Oct. 12, 1965 H. H. KOBRYNER 3,211,859

FUSIBLE KNIFE-BLADE SWITCH HAVING A DRIVING BAR FOR BOTH DISCONNECTING THE MAKE-BREAK FREE END AND ROTATING THE HINGE END FROM THEIR RESPECTIVE BLADE CONTACTS

Filed Oct. 10, 1960 3 Sheets-Sheet 1

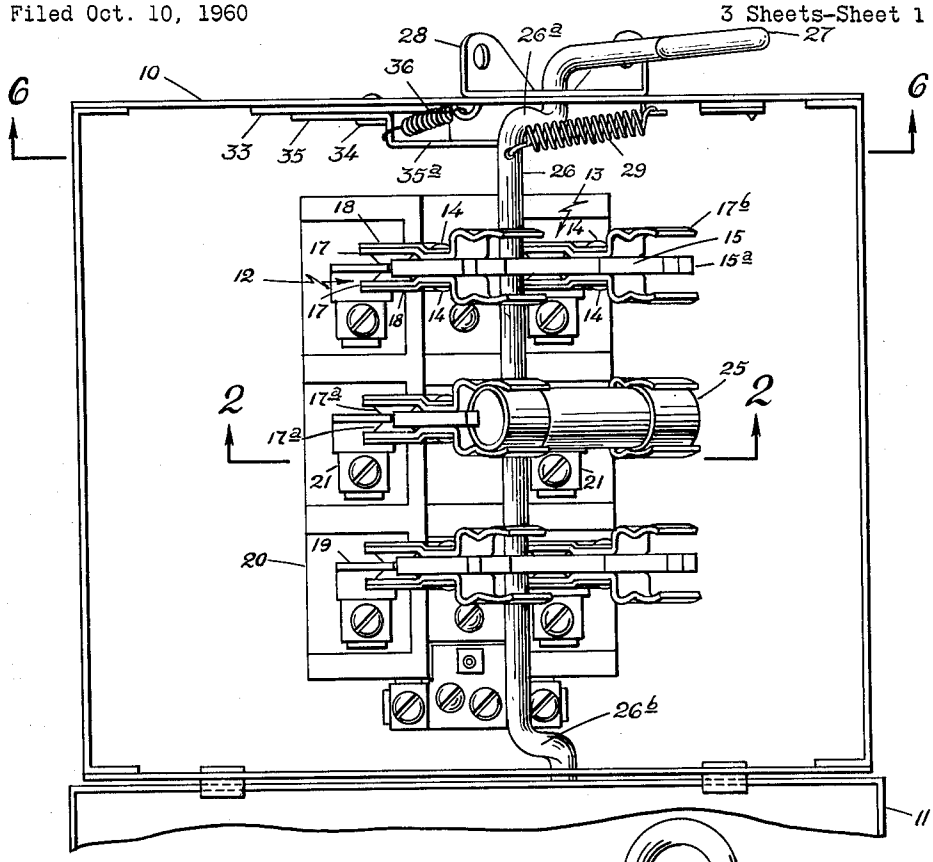


Fig. 1

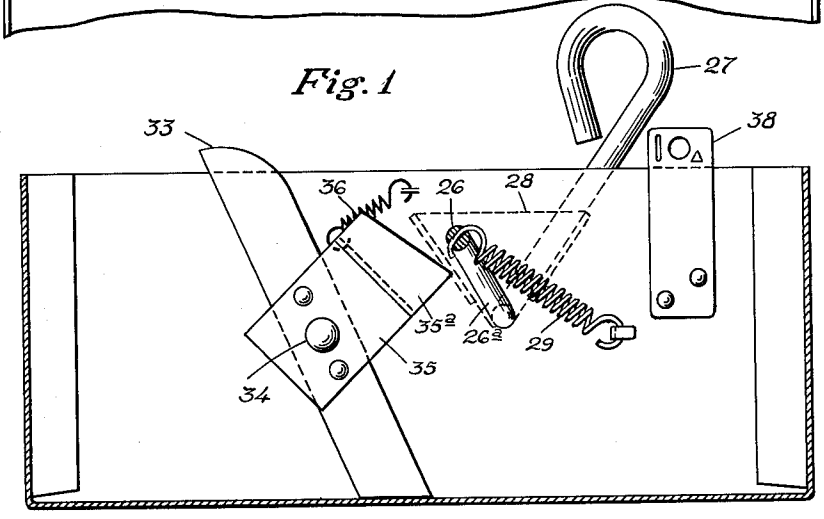


Fig. 6

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3 Sheets-Sheet 2

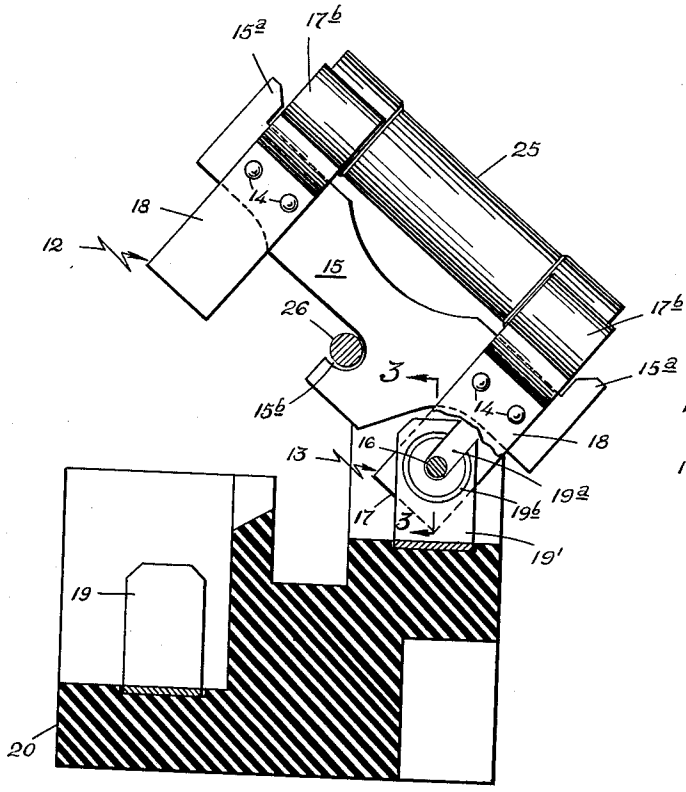


Fig. 2

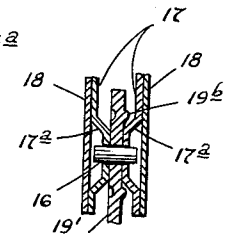


Fig. 3

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Filed Oct. 10, 1960 3 Sheets-Sheet 3

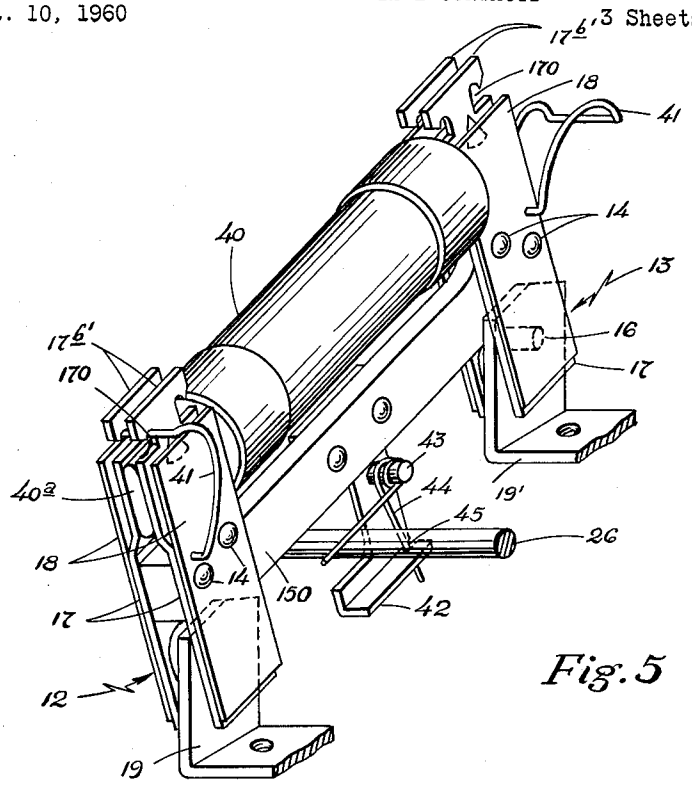


Fig. 5

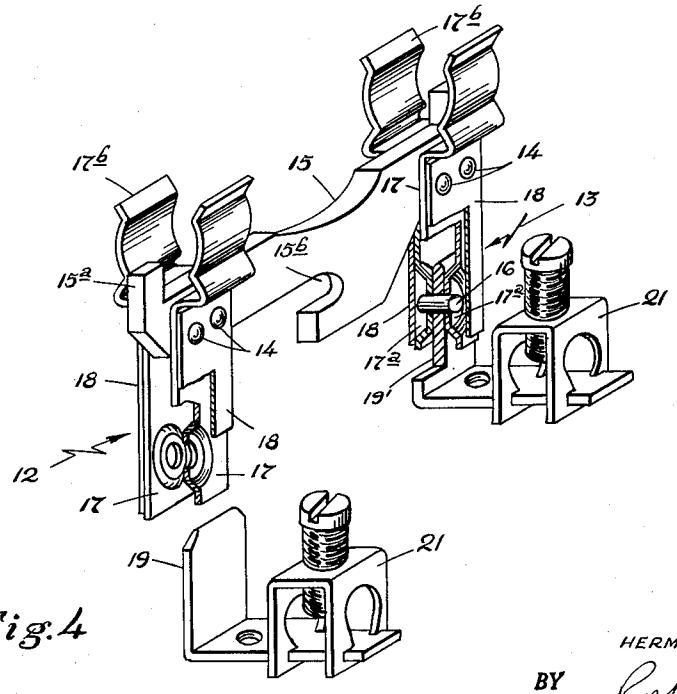


Fig. 4

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United States Patent Office

3,211,859

Patented Oct. 12, 1965

3,211,859

FUSIBLE KNIFE-BLADE SWITCH HAVING A DRIVING BAR FOR BOTH DISCONNECTING THE MAKE-BREAK FREE END AND ROTATING THE HINGE END FROM THEIR RESPECTIVE BLADE CONTACTS

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Filed Oct. 10, 1960, Ser. No. 61,411
4 Claims. (Cl. 200—114)

This invention relates to line connecting means which involves fuses and switches between power and load lines.

Prior line connecting means comprise separate switch and fuse units arranged in series and having individual connections to line terminals.

An object of the invention is to eliminate the need for separate switch and fuse units and to provide, instead, a single novel switch-fuse unit merging switching and fusing functions and requiring only one set of connections to the line.

This aspect of the invention involves a switch incorporating a fuse as one of its elements. More particularly, a knife switch is provided which utilizes a fuse as a connector between switch ends of common switch metal such as copper. The novel switch has make-break and hinge switch ends assembled in mutually insulated relation on a rigid carrier and provided with means to mount a fuse as a bridge between the switch ends. In one embodiment, the switch ends are provided with clips for mounting a ferrule fuse.

In another embodiment, the clips are adapted to mount a knife-ended fuse. Preferably, keepers are associated with the latter form of clips to prevent the fuse from being dislodged.

A fuse-switch unit according to the invention eliminates metal connections required in prior line connecting means for serially connecting separate switch and fuse units and for individually connecting the units to the line. Further, the novel fuse-switch unit eliminates switch metal between the make-break end and the hinge end. Because of the fewer metal connections and parts required by the novel fusible switch and because of its shorter total current path in metal, the heat generated under rated current is less than normal, making it feasible to use switch metal of reduced cross section. All these factors contribute toward lowering the cost of the switch. Further, because of the shorter length of the composite switch and fuse unit compared to the length of serially arranged separate switch and fuse units, a switching device comprising one or a gang of the fusible switches can be set in a smaller enclosure, requiring less wall space; the cost of manufacture also being less.

Another object of the invention is to provide a switching device which permits ready inspection, cleaning and adjustment of contact surfaces. This aspect of the invention involves a mounting for a hinged switch pole which enables the pole to be removed or replaced without tools and independently of other poles in a multipole switching device. Each switch pole has pin and slot hinge connection with a fixed element in the enclosure for the switching device, the slot being open at one end and angled to allow release of the hinge pin from the slot only when the circuit breaker is in its off position. The enclosure for a switching device comprising a gang of such switch poles includes a cross rod engaged by intermediate portions of the switch poles; the cross rod being operable to drive the switching device to "on" and "off" positions. According to the invention, when the circuit breaker is in the "off" position, any of its switch poles can be dismounted by rocking the pole about the driving

cross rod, which serves as a fulcrum, to release the hinge pin from its seating slot.

Other objects of the invention include a novel hinge blade for normally retaining the hinge pin of the switch properly seated in a slot in the hinge blade; quick-break means for the switching device; and means for barring accidental closure of the circuit breaker while the enclosure for the circuit breaker is open.

The above mentioned and other features and objects of this invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a plan view of a typical 3-pole switching device and its enclosure, both constructed according to the invention;

FIG. 2 is a fragmentary section on line **2—2** of FIG. 1 and shows a switch pole at its limit "off" position;

FIG. 3 is a fragmentary section on line **3—3** of FIG. 2, through the hinge end of the switch pole;

FIG. 4 is a partly sectioned perspective of the switch pole in a position approaching "on" position, portions of the switch pole being broken away to expose other portions;

FIG. 5 is a perspective view of a switch pole in "on" position and modified to mount a knife type of fuse cartridge; and,

FIG. 6 is a fragmentary section on lines **6—6** of FIG. 1

Referring now to FIG. 1, a 3-pole switching device is shown, usable for example to connect a 3-phase 220 volt power line to load lines. The switching device is mounted in an enclosure **10** provided with a hinged door **11**. Each switch pole includes a hinged assembly having a make-break end **12** and a hinge end **13**, respectively fastened by bolts **14** to the front and rear ends of a strong and rigid carrier plate **15** of insulating material. The make-break end and the hinge end are similarly constructed, the hinge end being supplemented by a hinge pin **16**. Each of these ends comprises paired copper blade jaws **17** backed and reinforced by steel blade springs **18**. One jaw **17** and its backing spring **18** are fastened against one side of the insulating carrier **15** by two of the bolts **14**, and the companion jaw with its backing spring are fastened against the other side of the carrier by the same two bolts. The paired jaws have facing bosses **17***a* spaced to clasp a fixed contact blade **19** or **19'**, with inherent spring pressure reinforced by the clamping pressure of backing springs **18**. Blades **19** and **19'** are respectively embraceable by the make-break pair of jaws **17** and the hinge pair of jaws. These blades are formed as vertical legs of copper angle pieces mounted on an insulating block **20** fixed to the base of enclosure **10**. Terminal connectors **21** are associated with the horizontal legs of the angle pieces.

Blade **19'**, which serves as a hinge blade, has an inclined slot **19***a* opened at the outer end to receive hinge pin **16**. The hinge pin is supported in the center holes of the bosses **17***a* in the rear hinge jaws **17** and is confined endwise by the backing spring plates **18** for these jaws. The hinge blade **19'** is formed at one side with a raised ring **19***b* concentric about the rounded bottom of slot **19***a* and affording a circular depression into which the protuberance or boss **17***a* of one of the hinge jaws **17** snaps when the hinge pin **16** is seated at the bottom of the slot **19***a*. The ring **19***b* thus normally locks the hinge jaws in proper position for holding the hinge pin down on its seat at the bottom of the slot **19***a*.

Each of the jaws **17** is integrally formed with an upper curved portion **17***b* serving as one half of a ferrule fuse clip. When two of the jaws are paired at an end of insulating carrier **15**, their curved portions **17***b* extend above

the carrier as complemental halves of a flexible fuse clip. A ferrule fuse cartridge **25** is insertable into the front and rear clips **17***b* to serve as a fusible bridge between the switch ends. Lugs **15***a* of insulating carrier **15** act as end stops for the cartridge fuse.

Each insulating carrier is formed with an open-ended longitudinal slot **15***b* for receiving an operating cross bar **26**. The cross bar is a crank rod eccentrically mounted by side arms **26***a* and **26***b* in opposite sides of enclosure **10** (see FIGS. 1 and 6). Integral with arm **26***a* and located outside the enclosure **10** is a handle **27**. The handle is rockable between limits determined by its engagement with spaced ears of a bracket **28** riveted to the adjacent side of the enclosure. A coil spring **29** extends between the cross bar **26** and an inside wall of the enclosure to act with toggle spring effect for snapping the cross bar to one or the other of the its limit positions. The cross bar passes through the slots **15***b* of the three hinged switch pole assemblies provided in the shown switching device and is rockable by means of the handle **27** to swing the switch pulse to "on" and "off" positions.

Any of the switch poles can be dismounted without tools when the switching device is at its "off" limit. For this purpose, the slot **19***a* in hinge blade **19'** is angled rearwardly and upwardly and is open at its outer end. When the switching device is "on" or down from its "off" position, the switch poles and the cross rod **26** are in lower positions. Rocking of a switch pole, therefore, about the rod as a fulcrum in a direction, counterclockwise in FIG. 2, to raise the hinge end **13** is prevented because the slot **19***a* is at an angle intersecting the attempted arc of movement of the hinge pin **16**. Pulling out the pole in the direction of the slot is also impossible due to the shape of the insulating base.

On the other hand, when the switch is "off," the rod **26** and switch poles are in upper positions and the relative disposition of the parts is such that leverage applied to a switch pole by the hand for rocking the pole about the rod in a direction to raise the hinge end **13** moves the hinge pin in an arc aligned with the angle of slot **19***a*, whereby the hinge pin can be moved out of the slot. The switch pole can then be manipulated to shift its slot **15***b* off the rod **26**, leaving the switch pole free to be removed.

A reverse procedure is followed to re-mount the switch pole or to mount a new pole in place. Thus, with the switching device in the "off" position, and only in the "off" position, a switch pole can be manipulated to receive the rod **26** in its slot **15***b*. The switch pole can then be rocked about the rod in a direction to swing the hinge end **13** down, whereupon the hinge pin **16** will enter the seating slot **19***a* in hinge blade **19'** and the boss **17***a* on one of the hinge jaws **17** will snap into the recess formed by the raised ring **19***b* to hold the hinge pin in its seat.

Means are provided to bar the inadvertent closure of the switches when the door **11** of enclosure **10** is open. This means includes an upright bar **33** disposed alongside the inside wall of the enclosure opposite the side to which the door is hinged. Bar **33** is pivoted on a stud **34** projecting from the adjacent wall. Riveted to the free side of the bar **33** is a plate **35** integrally formed with an offset upper part **35***a*. A spring **36** biases the bar **33** and attached plate **35** clockwise (FIG. 6). When the door **11** is open, the bar **33** takes a position, under the influence of spring **36**, in which its upper end protrudes above the enclosure, the lower end of the bar striking the bottom of the enclosure to limit the clockwise position of the bar. In this position of the bar, the ledge **35***a* is in the path of the downward movement of the cross rod **26** from "off" to "on" position. Hence, when the door **11** is open, operation of the rod **26** to close the switches is blocked by ledge **35***a*.

When the door is closed, it engages the upper end of bar **33** and rocks the bar and attached plate **35** counterclockwise. The ledge **35***a* then occupies a position removed from the arc of travel of switch operating cross rod **26**. A common snap latch **38** is provided on the enclosure **10** for holding the door **11** closed.

FIG. 5 shows a modification of the composite switch-fuse unit, the unit here being shown in the "on" position. Elements which are essentially the same as in the previously described embodiment are given the same reference designations in FIG. 5.

The jaws **17** at each end are modified in their upper portions to provide flat flexure clips **17***b'* for reception of the knife ends **40***a* of a knife-ended fuse cartridge **40**. This fuse cartridge is heavier than and more adversely affected by inertia during change-overs of the switch from one position to the other and therefore tends to slide out of the fuse clips **17***b'*. To prevent this, retainers in the form of wire bail hooks **41** are pivoted at their lower ends in suitable holes through blades **18** and **17** and their insulating carrier **150**. The bails can be swung into positions in which their upper cross-pieces snap into bayonet slots **170** formed in clips **17***b'* above the knife ends **40***a*. The backing blade springs **18** are here extended upwardly and slightly bent backward to engage the sides of bails **41** with sufficient tension to maintain the bails in their fuse latching positions. In FIG. 5, the bail **41** at the make-break end is in operative position over a fuse end, while the bail at the hinge end is shown in its release position.

FIG. 5 also shows a modified insulating carrier **150**. This carrier, instead of integrally incorporating a slot for passage of driving rod **26**, has fastened to it a steel hook **42**. The toe of hook **42** is spaced below the carrier **150**. A pin **43** is riveted to the hook **42** below the carrier. The vertical leg of a hair-pin torsion wire spring **44** is engaged at its free end in a rear slot **45** of the hook toe. The horizontal leg of the spring **44** is flexed into position over the driving cross rod **26** which engages the upper edge of the toe of the hook. This arrangement causes a quick-break action of the switch when the rod **26** is rocked upwardly to open the switch. Upon moving the rod **26** upwardly it acts on the horizontal leg of spring **44** to increase its spread from the vertical leg, thereby increasing the spring tension until the rod hits the carrier **150** and pushing it, rocks the switching pole around pin **16** up to the point of disengagement between terminal **19** and switching end **12**. In this position, due to the disappearance of frictional forces in the disengaged contact, the tension of the spring is big enough for snaping the switching pole up and causing a quick-break.

While the foregoing description sets forth the principles of the invention in connection with specific apparatus, it is to be understood that this description is made only by way of example and not as a limitation of the scope of the invention as set forth in the objects thereof and in the accompanying claims.

What is claimed is:

1. A knife switch including a hinged switch pole having a make-break free end and an opposite hinge end, and a complementary stationary hinge bracket having hinge pin and slot connection with the hinge end of the switch pole, the slot being closed at the inner end to provide a seat for the hinge pin and being open at the outer end and angled to permit entry or exit of the hinge pin through the open end of the slot only when the switch pole is in off position, the hinge bracket comprising a hinge blade, the hinge end of the switch pole comprising spaced arms for straddling the hinge blade, the hinge pin being supported across said arms and the slot being in said blade for seating the hinge pin when the arms are astride the blade, a driving bar member pivotally attached to said switch pole between the free end and hinged end thereof, the switch pole being rotatable about said driving bar member while in off position in a direction to shift the hinge pin out of the open end of the slot and said arms away from the hinge blade, thereby to dismount the switch pole.

2. The invention according to claim **1**, said blade having a circular portion concentric with the hinge pin seat-

ing end of the slot and at least one of said arms having a complementary circular portion, one of said portions being a depression and the other being a mating protuberance to snap into the depression when the hinge pin is at the seating end of the slot, so as to retain the hinge pin releasably in seated position.

3. A knife switch according to claim 2, said spaced arms of the hinge end being flexible jaws for clasping said hinge blade with inherent spring pressure and being provided with receiving holes for the hinge pin, and reinforcing spring blades backing said arms and engaging the hinge pin ends to maintain the hinge pin in position betwee said jaws.

4. A circuit breaker comprising a gang of knife switches in parallel formation, a box enclosure for the knife switches, each knife switch having spaced front and rear contact elements fixed through insulation to the base of the box and having a hinged switch pole with correspondingly spaced make-break and hinge switch ends, an elongated carrier to which the switch ends are fixed in mutually insulated relation, fuse clips provided on the switch ends for replaceably mounting a fuse cartridge, the hinge end and the associated rear contact element having hinge pin and slot connection, the slot being closed at the inner end to seat the pin and being open at the outer end and angled to permit entry or exit of the pin only while the switch pole is in off position in which the make-break end is away from the associated front contact element, a driving bar mounted eccentrically in opposite sides of the enclosure and extending across the elongated carriers of the gang of switch poles, a handle connected with the driving bar and located outside the enclosure for rocking the driving bar to act on the elongated carriers for

swinging the gang of switch poles from off to on position or vice versa, the switch poles and driving bar being in such relative positions in off position that rocking of any switch pole apout the driving bar in a direction to raise the hinge end produces relative movement between the hinge pin and slot, of the hinging connection between the hinge end and associated rear contact element, in a direction aligned with the slot direction so as to cause the hinge pin to leave the slot through its open end while at the same time the hinge end is withdrawing from the associated rear contact element, whereby the switch pole is dismounted, the switch pole being mounted and the hinge connection established by rocking the switch pole about the driving bar, while in off position, in a direction opposite the aforementioned direction.

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