Oct. 10, 1933. F. H. MACNEIL 1,929,983

CELL ENCLOSED ELECTRIC SWITCH AND DISCONNECTING SWITCH THEREFOR

Filed June 3, 1929 3 Sheets-Sheet 1

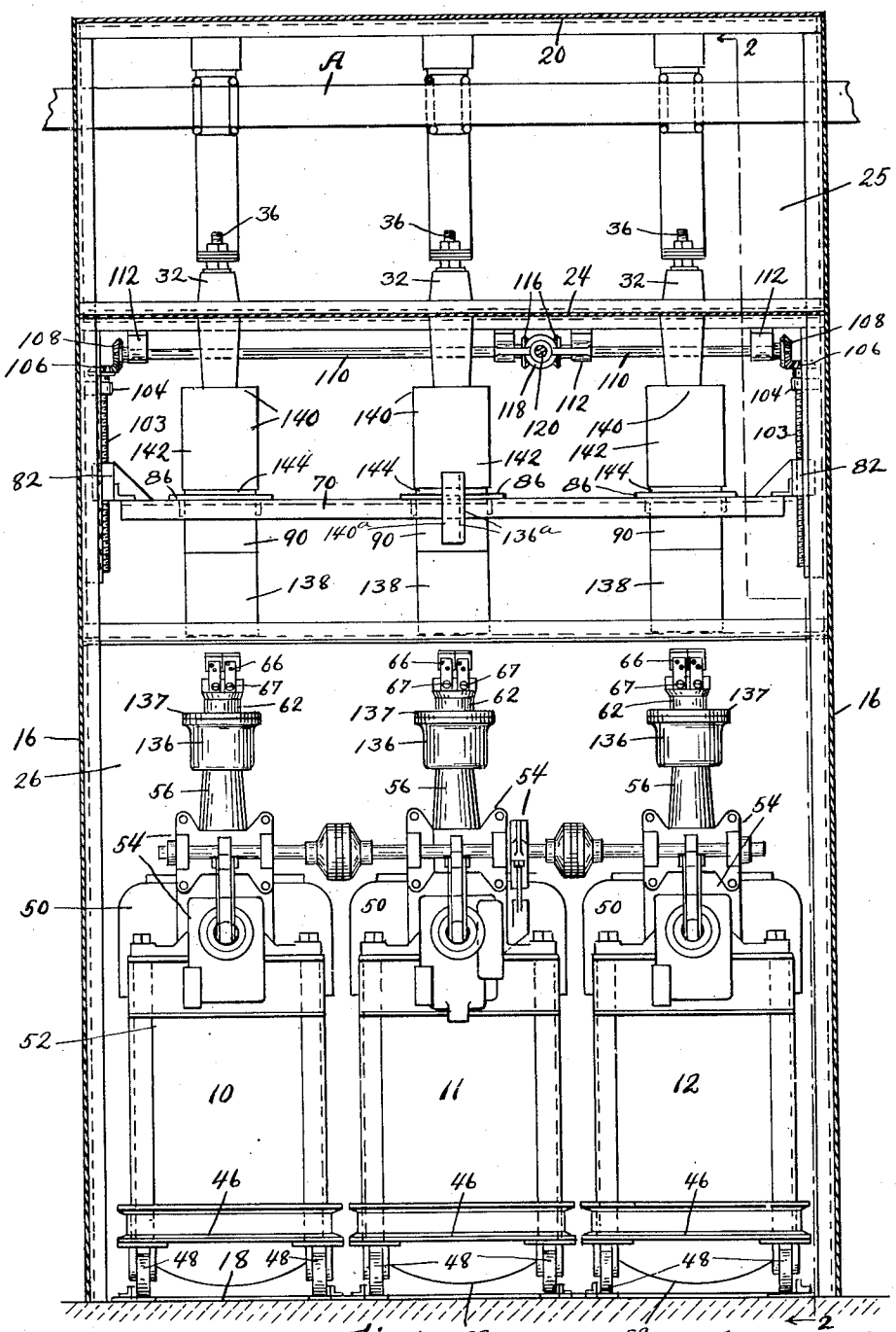



Fig. 1.

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CELL ENCLOSED ELECTRIC SWITCH AND DISCONNECTING SWITCH THEREFOR

Filed June 3, 1929 3 Sheets-Sheet 2

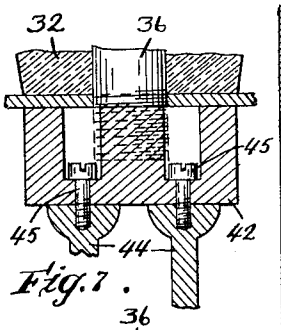


Fig. 7.

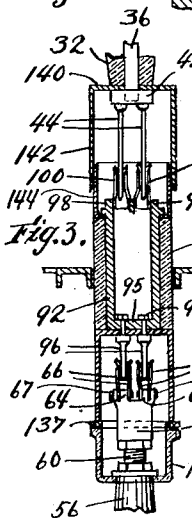


Fig. 3.

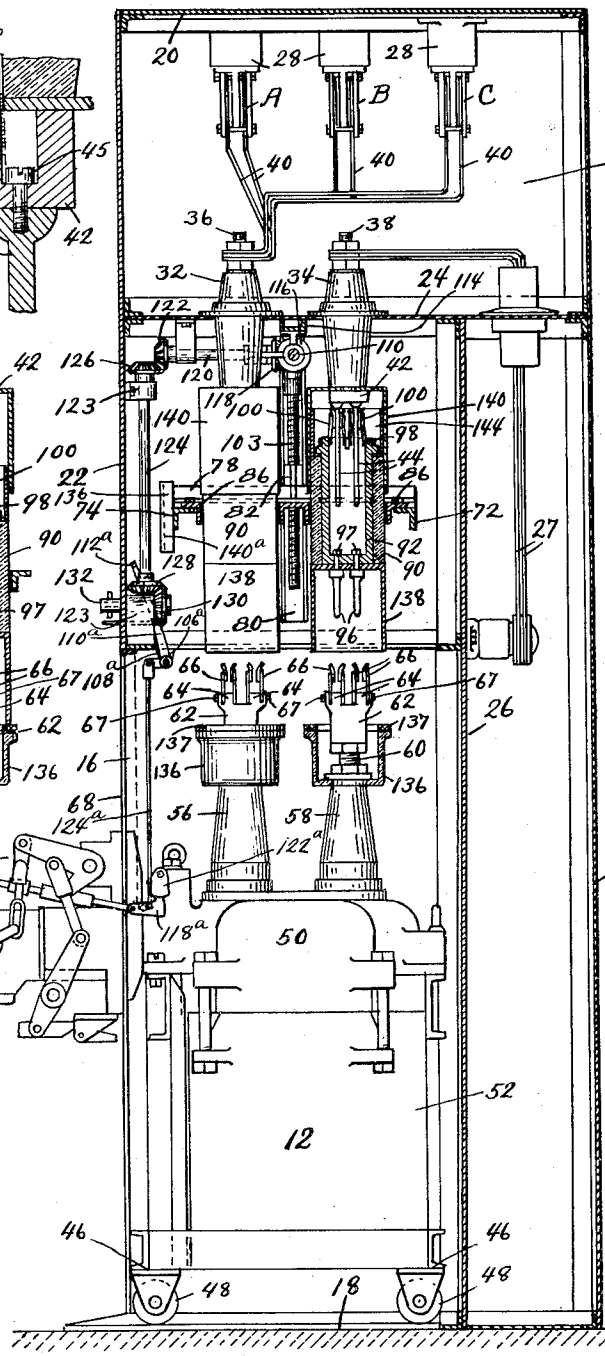


Fig. 2.

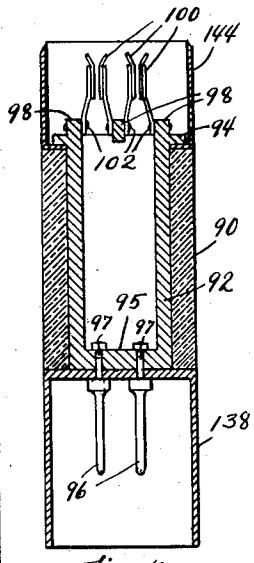


Fig. 4.

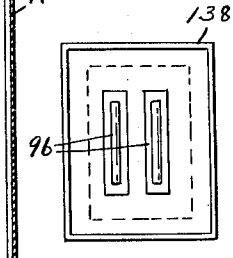


Fig. 5.

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CELL ENCLOSED ELECTRIC SWITCH AND DISCONNECTING SWITCH THEREFOR

Filed June 3, 1929. 3 Sheets-Sheet 3

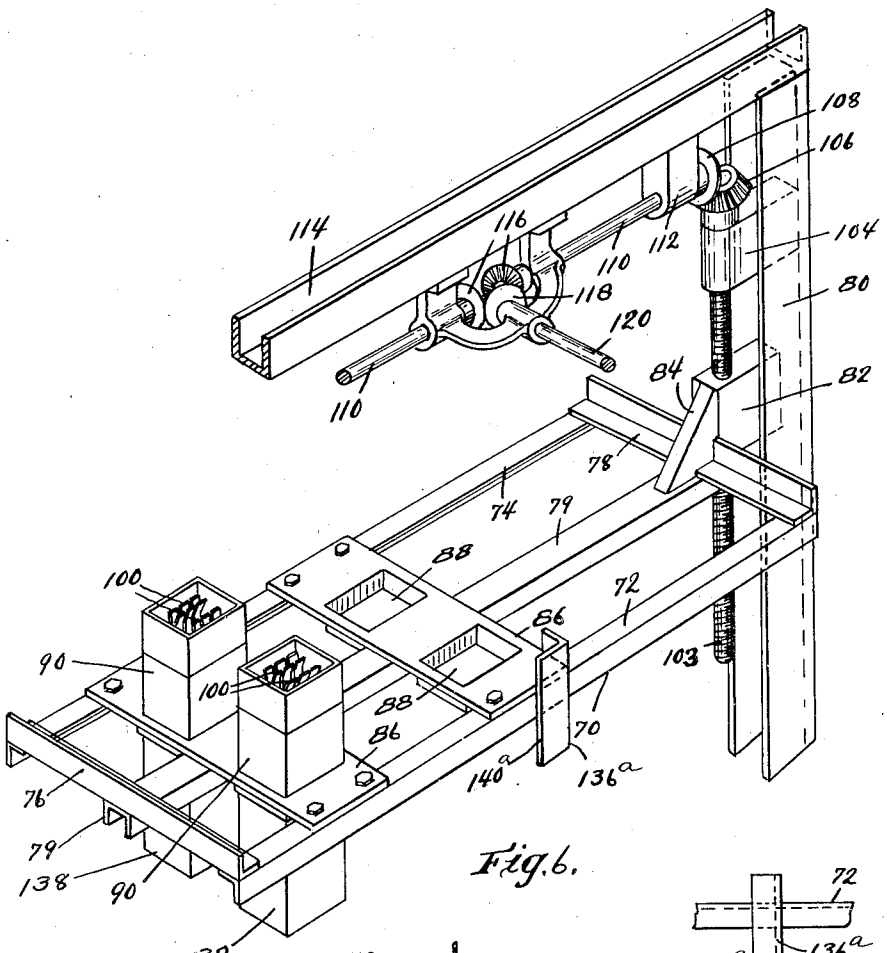



Fig. 6.

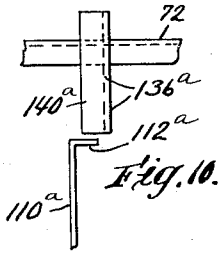



Fig. 10.

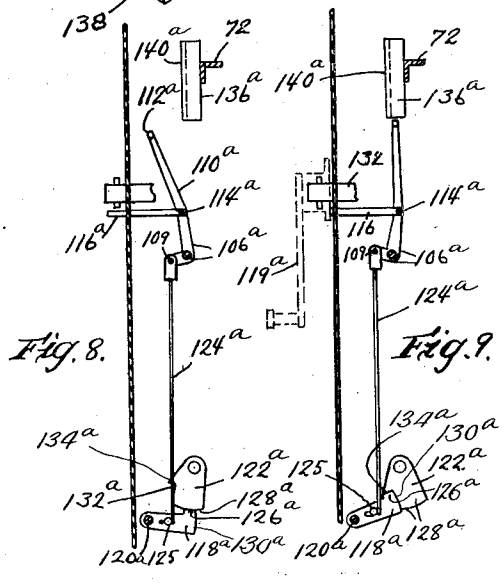



Fig. 8.




Fig. 9.

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Patented Oct. 10, 1933 1,929,983

# UNITED STATES PATENT OFFICE

1,929,983

## CELL-ENCLOSED ELECTRIC SWITCH AND DISCONNECTING SWITCH THEREFOR

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Application June 3, 1929. Serial No. 368,113

18 Claims. (Cl. 175—298)

This invention relates to high potential cell-enclosed electric switches of the oil immersed type which are adapted to have their exposed terminals connected electrically with and disconnected from fixed line terminals carried by the enclosing cell structure.

An oil immersed electric switch may be open and the contacts thereof spaced apart under the oil and yet the line conductors connected therewith may be charged to a dangerous potential due to a carbonized condition of the oil resulting from the circuit interrupting arc drawn within the oil. It is necessary therefore to provide some means to isolate the switch from the line conductors. Air break disconnecting switches of the knife blade type have been commonly used, but these require so much room where the potentials are high that they become impracticable. Truck type switches have also been employed having exposed switch terminals which constitute the movable contact members of isolating switches, the cooperating stationary contact members of which have been carried by the cell in position to be automatically engaged and disengaged upon movement of the switch to and from its enclosing cell. This arrangement, while compact, necessitates the removal of the switch from its cell in order to disconnect it from the line conductors. In larger sizes of switches this is in itself undesirable since the switches are cumbersome and heavy and can be moved only with great effort. A further difficulty, and one which imposes a greater limitation on this type of switch gear, is the difficulty of moving the switch into position against the friction of the cooperating automatically-engageable contact members. This difficulty is so marked that where more than two contacts are involved it is necessary to provide some force multiplying, or racking, device to effect the engagement of the contact members.

It is an object of this invention to provide an improved means for isolating a cell-enclosed oil-immersed switch from its circuit conductors which is economical of space and which is operable without moving the switch from its circuit controlling position in the cell.

Another object is the provision of a multi-phase cell enclosed electric switch and isolating means therefor having a single operating lever for effecting the simultaneous disconnection of all of said phase units.

A further object is the provision of a disconnecting switch which in its open position provides an unenclosed air gap between the circuit breaker terminals and the line terminals but which in its closed position is adapted to have fully enclosed all live conducting parts thereof.

A still further object is the provision of a circuit interrupter having terminals, and an enclosing cell structure therefor having line terminals vertically aligned with and spaced from said switch terminals, and contact members disposed between said line and switch terminals and movable into and out of engagement with one of said terminals and having a lost-motion connection with the other of said terminals.

It is a further object to provide a multi-phase cell enclosed circuit interrupter and a plurality of vertically movable disconnecting switches therefor having a common supporting structure and a common operating means, by which all of said disconnecting switches can be operated in unison and also by which they can be removed as a unit from the cell when the interrupter is withdrawn therefrom.

A yet further object is the provision of a vertically-movable disconnecting switch disposed between the switch and line terminals and having a rigid lost-motion electrical connection with one of them.

A still further object of the invention is the provision of a vertically movable intermediate disconnecting switch disposed between and adapted to electrically connect the switch and line terminals of a switch gear, and means to lock said disconnecting switch against vertical movement when the switch is closed and also to prevent opening and closing of the switch when said disconnecting switch is disposed intermediate its fully raised and lowered positions.

A further object is generally to improve the construction and performance of cell-enclosed switches.

Fig. 1 is an elevation of a cell-enclosed electric switch embodying the invention, the front panel and connected mechanism being broken away.

Fig. 2 is a side elevation taken on line 2—2 of Fig. 1.

Fig. 3 is a sectional elevation of an isolating switch of Fig. 1 in the closed position.

Fig. 4 is an enlarged sectional detail of an intermediate disconnecting switch member.

Fig. 5 is a bottom plan view of Fig. 4.

Fig. 6 is an enlarged perspective view showing the supporting means for the intermediate isolating switch members and the operating and guiding means therefor, parts being broken away for clearness.

Fig. 7 is a sectional detail of one of the line terminals.

Fig. 8 is a detail of the mechanism for interlocking the interrupter and disconnecting switches showing the interrupter closed and the operating means for the disconnecting switches disabled against vertical movement.

Fig. 9 is a view similar to Fig. 8, but with the interrupter locked open and the interlocking means in position to permit the intermediate disconnecting switches to be lowered into engagement with the switch terminals.

Fig. 10 is a detail view showing the cooperating parts of the interlocking mechanism which prevent closing of the interrupter when the disconnecting switches are in an intermediate position.

The electric switch herein shown as embodying the invention includes an oil immersed circuit interrupter including the three separate phase units 10, 11 and 12 which are adapted to be received within a common cell enclosure comprising the rear wall 14, opposed side walls 16, a bottom wall 18 and a top wall 20. The upper portion of said cell is further provided with a permanent front closure 22. A horizontal partition wall 24 in the upper portion of the cell provides an upper enclosed bus compartment 25, and a vertical partition wall 26, which is spaced from and is parallel to said rear wall 14, provides a rear conductor compartment for the outgoing lines 27.

Busses A, B, and C of a three phase power source extend transversely through the upper bus compartment 25 and through and beyond the side walls of the cell and are supported by the top wall 20 by means of insulating posts 28 which depend therebelow into the bus compartment of the cell. Insulating bushings 32 and 34 are provided for each of said interrupter units 10, 11 and 12 and are supported on and extend through the horizontal partition wall 24. Said bushings are provided with axial conducting studs 36 and 38. The upper ends of studs 36 are separately connected electrically through conductors 40 with the three phase busses A, B, and C, and the upper terminals of the studs 38 are similarly connected to the outgoing line conductors 27. Contact blocks 42 are screw-threaded to the lower ends of said studs 36 and 38 and each of said blocks is provided with a pair of relatively long depending knife blade contact members 44 which are secured removably thereto by means of screws 45. Said blades 44 are adapted to provide the fixed contact members of line disconnecting switches hereinafter more fully described.

The three single phase circuit interrupters 10, 11 and 12 are connected for conjoint operation, and in their switch open position are adapted to be moved from the cell and for this purpose are mounted on platforms 46 provided with truck wheels 48 by means of which the interrupters are adapted to be rolled on the floor 18 into and out of the cell.

Said interrupter units are identical and, as shown in Fig. 2, each comprises a switch frame 50 which is supported in an elevated position above said platform by and forms a cover for an oil receptacle 52. Said switch frame carries the switch operating mechanism 54 and also a pair of horizontally spaced upstanding stationary switch members 56 and 58 including the insulated studs 60 which extend within the oil receptacle 50 and terminate in the stationary contact members of the interrupter. Said stationary switch members 56 and 58, as shown in Fig. 2, are adapted to be directly beneath and axially aligned with the corresponding bushings 32 and 34 carried by the cell when the switch is in its normal position within the cell. Said studs 60 are further provided with terminal blocks 62 having upstanding ribs 64 to which the resiliently supported contact fingers 66 are secured by bolts 67. Said three phase units 10, 11 and 12 are provided with a common front closure 68 which forms a closure for the open front of the cell when the switch is disposed therein.

According to the present invention, means are provided to make and break the electrical connection between the contact terminals 62 carried by the switch and the fixed contact terminals 44 carried by the cell, while maintaining the switch in its normal position in the cell. To this end, a vertically movable disconnecting switch member is provided between each of the switch terminals 62 and the aligned fixed line terminals 44, all of which are conjointly operable from the front of the cell to connect and disconnect the switch from its circuit. As shown most clearly in Fig. 6, a horizontal supporting frame 70 is provided for said intermediate disconnecting switch contact members which includes the spaced parallel angles 72 and 74 which extend substantially across the cell at the front and back thereof between the walls 16, and the transverse angles 76 and 78 which are secured to the ends thereof, as by welding, to form a rigid rectangular frame work. A channel member 79 is disposed midway between the angles 72 and 74. Said frame 70 is adapted to be supported in position between guiding means carried by the side walls 16 of the said cell. Said guiding means may comprise the channel members 80, only one of which is shown, having their backs secured to the opposite side walls 16 of the cell. Rectangular guide blocks 82 are secured to the backs of the transverse angles 76 and 78 midway of the frame and are adapted to be received between the inwardly-directed parallel legs of said channel members 80 for vertical movement in the cell. Triangular web members 84 are secured to the back of said channel member 79 and the blocks 82 by welding whereby to secure said blocks fixedly to the frame.

The vertically-movable switch members of the intermediate disconnecting switches, as shown most clearly in Figs. 4 and 5, are carried on said frame 70 by means of supporting plates 86 which are provided with rectangular flanged openings 88 therein within which the rectangular insulating bushings 90 are adapted to be secured by cement. Internal conducting members 92, which conform with the rectangular axial passages in said bushings 90 and which are of cup shape, extend through said bushings and are provided with integral upper outstanding flanges 94 which rest upon the tops thereof. Said members 92 have integral bottom portions 95 which are adapted to support the lower knife blade contacts 96. Said blades 96 are adapted to be secured conductively thereto by means of bolts 97. Said members 92 are further provided at their upper ends with three transverse ribs 98 which upstand above said flanges 94 and to which the upstanding resilient contact fingers 100 are removably secured by bolts 102. The long depending knife blade contacts 44 which are carried fixedly by the cell structure are adapted to extend downwardly into engagement with said contact fingers and a substantial distance therebelow within the cup-shaped conducting members 92 whereby, upon lowering movement of the frame from the posi-

tion shown in Fig. 2 into a position in which the lower knife blades 96 are received and electrically connected with the contact fingers 66 of the switch terminals, the cooperating contacts 44 and 100 will remain in engagement.

It will be evident that with the lost-motion that is provided between the upper cooperating contact members 44 and 100 of the isolating, or disconnecting, switches, it is possible to connect and disconnect the circuit interrupter from its circuit without changing its position in the cell with relation to the fixed contact members therein and, when the intermediate contact members are elevated into the position shown in Fig. 2, a positive and visible air gap is provided between the switch terminals 62 and the line terminals 44 which will prevent charging of the lines 27 with a high potential.

The switch frame 70 with the movable disconnecting switch members carried thereby is adapted to be raised and lowered in the cell to effect the aforesaid engagement and disengagement between the line and the switch terminals, and, to this end, a pair of vertical screw threaded shafts 103 are provided which are journalled for rotation in bearing blocks 104 carried by the channel members 80 at the ends of the frame. Said shafts are adapted to cooperate with vertical screw threaded passages in the blocks 82 of said frame 70 whereby to elevate the frame in the cell upon the conjoint rotation of said shafts. Means are provided to rotate said shafts 103 in unison by a common operating lever at the front of the cell structure. Each of said shafts 103 is accordingly provided at its upper end with a bevel gear 106 which is arranged to mesh with similar bevel gears 108 carried at the ends of a pair of similar shafts 110 which shafts are journalled in the bearing blocks 112 carried by the fixed channel member 114 which extends across the cell and is welded at its ends to the tops of the channels 80. Said shafts 110 are provided at their proximate ends with opposed bevel gears 116 which are arranged to mesh with a common bevel gear 118 which is carried by the operating shaft 120. Said shaft 120 extends forwardly in the cell and terminates in a bevel gear 122, as shown in Fig. 2. A vertical shaft 124 which is journalled on bearings 123 on the front wall 22 of the cell is provided with bevel gears 126 and 128 at the ends thereof, the gear 126 being arranged to mesh with the gear 122 of said common operating shaft 120 and the gear 128 being arranged to mesh with a similar bevel gear 130 carried by a short horizontal shaft 132, journalled in the bearing 123, which extends through the wall 22 and which is adapted to be rotated by means of a detachable crank 119, see Fig. 9, to effect the vertical movement of the frame 70. Said shaft 132, as well as the associated shafts, are located above the oil switches and their upstanding terminals so that there is no obstruction in the path of withdrawing movement of the switches.

While it is desirable to provide a positive air gap in the circuit when the disconnecting switch is opened it is also desirable that live conducting parts which are within the cell compartment shall be enclosed and thus protected from conducting gases, which may be present in the cell upon circuit interruption. To this end, means are provided separately to enclose the aligned cooperating contact members of each switch terminal. Said means, as here shown, includes a lower cup-shaped insulating member 136 which may be formed of bakelite or other molded insulating material and which surrounds the exposed terminals of the main switch. A cooperating inverted cup-shaped member 138 of insulating material is adapted to cooperate with a felt packing 137 carried by the peripheral rim of said member 136 to enclose the terminal 62 and the contact members carried thereby when the disconnecting switch is in its lower position. Said cup-shaped member 138 is secured dependingly to the bottom of said insulating bushing 90 and is secured between said contact blades 96 and the bottom 95 of said conducting member 92. A further insulating enclosing shell 140 is adapted to be secured between the contact terminals 42 at the lower end of said insulating bushings 32 and 34 having the depending rectangular side walls 142 which are adapted to closely surround and slide freely over the rectangular insulating bushings 90 of said disconnecting switches. A cooperating upstanding cup-shaped member 144 is secured to said insulating bushing 90, as shown in Fig. 4, beneath the flange 94 and is adapted to conform with the outward configuration of said insulating bushing 90, and to be slidably received within the side walls of said shell 140 whereby at all times to enclose the upper contact members 44 and 100 of said disconnecting switches.

Means are provided to lock the frame 70 and the disconnecting switches carried thereby against vertical movement whenever the interrupter is in closed position and also to prevent the closing of the interrupter when the disconnecting switches are conditioned for vertical movement or when the disconnecting switches are in any position other than the fully raised or lowered positions thereof. As shown most clearly in Figs. 8 and 9, the interlocking means includes a bell crank 106*a* which is pivotally supported on a bracket 108*a*, Fig. 2, carried by the cell structure directly beneath the bearing 123 for the operating shaft 132. Said bell crank comprises a short forwardly extending lever 109 and a longer upstanding lever 110*a* having its upper free end reflexed laterally at 112*a* (Fig. 10). Said bell crank lever 110*a* has pivoted thereto at 114*a* a horizontal abutment lever 116*a* which is supported for horizontal sliding movement by the front cell panel 22 in a position parallel to and closely alongside the operating shaft 132 for said disconnecting switches. Said lever 116*a* when in its forward position, as shown in Fig. 8, prevents the application of the operating crank 119 for vertical movement of the disconnecting switches.

A locking lever 118*a* pivoted to said cell structure at 120*a* extends rearwardly in said cell in position to cooperate with a crank arm 122*a* which is operatively connected with the switch operating mechanism of interrupter 11. A vertical rod 124*a* pivoted to said locking lever at a point 125 intermediate its ends is pivotally connected with the forwardly extended end of lever 109 of bell crank 106*a*. Said locking lever is provided with a projection 126*a* which is adapted to engage the bottom arcuate face 128*a* of the crank arm 122*a* when the switch is in closed position, as shown in Fig. 8, whereby to prevent the counterclockwise rotation of the locking lever 118*a*. Said locking lever is also provided with an arcuate end face 130*a* which is adapted to closely overlie a correspondingly arcuate face 132*a* of said crank arm 122*a* when the interrupter is open and the locking lever is rotated in a counterclockwise direction about its pivotal support 120*a*, as shown in Fig. 9. A projection 134*a* on said

crank arm 122a limits the rotation of the locking lever 118a in a counterclockwise direction beyond that shown in Fig. 9. A vertically disposed angle section 136a, shown most clearly in Fig. 6, is secured to the angle 72 of frame 70 in position to receive the reflexed end 112a of lever 110a behind the forward web 140a thereof whenever the frame 70 is in any position other than its fully raised or fully lowered position, whereby to prevent the clockwise rotation of locking lever 118a from the position shown in Fig. 9 with the consequent release of the crank arm 127a.

It will be evident that with the mechanism in the position shown in Fig. 8, wherein the interrupter is closed, and the lever 118a is prevented from counterclockwise rotation by the abutment surface 128a, the lever 116a is in a forward position and prevents application of the disconnecting switch operating crank 119 on the shaft 132. Since the interlocking mechanism is biased by gravity or, if desired, by a spring, not shown, into the locking position shown in Fig. 8, the interrupter can be opened and closed if desired free from the interlocking mechanism. The position of the parts is the same when the disconnecting switch frame 70 is in a lowered position wherein the top of the angle 136a is slightly below the reflexed end 112a of the lever 110a.

If now the interrupter be opened, the crank arm 122a will be moved in a counterclockwise direction, and by applying the crank 119 to shaft 132, the lever 116a can be pushed inwardly by the crank whereby to rotate the locking lever 118a in a counterclockwise direction into the position shown in Fig. 9, wherein the lever 110a is vertical and is free to pass behind web 140a of angle 136a. In this position of the interlocking mechanism, the disconnecting switch is in condition for vertical movement either into or out of engagement with the switch terminals 62 and the interrupter is locked against closing movement by the engagement of the cooperating faces 130a and 132a of locking lever 118a and crank arm 122a respectively.

During the vertical movement of the disconnecting switch frame 70, the reflexed end 112a of lever 110a is disposed behind the web 140a of angle 136a, which prevents the interlocking mechanism from returning to the lowered or interrupter releasing position shown in Fig. 8, regardless of whether the operating crank 119 is removed or not. Consequently, the breaker is locked open until the disconnecting switch frame 70 is either fully lowered or fully raised, as the case may be, in which positions the reflexed end of lever 110a will be entirely clear of angle 136a. Hence, it is impossible to cause a disastrous arc by closing the interrupter when the disconnecting switches are in an intermediate position.

It will be evident from Fig. 6 that upon the withdrawal of the switch from the cell, it is possible by the operation of the operating shaft 120 to lower the disconnecting contact frame 70 below the normal switch closed position of Fig. 2 into a still lower position wherein the screw-threaded blocks 82 will be below and free from the screw-threaded elevating shafts 103 so that the frame 70 carrying the intermediate disconnecting contacts can be lowered to the cell floor and withdrawn horizontally from the cell for inspection and repairs.

Various modifications may be made in the construction without departing from the scope of the invention.

I claim:

1. Electric switching apparatus including the combination of a main truck type switch having switch terminals, an enclosing cell therefor having line terminals spaced above and vertically aligned with said switch terminals, said switch being horizontally movable into and out of a circuit controlling position in said cell, a disconnecting switch carried by said cell intermediate said switch and line terminals having upper and lower contact members, said upper contact members having a lost-motion electrical connection with said line terminals, and means to raise and lower said disconnecting switch in the cell, whereby to effect the disengagement and engagement of said lower contact members and said switch terminals.

2. Electric switching apparatus including an enclosing cell and a switch horizontally removably located in said cell, said cell and switch having relatively fixed vertically-aligned terminal contact members which are vertically spaced apart, and a vertically movable switch member carried by said cell arranged to make and break the electrical connection between said terminal contact members and engage and disengage the switch contact members.

3. Electric switching apparatus including the combination of a main truck type switch having upstanding switch terminals, an enclosing cell structure therefor having a side wall opening through which said switch is adapted to be moved into said cell and having depending line terminals which are disposed above said opening and are vertically aligned with and spaced apart from said switch terminals, a frame carried by said cell intermediate said switch and line terminals, mutually insulated conducting members carried by said frame in vertical alignment with said terminals and having upper and lower contact members, said upper contact members having a lost-motion electrical connection with said line terminals, and frame lowering and raising means arranged to effect the engagement and disengagement of said lower contact members and the cooperating switch terminals, whereby to isolate the switch from its circuit and also to permit the switch to be withdrawn through said opening.

4. Electric switching apparatus including an enclosing cell structure having depending line terminals in the upper portion thereof, a truck type switch arranged to be rolled horizontally into and out of said cell structure and having upstanding switch terminals which are vertically aligned with said line terminals when the switch is in its normal position within the cell, intermediate terminal connecting means carried by said cell structure and having a lost-motion electrical connection with said line terminals, and means to elevate said connecting means above said switch terminals whereby to permit withdrawal of the switch from the cell.

5. Electric switching apparatus including the combination of a main switch having switch terminals carried thereby, an enclosing cell structure therefor having line terminals aligned with and spaced above said switch terminals, a frame having outstanding abutments on opposite sides thereof which is carried by said cell intermediate said switch and line terminals having conducting members extended above and below it and arranged to engage and separately connect electrically said aligned switch and line terminals, said conducting members having a rigid lost-motion electrical connection with one of said terminals, whereby to permit a relative vertical movement

therebetween, means including spaced vertical shafts which pass through and have a screw-threaded connection with said abutments to effect a vertical displacement of said frame, whereby to disconnect the other of said terminals and vertical guide means cooperating with said abutments to effect a straight line vertical movement of said frame.

6. Electrical switching apparatus including the combination of an enclosing cell structure having a terminal supporting structure, line terminals thereon having depending contact members, an oil switch movable therebeneath into and out of the cell having upstanding switch terminals terminated in contact members, the contact members of said line and switch terminals constituting relatively fixed vertically aligned and spaced stationary contact members of line disconnecting switches, and vertically movable contact members carried by said terminal structure adapted to cooperate with and separately bridge the pairs of aligned line and switch terminal contact members, insulating means surrounding each of said movable contact members, and separate insulating means surrounding each of said line and switch terminals arranged to cooperate with the insulating means of said movable contact members, whereby to enclose separately the fixed and movable contact members of each line disconnecting switch, and operating means for said movable contact members carried by said cell struture for opening said disconnecting switches independent of and prior to the removal of said oil switch from the cell.

7. Electrical switching apparatus including the combination of a terminal supporting structure, line terminals thereon having depending contact members, a switch disposed therebeneath having upstanding switch terminals terminated in contact members, the contact members of said line and switch terminals constituting relatively fixed vertically aligned and spaced stationary contact members of line disconnecting switches, and vertically movable contact members carried by said terminal structure adapted to cooperate with and separately bridge the pairs of aligned line and switch terminal contact members, an insulating shell surrounding said movable contact members, an insulating shell surrounding said line terminals having a telescoping connection with the insulating shell of said movable contact members, and an insulating shell surrounding said switch terminals below said disconnecting contact members having an abutment adapted to receive the lower edge of the insulating shell of said movable member in a lowered position thereof whereby to enclose and isolate the several disconnecting switches.

8. Electrical switching apparatus including the combination of an enclosing cell structure having fixed depending line terminals, a truck type circuit interrupter adapted to be moved horizontally into and out of said cell and having upstanding switch terminals which are vertically aligned with and are spaced below said line terminals, said confronting line and switch terminals constituting stationary contact members of line disconnecting switches, a frame disposed in said cell intermediate said terminals, conducting members carried by and extended above and below said frame, said conducting members constituting the movable switch members of said line disconnecting switches and having upper and lower contact members adapted to cooperate with and bridge the aligned stationary contact members thereof, means to raise and lower said frame and the movable switch members carried thereby, whereby to make and break engagement between said lower contact members and said switch terminals, said upper contact members having a lost-motion electrical connection with said line terminals, and insulating means separately enclosing said aligned stationary and movable disconnecting switch members both in the raised and lowered positions of said frame.

9. Electrical switching apparatus including the combination of an enclosing cell structure having fixed depending line terminals, a circuit interrupter adapted to occupy said cell and having upstanding switch terminals which are vertically aligned with and are spaced below said line terminals, said confronting line and switch terminals constituting stationary contact members of line disconnecting switches, a frame disposed in said cell intermediate said terminals, conducting members carried by and extended above and below said frame, said conducting members constituting the movable switch members of said line disconnecting switches and having upper and lower contact members adapted to cooperate with and bridge the aligned stationary contact members thereof, means to raise and lower said frame and the movable switch members carried thereby, whereby to make and break engagement between said lower contact members and said switch terminals, said upper contact members having a lost-motion electrical connection with said line terminals, insulating means separately enclosing said aligned stationary and movable disconnecting switch members in the lowered terminal engaging position thereof, and means to displace a portion of said insulating means in the vicinity of said switch terminals in the open position of said disconnecting switches whereby to provide an unenclosed air gap between said lower contact member and the contact member of said switch terminal.

10. Electric switching apparatus including the combination of a main switch, a disconnecting switch having operating means therefor including a rotatable shaft adapted to be detachably engaged by a crank handle and interlocking mechanism interconnecting said two switches having means to prevent the operative engagement of said shaft by the crank handle except when both of said switches are in predetermined condition.

11. Electric switching apparatus including the combination of a main switch, a disconnecting switch having operating means therefor including a rotatable shaft adapted to be detachably engaged by a crank handle and interlocking mechanism interconnecting said two switches, and means arranged to prevent the engagement of said shaft by the crank handle except when both of said switches are in predetermined condition, said means including an abutment having an operative connection with said interlocking mechanism and movable over said shaft into and out of a position wherein it prevents the operative connection of the crank handle thereto.

12. Electric switching apparatus including the combination of a main switch and a disconnecting switch having a frame which is vertically movable above said main switch and which carries disconnect terminals, said frame having a vertical abutment member, and interlocking mechanism interconnecting said switches arranged to prevent the operation of said main

switch except when said disconnecting switch is in fully open and fully closed positions, said interlocking mechanism including a member which is free to reciprocate beneath and also above said abutment member when said frame is in positions corresponding to open and closed positions of said disconnecting switch and is restrained from movement by said abutment member when said frame is in an intermediate position whereby to lock said main switch against operation.

13. Electric switching apparatus including an enclosing cell having a top wall, insulating bushings extended therethrough and terminated in the cell in line terminals, a truck type switch located in the cell beneath said line terminals and having upstanding terminals, and a disconnecting switch located between the line and switch terminals arranged to connect both terminals and also to disengage the switch terminals and having a housing which encloses the line terminals when disengaged from the switch terminals, and operating mechanism independent of the truck switch for operating said disconnecting switch.

14. Electric switching apparatus including an enclosing cell having a top wall, insulating bushings extended therethrough and terminated in the cell in line terminals, a truck type switch located in the cell beneath said line terminals and having upstanding terminals, and a disconnecting switch located between said line and switch terminals and arranged to control the connection therebetween, said disconnecting switch including a housing having contacts in the upper end which engage the line terminals and other contacts in the lower end which engage the switch terminals, and an insulating housing which encloses the upper contacts and line terminals when the disconnecting switch is open and which surrounds and projects below the lower contacts sufficiently to render difficult manual access thereto, and operating mechanism independent of the truck switch for operating said disconnecting switch.

15. Electric switching apparatus including an enclosing cell having a top wall, insulating bushings extended therethrough and terminated in the cell in line terminals, a truck type switch located in the cell beneath said line terminals and having upstanding terminals, and a disconnecting switch located between each line and switch terminal and arranged to control the connection therebetween, said disconnecting switches including a housing having contacts in the upper end which engage the line terminals and other contacts in the lower end which engage the switch terminals, and an insulating housing which encloses the upper contacts and line terminals when the disconnecting switch is open and which surrounds and projects below the lower contacts sufficiently to render difficult manual access thereto, each switch terminal having an insulating casing which surrounds it and which is engaged by said insulating housing to enclose said switch terminal and lower contact when the disconnecting switch is closed, and operating mechanism independent of said truck switch for operating said disconnecting switch.

16. Electric switching apparatus comprising a cell structure having a top wall, line terminals carried by said top wall within the cell, a circuit breaker having upstanding terminals located in the cell under said line terminals, in combination with a disconnecting switch comprising a frame vertically movable in said structure between said terminals, insulated conductors carried by said frame for connecting and disconnecting said line and breaker terminals, vertical channel members carried by said cell structure at opposite ends and in the median line of said frame, said frame having guide members which are movable along said channels and are arranged to guide said frame for vertical movement in parallel lines, screw-threaded shafts screw-threaded in the ends of said frame at said channels for moving said frame vertically, and means independent of said circuit breaker for rotating both shafts conjointly in the same effective direction.

17. Electric switching apparatus comprising a main switch, a disconnecting switch, actuating mechanism for said disconnecting switch having a breakable operative connection therewith, and interlocking mechanism associated with both switches having means to prevent the operative connection between said actuating mechanism and said disconnecting switch except when both switches are in predetermined condition.

18. Electrical switchgear comprising a cubicle, an oil circuit breaker unit of large interrupting capacity mounted within the cubicle, means for permitting withdrawal of the unit from the cubicle, a disconnecting device for electrically disconnecting and isolating the circuit breaker from other parts of the system in which it is connected, and operating mechanism mounted in said cubicle independently of the circuit breaker unit for effecting disconnection and isolation of the circuit breaker prior to withdrawal of the unit from the cubicle.

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