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DRAW-OUT TYPE SWITCH-FUSE ASSEMBLY

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Fig. 1.

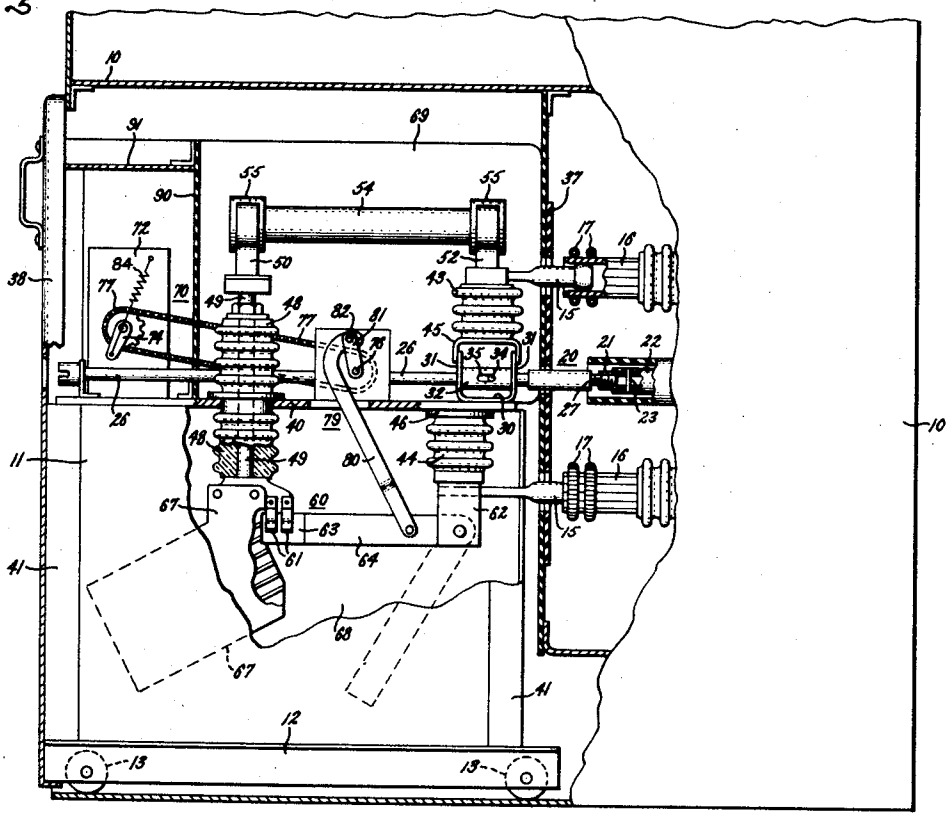
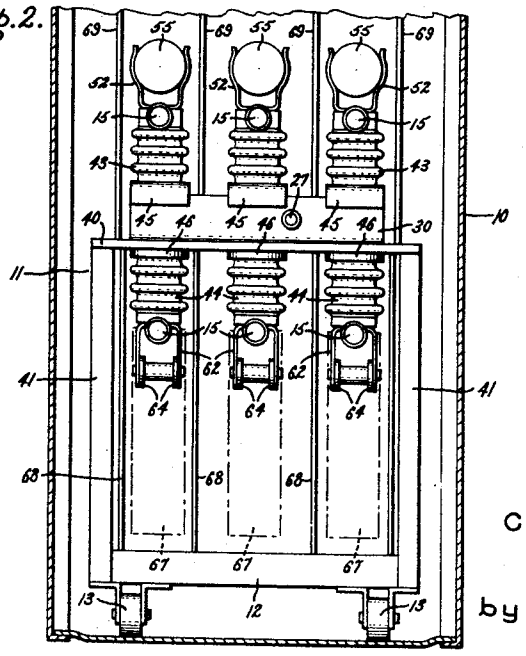


Fig. 2.



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DRAW-OUT TYPE SWITCH-FUSE ASSEMBLY

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9 Claims. (Cl. 200—51)

This invention relates to electric switchgear and, more particularly, to that type of switchgear which comprises the combination of a switch and fuse electrically connected in series.

The invention is especially concerned with a switch-fuse combination that is constructed as a structural unit that can be horizontally racked into and out of a connected position inside of a suitable enclosure. A problem encountered in designing a unit of this character is that the unit tends to become unduly tall and unwieldy because of the internal space that must be provided to accommodate the fuse or fuses in addition to the usual switch. Generally speaking, the greater the height of the unit, the less stable it is, the more easily it tends to tip over, and the more difficult it is to rack the unit horizontally into a fully-connected position without jamming or misalignment between the usual disconnect contacts of the apparatus.

Accordingly, an object of our invention is to construct such a switch-fuse combination in such a manner that it is a compact, highly stable structural unit, not susceptible to being tipped over and capable of being easily and smoothly racked into fully-connected position.

Another object is to construct the switch-fuse combination in such a manner that it requires a near-minimum number of insulators for supporting its main components and in such a manner that rack-in forces subject the fuse to no appreciable mechanical loads.

Another object is to construct the switch-fuse combination in such a manner that its main operating components can be assembled as a unit before being incorporated into the overall movable assembly and can, when renewal is required, be replaced as a unit, if so desired.

In carrying out our invention in one form, we provide an enclosure having a set of vertically-spaced disconnect contacts mounted thereon. Movable into and out of the enclosure is a horizontally movable switchgear assembly that has a second set of vertically-spaced disconnect contacts for mating with said first set when the assembly has been fully inserted into the enclosure. The movable assembly comprises a truck and a generally horizontally-disposed base plate secured to the truck and located in a position vertically between the vertically-spaced contacts of the assembly. The assembly is forced into and out of its fully connected position by means of a racking mechanism transmitting forces to the assembly through this base plate. Supported on the base plate at one side thereof is one of the disconnect contacts of the assembly and also a horizontally extending elongated fuse. Supported on the base plate at its other side is the other disconnect contact of the assembly and a switch. The switch comprises a pivotally-mounted circuit-controlling blade which is movable into and out of a generally horizontal circuit-closing position. The switch and the fuse are electrically connected in series between the disconnect contacts.

For a better understanding of our invention, reference

may be had to the following description taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a side elevational view of switchgear apparatus embodying one form of our invention. The apparatus comprises a horizontally movable switch-fuse assembly shown in its fully connected position within an enclosure.

Fig. 2 is end view of the horizontally-movable switch fuse assembly taken from the right hand end thereof, as viewed in Fig. 1.

Referring now to Fig. 1, the switchgear apparatus shown therein comprises a stationary enclosure **10** and a removable, or draw-out, switchgear unit in the form of a fuse-switch assembly **11**. The removable assembly **11** comprises a truck **12** mounted on suitable wheels **13**, which allow the removable assembly **11** to be rolled horizontally into and out of its fully-connected position shown in Fig. 1. In the fully-connected position of Fig. 1, three sets of plug-type disconnect contacts **15** carried by the movable assembly **11** are fully inserted into three sets of socket-type stationary disconnect contacts **16** suitably supported on the enclosure **10**. Mating pairs of contacts **15** and **16** form the terminals for a three-phase power circuit extending through the assembly **11** and controlled thereby, as will soon be explained. Each phase of the circuit extends from one pair of mating contacts **15**, **16** through the assembly **11** to a second pair of mating contacts **15**, **16** vertically aligned with the first pair.

The contacts **15** and **16** can be of any suitable conventional form, but in the drawing we have shown the stationary contact **16** formed as a longitudinally split, or segmented, tube encircled by a pair of garter springs **17**. Each of the movable plug contacts **15** is shown formed with an enlarged head that is adapted to be forceably slid to the right into one of the tubes **16**. To provide the desired contact pressures when the disconnect contacts **15** and **16** are in their fully engaged position, the garter springs **17** must be relatively strong, and, as a result, considerable force is required in order to force the movable contacts **15** to the right from a position of initial contact engagement to the illustrated position of full engagement.

To aid in driving the switchgear assembly **11** together with its movable disconnect contacts **15** into the fully-connected position of Fig. 1, a racking mechanism **20** is provided. This racking mechanism can be of any suitable form but is preferably of the type disclosed and claimed in application S.N. 705,657 (now Patent No. 2,885,502), Eichelberger et al., filed December 27, 1957, and assigned to the assignee of the present invention. The disclosed racking mechanism **20** comprises an internally-threaded nut **21**, which is mounted on the enclosure **10** by means of a tube **22** fixed to the enclosure and an anchoring pin **23**. The racking mechanism **20** further includes a jackscrew **26** which is carried by the movable switchgear assembly **11** and is rotatably mounted thereon. The jackscrew **26** extends in a direction generally parallel to the path of movement of the switchgear assembly **11**, and at its right hand end, has external threads **27** which are adapted to mesh with the internal threads of the nut **21**. When these threads are in mesh, rotation of jackscrew **26** causes the threads to shift the jackscrew longitudinally, and this longitudinal movement is utilized to rack the switchgear assembly **11** into and out of its fully connected position. Rotation of the jackscrew **26** is effected by means of a suitable wrench or the like (not shown) applied to the left hand end of the jackscrew. The wrench can be inserted through an opening in a protective panel **38** suitably secured to the left hand side of the movable assembly **11**.

For utilizing longitudinal movement of the jackscrew

26 to produce the required racking action, coupling means comprising a U-shaped bracket 30 fixed to the movable assembly 11 is provided. Each arm 31 of the bracket 30 has an opening therein which loosely receives an unthreaded portion of the jackscrew 26. Between the arms 31 and encircling the jackscrew is a sleeve 32, which is freely rotatable with respect to the arms 31. The sleeve 32 has a slot 35 formed therein and extending longitudinally of the jackscrew. A projecting pin 34 fixed to the jackscrew 26 is loosely received within the slot 35 so as to allow for a limited amount of free longitudinal movement of the jackscrew relative to the sleeve 32.

This limited longitudinal movement serves, among other things, to allow the movable switchgear assembly 11 to be pushed into a position of initial engagement of the contacts 15, 16 without interference from the racking mechanism 20. When this position of initial contact engagement has been reached, the jackscrew 26 can be shifted axially until its threads engage those of the nut 21. Thereafter, the jackscrew can be threaded into the nut 21, thereby moving the pin 34 into engagement with the forward wall of the slot 35. Thereafter, as the jackscrew moves longitudinally to the right in response to rotation thereof, the pin 34 acts through the sleeve 32 and the brackets 31 to drive the movable switchgear assembly 11 to the right. This is continued until the switchgear assembly 11 together with its contacts 15 have reached their fully connected position, depicted in Fig. 1.

The switchgear assembly 11 can be racked-out of its fully-connected position of Fig. 1 simply by rotating the jackscrew 26 in a direction opposite to that just described. This jackscrew rotation drives the assembly 11 to the left until the contacts 15 barely engage the contacts 16. Thereafter, the assembly 11 may be rolled manually from the enclosure 10 without restraint from the garter springs 17 or from the racking mechanism 20. To prevent an attendant from accidentally contacting the elements 16 when the assembly 11 is removed, a suitable shutter 37 is provided. This shutter operates in a known manner to cover the contacts 16 when the assembly is removed.

It will be noted that we have located the racking mechanism 20 in a generally central location relative to the upper and lower disconnect contacts 15. A central location is highly desirable because racking-in forces applied from such a location, in comparison to other locations, have a greater tendency to be more equally distributed between the disconnect contacts 15 and to produce equal displacement of the contacts 15. As a result, there is less chance for possible jamming of the mating disconnect contacts during racking-in and less chance for possible tipping of drawout unit 11 during racking-in.

Other factors which help to reduce any tendency toward tipping of the removable assembly 11 during insertion thereof are the fact that the removable assembly is compact and, in particular, is relatively short vertically and also the fact that the racking mechanism 20 is located relatively close to the wheels 13 on which the unit 11 is mounted. There are a number of internal features of the drawout unit 11 which make possible this compactness and which enable the racking mechanism to be located relatively close to the wheels 13 and yet centrally of the disconnect contacts 15. These features will be pointed out in connection with the following description of the internal components of the fuse-switch assembly.

Referring now to Fig. 1, it will be noted that the movable fuse-switch assembly 11 comprises a horizontally-extending base plate 40 located in a position vertically between the vertically-spaced disconnect contacts 15. This base plate 40 is supported on the truck 12 by means of vertically-extending channels 41 shown located near each corner of the truck 12. Preferably, the base plate 40 is bolted or otherwise suitably secured to the channels 41 so that it can be readily removed therefrom.

As will soon be apparent, the base plate 40 constitutes a support for all of the major operating components of the movable switch-fuse assembly. In this regard, the entire removable portion of the previously-described racking mechanism 20 is supported on the base plate 40 by virtue of the fact that the jackscrew-supporting channel 30 is secured to the base plate 40. The disconnect contacts 15 are supported on the base plate 40 by means of pin-type insulators 43 and 44 mounted on the baseplate at vertically-opposite sides thereof.

The upper insulators 43 are shown supported on the base plate 40 by means of channel-like members 45 fixed to the top of channel 30. The upper disconnect contacts 15 are suitably bolted to the tops of the insulators 43. The lower insulators 44 are secured to the base plate 40 through suitable shims or spacers 46, and the lower disconnect contacts 15 are suitably bolted to the bottoms of these lower insulators 44.

Horizontally-spaced from the insulators 43 and also supported on the base plate 40 are three through-bushings 48, each having a conductive stud 49 extending therethrough. Mounted atop the respective conductive studs 49 are three fuse-clip structures 50. Mounted atop the respective insulators 43 are three additional fuse clip structures 52, each electrically connected to its corresponding upper disconnect contact 15.

Electrically-bridging the fuse-clips 50 and 52 in each electrical phase of the assembly is an electric fuse 54, preferably of the current-limiting type. The details of these fuses form no part of the present invention, and any suitable conventional form of fuse may be utilized. In each phase of the assembly, the clips 50 and 52 firmly grip the fuse ferrules 55 and electrically connect the fuse in series-circuit relationship with the upper disconnect contact 15 and the stud 49. As shown in Fig. 2, the clips are of a U-shaped configuration which allows the fuses to be replaced by lifting them vertically out of their respective clips.

Mounted at the lower side of the base plate 40 is a three-phase load-break switch 60. Each phase of this switch includes stationary contact structure 61 suitably mounted at the lower end of the conductive stud 49 and conductive pivot structure 62 mounted at the lower end of the insulator 44. The conductive pivot structure 62 is electrically-connected to the lower disconnect contact 15. Pivotally mounted on the pivot structure 62 is a conductive circuit-controlling blade 64 which carries movable contact structure 63 at its outer end for cooperating with the stationary contact structure 61. When the blade 64 is moved toward its dotted line position, the contacts 61, 63 are separated to open the switch. When the blade 64 is in the generally horizontal position shown in Fig. 1, the contacts 61, 63 are engaged, the switch is therefore closed, and the blade 64 conducts current between the stud 49 and the pivot 62. Thus, it will be seen that when the switch is closed, the fuse and switch are connected in series between the disconnect contacts 15.

Opening of the switch is effected by driving the blade from its solid-line horizontal position into the dotted line position shown. Assuming the circuit through the assembly to be energized, this opening movement of the blade 64 establishes a circuit-interrupting arc between the contact 63 and the contact 61. For extinguishing the arc to interrupt the circuit, a suitable arc-chute 67 supported from the lower end of the through-insulator 48 is provided. The arc is suitably driven into this chute, where it is rapidly cooled and elongated and thereby extinguished, all in a well known manner. The details of this arc chute form no part of the present invention and the arc-chute can, for example, be constructed as described in greater detail in U.S. Patent No. 2,417,683—Harlow, assigned to the assignee of the present invention.

Since the three poles or phases of the switch are substantially identical, only one pole has been shown and described in detail. It will be noted from Fig. 2 of the

drawing that the three poles are physically and electrically isolated from each other by suitable insulating barriers **68** located therebetween. Similar barriers **69** are also provided between the individual fuses.

For driving the blades **64** between their respective open and closed positions, a suitable switch-operating mechanism **70** is provided. This operating mechanism can be of any suitable conventional form, but is preferably of the particular type described and claimed in application S.N. 754,400, Lester and Shaw, filed August 11, 1958, and assigned to the assignee of the present invention. Since the details of the operating mechanism form no part of the present invention, it has been depicted in Fig. 1 in schematic form only. As illustrated in Fig. 1, the operating mechanism comprises a suitable spring motor, shown in block form at **72**. This spring motor can be suitably released to rotate the shaft **74** clockwise so as to initiate a switch-closing operation (assuming the switch is then open). Clockwise rotation of the shaft **74** is transmitted to the shaft **76** by means of a belt or chain **77** to effect clockwise rotation of shaft **76**. Assuming the switch blade **64** is then in its open position, clockwise rotation of the shaft **76** is transmitted to the switch blade **64** through a suitable linkage **79** projecting through the base plate **40** to effect switch-closing. In this regard, the linkage **79** causes clockwise rotation of the shaft **76** to drive the switch blade **64** clockwise from its dotted line open position into its solid-line closed position. The linkage **79**, it will be noted, comprises a connecting link **80** of insulating material pivotally coupled at its lower end to the blade **64** and coupled at its upper end to the shaft **76** through a suitable crank **81** secured to the shaft and pivotally connected at **82** to the link **80**. Identical linkages **79** are provided for connecting the other blades **64** to the operating shaft **76**.

Opening of the switch blade **64** is effected by rotating the shaft **74** in a counterclockwise direction from its position of Fig. 1. This counterclockwise rotation is initiated by means of a suitable handle (not shown) which extends through the front panel **38** into coupled relationship with the shaft **74**. After a small amount of initial counterclockwise motion, an overcenter spring **84** coupled to the shaft **74** is carried overcenter relative to the shaft **74**, whereupon the spring discharges and further rotates the shaft **74** counterclockwise. Rotation of the shaft **74** under the influence of the spring **84** is at a relatively high speed, and this high speed motion is capable of driving the switch blade **64** open at a relatively high speed. The details of this operating mechanism form no part of the present invention, and reference may be had to the aforementioned application S.N. 754,400, Lester et al. for a more detailed description thereof.

It will be noted that the switch-operating mechanism **70** is, like the other major components of the assembly **11**, mounted on the base plate **40**. As a result, it is possible with our disclosed construction to assemble all of the major operating components of the assembly on the base plate **40** prior to the time the base plate **40** is mounted on the truck **12**. During this preliminary operation the various components can be adjusted and aligned in the required manner with assurance that these adjustments and alignments will be maintained when the plate is thereafter mounted on the truck **12**. If, for some reason, it is desired to replace or repair the internal structure of the assembly, it is a simple matter to detach the base plate **40** from the truck and to lift the base plate **40** together with the various switch and fuse components off of the truck **12**, replacing this subassembly with an identical or similar subassembly, if desired. It should be understood, of course, that assembly or removal of the base plate **40** can be effected only when the whole drawout unit **11** is withdrawn from the enclosure **10**.

It will be apparent from Fig. 1 that the internal circuit of the disclosed fuse-switch assembly is of a simple configuration and, thus, requires a near-minimum of insulators for its support. For example, for each phase of the circuit, only three insulators are needed—the two pin insulators **43**, **44** and the through-insulator **48**. Some prior efforts to build a switch-fuse combination of this character have involved using five and six insulators per phase. Inasmuch as these insulators are relatively expensive, it will be apparent that a circuit design which requires a minimum of insulators is distinctly advantageous.

It should also be apparent from Fig. 1 that the racking operation subjects the fuses to no appreciable mechanical loads. The forces that oppose racking-in are applied through the disconnect contacts **15** and are transmitted to the base plate **40** through a path by-passing the fuses, i.e., from the disconnect contacts **15** through the insulators **43** and **44** to the base plate **40**.

We have been able to achieve a considerable reduction in the overall height of the movable assembly by constructing the parts thereof in such a manner that the fuses, when connected, are disposed generally horizontally and the blades of the switch, when closed, are disposed generally horizontally. The horizontal disposition of the fuses has also enabled each of the upper disconnect contacts **15** to be located at a point which is relatively close to the wheels **13**, as compared, for the example, to the point at which this disconnect contact would be located if the fuses were vertically disposed. More particularly, had the fuses been vertically disposed, it would have been necessary to locate the upper disconnect contacts at the same level as the upper end of the fuses had it been desired to avoid complications in the configuration of the internal circuit of the assembly. With the upper disconnect contact disposed at the appreciably lower position shown in Fig. 1, it is possible to locate the racking mechanism **20** at a correspondingly lower point and still have the racking mechanism located in its ideal racking position, i.e., generally midway between the upper and lower contacts. With the racking mechanism at this correspondingly lower point, it is closer to the wheels **13** of the truck and therefore has less tendency during a racking-in operation to tip the truck in a forward direction.

The fact that the switch and fuse assembly is of a removable, or draw-out, construction has a number of important advantages. For example, as compared to a stationarily-mounted switch-fuse combination, the draw-out design allows the internal parts of the assembly to be more easily inspected, repaired, and replaced. In addition, the draw-out design allows the fuses to be safely replaced by hand even though they are located on the source side of the switch. In this regard, draw-out of the assembly disconnects and therefore deenergizes the fuses. With the assembly fully drawn-out, it is a simple matter to lift the fuses out vertically through the open top of the assembly. To assure that access will not be had to the fuses at any time the disconnect contacts **15—16** are in or near engagement, barriers **90**, **91** are provided. If the draw-out assembly were partially withdrawn but not to the required safe extent, these barriers **90**, **91** in combination with the closely-fitted walls of the enclosure **10** would prevent a careless operator from gaining access to the fuse, say by attempting to reach over the protective panel **38** at the front of the assembly. The fact that the barrier **90** is spaced from the front panel contributes to the desired inaccessibility of the fuses during this interval when the assembly is only partially withdrawn. Efficient utilization of the space available between the front panel **38** and the barrier **90** is achieved by using this space as a location for a portion of the previously-described switch-operating mechanism **70**.

Although we have described our invention particularly in connection with a switchgear assembly of the horizontal rack-out type, it will be apparent that certain aspects of the invention are also applicable to switchgear

assemblies of the type that are racked vertically into and out of connected position.

While we have shown and described particular embodiments of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made without departing from our invention in its broader aspects and we, therefore, intend in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

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

1. Switchgear apparatus comprising an enclosure; a first set of vertically spaced disconnect contacts mounted on said enclosure; a removable switchgear assembly horizontally movable into and out of said enclosure and having a second set of spaced disconnect contacts for mating with said first set of contacts when said assembly has been fully inserted into said enclosure, said removable assembly comprising a truck and a generally horizontal base plate secured to said truck and located in a position vertically between the vertically spaced contacts of said assembly, an elongated electric fuse mounted in a horizontal position at one vertical side of said base plate and electrically insulated from said base plate, a switch supported at the other vertical side of said base plate and electrically insulated therefrom, said switch having a blade which is movable into and out of a generally horizontal circuit-closing position, and means electrically connecting said switch and said fuse in series between the disconnect contacts of said assembly.

2. The apparatus of claim 1 in combination with racking means for racking said removable assembly into a fully-inserted position within said enclosure, said racking means comprising a portion which is mounted on said base plate and which applies racking forces to said removable assembly at a location vertically between said disconnect contacts.

3. The switchgear apparatus of claim 1 in which said assembly further comprises switch operating mechanism mounted on the fuse side of said base plate and linkage means for transmitting operating forces from said mechanism to said blade, said linkage means extending through said base plate into coupled relationship with said blade.

4. Switchgear apparatus comprising an enclosure; a first set of vertically-spaced disconnect contacts mounted on said enclosure; a removable switchgear assembly horizontally movable into and out of said enclosure and having a second set of vertically-spaced disconnect contacts for mating with said first set of contacts when said assembly has been fully inserted into said enclosure; said removable assembly comprising a truck and a generally horizontal base plate secured to said truck and located in a position vertically between the vertically-spaced contacts of said assembly, a pair of insulators mounted on said base plate at vertically opposite sides thereof and respectively securing the individual contacts of said second set of disconnect contacts to said base plate, an additional insulator mounted on said base plate at a location spaced from said pair of insulators, an elongated electric fuse, means for mounting said fuse in a generally horizontal position at one vertical side of said base plate on said additional insulator and on one of said pair of insulators, a switch mounted on said base plate at a side thereof vertically opposite from the location of said fuse, said switch comprising a pair of relatively movable interrupting contact structures, means for insulatingly mounting one of said interrupting contact structures on said base plate and the other of said interrupting contact structures on the other insulator of said pair of insulators, the mounting means for one of said interrupting contact structures comprising a blade mounted for pivotal movement into and out of a generally horizontal position circuit-closing position, and means electrically connecting said switch and said fuse in series between the disconnect contacts of said assembly.

5. The apparatus of claim 4 in combination with racking means for racking said assembly into a fully-inserted position within said enclosure, said racking means comprising a portion which is mounted on said removable assembly and which applies racking forces to said assembly at a location vertically between said disconnect contacts.

6. The apparatus of claim 4 in which said base plate is detachably secured to said truck and in which said insulators, said fuse, said switch and the disconnect contacts of said assembly form in combination with said base plate a subassembly that can be removed as a unit from said truck.

7. Switchgear apparatus comprising an enclosure; a first set of vertically-spaced disconnect contacts mounted on said enclosure; a removable switchgear assembly horizontally movable into and out of said enclosure and having a second set of vertically-spaced disconnect contacts for mating with said first set of contacts when said assembly has been fully inserted into said enclosure; said removable assembly comprising a truck and a generally horizontal base plate secured to said truck and located in a position vertically between the vertically-spaced contacts of said assembly, an elongated electric fuse, means for mounting said fuse in a generally horizontal position at the upper side of said base plate and electrically insulating said fuse from said base plate, a switch mounted at the lower side of said base plate and electrically insulated therefrom, means for electrically connecting said switch and fuse in circuit with said disconnect contacts, a vertical panel secured to said truck and preventing access to the energized parts of said assembly while said disconnect contacts are fully engaged, barrier means located between said panel and said fuse for preventing access to said fuse when said assembly is partially withdrawn but prior to the point at which a safe clearance is established between said disconnect contacts.

8. The switchgear apparatus of claim 7 in which said assembly further comprises switch-operating mechanism mounted on the upper side of said base plate and comprising linkage means extending through said base plate for transmitting operating forces to said switch, a portion of said operating mechanism being located between said panel and said barrier means.

9. Switchgear apparatus comprising an enclosure; a first set of spaced disconnect contacts mounted on said enclosure; a removable switchgear assembly movable into and out of said enclosure and having a second set of spaced disconnect contacts for mating with said first set of contacts, means for driving said assembly along a predetermined path into and out of a fully-connected position wherein said sets of contacts mate, said removable assembly comprising a base plate extending generally parallel to said predetermined path and located in a position between the spaced contacts of said assembly, an elongated electric fuse mounted at one side of said base plate generally parallel thereto and electrically insulated therefrom, a switch supported at the other side of said base plate and electrically insulated therefrom, said switch having a blade which is movable into and out of a circuit-closing position generally parallel to said base plate, and means electrically connecting said switch and said fuse in series between the disconnect contacts of said assembly.

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