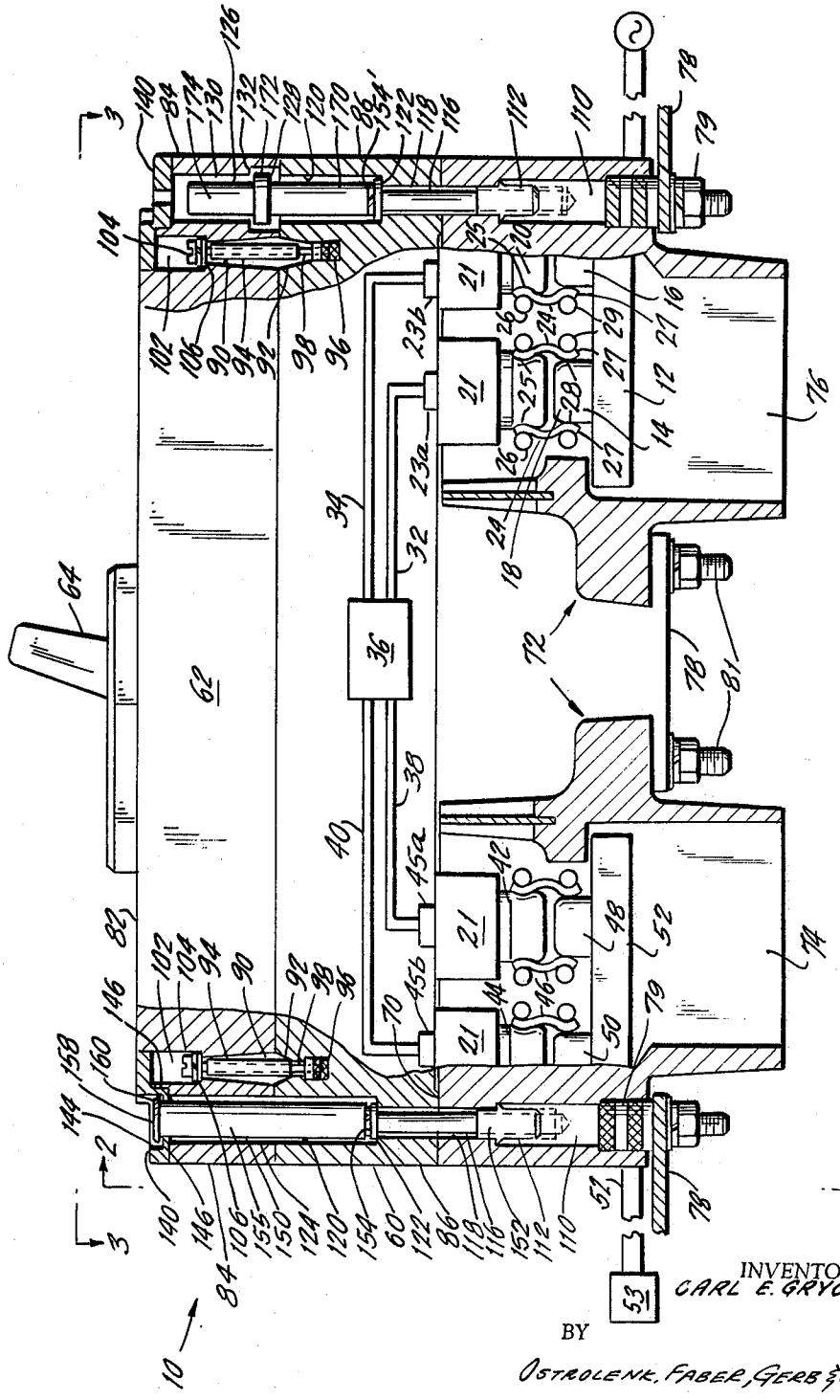
Oct. 21, 1969 C. E. GRYCTKO 3,474,206

CIRCUIT BREAKER MOUNTING AND REMOVAL JACK SCREW COMBINATION

Filed April 25, 1968 2 Sheets-Sheet 1

FIG. 1.



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Filed April 25, 1968 2 Sheets-Sheet 2

FIG. 2.

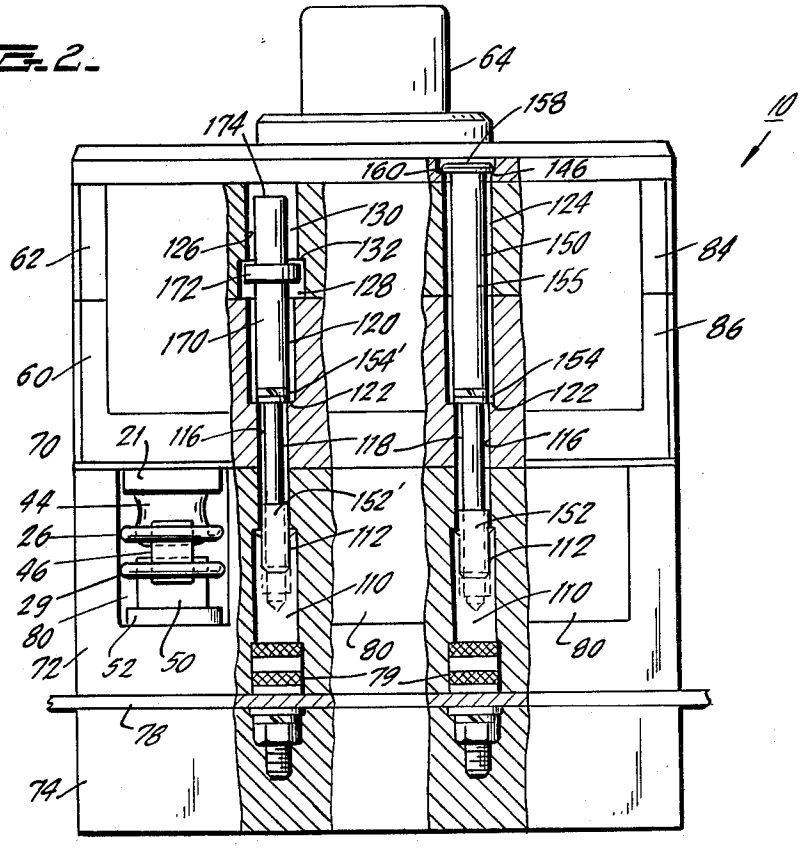
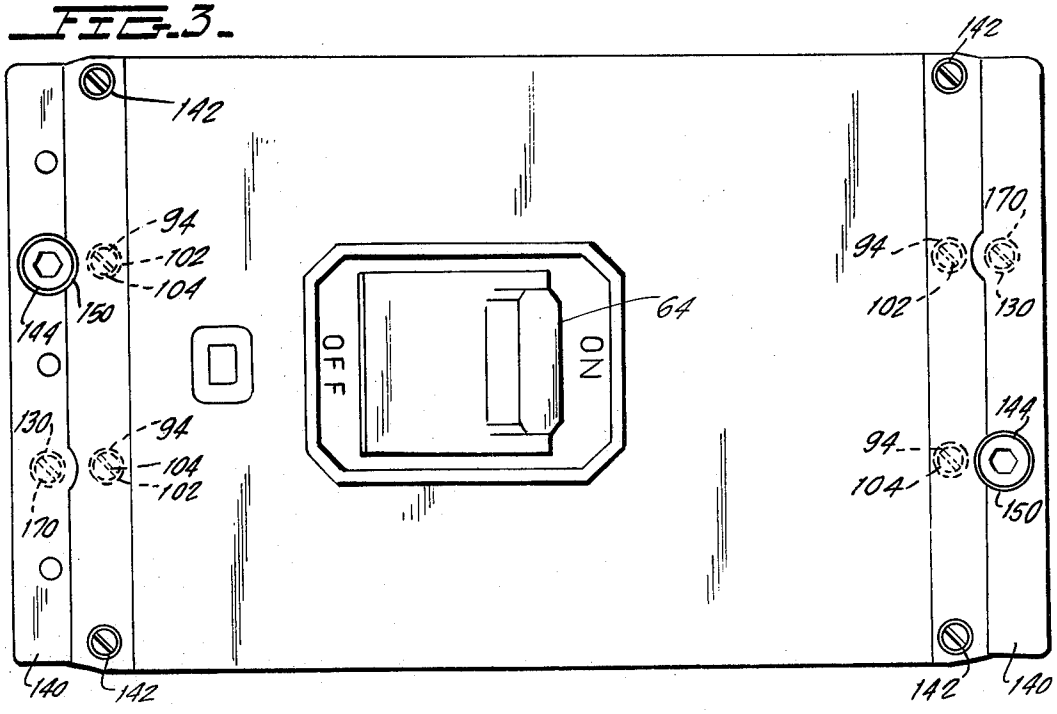


FIG. 3.



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CIRCUIT BREAKER MOUNTING AND REMOVAL JACK SCREW COMBINATION

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US. Cl. 200—168 8 Claims

ABSTRACT OF THE DISCLOSURE

In a casing for a circuit breaker which is to be connected by a plug-in connection, a base for containing the circuit breaker components, a removable cover for covering the base of the casing, the base and cover being secured together and having aligned screw receiving apertures; one jacking screw in one of the apertures at each of two diagonally opposite corners of the casing, the upper end of the jacking screw being captured within the casing cover whereby tightening the jacking screw secures the casing base to a support and unscrewing the jacking screws draws the cover upward, thereby drawing the casing away from the support; removable end covers for preventing access to the heads of the jacking screws after they are tightened; mounting screws passing through the end covers and releasably positioned in other screw receiving apertures for holding the casing base to the mounting support.

The present invention relates to means for mounting and separating plug-in circuit breakers from their cooperating terminal means and more particularly to a circuit breaker mounting and jack screw combination for aiding in the separation of the circuit breaker connectors from the terminal means.

A circuit breaker is connected in a circuit to operate to break the circuit when an overload current condition develops. The circuit breaker may be connected into the circuit by a plug-in mechanism comprising a stab which is frictionally engaged by an engaging means or comprising a post which is engaged by a resilient clip connector, the clip connector spreading and squeezing the post as the post moves into the connector.

The plug-in connectors of a breaker are usually mechanically secured to the breaker casing. Therefore, to connect or disconnect the connectors, appropriate mechanical forces are applied to the breaker casing. In smaller size molded case circuit breakers rated, for example, up to 800 amperes, the force that must be applied to the breaker casing to separate the circuit breaker plug-in connectors from their terminal means is sufficiently small so that mechanical aids, such as jacking means, for forcing the circuit breaker apart from its connectors are not required.

In breakers of higher amperage ratings, the number of plug-in connectors required to provide adequate current carrying capacity is greatly increased. In addition, where a single molded case circuit breaker contains protective equipment for protecting a number of phases of a multiphase circuit, each of the phases requires separate plug-in connectors, thereby further increasing the number of plug-in connections. The combined frictional or engaging forces exerted by the circuit breaker clip connection means become sufficiently large to make both plugging in and pulling out, the latter being otherwise referred to as jacking out or unracking of the circuit breaker, difficult without an auxiliary jacking device applying force to the breaker casing.

Presently, in some large circuit breaker installations, pantograph type units, riding in frames and on guide rails are used as jacking devices, occasionally in combination with gearing means. These devices require considerable space, are cumbersome to operate, are expensive, and are not suitable for use with molded case circuit breakers.

In typical molded case circuit breakers, a plurality of breaker mounting means are used for securing the circuit breaker casing to a mounting support.

For example, four screws might be employed, two on each of two opposite sides of the circuit breaker. Each screw typically extends through a receiving aperture in the cover, through a receiving aperture passing longitudinally through a side of the base of the breaker casing and into the mounting support.

The typical aperture extending through the side of the base of the circuit breaker casing has a shoulder therein facing toward the cover of the circuit breaker casing. Depending upon the particular casing design, in the screw receiving aperture, there is a shoulder in either the casing base or the casing cover which is engaged by a cooperating collar on the mounting screw, so that as the screw is tightened, pressure on the shoulder secures the casing to its support. After the cover is placed over the base, a mounting screw having a cooperating collar for mating with the shoulder in the casing is positioned in the aperture and is screwed in. The screw passes into the casing mounting support. The screw collar presses the casing into secure engagement with the mounting support.

As the circuit breaker is being screwed into position, the plug-in connectors of the circuit breaker, which are attached to the casing, are moved or snapped into engagement with cooperating terminal studs connected in the circuit being protected. However, when it becomes necessary to remove the circuit breaker from its support and to disconnect the plug-in connectors from the cooperating contacts, the mounting screws just described are of no help.

The present invention contemplates substituting a jacking means for two of the circuit breaker mounting screws just described. Jacking screws are shown herein but other jacking means which similarly act upon and cooperate with the circuit breaker casing base and cover and with the circuit breaker support may be employed.

One jacking screw is provided at a spot along each of two opposite sides of the casing. It is preferable to separate the jacking screws as great a distance as possible. Preferably, therefore, these screws are near two diagonally opposite corners of the breaker casing.

For reasons to be discussed below, when jacking screws are used, the separate mounting screws are positioned and tightened only after the jacking screws have been tightened and are loosened and removed before the jacking screws are loosened. Hence, considerations as to the placement of the jacking screws are not affected by the locations for the mounting screws.

Since the jacking screws are far apart, twisting of the breaker casing about one jacking screw while the other is being tightened or loosened is possible and one jacking screw will not impede the mounting or dismounting of the breaker through operations upon the other jacking screw. If the jacking screws were near each other, they would have to be tightened or loosened in a carefully controlled sequence and with great care so as not to loosen or tighten one of these screws too much with respect to others, lest the twisting of the breakers damage the jacking screws, the breaker casing or the breaker support.

The apertures in the base of the circuit breaker casing for receiving the jacking screws are substantially identical to those described above for receiving the mounting screws. The section of the jacking screw that is within the base of the casing has a similar collar to that of the normal mounting screw.

However, the cover of the circuit breaker casing is somewhat different where a jacking screw is to be used. The jacking screw receiving aperture in the cover has a shoulder facing toward the base of the circuit breaker. The portion of the jacking screw extending out of the base section of the casing has a collar which is adapted to engage the downward facing shoulder in the cover. Therefore, when screwed in, a jacking screw presses the base of the casing against the breaker support and when unscrewed, the jacking screw presses on the cover of the breaker to move same away from the base. Cover to base connecting means, e.g. screws extending between cover and base, hold the cover on the base, whereby unscrewing of the jacking screw pulls the entire circuit breaker away from the breaker support.

When the jacking screw is tightened, it secures the base of the casing, which is the heaviest section because it contains all of the operative components of the circuit breaker, to the circuit breaker mounting support. However, the design of the jacking screw illustrated herein precludes its aiding in the securing of the cover of the circuit breaker casing to the base. However, the cover is relatively light in weight, as compared with the circuit breaker component filled base, and the cover requires fewer screws to hold it in position. Thus, by use of the jacking screw in conjunction with the present invention, none of the necessary support of the circuit breaker through the use of normal mounting screws is sacrificed.

In a breaker casing adapted with the invention, end covers are provided which are positioned near the ends of the top of the casing cover to cover the exposed heads of the jacking screws to prevent access to them after they have been tightened. The end covers are designed so that only after the end covers have been mounted can the additional mounting screws for the breaker be inserted through the end covers, the casing cover, the casing base and the breaker support, and be tightened. This is accomplished by providing an aperture through an end cover for through passage of each mounting screw. A mounting screw has a head wider than its shaft and the opening through the end cover is narrower than the screw head whereby the end cover cannot be positioned once the mounting screw has been mounted, which ensures that the end cover is positioned first.

As an additional feature, the end covers hide the ends of the jacking screws on which operations are performed whereby the end covers must be mounted only after the jacking screws have been tightened.

One beneficial result of the mounting screw, jacking screw and end cover arrangement just described is that the mounting and dismounting operations can only be performed in the proper sequence, without detailed instructions being required.

When it is desired to unrack a circuit breaker designed in accordace with the invention, the mounting steps described above are performed in reverse order. The end covers prevent loosening of the jacking screws until after all the mounting screws have been removed, thereby preventing harm due to some mounting screws remaining secured.

Accordingly, it is the primary object of the present invention to provide a means for mechanically separating a circuit breaker from plug-in connection terminals.

It is another object of the present invention to provide a jacking means for jacking a circuit breaker away from plug-in connection terminals.

It is another object of the present invention to provide a means for mounting a circuit breaker on plug-in terminals.

It is a further object of the present invention to provide a circuit breaker mounting and removal jack screw combination for accomplishing the foregoing objects.

It is another object of the present invention to provide a jacking means which cooperates in the mounting of a circuit breaker to a circuit breaker support, in the

engaging of plug-in connectors on the breaker with plug-in terminals and in the unracking of the circuit breaker and in the separation of its connectors from their respective plug-in terminals.

It is a further object of the invention to so position the jacking screws that each may be loosened or tightened without any limitation on the sequence in which these screws are operated upon or the amount each may be rotated before the others must be rotated a corresponding amount.

It is another object of the present invention to design a circuit breaker casing so that when mounting and jacking screws are used in accordance with the invention, they will have to be inserted, tightened, loosened and removed in proper sequence without detailed instructions being necessary.

These and other objects of the present invention will become apparent when the following description is read in conjunction with the acompanying drawings in which:

FIGURE 1 is an elevation, partially in cross-section, of a circuit breaker designed in accordance with the present invention;

FIGURE 2 is an end view, in the direction 2—2 of FIGURE 1 showing the circuit breaker and its mounting partially in cross-section; and

FIGURE 3 is a plan view in the direction 3—3 of FIGURE 1, showing the top of the circuit breaker.

Referring to the figures, and particularly to FIGURE 1, a circuit breaker **10** is shown which is of a conventional variety illustrated in Patent No. 3,356,805 by Carl E. Gryctko, entitled "Circuit Breaker Trip Unit Assembly with Improved Thermal Characteristics," and assigned to the assignee hereof. The circuit breaker may be single or multi-phase, although the circuit breaker shown in the above-identified application is multi-phase. In FIGURE 1, only the terminals of a single phase are visible and for simplicity of description, only a single phase will be discussed.

A bus bar **12** is connected in the circuit being protected and conducts line current from the power source to the circuit breaker. Electrically connected with the bus bar **12** is at least one, but may be a plurality, of rigid plug-in cylindrical terminal studs **14, 16**. The terminal studs are secured to a fixed rigid base which will not flex under the forces normally exerted upon the terminal studs when the connectors of the circuit breaker are mounted and dismounted from the terminal studs **14, 16**. Studs **14, 16** may sit directly on and be braised onto bus bar **12** as illustrated, or may be remote therefrom and connected thereto by a conductor. Bus bar **12** may be of greater thickness or have a support element beneath it to prevent its flexing when the connectors of the circuit breaker are connected to or separated from studs **14, 16**. The connectors **18** and **20** of the circuit breaker, in a manner to be described, have connected to them by being plugged-in, the terminal studs **14, 16**, respectively.

Clip connectors **18, 20** each have a spacer support block **21** which is brazed to and mechanically supported on one of conductors **23***a*, **23***b*, respectively. The conductors are sufficiently thick and inflexible or are supported by an additional element so that they will not bend due to the forces exerted during breaker connection and disconnection. Integral with each block **21** is a rigid electrically conductive, undercut, depending connector portion which is undercut to receive and position the curved portions **25** of resilient clips **24**.

A garter spring **26** wraps around clips **24** and holds the clips **24** against the undercut part of the connector. The clips **24** extend downward past the ends of connectors **18, 20** to the free ends **27** of the clips **24**. The clips are adapted to engage a terminal post, like **14** or **16**.

The clips **24** are curved inward at **28** to receive a second garter spring **29** which biases the clips **24** inward toward each other. A plurality of clips all biased inward

and disposed around the terminal post may be provided; this being commonly known as a tulip connector.

Furthermore, while clip type connectors are shown, any type of plug-in connection between the connectors of the circuit breaker and the terminals of the circuit breaker mounting device may be used in conjunction with the present invention. For instance, in place of the terminal studs **14**, **16**, there may be provided stab prongs having flat sides which are frictionally engaged by an inwardly biased pair of clips, in opposed relationship, attached to the breaker. While the present invention is used in connection with a plug-in type connection, the particular type of plug-in connection used in conjunction with the present invention is not a necessary part of the present invention.

When connectors **18**, **20** are forced toward terminal studs **14**, **16**, the clips **24** are separated by the posts and then frictionally engage them.

The connectors **18**, **20** are each respectively connected to a conductive path **32** and **34**. Paths **32**, **34** which are shown schematically, are connected to a circuit breaker operating mechanism **36**, also shown schematically.

A circuit breaker operating mechanism is shown in the above-identified Patent No. 3,356,805. The operating mechanism comprises a pair of cooperating contacts in each current path and an operating mechanism to separate the cooperating contacts in the event of an overload current condition in the circuit being protected.

Current paths **38** and **40**, shown schematically and leading from operating mechanism **36**, complete the current path and are respectively connected to the terminal connectors **42** and **44**, each of which is structurally the same as terminal connectors **18**, **20**. As with connectors **18**, **20**, connectors **42**, **44** are supported against movement by conductors *45a*, *45b* within casing base **60**. Resilient clip connectors **46**, identical to connectors **24**, connect the terminal connectors **42**, **44** to load terminal studs **48**, **50**. The manner of interconnection between connectors **42**, **44** and studs **48**, **50** is the same as between connectors **18**, **20** and studs **14**, **16**.

The terminal studs **48**, **50** are mounted on a rigid platform which cannot be flexed or damaged due to the forces exerted during the mounting and dismounting of the circuit breaker from the terminal post **48**, **50**. The platform to which the terminal post **48**, **50** is connected is shown as comprising the load current bus bar **52** which leads to the installation **53** being serviced with current flowing through the circuit breaker **10**.

The present invention is concerned with means for mounting and unmounting the circuit breaker and only the circuit breaker elements which are concerned in the mounting and unmounting are here considered.

The casing of the circuit breaker **10** comprises a base portion **60** and a cover portion **62**. The various operating components of the circuit breaker are mounted in the base portion **60**, whereby the base portion is much heavier than the cover **62**. The base must be more securely held lest it break free from the circuit breaker mounting.

The circuit breaker cover **62** has the manual operating handle **64** extending through an aperture therein. Handle **64** manually operates the operating mechanism **36**.

Considering FIGURES 1 and 2, the lower surface **70** of the base portion **60** of the circuit breaker casing is positioned upon a circuit breaker mounting support **72**. Various securing means, to be described, retain the circuit breaker **10** in place on this support. As can be seen in FIGURE 1, support **72** consists of two separate sections **74** and **76**. Each section extends inward from an end of the circuit breaker casing toward the other mounting support. The mounting support itself is secured to or is part of a mounting plate or panel board **78** which ultimately supports the circuit breaker. Each end of section **74**, **76** of the mounting support **72** is supported on plate or panelboard **78** by screw and nut combinations **79**, **81**.

Turning to FIGURE 2, the support section **74** has cut-outs **80** which provide clearance spaces for the terminal connectors beneath the circuit breaker while the lower surface **70** of the base of the circuit breaker casing is in engagement with the mounting support **72**. Also, the cut-outs provide chambers into which the terminal post support platforms and bus bars **52** may be positioned. Only one of the cut-outs **80** is shown in use, it being understood that any number of these cut-outs may be used depending upon the number of circuit breaker phases and on the number of connectors on the circuit breaker which must be engaged with terminal posts secured to the mounting support.

Referring to FIGURE 1, the cover **62** of the circuit breaker has a top surface **82** and sides **84**. The base portion of the circuit breaker **60** has sides **86** extending up to sides **84** from its lower surface **70**. Both of sides **84** and **86** are of sufficient thickness to receive the circuit breaker mounting and dismounting means to be described.

First, the cover and base of the breaker casing must be secured together. When the casing cover **62** is mounted on the casing base **60**, the plurality of apertures **90** in the cover register with the plurality of corresponding apertures **92** in the base to provide passages for the cover mounting means, viz. screws **94**, to be described. At the end of each aperture **92** away from cover **62** is located a threaded receptacle **96** for receiving the threaded end **98** of cover mounting screws **94**. Each aperture **90** in the cover has a widened upper section **102** through which the head **104** of a mounting screw **94** readily passes. Just beneath the widened portion **102** each aperture **90** narrows, thereby forming a shoulder **106** upon which the head **104** of a screw **94** rest. When each screw **94** is tightened, its threaded end **98** moves into receptacle **96**, thereby drawing head **104** against shoulder **106**. This holds the circuit breaker cover **62** securely against the circuit breaker base **60**.

In FIGURE 3, it can be seen that there are two screws **94** passing through each of sides **84**, **86**. The number of screws **94** is a matter of choice and must only be sufficient to hold the circuit breaker casing cover **62** securely on the circuit breaker base **60** when the jacking screws **170**, to be described, exert a force upon the circuit breaker cover **62** which tends to separate same from the base **60**.

Turning to FIGURES 1 and 2, above each of the nut and bolt combinations **79** in circuit breaker mounting support elements **74**, **76**, is an aperture **110** for containing an internally threaded sleeve **112** which is fixedly mounted within the aperture **110** and which receives the end of either a mounting screw **150** or a jacking screw **170**, to be described. Apertures **110** need not only be above bolt combinations **79**, however. They may be at any location along the sides of the supports **74**, **76**. As suggested in FIGURE 2, there are two openings **110** on each side of the circuit breaker **10**. The number of apertures **110** and thus the number of mounting and jacking screws that may be used for mounting a circuit breaker in accordance with the present invention is a matter of choice. Only one of the apertures on each of the opposite sides will be used for a jacking screw. The other apertures will be used to receive mounting screws.

Each opening **110** in support **72** registers with an opening **116** that extends completely through the sides **86** of the circuit breaker casing base from the support beneath the base to the cover **62** above the base. All openings **116** in the casing base, whether for mounting or jacking screws, are identical. Each opening **116** has a narrowed lower section **118** and a wider upper section **120**. The sections **118** and **120** meet at shoulder **122**, which faces toward the circuit breaker casing cover, and enables the circuit breaker to be secured to the mounting support **72** in a manner to be described. The shoulder **122** is also facing away from the direction the casing **60** must move for the connectors **18**, **20**, **42**, **44** to enter plug-in engagement with terminal studs **14**, **16**, **48**, **50**.

The openings **116** through the circuit breaker casing base **60** register with openings **124** or **126** that pass through cover **62**. The openings **124** in the cover for the circuit breaker mounting screws **150**, to be described, need merely be of sufficient width to permit the free passage through these openings of the circuit breaker mounting screws. On the other hand, the openings **126** for the jacking screws **170**, to be described, must have a particular conformation. The section **128** of each opening **126**, which is closer to the housing base **60**, must be wider than section **130** of each opening **126**, which is away from the circuit breaker housing base. The sections **128**, **130** meet at a shoulder **132** which faces downward, or in the direction opposite that which the breaker casing must move under the influence of the jacking screws **170** for causing separation of the circuit breaker **10** from its plug-in terminals, in a manner to be described. All apertures through the casing cover may be of the same shape as the apertures **126** for the jacking screws since these apertures also permit mounting screws to be passed through them.

At least one jacking screw **170** is provided. Each jacking screw, when tightened, cooperates with the mounting screws, to be described, to hold the circuit breaker in position. When loosened, the jacking screw raises the circuit breaker from its mounting position and thereby separates its plug-in connection terminals from the circuit terminal connection posts. A single jacking screw would raise whichever corner of the breaker it was placed in. The connections between the circuit breaker connectors and the terminal posts resist the separation and the breaker will, therefore, pivot up, rather than lift up. Each additional jacking screw will further lift up the breaker and separate from their respective terminal posts those connectors which are not separated by the first jacking screw. In FIGURE 3, it can be seen that the illustrated breaker employs two jacking screws **170** near diagonally opposite corners of the breaker. One jack screw is at the line end of the breaker and the other is at the load end. There are no other jack screws. Since there is only one jack screw at each of the line and load ends, a considerable distance apart, either of the jacking screws can be fully engaged or disengaged, as will be described, without damage to the breaker. Such damage might result were two jacking screws near each other and one was engaged while the other was disengaged, since disengagement moves the casing upward against the downward hold of an engaged screw.

A jacking screw **170** is provided having a lower portion **152'** which is matingly threaded into threaded sleeve **112** in casing support **72**, thereby to be engaged by said sleeve. Rotation of the jacking screw will cause it to move upward and downward in sleeve **112**, thereby tightening or releasing the mounting screw. Screw **170** has an annular collar **154'** which engages the shoulder **122** within opening **116** in the circuit breaker casing base when the mounting screw is tightened. This holds the circuit breaker base **60** against the support **72**, thereby securing the circuit breaker in position.

The jacking screw **170** is provided with an annular collar **172** which fits within widened portion **128** of opening **126** in the circuit breaker casing cover. The head **174** of the jacking screw which remains within portion **130** of casing over opening **126** is provided with means, e.g. a notch, into which a screw driver can be inserted, for tightening or loosening the jacking screw. When the jacking screw is loosened or unscrewed, the upper surface of collar **172** engages the downward facing shoulder **132** within opening **126** in the casing cover, and thereby exerts a force upon the casing cover to move the cover, and hence the circuit breaker, away from the terminal connectors, **14**, **16** and **48**, **50**.

Turning to FIGURES 2 and 3, access into the casing cover to the casing base connecting screws **94** is obtained from the top surface **82** of the breaker cover through openings **102**. Similarly, access into the casing cover to the heads of the jacking screws is through the top surface **82**. After the screws **94** have been tightened and the jacking screws **170** have been tightened, for proper operation of the invention, as will be described further below, access to these screws should be prevented.

The circuit breaker is provided with stepped end covers **140** which extend inward from the ends **84** of the breaker casing cover sufficiently far to cover the openings **192** and **130**. The screws **94** and **170** are hidden by the end covers **140**, whereby these screws **94** are shown as invisible in FIGURE 3. The end covers **140** are secured in position by screws **142**, shown in FIGURE 3, which screws pass through the end covers and extend into the breaker casing cover.

Referring to FIGURES 1 and 2, the end covers **140** are provided with apertures **144** which pass completely therethrough. A shoulder **146** is formed near the base but within opening **144**, which faces upward so that the head of the mounting screw **150** may be blocked by it for reasons to be described.

The end covers ensure that the proper sequence of insertion and tightening of the jacking screws and of the mounting screws is maintained. Since the jacking screws are inaccessible once the end covers are positioned, they must be tightened before the end covers are positioned. The shoulders **146** within openings **144** of the end covers form narrower diameter openings than the diameter of the heads **160** of the mounting screws **150**, whereby the end covers cannot be positioned after the mounting screws have been positioned because the collars **146** will be blocked by the heads **160** and the end covers will not seat properly. The end covers, in the same manner, ensure that circuit breaker dismounting is in the proper sequence.

At least one mounting screw is provided. The portion of each mounting screw within the circuit breaker casing base **60** and within the mounting support **72** is substantially identical to the analogous portion of a jacking screw **150**. Screw **150** has a lower portion **152** and a collar **154**, respectively substantially identical to portion **152'** and collar **154'** of jacking screw **170**. A jacking screw **170** can be used to perform the same function as a mounting screw **150** in holding the base **60** of the circuit breaker against the mounting support. Accordingly, no separate mounting screws are required so long as the jacking screws hold the breaker securely enough.

In FIGURE 3 only a single circuit breaker mounting screw **150** is shown on each of two opposite sides of the circuit breaker. It is to be understood that there may be any number of mounting screws on any side of the circuit breaker, so long as the number is sufficient to hold the circuit breaker in place.

The cylindrical mounting screw shaft **155** terminates in mounting screw head **158**, which also is notched or has a hexagonal gripping portion to enable a tightening tool to be therein inserted or thereto connected.

The circuit breaker mounting and removal jack screw combination is employed in the following manner. When it is desired to mount a circuit breaker **10** on its terminal studs **14**, **16**, **48**, **50** after the circuit breaker operating mechanism **36** has been mounted within the circuit breaker casing, the jacking screws **170** are inserted in their receiving apertures **116** in the circuit breaker base **60**. The threaded shafts of the jacking screws **170** extend the base of the circuit breaker casing. The casing cover **62** is next attached to the casing base **60** by means of screws **94**. The jacking screws have now been captured by their collars **172**. The circuit breaker is then moved so that its terminal connectors **18**, **20** and **42**, **44** are each adjacent their respective terminal studs **14**, **16**, **48** and **50**. If it is possible to manually do so, the terminal connectors are pressed into plug-in engagement with the clip connectors **24**, **46**.

When the terminal connectors **18**, **20**, **42**, **44** are adjacent their respective terminal posts, the apertures **110** in the circuit breaker mounting support **72** are in registry

with the apertures **116** through the circuit breaker base, whereby the portions **152** of the jacking screws **170** extend into the openings **110** and into their respective receiving sleeves **112**. The jacking screws are each tightened. The sequence of tightening is of no significance, as noted above, due to the distance of separation between the jacking screws. As the downward facing collars **154'** of the jacking screws engage the upward facing shoulders **122** in their respective apertures in the circuit breaker casing base, the force exerted by the tightening of the jacking screws slowly forces the terminal studs **14, 16, 48, 50** into their respective resilient clip connectors **24, 46** until the circuit breaker is properly mounted.

By use of the jacking screws, the person mounting the circuit breaker obtains a substantial mechanical advantage, reducing the force he must exert to cause the plurality of circuit breaker connectors to engage the plurality of terminal studs, as compared with his having to bring about the connection manually by the application of pressure upon the circuit breaker casing itself.

Next, the end covers **140** are mounted by screws **142**. Were an attempt made to mount the mounting screws before the end covers, the shoulders **146** in the end cover openings **144** would abut the mounting screw heads **160** and prevent mounting of the end covers. After the end covers are mounted, the mounting screws **150** are positioned in their respective apertures **124** in the casing cover, **116** in the casing base. Their threaded lower shafts **152** extend into the threaded sleeves **112** in breaker support **72**. Screws **150** are each tightened, the sequence of tightening being of no significance, until the collars **154** on each of them securely seat on their respective shoulders **122** in the casing base, thereby further securing the breaker casing to its support **72**.

When it is desired to dismount the circuit breaker for repair or other reasons, the mounting screws **150** are removed. The mounting screws are the only items that can be removed or loosened. The jacking screws **170** are inaccessible under the end covers. If the end cover screws **142** are removed, the end covers still cannot be removed because their shoulders **146** will abut mounting screw heads **160** which they cannot pass. After removal of the mounting screws, the end covers are removed. This exposes the jacking screws.

Then the jacking screws are loosened or unscrewed. The sequence of loosening is of no significance. As the jacking screws move upward, as viewed in FIGURE 1, their upward facing collars **172** each engage the cooperating downward facing shoulders **132** within the respective openings **126** through the circuit breaker casing cover. Continued loosening or unscrewing of the jacking screws causes the collars **172** to apply pressure that draws the circuit breaker connectors **18, 20, 42, 44** away from their terminal studs **14, 16, 48, 50**. As was discussed in connection with mounting a breaker, the mechanical advantage of the force applied by the person dismounting or disconnecting or unracking the circuit breaker is increased by providing screw out jacking means instead of the person having to manually attempt to pry the circuit breaker free.

Finally, if access into breaker casing **60** is desired, removal of screws **94** permits this.

There has just been described a circuit breaker mounting and removal jack screw combination which with a minimum of modification of the standard circuit breaker mounting screw construction permits a circuit breaker to be readily mounted and unracked without the need for applying excessive manual force and without the need for utilizing complex unracking mechanisms, such as pantograph devices.

Although the invention has been described above with respect to its preferred embodiments, it will be understood that many variations and modifications will be obvious to those skilled in the art.

What is claimed is:

1. In a circuit breaker comprising, a current path connected into a circuit being protected by said breaker, said current path passing through said circuit breaker, cooperating contacts in said current path, and an operating mechanism for separating said contacts in the event of a current overload condition through said current path;

said current path extending to and terminating in electric connector means; said electric connector means being adapted for plug-in connection to plug-in terminal means;

a circuit breaker casing having said operating mechanism mounted within it and carrying said electric connector means;

the improvement comprising, a mounting screw and jacking screw combination comprising,

mounting screw means in said casing and having first means for engaging said casing when said mounting screw means is tightened into a receiving receptacle; when said mounting screw means is tightened, the engagement between said casing and said first means holding said electric connector means in plug-in engagement with a terminal means;

jacking screw means in said casing and having second means for engaging said casing when said jacking screw means is unscrewed from a receiving receptacle in which it is mounted;

when said jacking screws means is unscrewed, the engagement between said casing and said second means moving said electric connector means out of plug-in engagement with said terminal means.

2. In the circuit breaker of claim **1**, said casing having aperture means passing therethrough for receiving said mounting and jacking screw combination, including a first aperture for said mounting screw means and a second aperture for said jacking screw means, which apertures are open ended for permitting said mounting screw means and said jacking screw means to extend beyond said casing whereby they can extend into engagement with separate receiving receptacles; said aperture means having a common direction of extension;

said electric connector means being positioned to be caused to be moved into and out of plug-in engagement with terminal means by said casing being moved in directions parallel to said common direction of extension of said aperture means;

the improvement further comprising,

a first shoulder within said first aperture, said first shoulder facing away from the direction of movement of said circuit breaker casing when said casing is moved for plug-in connection of said electric connector means; said mounting screw means having a first collar thereon with a first surface which faces toward said first shoulder, whereby when said mounting screw means is tightened, said first surface of said first collar presses on said first shoulder and thereby moves said casing in a first direction which brings about plug-in engagement of said electric connector means and plug-in mounting of said circuit breaker;

said second aperture having a second shoulder therein facing away from the direction of movement of said circuit breaker casing when said casing is moved to bring about plug-in disconnection between said electric connector means and terminal means therefor; said jacking screw means having a second collar thereon which collar has a second surface for engaging said second shoulder and moves said casing in a direction which brings about plug-in disconnection between said electric connector means and terminal means to which said electric connector means are connected, and also brings about dismounting of said circuit breaker.

3. In the circuit breaker of claim **2**, said breaker having line terminals near one end of said casing and load terminals near the opposite end of said casing;

the improvement further comprising,

only two of said jacking screw means and two of said

second apertures therefor; one of said second apertures for one of said jacking screw means being at said line terminal end of said casing and another of said second apertures for the other of said jacking screw means being at said load terminal end of said casing.

4. In the circuit breaker of claim 2, said breaker having line terminals near one end of said casing and load terminals near the opposite end of said casing;

a jacking screw means and a second aperture therefor at both of said line terminal end of said casing and said load terminal end of said casing;

a mounting screw means and a first aperture therefor at both of said line terminal end of said casing and said load terminal end of said casing;

the improvement further comprising,

an end cover means for said casing for covering over all of said first and said second apertures, thereby precluding access to said jacking screw means into said second apertures after said end cover means is positioned on said casing; said end cover means having third apertures therethrough which register with said first apertures in said casing when said end cover means is positioned on said casing; each of said third apertures having a shoulder on the wall surrounding said third aperture, which shoulder forms an opening of a first diameter;

said mounting screw means being passed through said third aperture and into said first aperture after said end cover means is positioned on said casing; said mounting screw means having a head at an end thereof with a diameter greater than said first diameter,

whereby said mounting screw means can be positioned only after said end cover means is positioned and said end cover means can be positioned only after tightening of said jacking screw means is completed, and whereby the jacking screws may be loosened to release said circuit breaker only after said end cover means is removed, which, in turn, cannot be done until said mounting screw means is removed.

5. A circuit breaker and panel board combination comprising the circuit breaker of claim 4 and a panel board for mounting said circuit breaker;

said panel board having terminal means to which said electric connector means of said circuit breaker can be connected by plug-in connection; said terminals being, in turn, connected in a circuit being protected by said circuit breaker;

receiving receptacles on said panel board for receiving said mounting screw means and said jacking screw means therein; said receptacles each having a threaded interior surface; each of said mounting screw means and said jacking screw means having a threaded portion which sits within one of said receptacles in said panel board, whereby tightening of said mounting screw means moves said circuit breaker into secure engagement with said panel board and causes plug-in terminal connection; and unscrewing of said jacking screw means moves said circuit breaker to disengage from said panel board and causes disconnection of said plug-in connectors from said terminals.

6. In the circuit breaker of claim 2, the improvement further comprising, said jacking screw means including said first collar of said mounting screw means and said second aperture for said jacking screw means including said first shoulder of said first aperture;

securing means for holding said breaker casing cover on said breaker casing base.

7. In the circuit breaker of claim 6, said casing comprising a base portion with an open top, for holding said current path and said operating mechanism; and a separate cover portion for enclosing said circuit breaker casing;

the improvement further comprising,

said second shoulder being located within said cover portion of said casing;

said first shoulder being located within said base portion of said casing; and

securing means for securing said cover portion of said casing to said base portion thereof.

8. In the circuit breaker of claim 6,

said circuit breaker casing having a bottom in the vicinity of which said electric connector means are positioned;

the improvement further comprising,

said first shoulder within said first aperture facing away from said bottom of said circuit breaker casing;

said jacking screw means having a first collar means thereon with a first surface which faces toward said first shoulder and toward said bottom of said circuit breaker casing;

said second aperture having a second shoulder therein facing toward said bottom of said circuit breaker casing;

said jacking screw means having a second collar means thereon, which collar means has a second surface facing away from said bottom of said circuit breaker casing for engaging said second shoulder.

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