Nov. 24, 1959 J. W. TIMMERMAN 2,914,707

CIRCUIT BREAKER STRUCTURE WITH IMPROVED INTERLOCKING MECHANISM FOR PROTECTING OPERATING PERSONNEL

Filed March 29, 1956 4 Sheets-Sheet 1

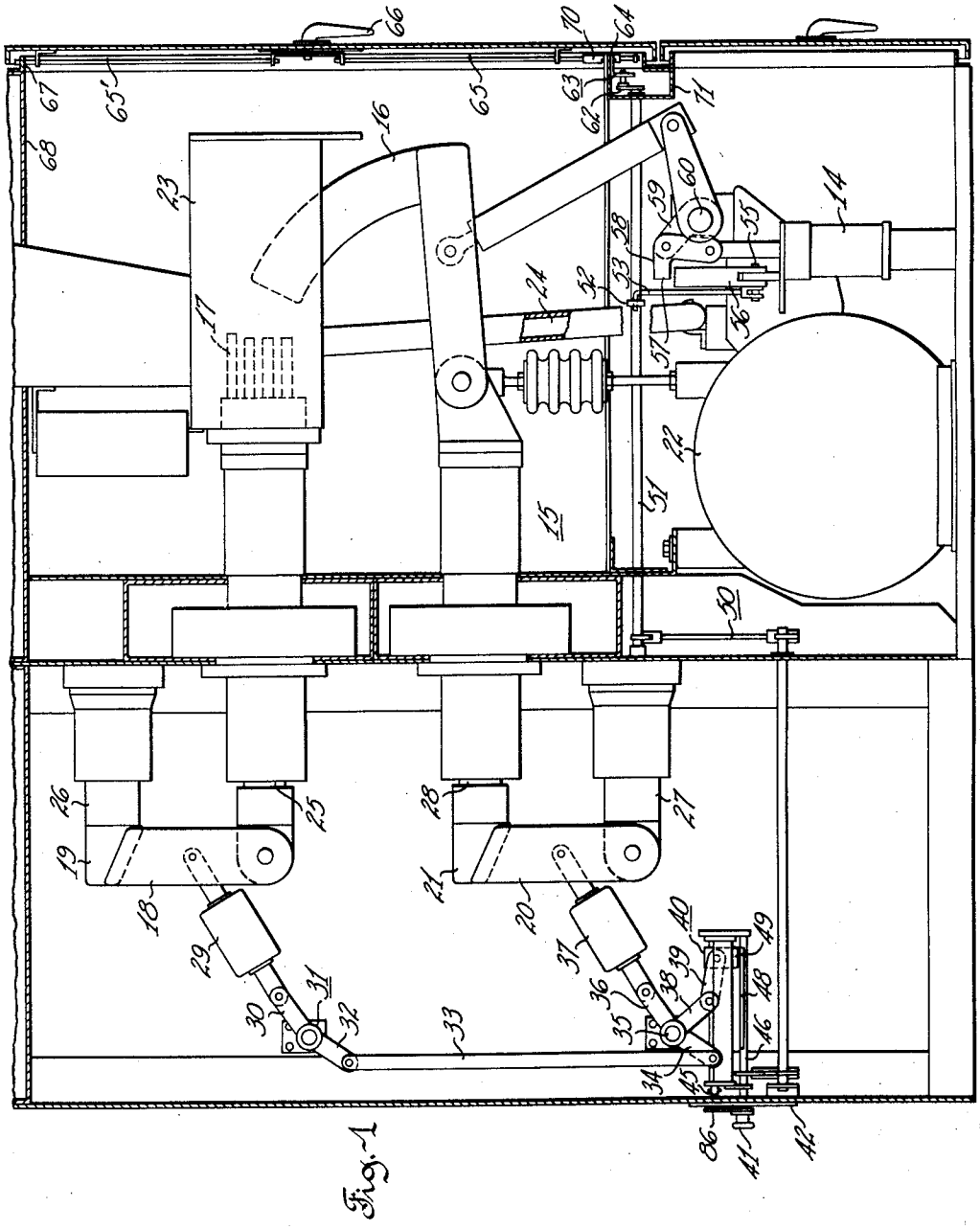


Fig. 1

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Filed March 29, 1956 4 Sheets-Sheet 2

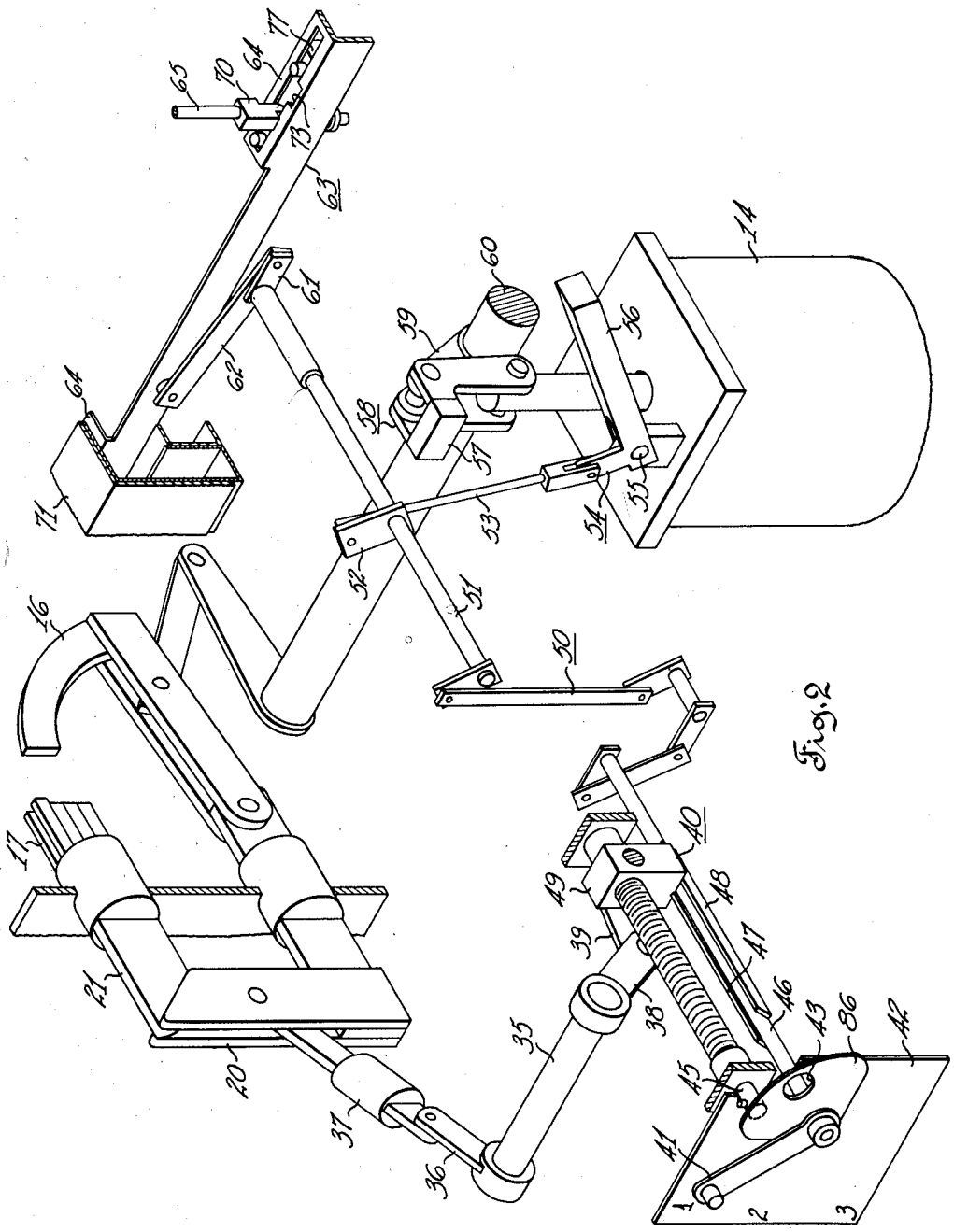


Fig. 2

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CIRCUIT BREAKER STRUCTURE WITH IMPROVED INTERLOCKING MECHANISM FOR PROTECTING OPERATING PERSONNEL

Filed March 29, 1956 4 Sheets-Sheet 3

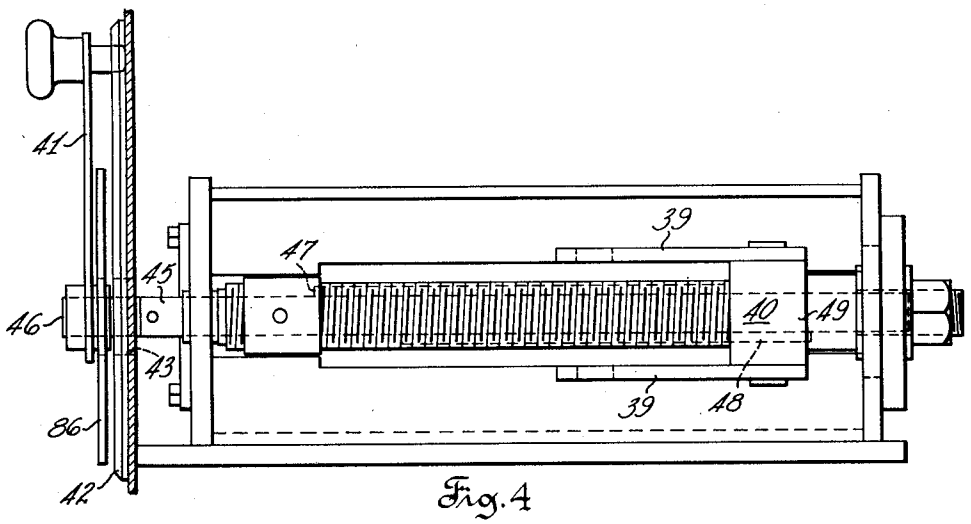


Fig. 4

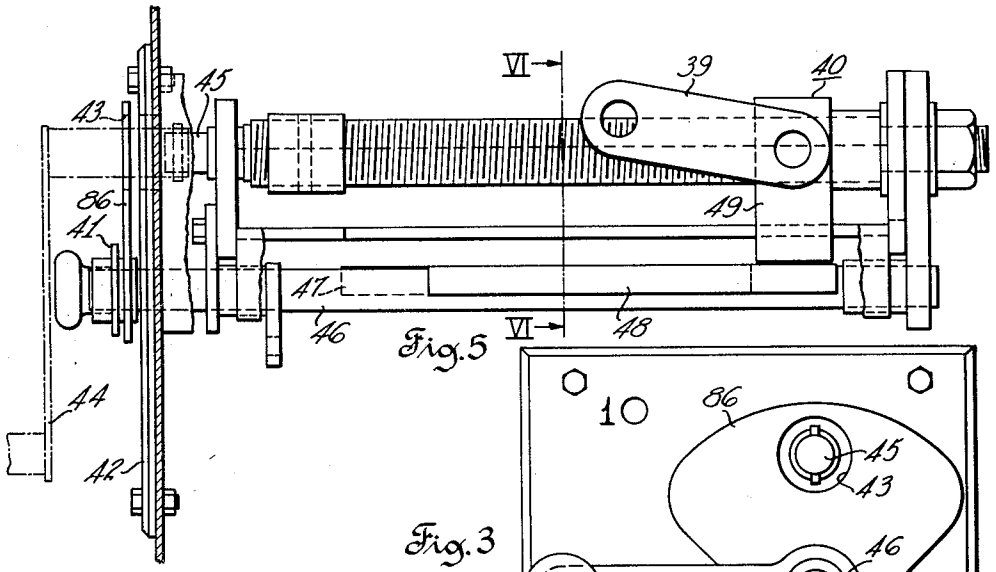


Fig. 5

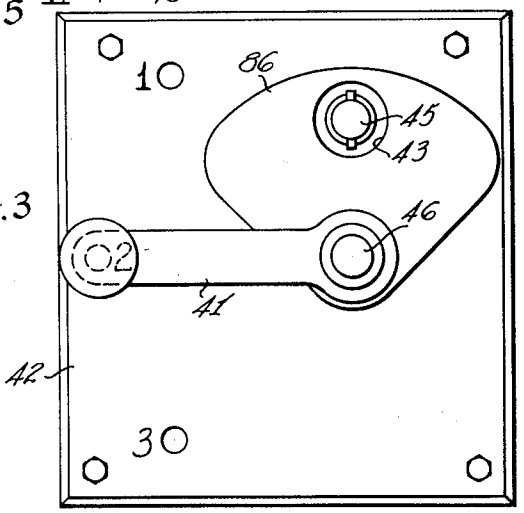


Fig. 3

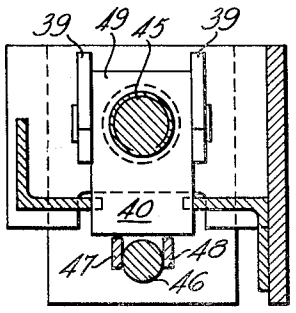


Fig. 6

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CIRCUIT BREAKER STRUCTURE WITH IMPROVED INTERLOCKING MECHANISM FOR PROTECTING OPERATING PERSONNEL

Filed March 29, 1956 4 Sheets-Sheet 4

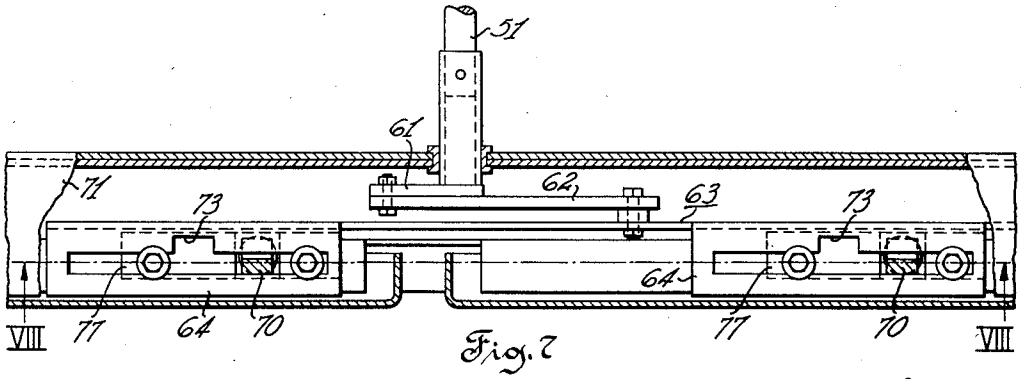


Fig. 7

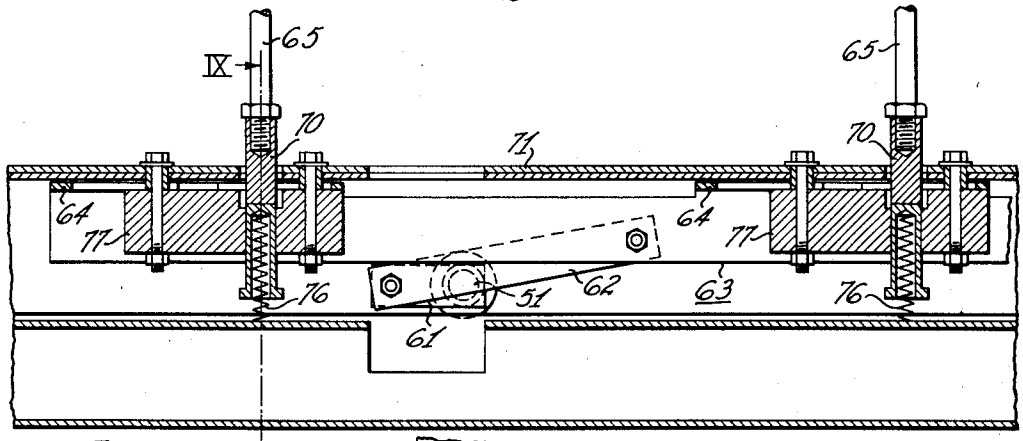


Fig. 8

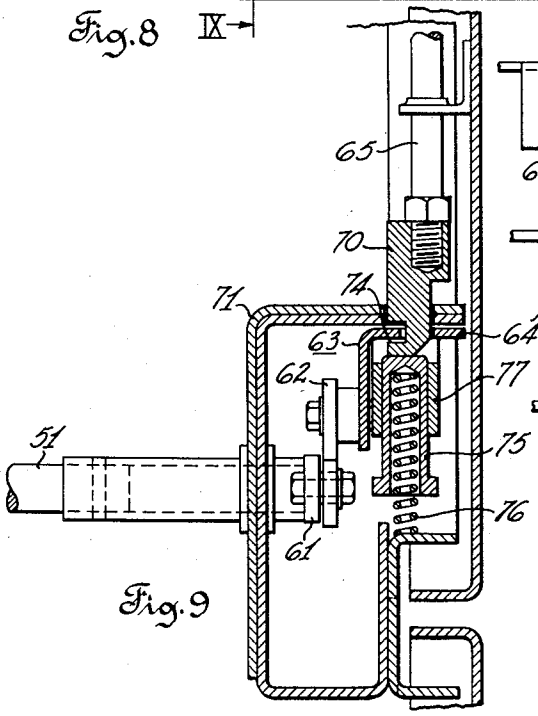


Fig. 9

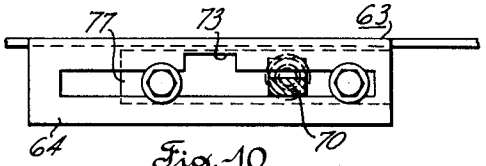


Fig. 10

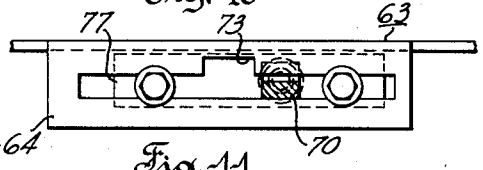


Fig. 11



Fig. 12

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United States Patent Office 2,914,707 Patented Nov. 24, 1959

2,914,707

CIRCUIT BREAKER STRUCTURE WITH IMPROVED INTERLOCKING MECHANISM FOR PROTECTING OPERATING PERSONNEL

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Application March 29, 1956, Serial No. 574,670

3 Claims. (Cl. 317—103)

This invention relates to interlocking devices and systems for adequately protecting the operating personnel of circuit breaker structures.

The primary purpose of this new and improved interlock assembly is to permit accessibility to circuit breaker high voltage compartments when and only when the circuit breaker is electrically isolated from the circuit being controlled and the disconnect switches are blocked in their fully opened position.

In accordance with the invention claimed a new and improved interlock assembly is provided which prevents access to, or makes accessible high voltage terminals only after a proper sequence of steps has been traversed in the setting of the interlocking devices.

It is, therefore, one object of the present invention to provide a new and improved interlocking system for electric switchgear.

Another object of this invention is to provide new and improved interlocking means.

A further object of this invention is to provide new and improved interlocking means which cooperate with each other in a novel way to protect operating personnel from the dangers of the power circuit controlled.

A still further object of this invention is to provide a new and improved interlocking system which makes accessible certain circuit breaker compartments only after a proper sequence of steps has been traversed in the setting of certain interlocking devices.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawings, in which:

Fig. 1 is a side elevation partly in section of a circuit breaker structure embodying the invention;

Fig. 2 is a diagrammatic representation of the interlock mechanism used in the structure illustrated in Fig. 1;

Fig. 3 is an enlarged view of the selector switch shutter panel and operating arm illustrated in Fig. 2;

Fig. 4 is an enlarged plan view partly in section of the selector, switch shutter panel, operating arm and worm gear illustrated in Fig. 2;

Fig. 5 is a side view of the structure illustrated in Fig. 4 with parts broken away to more clearly show the structure;

Fig. 6 is a cross sectional view looking in the direction of the arrows of the structure illustrated in Fig. 5;

Fig. 7 is a plan view partly in section of the panel door control mechanism and a partial view of the disconnect contact actuating means;

Fig. 8 is a cross sectional view of the structure illustrated in Fig. 7 taken along the line VIII—VIII;

Fig. 9 is a cross sectional view of the structure illustrated in Fig. 8 taken along the line IX—IX; and

Figs. 10, 11 and 12 are diagrammatic representations of the three different positions of the sliding panel illustrated in Fig. 7.

Referring more particularly to the drawings by characters of reference, Fig. 1 shows diagrammatically a circuit breaker **15** and a control system therefor. Although in general, circuit breaker structures of the type herein considered are provided with a plurality of similar switch elements or pole units to be used in the several conductors of a polyphase electric circuit, the device is described in detail as if it were of the single pole type. Circuit breaker **15** designates a breaker of the fluid actuated type having a plurality of pole portions each comprising cooperating arcing contacts **16** and **17** serially connected with cooperating disconnecting contacts **18**, **19** and **20**, **21** in one phase of a polyphase electric circuit (not shown). The circuit breaker **15** may be considered as comprising a plurality of switches mounted within a cubicle and each switch controlling an electric circuit having terminals in the cubicle. Each of the switches which comprises the cooperating arcing contacts in one switch and the cooperating disconnect contacts in another switch have a movable circuit controlling contact member. A reservoir **22** serves as a source of supply of fluid under pressure. The fluid utilized for actuating the circuit breaker structure is assumed to be compressed air supplied to reservoir **22** and maintained therein at a substantially constant pressure by a suitable compressor (not shown) but it will be understood that other suitable fluids such as nitrogen or helium may also be used if so desired.

The arcing contacts **16** and **17** are mounted to engage within an arcing chamber **23** which is aligned with a hollow insulator **24** to provide a connection between reservoir **22** and arcing chamber **23** through a suitable blast valve for directing a blast of arc extinguishing fluid under pressure between the arcing contacts and through the arcing chamber.

Contacts **16** and **17** are controlled by a fluid motor mechanism **14** which cooperates with the blast valve controlling the fluid flow through insulator **24** to separate the contacts when the blast of fluid under pressure has reached the arcing zone.

The movable disconnect contact **18** is pivotally mounted on an extension of a terminal stud **25** which interconnects arcing contact **17** and disconnect contact **18**. The stationary disconnect contact **19** is connected to terminal **26** which is connected to the power circuit controlled. The movable disconnect contact **20** is pivotally mounted on terminal **27** and coacts with stationary disconnect contact **21** which is connected to the terminal stud **28** interconnecting contacts **21** and **16**. The movable disconnect contact **18** is connected intermediate the ends thereof by means of an insulated connecting rod **29** to an arm **30** of bell crank **31**. A second arm **32** of bell crank **31** is connected to one end of a connecting rod **33**. The other end of connecting rod **33** is connected to one end of a crank **34** which is secured at its other end to a rotatable shaft **35**. The movable disconnect contact **20** is connected intermediate its ends by a crank **36** and an insulating connecting rod **37** to shaft **35**. A crank **38** connected at one end thereof to shaft **35** is connected at the other end through a link **39** to a worm gear actuated locking means **40**.

Fig. 2 illustrates diagrammatically the interlock system of this invention. In order to simplify the illustration and description thereof only one disconnect contact has been shown in circuit with the arcing contacts. This disconnect contact and its actuating elements are herein assumed to be disconnect contacts **20** and **21** illustrated in Fig. 1.

The interlock assembly or mechanism for the cross blast type circuit breaker disclosed has three working positions which are controlled by an interlock mechanism operating handle **41**. Handle **41** is part of a selector switch shutter arrangement which comprises an indicator panel **42** having three indicated numerical positions 1,

2 and 3 and clearance holes 43 in indicator panel 42 and shutter panel 86 through which a handle mechanism 44 (shown dotted in Fig. 5) may be inserted and suitably secured to a disconnect contact actuating shaft 45. When the handle 44 is inserted through holes 43 and connected to shaft 45 the disconnect contacts may be actuated to contact open position. The handle 41 of the selector shutter arrangement is mounted on a shaft 46 and upon rotation of handle 41 shaft 46 is rotated to control the arcing contacts and the doors of the breaker cubicle.

As noted from Figs. 4–6, the selector switch shutter arrangement defines an interlock member comprising bars 47 and 48 of varying length fastened axially along the periphery of shaft 46 on opposite sides thereof. Bar 47 extends beyond bar 48 in the direction of panel 42 and bar 48 extends further than bar 47 in the opposite axial direction. Upon rotation of shaft 45 a block 49 which is threadably mounted on shaft 45 and connected through crank 38 and link 39 to rotating shaft 35 is moved axially therealong. If block 49 reaches the panel end of shaft 45 (shown at the left hand end in Figs. 4 and 5) the handle 41 and shaft 46 may be turned counterclockwise because its rotation is not blocked by the bars 47 and 48 bearing against the bottom surface of block 49. At any point along shaft 45 where both of the bars 47 and 48 are parallelly positioned, handle 41 cannot be actuated either clockwise or counterclockwise. In the position of block 49 shown in Fig. 5, the handle 41 may be actuated clockwise as shown in Fig. 2. Thus, it is noted that block 49 controls the movement of shaft 46 and releases shaft 46 for predetermined rotations only when block 49 is in given positions.

Shaft 46 is rotatably connected through a linkage mechanism 50 to one end of a rotatable shaft 51. Shaft 51 is connected intermediate the ends thereof to a crank 52. Crank 52 is connected through a rod 53 and bell crank 54 to a pivotally mounted pin 55. Crank 54 has one arm 56 which when rotated counterclockwise from the position shown in Fig. 2 moves under an arm 57 of a pivotally mounted L-shaped member 58. Member 58 is pivotally connected through a crank 59 to a rotatable rod 60. When rod 60 is rotated counterclockwise under the influence of motor 14 to close the arcing contacts 16 and 17 shown in Fig. 2 member 58 rotates crank 59 counterclockwise. If arm 56 of crank 54 is rotated in the path of movement of arm 57 of member 58 the arcing contact 16 will be locked in its contact open position.

Welded to one end of shaft 51 is a crank 61 which is pivotally mounted to one end of a link 62. Link 62 is pivotally mounted at its other end to a reciprocally mounted angle member 63. Forming a part of angle member 63 is a cutout horizontal portion 64 which upon reciprocating motion of member 63 locks and unlocks the cubicle doors by engaging or releasing vertically reciprocating door latching rods 65 and 65'. It is a feature of this invention that rod 65, which coacts with member 63 to lock and unlock the cubicle door, also acts simultaneously with rod 65' to latch and unlatch the cubicle door at the top. Rod 65 when released by reason of the position of bracket 64 may be reciprocated by rotation of cubicle handle 66. Rod 65' is mounted on handle 66 and guided by a plurality of apertured brackets through which it moves to lock or latch and unlock or unlatch the cubicle doors by moving into and out of the aperture provided in a bracket 67 mounted on the frame 68 of the cubicle structure.

Figs. 7 to 12, inclusive, illustrate more clearly the details of construction of the cubicle door interlocking member comprising a part of the interlock mechanism. Bolted to the end of rod 65 and forming a part thereof is a finger shaped clamping mechanism 70 which fits through a slot in a bracket 71 forming a part of the cubicle structure and through the cutout portion 64 of member 63. The finger portion of mechanism 70 as shown in Fig. 9 extends underneath member 63 so that upward movement of rod 65 is prevented by a shoulder 74 of member 70 abutting against member 63. When member 63 is actuated longitudinally a predetermined distance so that cutout portion 73 is positioned immediately above the finger of mechanism 70, the door mechanism may be actuated vertically, that is, rod 65' is actuated downward until the end of it which fits through the aperture in bracket 67 is removed therefrom and rod 65 is actuated upward through the cutout portion 64 and the slot in bracket 71 thereby releasing the door of the cubicle for opening. Rod 65 and the finger clamp mechanism 70 are biased vertically upward by spring means 76. In order to provide a bearing surface for the spring biasing means 76 a block member 77 is bolted to bracket 71 but spaced a predetermined distance therefrom so that cutout portion 64 of member 63 may be moved over the top surface thereof without being restrained by bracket 71.

When handle 41 is moved to position marked No. 1 the circuit breaker structure can be operated for service. The disconnect contacts as shown in the diagrammatic illustration in Fig. 2 are closed and cannot be opened first because bar 48 engages block 49 to lock locking means 40 in the contact closed position shown and second because the disconnect operating handle 44 (shown in dotted lines in Fig. 5) cannot be inserted through apertures 43 to reach shaft 45 (note Fig. 2). In this position, a selector switch shutter 86 blocks apertures or openings 43. Further, when handle 41 is in position No. 1, the compartment doors are blocked or locked closed because shoulder 74 of the finger member 70 on rod 65 is blocked from upward movement by angle member 63. As noted in Fig. 2 when handle 41 is in position No. 1 the position of shaft 51 is such that the arm 56 of crank 54 is out of the way of arm 57 of member 58. Thus, shaft 60 may be actuated to open or close the arcing contacts 16 and 17.

When handle 41 is in position No. 1, it may be moved to position No. 2 because shaft 46 may be actuated counterclockwise without bar 48 engaging block 49. Bar 47 does not extend to block 49 when the circuit breaker is in the operative position. The breaker contacts must be in their contact open position when handle 41 is moved from position No. 1 to position No. 2. If breaker contacts 16 and 17 are closed when handle 41 is actuated from position No. 1 to position No. 2, arm 56 of bell crank 54 is blocked by arm 57 of member 58 from counterclockwise movement. When arcing contacts 16 and 17 are in their contact open position, arm 56 of crank 54 moves underneath arm 57 to block the arcing contact 16 open.

When handle 41 is in position No. 2 apertures 43 are axially aligned with the end of shaft 45 so that the disconnect operating handle 44 may be fastened to its end and the disconnect contacts opened by counterclockwise rotation of shaft 45.

As noted from Fig. 11 the position of rod 65 is such that the breaker cubicle doors are blocked closed when handle 41 is in position No. 2.

With the disconnect contacts fully opened, when the handle 41 is moved to position No. 3, bar 47 engages block 49 to lock locking means 40 in the contact open position and the shutter panel 86 closes the apertures 43 opposite shaft 45 so that the disconnect contacts cannot be closed. In position No. 3 the shaft 46 has been rotated far enough to actuate angle 63 to the position where cutout portion 73 is axially aligned with shoulder 74 of rod 65 and the cubicle doors may be unlocked as heretofore explained. See Fig. 12.

If the selector switch handle 41 is in position No. 1 and it is desired to move the interlock assembly to breaker test position No. 3 the following procedure must be followed: The circuit breaker must first be tripped

open. Then the handle **41** and the selector switch shutter **86** is moved to postion No. 2. This step rotates shafts **46** and **51** counterclockwise. Counterclockwise rotations of these shafts causes arm **56** of crank **54** to rotate underneath arm **57** of L-shaped member **58** to block the closing motion of the arcing contacts. The interlock assembly can be moved from position No. 1 to position No. 2 only when the arcing contacts **16** and **17** are in their contact open position. When the circuit breaker is in the contact open position the breaker closing piston rod and the closing piston rod L-shaped member **58** are in their raised position as shown in Fig. 2. In this position arm **56** can pivot on pin **55** and readily move underneath arm **57**. However, when the breaker is in the contact closed position the breaker piston rod and the L-shaped member **58** are in their lowered position so that arm **57** of member **58** prevents the shifting of the shafts **46** and **51** from No. 1 position to No. 2 position.

When the disconnect contacts are fully open, handle **44** is removed from the end of shaft **45** and handle **41** and shutter **86** are moved to No. 3 position. Movement of shafts **46** and **51** to No. 3 position moves arm **56** of crank **54** from underneath arm **57** of member **58** counterclockwise a predetermined distance so that the arcing contacts **16** and **17** may be actuated to the contact closed and then open positions. As previously stated, the breaker cubicle doors are blocked closed when the interlock assembly is in positions 1 and 2. However, when the interlock assembly is moved to position No. 3 the cubicle doors are unlocked. When the cubicle doors are open, spring **76** biases is cylindrical housing **75** upward into slot **73** of angle member **63** and into the opening in bracket **71** thereby locking angle member **63** in the door open position. All doors must be closed to permit motion of channel **63**. This feature eliminates the possibility of energizing the breaker with a cubicle door left open.

It is impossible to move the interlock assembly directly from position No. 1 to position No. 3 or from position No. 3 to position No. 1. The operator must stop at the intermediate position No. 2 and open the disconnect contacts when going from positions No. 1 to No. 3. In the reverse sequence of operation in moving the interlock mechanism from positions No. 3 to No. 1, the operator must stop at the intermediate position No. 2 and close the disconnect contacts.

When the disconnect contacts are in their closed positions and the interlock assembly is in position No. 2 block **49** of the worm gear actuating mechanism is in its extreme right hand position as shown in Figs. 2, 4 and 5. In this position the handle **41** and shutter **86** can be moved from positions No. 2 to No. 1 and vice versa, but handle **41** and shutter **86** cannot be moved to position No. 3 because bar **48** would abut against block **49** thereby preventing the rotation of shaft **46** in the counterclockwise direction.

When the disconnect contacts are in their fully opened positions, block **49** is at the extreme left hand position. The selector switch handle **41** can be moved from position No. 2 to No. 3 and vice versa but handle **41** cannot be moved to position No. 1 because bar **47** abuts block **49** and prevents shaft **46** from rotating in the clockwise direction.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. In combination, a cubicle comprising a plurality of doors; an electric circuit having terminals in said cubicle; a first switch and a second switch mounted in said cubicle and each controlling said circuit; said first switch and said second switch each having a movable circuit controlling contact member, means for individually actuating said movable contact members of said first and second switches to circuit controlling positions; and an interlock mechanism arranged in said cubicle for controlling the actuation of said first and second switches and said doors comprising a pair of rotatably mounted axes, one of said axes having an uneven contour extending along the length thereof and the other of said axes being connected to said contact actuating means of said first switch, means mounted on said other of said axes for cooperating with the contour of said one of said axes for controlling the movement of said first switch, a handle mounted on said one of said axes for moving said one of said axes to a plurality of positions, a first interlock member and a second interlock member; said first interlock member comprising a shield mounted on said one of said axes for rotation therewith and a pivotally mounted crank, said crank being connected to said one of said axes for pivotal movement thereby; said second interlock member comprising a latch connected to said one of said axes for engaging said doors upon movement thereof; said handle when moved to one position actuating said second interlock member to engage and lock said doors closed and actuating said one of said axes and said shield to prevent access to said contact actuating means of said first switch and causing said means mounted on said other of said axes to engage said contour of said first axes to prevent actuation of said contact actuating means of said first switch; said handle when moved to a second position actuating said second interlock member to engage and lock said doors closed, rotating said crank to block the movement of said contact actuating means for said second switch, actuating said shield for exposing said contact actuating means for said first contact member and actuating said one of said axes for disengaging with said means mounted on said other of said axes for releasing said contact actuating means for said first contact member; and said handle when in a third position actuating said second interlock member to unlock said doors, actuating said shield to block the access to said contact actuating means for said first switch, rotating said one of said axes to engage with said means mounted on said other of said axes to lock said first switch in contact open position, and rotating said crank to release said movable contact of said second switch for movement thereof; said shield and said one of said axes preventing said handle from being actuated from said third position to said first position without stopping at said second position and without having actuated said movable contact member of said first switch to contact closed position.

2. In combination, a cubicle comprising a plurality of doors; an electric circuit having terminals in said cubicle; a first switch and a second switch mounted in said cubicle and each controlling said circuit; said first switch and said second switch each having a movable circuit controlling contact member, means for individually actuating said movable contact members of said first and second switches to circuit controlling positions; and an interlock mechanism arranged in said cubicle for controlling the actuation of said first and second switches and said doors comprising a pair of rotatably mounted axes, one of said axes having an uneven contour extending along the length thereof and the other of said axes being connected to said contact actuating means of said first switch, means mounted on said other of said axes for cooperating with the contour of said one of said axes, a handle mounted on said one of said axes for moving said one of said axes to a plurality of positions, a first interlock member and a second interlock member; said first interlock member comprising a shield mounted on said one of said axes for rotation therewith and a pivotally mounted crank, said crank being connected to said one of said axes for pivotal movement thereby; said second interlock member comprising a slidably mounted latch connected to said one of

said axes for engaging said doors upon longitudinal movement of said second interlock member; said handle when moved to one position actuating said second interlock member to slidably engage and lock said doors closed and actuating said one of said axes and said shield to a position to prevent access to and actuation of said contact actuating means of said first switch and causing said means mounted on said other of said axes to engage said contour of said first axes to prevent actuation of said contact actuating means of said first switch; said handle when moved to a second position actuating said second interlock member to slidably engage and lock said doors closed, rotating said crank to block the movement of said contact actuating means for said second switch, actuating said shield for exposing said contact actuating means for said first contact member and actuating said one of said axes for disengaging said means mounted on said other of said axes for releasing said contact actuating means for said first contact member; and said handle when in a third position actuating said second interlock member to unlock said doors, actuating said shield to block the access to said contact actuating means for said first switch, rotating said one of said axes to engage with said means mounted on said other of said axes to lock said first switch in contact open position, and rotating said crank to release said movable contact of said second switch for movement thereof; said shield and said one of said axes preventing said handle from being actuated from said third position to said first position without stopping at said second position and without having actuated said movable contact member of said first switch to contact closed position.

3. In combination, a cubicle comprising a plurality of doors; an electric circuit having terminals in said cubicle; a first switch and a second switch mounted in said cubicle and each controling said circuit; said first switch and said second switch each having a movable circuit controlling contact member, means for individually actuating said movable contact members of said first and second switches to circuit controlling positions; and an interlock mechanism arranged in said cubicle for controlling the actuation of said first and second switches and said doors comprising a pair of rotatably mounted axes, one of said axes having an uneven contour extending along the length thereof and the other of said axes being connected to said contact actuating means of said first switch, means threadably mounted on said other of said axes for movement axially therealong upon movement of said first switch and for cooperating with the contour of said one of said axes for controlling the movement of said first switch, a handle mounted on said one of said axes for moving said one of said axes to a plurality of positions, a first interlock member and a second interlock member; said first interlock member comprising a shield mounted on said one of said axes for rotation therewith and a pivotally mounted crank, said crank being connected to said one of said axes for pivotal movement thereby; said second interlock member comprising a latch connected to said one of said axes for engaging said doors upon movement thereof; said handle when moved to one position actuating said second interlock member to engage and lock said doors closed and actuating said one of said axes and said shield to prevent access to said contact actuating means of said first switch and causing said threadably mounted means to engage said contour of said first axes to prevent actuation of said contact actuating means of said first switch; said handle when moved to a second position actuating said second interlock member to engage and lock said doors closed, rotating said crank to block the movement of said contact actuating means for said second switch, actuating said shield for exposing said contact actuating means for said first contact member and actuating said one of said axes for disengaging said threadably mounted means therefrom thereby releasing said contact actuating means for said first contact member; and said handle when in a third position actuating said second interlock member to unlock said doors, actuating said shield to block the access to said contact actuating means for said first switch, rotating said one of said axes to cause said contour to engage with said threadably mounted means to lock said first switch in contact open position, and rotating said crank to release said movable contact of said second switch for movement thereof; said shield and said one of said axes preventing said handle from being actuated from said third position to said first position without stopping at said second position and without having actuated said movable contact member of said first switch to contact closed position.

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