Sept. 20, 1966 J. E. GODFREY 3,274,356

DRAW-OUT FUSED SWITCH-GEAR APPARATUS

Filed March 1, 1965 3 Sheets-Sheet 1

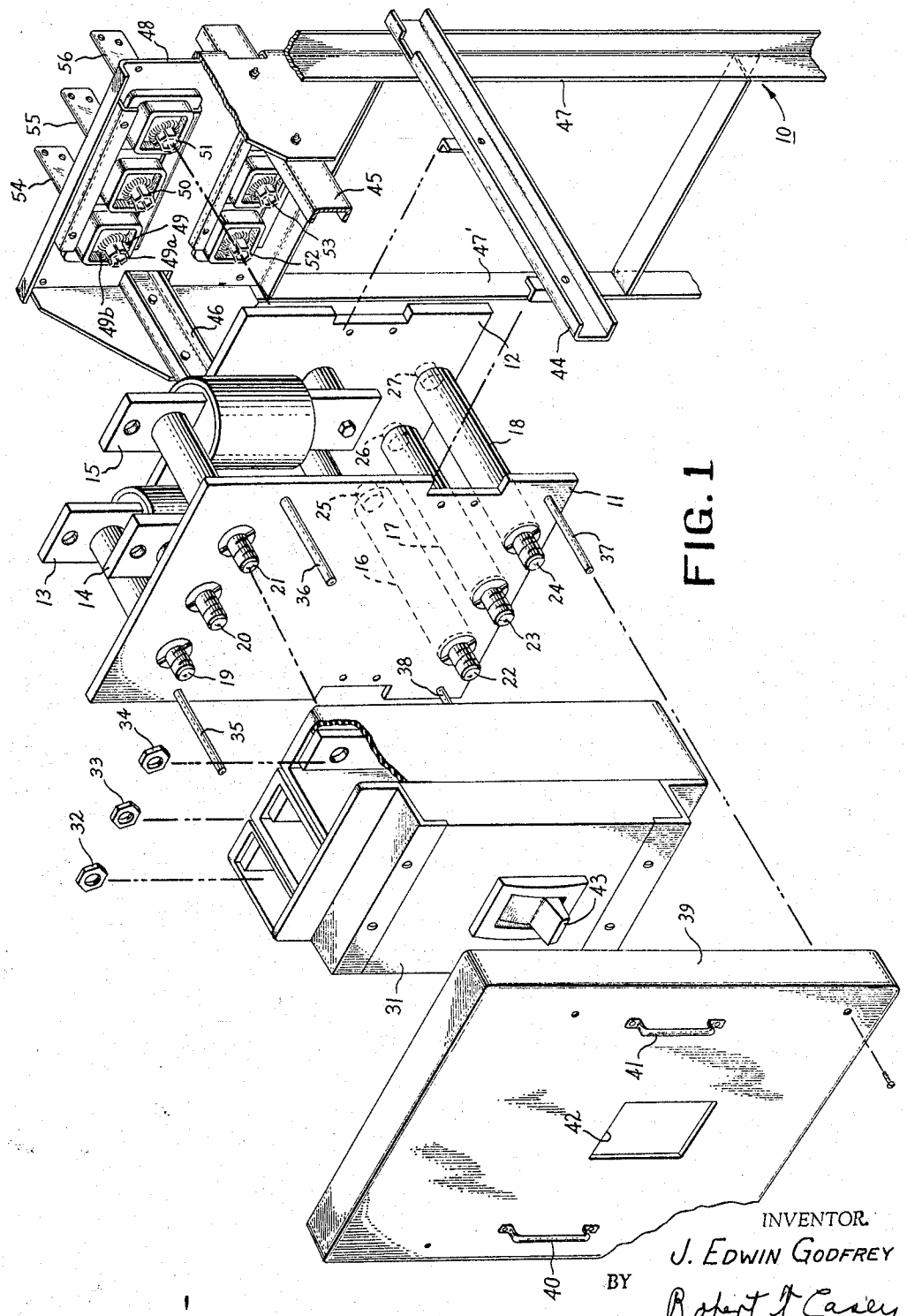


FIG. 1

INVENTOR.
J. EDWIN GODFREY
BY
Robert F. Casey
ATTORNEY

Sept. 20, 1966 J. E. GODFREY 3,274,356

DRAW-OUT FUSED SWITCH-GEAR APPARATUS

Filed March 1, 1965 3 Sheets-Sheet 2

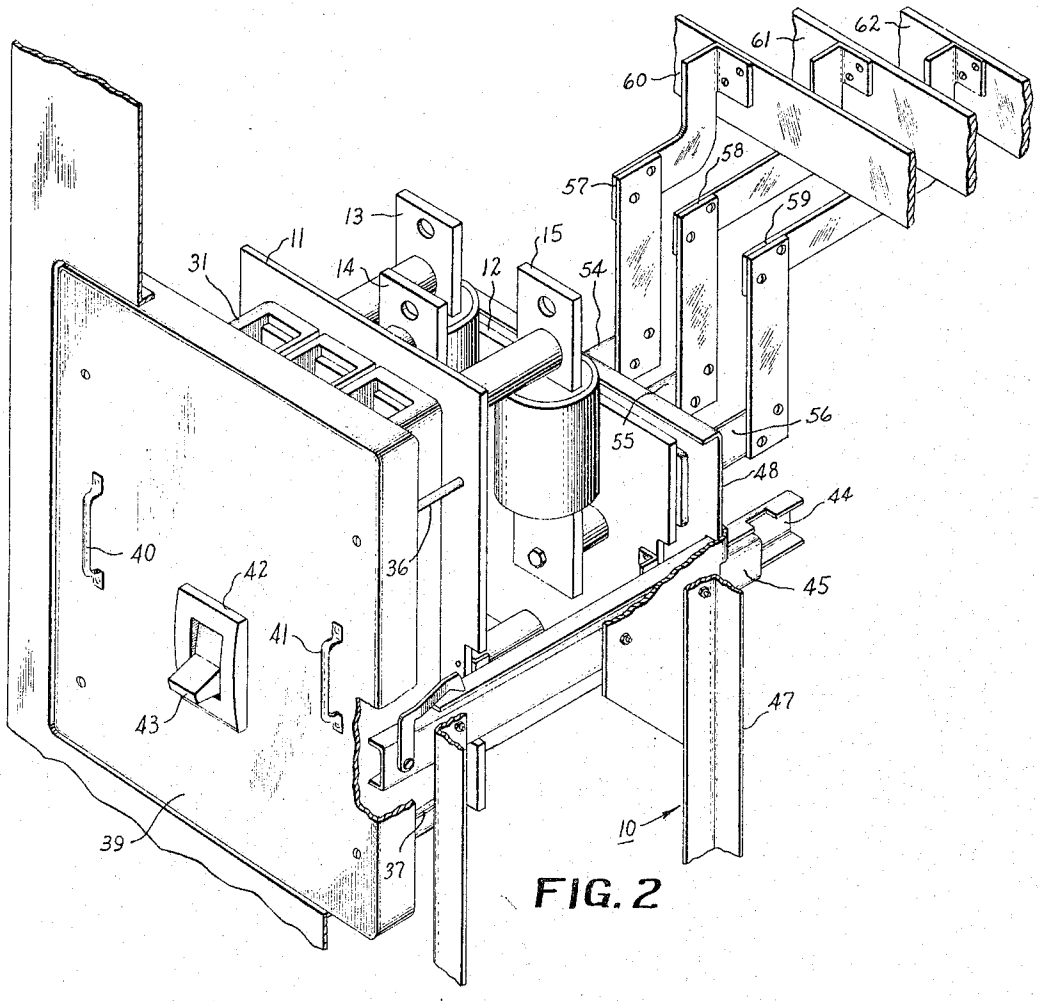


FIG. 2

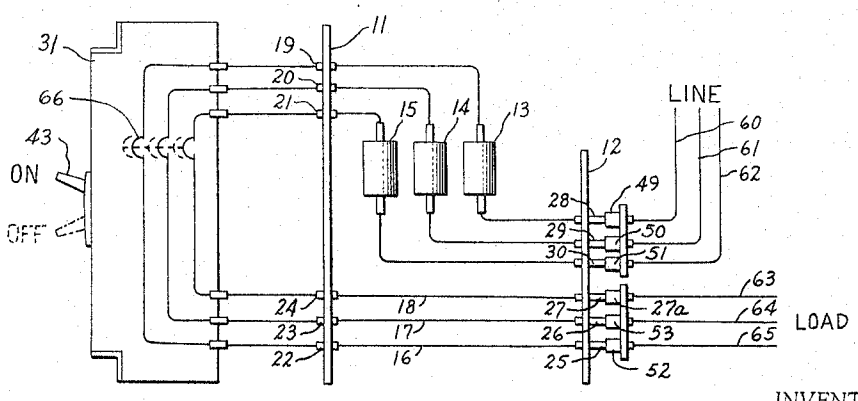


FIG. 3

INVENTOR.
J. EDWIN GODFREY
BY
Robert T. Casey
ATTORNEY

Sept. 20, 1966 J. E. GODFREY 3,274,356

DRAW-OUT FUSED SWITCH-GEAR APPARATUS

Filed March 1, 1965 3 Sheets-Sheet 3

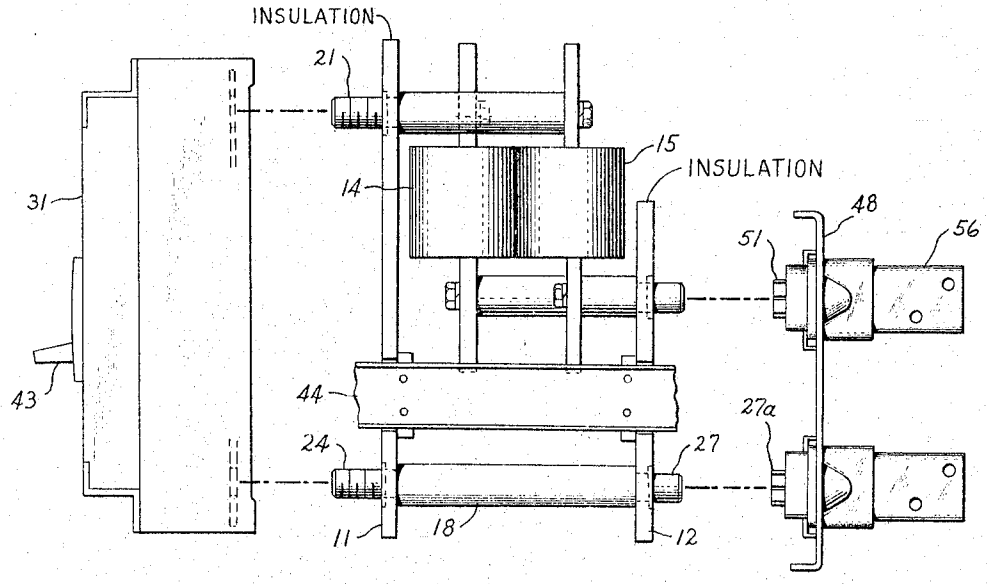


FIG. 4

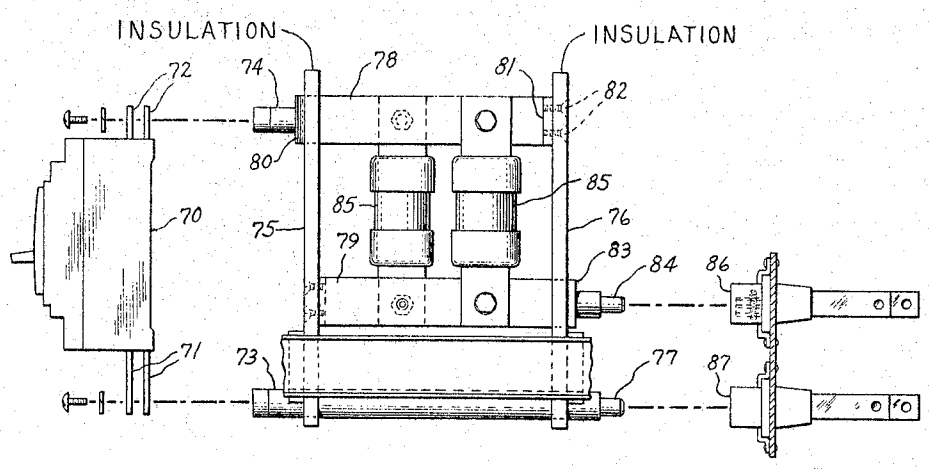


FIG. 5

INVENTOR.
J. EDWIN GODFREY
BY Robert G. Casey
ATTORNEY

United States Patent Office 3,274,356 Patented Sept. 20, 1966

3,274,356

DRAW-OUT FUSED SWITCH-GEAR APPARATUS

Joseph Edwin Godfrey, West Hartford, Conn., assignor to General Electric Company, a corporation of New York

Filed Mar. 1, 1965, Ser. No. 435,876
5 Claims. (Cl. 200—114)

This invention is related to a draw-out switch-gear apparatus, and more particularly to such apparatus which is especially adapted to be removably engageable with fixed electrical connectors connected to a source of electrical energy and to an electrical load. A particular feature of the present invention is the arrangement by which appropriate switch means connectable in circuit with the draw-out switch-gear apparatus is removably mounted upon that portion of the apparatus which may be selectively withdrawn from electrical engagement with the aforementioned electrical source and electrical load connectors.

A principal object of the present invention is to provide a draw-out switch-gear apparatus in which the switch means connected in circuit in such apparatus may be readily removed as desired.

Another object of the present invention is to provide such a draw-out switch-gear apparatus employing a circuit breaker as the switch means connected in circuit with the apparatus and providing that the circuit breaker may be easily and readily removed from its normal mounted position for replacement, repair, calibration, or test.

Another object of the present invention is to provide such a draw-out switch-gear apparatus incorporating current limiting means.

A further object of the present invention is to provide a draw-out switch-gear apparatus having a circuit breaker connected in circuit with the aforementioned current limiting means which circuit breaker may be automatically operable to interrupt the flow of overload currents or manually operable to interrupt the flow of currents therethrough before the switch-gear apparatus is withdrawn from electrical engagement with the electrical source connectors and electrical load connectors.

A still further object of the present invention is to provide such a draw-out switch-gear apparatus which is compact, simple, and of extremely durable construction.

The invention in one form may comprise a frame assembly including front and rear insulating walls aligned in generally parallel relationship and spaced from each other. The front and rear insulating walls have connected therebetween a plurality of fusible means disposed generally in spaced, horizontal alignment. Also supported in connection between the front and rear insulating walls of the frame assembly are a plurality of electrical conductors. Both the electrical conductors and fusible means are in electrical engagement with electrical connectors which pass through the front insulating wall; a like plurality of electrical connectors are arranged in electrical engagement with both the fusible means and the electrical conductors, respectively, and pass through the rear insulating walls. The electrical connectors passing through the rear insulating wall are arranged to be removably engageable in electrical contact with a like plurality of electrical connectors fixedly supported on a support structure. Such fixed electrical connectors may preferably take the form of the so-called "tulip-type" connectors and are arranged to be connected to an electrical source and an electrical load.

The electrical connectors which are aligned horizontally and pass through the front insulating wall are so spaced and disposed as to afford a means for removable electrical engagement with a switch means such as a circuit breaker, for instance, connected in series electrical

engagement to complete multi-pole circuits from the electrical source to the electrical load. The front insulating wall is also arranged to support a trim plate thereon to cover and protect the switch means and provide a suitable handle pull means for withdrawal of the frame assembly which forms the removable portion of the switch-gear apparatus. The trim plate has an aperture therein adapted to allow the externally extending, reciprocally operable handle of the circuit breaker or like switch means to pass therethrough. The front and the rear insulating walls, the fusible means and electrical connectors therebetween, the circuit breaker or switch means mounted on the front insulating wall, and the trim plate supported by the front insulating wall are supported by a suitable rail means secured to the front and rear insulating walls. One such rail is disposed on either side of the frame assembly and the rails are adapted to be received slidingly within rails of the fixed support structure, the rail arrangement being disposed to afford the alignment of the electrical connectors on the rear insulating walls for sliding engagement and electrical contact with the fixed connectors supported and mounted on the support structure by sliding the entire frame assembly along the rails to such engagement.

These and other objects and features of the present invention will be more fully understood from the following detailed description together with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawings:

FIGURE 1 is an exploded perspective view of an embodiment of the present invention;

FIGURE 2 is a perspective view of the embodiment of the present invention illustrated in FIGURE 1 but in its assembled state;

FIGURE 3 is a schematic electrical circuit diagram illustrating the electrical connections of the embodiment of the present invention illustrated in FIGURES 1 and 2;

FIGURE 4 is a side elevational view of the invention shown in FIGURE 1; and

FIGURE 5 is a view similar to FIGURE 4 but showing another embodiment of the invention.

Referring now to FIGURE 1, the draw-out switch-gear apparatus of the present invention comprises a fixed support structure shown generally at **10** and a removable frame assembly shown in exploded perspective view. The frame assembly comprises a front insulating wall **11** and a rear insulating wall **12** aligned generally in parallel spaced relationship and having connected therebetween a plurality of fusible means such as the fuses at **13**, **14**, and **15**. Also supported and connected between the rear insulating wall **12** and the front insulating wall **11** are a plurality of electrical conductors such as those shown at **16**, **17**, and **18**. The fusible means **13**, **14**, and **15** are in electrical connection with a plurality of electrical connectors **19**, **20**, and **21** which pass through the front insulating wall **11** and are disposed in generally horizontal alignment thereon. Similarly, the plurality of electrical conductors **16**, **17**, and **18** are connected in electrical engagement with a like plurality of electrical connectors disposed on the lower part of the front insulating wall **11**, passing therethrough as shown at **22**, **23**, and **24**. The electrical conductors **16**, **17**, and **18** are also connected at the rear insulating wall **12** to electrical connectors which pass therethrough and are disposed in horizontal alignment along the rear insulating wall **12** as shown by the dash-line outlines at **25**, **26**, and **27**. In a like manner, electrical connectors (not shown) pass through the rear insulating wall **12** and are connected in electrical circuit with the fusible means **13**, **14**, and **15** and are aligned on the rear insulating wall **12** so as to

be engageable with matching electrical connectors fixedly supported on the support structure **10**.

The electrical connectors **19**, **20**, and **21** aligned on the top portion of the front insulating wall **11** and the like plurality of electrical connectors **22**, **23** and **24** horizontally aligned on the lower portion of the front insulating wall **11** are disposed to receive and support in removable electrical engagement a circuit breaker such as that shown at **31**, the circuit breaker being affixed to the plurality of aligned electrical connectors by suitable means such as the nuts shown at **32**, **33**, and **34**. The front insulating wall **11** also carries suitable means such as the supports shown at **35**, **36**, **37**, and **38** which are disposed and adapted to support a trim plate **39** to cover and protect the circuit breaker **31** and also provide a means by which the entire frame assembly may be slidingly moved back and forth on the support structure. The trim plate **30** carries two handle grips **40** and **41** for purposes of slidingly positioning the frame assembly. The trim plate **39** also has an aperture therein as shown at **42** which is configured, sized, and disposed so as to permit the positioning therethrough of the externally extending handle **43** of the circuit breaker **31** which is reciprocally operable between two positions of "on" and "off" commensurate with closed and open circuit conditions of the circuit in electrical connection with the draw-out switch-gear apparatus. The front and rear insulating walls **11** and **12** have affixed therto a rail on each side such as that shown at **44**, which rail is adapted to be slidingly engaged with an appropriately dimensioned, complementary rail member such as the rails **45** and **46** fixedly mounted on the support structure to receive the rails of the movable frame assembly. Thus, the entire frame assembly including the rails, the front and rear insulating walls, the electrically conductive elements connected and supported therebetween, the circuit breaker or other appropriate switch means and the trim plate are movably supported for sliding engagement within the fixed rails **45** and **46**.

The fixed support structure **10** comprises suitable, upright supports such as those shown at **47** and **48** which carry a fixed structure including a fixed wall member **48** generally vertically oriented and disposed so as to be parallel to the rear insulating wall **12** of the frame assembly. The fixed wall **48** carried by the support structure **10** has disposed thereon an array of electrical connectors such as are shown at **49**, **50**, **51**, **52**, and **53**. These connectors are the so-called "tulip-type" and comprise a plurality of resilient, electrically conductive members such as those shown at **49***a* disposed so that an electrical connector of the type carried by the rear insulating wall **12** of the frame assembly may be slidingly received in electrical contact therebetween; a resilient spring member such as that shown at **49***b* surrounds the plurality of resilient, electrically conductive members **49***a* so as to urge those members into positive electrical contact with the electrical connector when inserted slidingly therebetween. The "tulip-type" electrical connectors **49**, **50**, **51**, **52**, and **53** are aligned horizontally and disposed upon the fixed wall **48** of the support structure **10** so as to be slidably engageable in electrical contact with the like plurality of electrical connectors carried by the rear insulating wall **12** of the frame assembly of the apparatus. The electrical connectors carried in fixed, mounted position on the wall **48** are in turn arranged to be connectable to a source of electrical energy and an electrical load through suitable connecting means such as the electrically conductive straps shown at **54**, **55**, and **56** which are in electrical connection with and related to the "tulip-type" connectors **49**, **50**, and **51** respectively. Similar straps (not shown) are arrayed upon and carried by the plurality of electrical connectors of the "tulip-type" such as those shown at **52** and **53**.

Referring now to FIGURE **2**, the draw-out switch-gear apparatus as embodied in FIGURE 1 is shown in its assembled state. The circuit breaker or other appropriate switch means **31** is shown as normally mounted in removable electrical connection with the plurality of electrical connectors carried by the front insulating wall **11** of the frame assembly. Immediately in front of the circuit breaker **31**, a trim plate **39** is carried by its appropriate support means so as to permit the externally extending, reciprocally operable handle **43** to pass through the aperture **42** in the trim plate **39**. The entire frame assembly is movably supported upon two horizontally disposed rails such as that shown at **44** and the complete frame assembly may be slidingly positioned forward and backward by means of the handles **40** and **41** disposed on the front trim plate **39**. The rails of the frame assembly such as those shown at **44** are slidingly engaged with complementary type rails carried in fixed position by the support structure **10** such as the rail shown at **45**. As was previously explained in connection with FIGURE 1, the "tulip-type" connectors carried by the fixed wall **48** are so disposed and arranged as to be aligned for engagement and electrical connection to the electrical connectors carried by the rear insulating wall **12** of the frame assembly of the apparatus. Thus, as shown in FIGURE 2, the movable frame assembly of the draw-out switch-gear apparatus is in its position of electrical engagement with the fixed support structure. The straps **54**, **55**, and **56** extending through the fixed wall **48** of the support structure **10** which, it will be recalled, are in electrical connection with "tulip-type" connectors **49**, **50**, and **51**, respectively, are connected through suitable electrically conductive means such as that shown at **57**, **58**, and **59**, respectively, to a source of electrical energy commonly referred to as the "line," which in the illustration of FIGURE 2 takes the form of electrically conductive bus bars as shown at **60**, **61**, and **62**. Similarly, the plurality of electrical connectors disposed along and passing through the rear insulating wall **12** and aligned horizontally on its lower portion are adapted to be engaged with a like array of aligned "tulip-type" connectors such as those shown at **52** and **53** of FIGURE 1, disposed in horizontal alignment on the fixed wall **48** of the support structure **10**. Such connection is completed through appropriate electrically conductive means to an electrical load which typically may be a three-phase load, for example. Such electrical connections are shown in more detail in FIGURE 3.

FIGURE 3, which is a schematic diagram of a typical electrical circuit including the draw-out switch-gear apparatus, carries numerical designations for elements of the actual structure as shown in FIGURES 1 and 2 though they are schematically represented in FIGURE 3. For clarity and simplicity in tracing the circuits, the "line" or source of electrical energy may be taken as the beginning of the multipole parallel circuits. As shown in FIGURE 3, "line" sources **60**, **61**, and **62** are electrically connected to the "tulip-type" connectors **49**, **50**, and **51**, respectively, which in turn are in electrical connection with electrical connectors **28**, **29**, and **30**, respectively, carried by the rear insulating wall **12** of the frame assembly. The connectors **28**, **29**, and **30** are also in electrical connection with the fusible means **13**, **14**, and **15**, respectively, which are electrically connected with a like plurality of electrical connectors **19**, **20**, and **21**, respectively, carried by the front insulating wall **11** of the frame assembly. The three electrical connectors **19**, **20**, and **21** are shown to be in electrical circuit connection with the circuit breaker **31** and furnish the electrical input thereto. The pairs of switch operated contact means which are relatively movable in respect to each other are schematically indicated within the circuit breaker **31** at **66**; and, consistent with the "on" position of the externally extending, reciprocally operable handle **43** as shown, the relatively movable pairs of contacts **66** will be in the closed circuit condition completing the three circuits from the source of energy as connected to electrical con-

nectors **19**, **20**, and **21** through the circuit breaker **31** and to the electrical connectors **22**, **23**, and **24**, respectively, also carried by the front insulating wall **11** of the frame assembly. The electrical conductors **16**, **17**, and **18** are supported in alignment between the front insulating wall **11** and the rear insulating wall **12** where they are connected to electrical connectors **25**, **26**, and **27**, respectively, carried by the rear insulating wall **12**. As was previously explained in connection with FIGURES 1 and 2, the electrical connectors **25**, **26**, and **27** carried on the lower portion of the rear insulating wall **12** of the frame assembly are disposed to be engageable electrically with an array of similarly aligned "tulip-type" connectors **52**, **53**, and a third "tulip-type" connector (not shown in the perspective views of FIGURES 1 and 2 but designated at **27***a* in FIGURE 3). The plurality of "tulip-type" connectors **27***a*, **53**, and **52** are connected through suitable electrical conductors **63**, **64**, and **65**, respectively, to an electrical load to complete the three multi-pole parallel circuits from source to load.

In the illustrations of FIGURES 1, 2, and 3, a typical application of the draw-out switch-gear apparatus of the present invention may be in a three-phase installation of substantial current carrying capacity.

Referring again to FIGURE 3, it will be seen that when the externally extending, reciprocally operable handle **43** of the circuit breaker **31** is moved from the position illustrated to its reciprocal position as indicated by the dash-line outline of FIGURE 3, the relatively movable pairs of contacts **66** will be actuated to interrupt the flow of current through the circuit breaker and the three circuits with which it is in electrical connection by movement of the pairs of electrical contacts **66** to open the three circuits simultaneously.

As will be appreciated by those skilled in the art, the fusible means as shown at **13**, **14**, and **15** afford a positive and reliable current limiting means, while the circuit breaker **31** provides an additional means responsive to the flow of overload currents therethrough to interrupt the circuits by automatically opening such circuits from their closed circuit condition to their open circuit condition.

In the form of the invention shown in FIGURE 5, a circuit breaker **70**, of relatively smaller capacity is shown, having extended terminal straps **71** and **72**, by which the breaker is mounted and connected to conductor studs **73** and **74** respectively. The studs **73** extend straight through between front and back spaced insulating plates **75**, **76** and terminate in rear line terminal portions **77**.

Three pairs of rigid conductive straps **78**, **79** are also provided. The straps **78** each extend through the plate **75** and have a bent-over end **80**, attached to the front surface of the front plate **75** by suitable means such as by screws, not shown. The straps **78** also have their opposite ends bent over at **81** and attached to the front surface of the rear insulating plate by screws **82**. The straps **79** are similarly formed and attached to the front and rear plates **75**, **76**. The bent-over end **83** of each of the straps **79** supports a rear load terminal **84**.

Three current-limiting fuses **85** are provided, each of which is connected between one of the straps **78** and a corresponding strap **79**.

The load current path for each pole of the breaker **70** is therefore as follows: from breaker load terminal **72** to front load terminal **74** to a strap **78**, through a fuse **85**, to a strap **79**, to rear load terminal **84**. Suitable stationary sockets **86**, **87** are provided to receive the terminals **77**, **84**.

The straps **78** and **79** are extended as described fully between the plates **75**, **76**, although this full length is not required for conducting purposes, for the purpose of providing adequate mechanical connection and support between the front and rear plates **75**, **76**.

It should be noted that, particularly as shown in the perspective illustrations of FIGURES 1 and 2, the fusible means such as the fuses **13**, **14**, and **15** are arranged to be disposed in a generally upright or vertical disposition so that one fuse is spaced adjacent to one of the two insulating walls while the other two fuses are spaced adjacent the other insulating wall. Thus, fuses of considerable current carrying capacity and relatively large physical size may be fitted compactly into the frame assembly and circuit arrangement of the present invention.

Additionally, the arrangement by which the circuit breaker or other suitable switch means of the present invention may be readily removed from the frame assembly of the draw-out switch-gear apparatus of the present invention without removal of the entire movable assembly affords a most convenient means by which the circuit breaker or other switch means may be quickly replaced, repaired, calibrated or tested.

The embodiments of the present invention as illustrated in the drawings incorporate three-phase circuit breakers of the molded case type, but it will be apparent to those knowledgeable in the art that a disconnect or other switch means of suitable and appropriate type may be employed equally as well within the concept and spirit of the present invention.

While I have disclosed only certain embodiments of the invention, it will be readily appreciated that many modifications thereof may be made. I therefore intend, by the appended claims, to cover all such modifications as fall within the true spirit and scope of the invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. Draw-out electrical switching apparatus comprising:

(a) a front insulating plate having a front and rear surface;

(b) a rear insulating plate having a front and rear surface;

(c) means rigidly interconnecting said front and rear insulating plates in parallel spaced relation to each other to form a draw-out frame assembly;

(d) a plurality of rear line terminals mounted on said rear surface of said rear insulating plate;

(e) a plurality of rear load terminals mounted on said rear surface of said rear insulating plate;

(f) a plurality of front line terminals mounted on said front surface of said front insulating plate;

(g) a plurality of front load terminals mounted on said front surface of said front insulating plate;

(h) a plurality of electrical conducting means between said front and rear insulating plates each interconnecting one of said front line terminals and a corresponding one of said rear line terminals by means extending through said front and rear insulating plates respectively;

(i) a plurality of electrical fuses supported between said insulating plates and each connected between one of said front load terminals and a corresponding one of said rear load terminals by conductive means extending through said front and rear insulating plates respectively,

(j) an electrical circuit control device mounted on said front surface of said front insulating plate and interconnected between said front line terminals and said front load terminals, and

(k) means carried by said frame assembly for slidably guiding said assembly for movement with respect to a relatively stationary support structure.

2. Draw-out electrical apparatus as set forth in claim **1** wherein:

(a) said front and rear insulating plates have corresponding opposed side edge portions;

(b) said means interconnecting said front and rear plates comprising a pair of rigid members disposed adjacent said opposed side edge portions of said insulating plates respectively and each including at least one elongated guide surface extending substantially

perpendicular to said front and rear plates for supporting and guiding said apparatus for movement generally perpendicular to the plane of said front and rear plates, and

(c) said rear line and said rear load terminals each comprising plug-in type electrical connecting means including means for making plug-in type engagement with corresponding stationary plug-in type terminals by movement in said direction perpendicular to said planes of said plates.

3. Draw-out electrical switching apparatus comprising:

(a) a front insulating plate having a front and rear surface;

(b) a rear insulating plate having a front and rear surface;

(c) means rigidly interconnecting said front and rear insulating plates in parallel spaced relation to each other to form a draw-out frame assembly;

(d) a plurality of rear line terminals mounted on said rear surface of said rear insulating plate;

(e) a plurality of rear load terminals mounted on said rear surface of said rear insulating plate;

(f) a plurality of front line terminals mounted on said front surface of said front insulating plate;

(g) a plurality of front load terminals mounted on said front surface of said front insulating plate;

(h) a plurality of electrical conducting means between said front and rear insulating plates each interconnecting one of said front line terminals and a corresponding one of said rear line terminals by means extending through said front and rear insulating plates respectively;

(i) said rear line terminals being substantially in alignment with corresponding ones of said front line terminals;

(j) said rear load terminals being spaced a lesser distance from said rear line terminals than the spacing of said front load terminals from said front line terminals;

(k) a plurality of electrical fuses supported between said insulating plates and each connected between one of said front load terminals and a corresponding one of said rear load terminals by conductive means extending through said front and rear insulating plates respectively,

(l) said fuses each comprising an elongated tubular body member having terminals at first and second ends thereof, said fuses having their longitudinal dimension substantially parallel to said front and rear insulating plates and each having said first end terminal substantially in alignment with one of said front load terminals and having said second end thereof substantially in alignment with one of said rear load terminals, and

(m) means carried by said frame assembly for slidably guiding said assembly for movement with respect to a relatively stationary support structure.

4. Draw-out electrical switching apparatus comprising:

(a) a front insulating plate having a front and rear surface;

(b) a rear insulating plate having a front and rear surface;

(c) means rigidly interconnecting said front and rear insulating plates in parallel spaced relation to each other to form a draw-out frame assembly;

(d) a plurality of rear line terminals mounted on said rear surface of said rear insulating plate;

(e) a plurality of rear load terminals mounted on said rear surface of said rear insulating plate;

(f) a plurality of front line terminals mounted on said front surface of said front insulating plate;

(g) a plurality of front load terminals mounted on said front surface of said front insulating plate;

(h) a plurality of electrical conducting means between said front and rear insulating plates each interconnecting one of said front line terminals and a corresponding one of said rear line terminals by means extending through said front and rear insulating plates respectively, said conducting means comprising a plurality of elongated rigid members fixedly connected to said front and rear insulating plates respectively;

(i) a plurality of electrical fuses supported between said insulating plates, rigid conductive means connecting said fuses each between one of said front load terminals and a corresponding one of said rear load terminals;

(j) whereby said rigid conducting means and said rigid conductive means provide mechanical spacing and supporting means between said insulating plates,

(k) an electrical circuit control device mounted on said front surface of said front insulating plate and interconnected between said front line terminals and said front load terminals, and

(l) means carried by said frame assembly for slidably guiding said assembly for movement with respect to a relatively stationary support structure.

5. Draw-out electrical switching apparatus comprising:

(a) a front insulating plate having a front and rear surface;

(b) a rear insulating plate having a front and rear surface;

(c) a pair of rigid guide rails rigidly interconnecting said front and rear insulating plates in parallel spaced relation to each other to form a draw-out frame assembly;

(d) a plurality of rear line terminals mounted on said rear surface of said rear insulating plate;

(e) a plurality of rear load terminals mounted on said rear surface of said rear insulating plate;

(f) a plurality of front line terminals mounted on said front surface of said front insulating plate;

(g) a plurality of front load terminals mounted on said front surface of said front insulating plate;

(h) a plurality of electrical conducting means between said front and rear insulating plates each interconnecting one of said front line terminals and a corresponding one of said rear line terminals by means extending through said front and rear insulating plates respectively;

(i) a plurality of electrical fuses supported between said insulating plates and each connected between one of said front load terminals and a corresponding one of said rear load terminals by conductive means extending through said front and rear insulating plates respectively,

(j) an electric circuit control device mounted on said front surface of said front insulating plate and interconnected between said front line terminals and said front load terminals, and

(k) said guide rails including portions for slidably guiding said draw-out frame assembly for movement with respect to a relatively stationary support structure.

No references cited.

BERNARD A. GILHEANY, *Primary Examiner.*