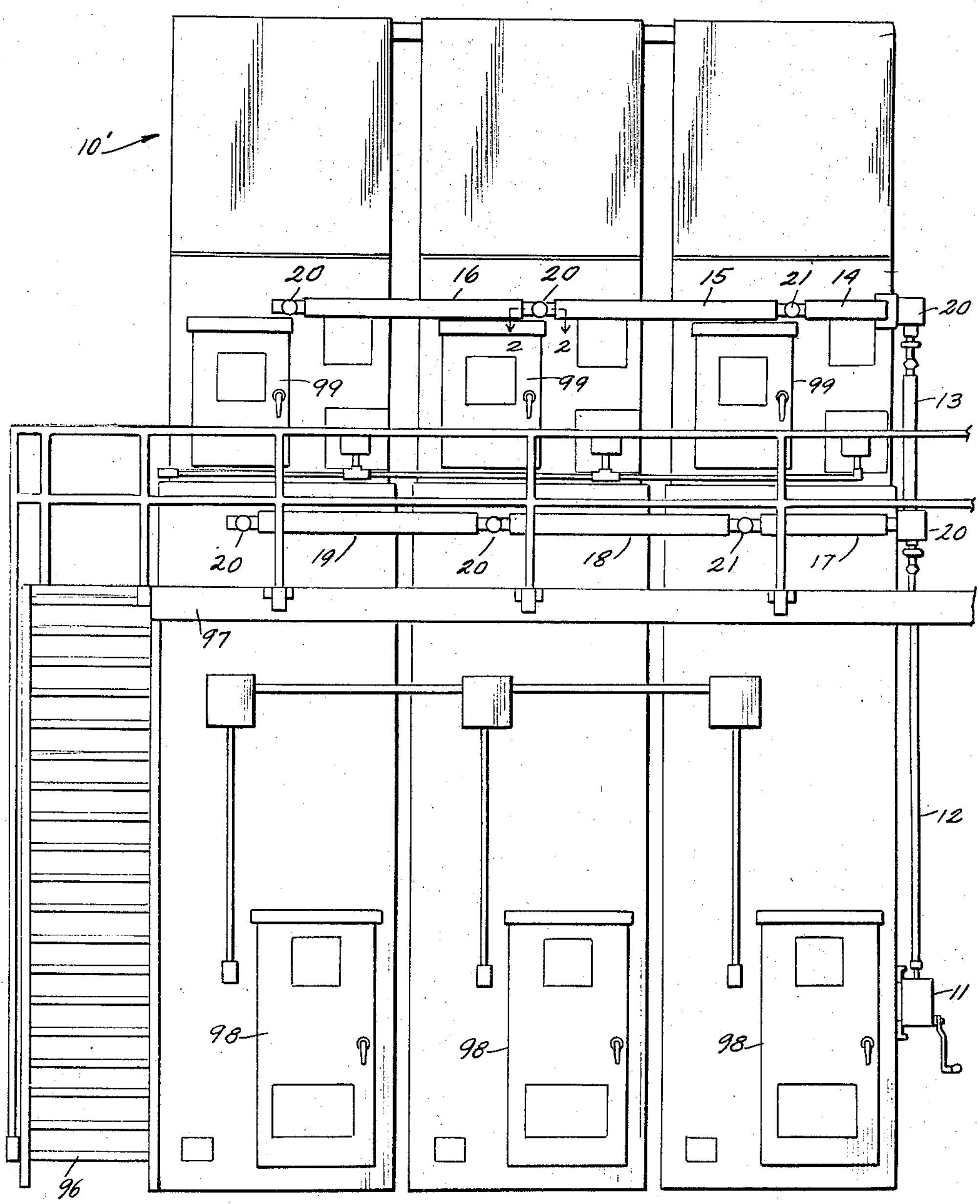
June 2, 1959 R. H. ALBRIGHT 2,889,435

TELESCOPING BLADE SWITCH

Filed May 22, 1957 4 Sheets-Sheet 1

FIG. 1



INVENTOR.
ROY H. ALBRIGHT

BY Ostrolenk, Faber, Gerb & Soffen

ATTORNEYS

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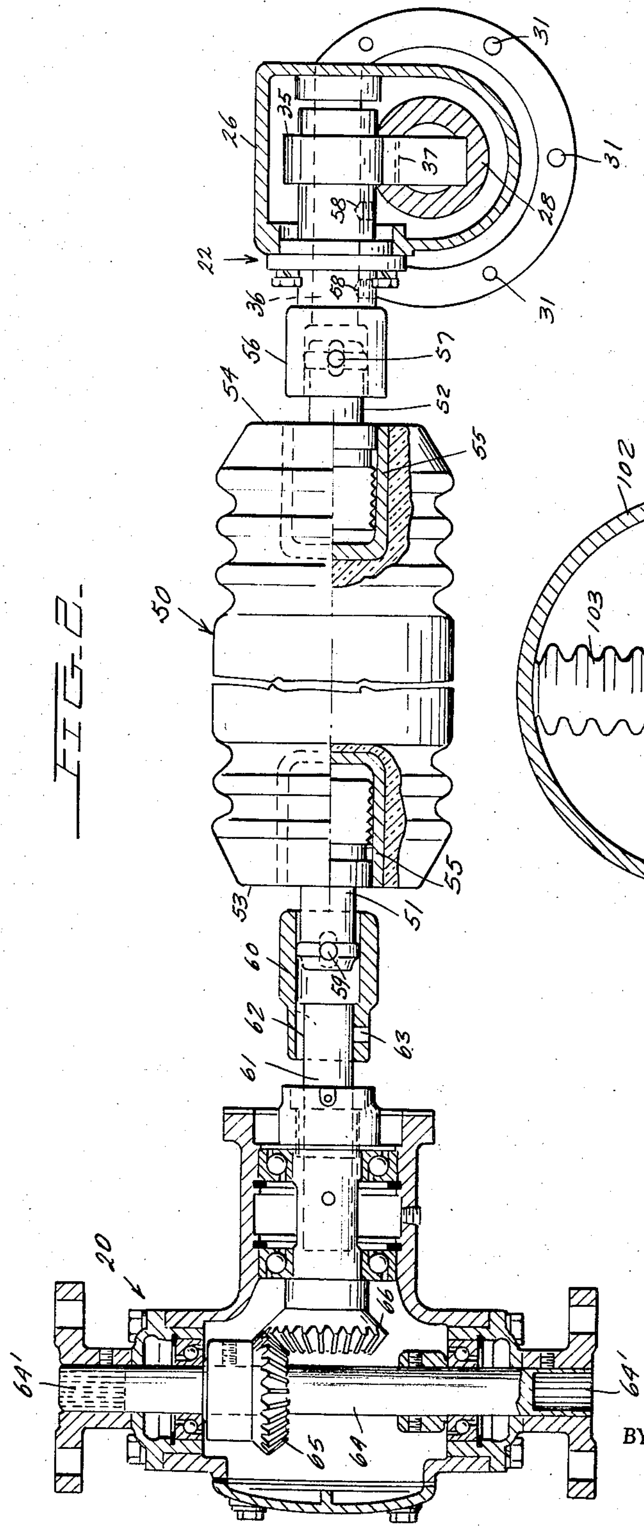

FIG. 2.

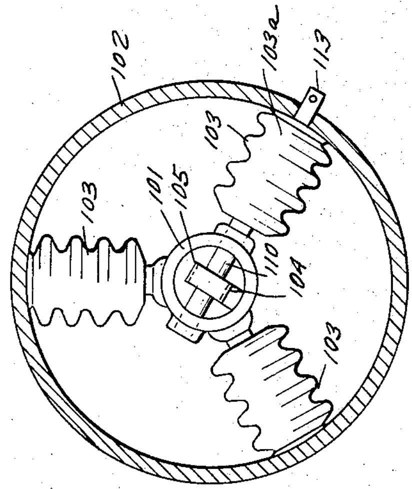

FIG. 9A.

INVENTOR.
ROY H. ALBRIGHT

BY Ostrolenk, Faber, Gerb & Soffen

ATTORNEYS

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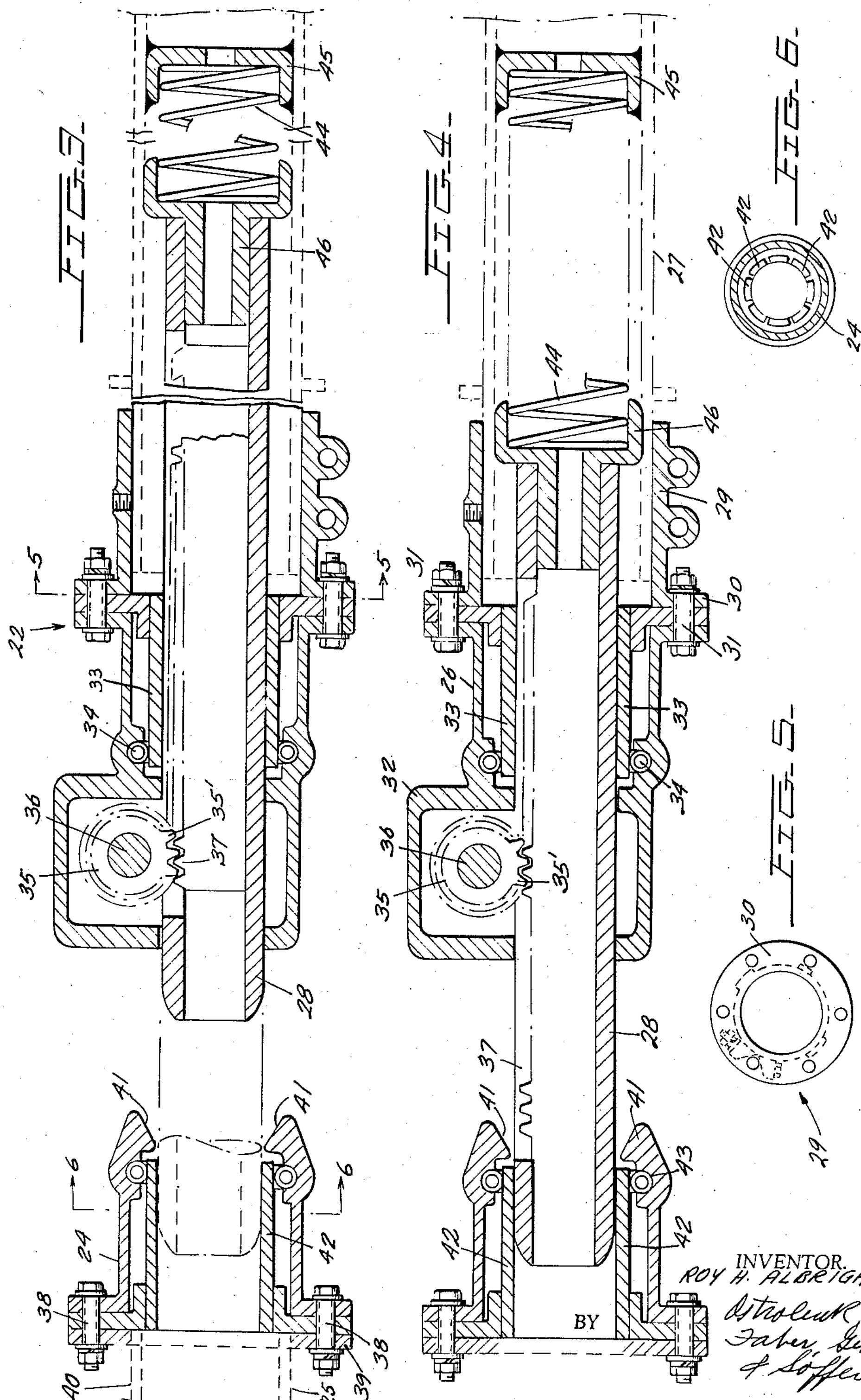
TELESCOPING BLADE SWITCH

Filed May 22, 1957 4 Sheets-Sheet 3



INVENTOR.
ROY H. ALBRIGHT
BY
Ostrolenk, Faber, Gerb, & Soffen
ATTORNEYS

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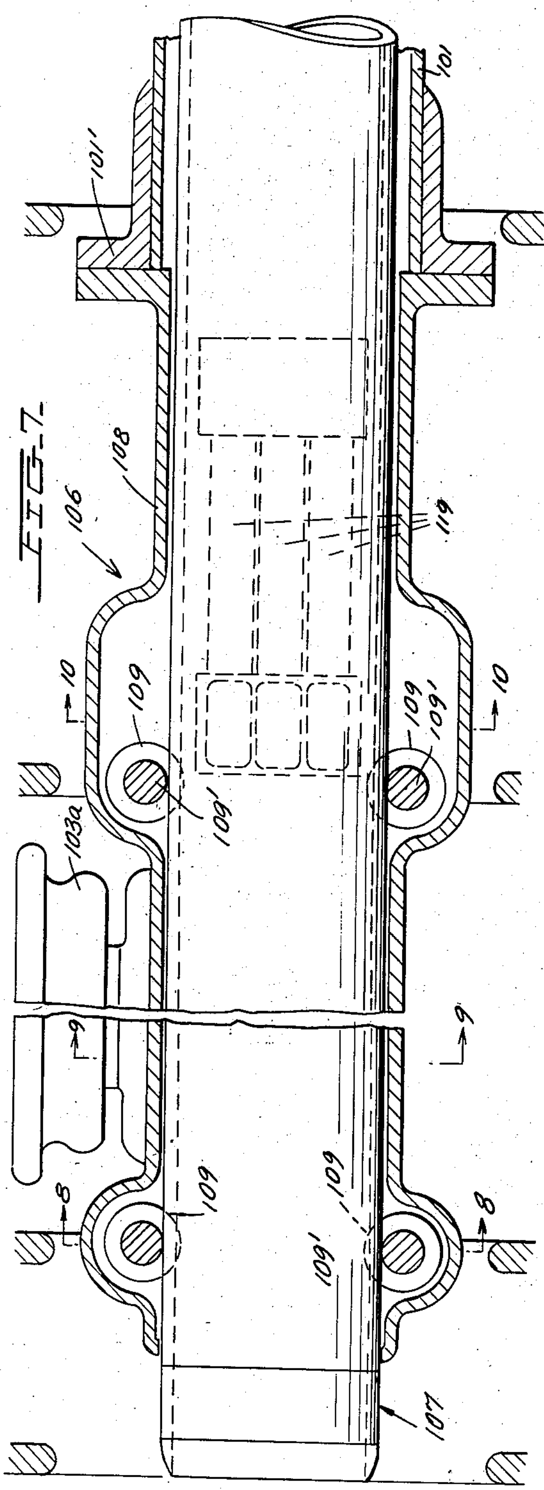
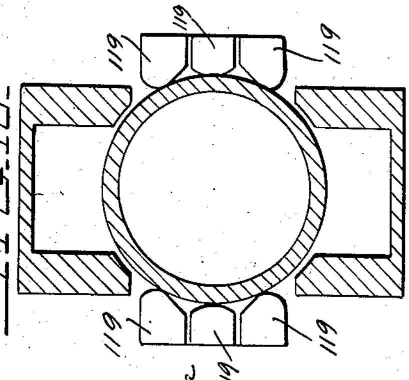
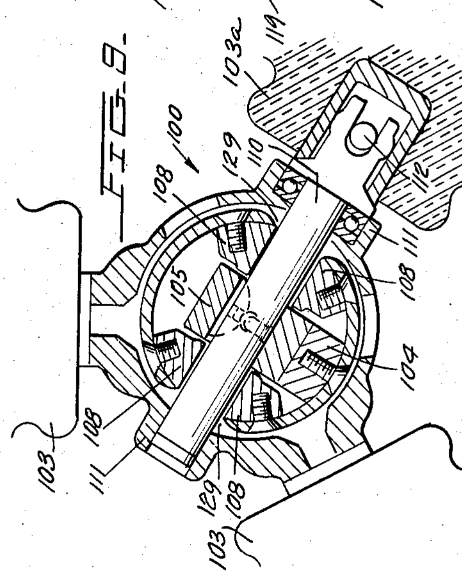
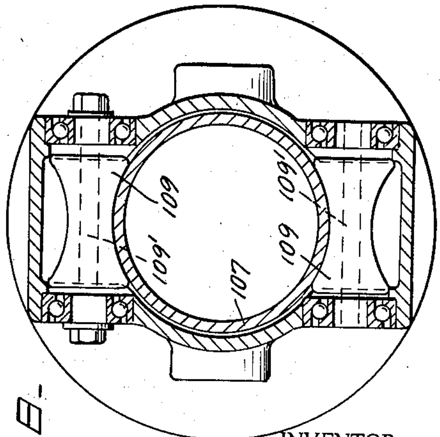
Filed May 22, 1957

4 Sheets-Sheet 4









INVENTOR.
ROY H. ALBRIGHT

BY Ostrolenk, Faber, Gerb & Soffen

ATTORNEYS

United States Patent Office

2,889,435

Patented June 2, 1959

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2,889,435

TELESCOPING BLADE SWITCH

Roy H. Albright, Greensburg, Pa., assignor to I-T-E Circuit Breaker Company, Philadelphia, Pa., a corporation of Pennsylvania

Application May 22, 1957, Serial No. 660,920

5 Claims. (Cl. 200—163)

This invention relates to electric switches used in high current and high voltage applications and more particularly to an electric switch wherein the operating force therefore is transmitted through a rotating insulator to move the switch blade along its longitudinal axis, which coincides with the longitudinal axis of the terminating conductor, to effect circuit opening and closing.

In isolated phase bus, metal enclosed switchgear, and certain indoor applications space is at a premium. At the present time the conventional methods of breaking the circuit, in such equipment, comprise a pivoted blade or a blade that is moved transverse to its own axis to produce a double break. Therefore, equipment must be constructed with large unoccupied spaces through which the blades will travel during operation of the switches.

This invention provides a blade which is moved along its longitudinal axis to telescope within one of the terminating conductors thereby achieving a large saving in space. The telescoping blade switch lends itself to high current applications as it permits the use of more highly efficient tubular conducting members for blades than the conventional switches using bar type blades. The telescoping blades permit the use of multiple contacts on the outer surface of the blades to provide a uniform and effective current distribution. Inasmuch as the blade may have essentially the same contour as the conductors, the blade will have an equalized current distribution. Furthermore, this switch is adaptable for high voltage applications since the parts can be effectively shielded to approach a uniform electrostatic field which is essential for high dielectric characteristics.

Movement is imparted to the blade by means of an operating mechanism comprising a pinion gear which is in operative engagement with a rack secured to the blade. A rotatable insulator is interposed between the pinion gear and the switch actuating means which may be hand or power operated.

The rack and pinion require very little space. In fact, in the case of isolated phase bus, with its large hollow conductors, the rack and pinion will mount inside the conductors and the entire switch will mount inside an enclosure of the same dimensions as the bus housing. For smaller sized conductors the pinion will be mounted outside of the blade and cooperate with a rack mounted on the inner surface of the blade.

Operational force requirements are very low which reduces the stresses on the rotatable insulator. Furthermore, the insulator is not subjected to a cantilever load but rather to a torsional load which it is better able to withstand.

Accordingly, a primary object of this invention is to provide an electric switch for high current and high voltage application which does not require additional space for blade movement during operation of the switch.

Another object is to provide an electric switch having

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a telescoping blade operated by means of a rack and pinion.

Still another object is to provide an electric switch having a telescoping blade operated by means of a rack and pinion wherein the pinion is driven through a rotatable insulator.

A further object is to provide an electric switch having a telescoping blade operated by means of a rack and pinion both mounted within the blade.

Still another object is to provide an electric switch having a telescoping blade operated by means of a rack and pinion wherein the rack is mounted on the blade and the pinion is mounted outside the blade.

Yet another object is to provide an isolated phase bus having a telescoping blade switch wherein the blade is operated by means of a rack and pinion both mounted inside the blade and the pinion is driven by a rotatable insulator positioned between the bus housing and hollow bus bar.

These objects and other objects will readily become apparent after reading the following description of the accompanying drawings in which:

Figure 1 is a side elevation of a switchgear enclosure wherein the telescoping blade switch may be mounted.

Figure 2 is a section through line 2—2 of Figure 1 looking in the direction of arrows 2—2.

Figure 3 is a longitudinal section of a telescoping blade switch having the actuating pinion mounted externally of the blade. In Figure 3 the switch is open.

Figure 4 is a view similar to that of Figure 3 with the switch closed.

Figure 5 is a section, reduced in size, through line 5—5 of Figure 3 looking in the direction of arrows 5—5.

Figure 6 is a section, reduced in size, through line 6—6 of Figure 3 looking in the direction of arrows 6—6.

Figure 7 is a longitudinal section of another embodiment of the telescoping blade switch.

Figure 8 is a section through line 8—8 of Figure 7 looking in the direction of arrows 8—8.

Figure 9 is a section through line 9—9 of Figure 7 looking in the direction of arrows 9—9.

Figure 9*a* is a transverse section of isolated phase bus having a telescoping blade switch.

Figure 10 is a section through line 10—10 of Figure 7 looking in the direction of arrows 10—10.

Referring more particularly to Figures 1–6, switchgear enclosure **10′** is provided as a setting for the first embodiment of this invention. Balcony **97**, reached by stairway **96**, encircles enclosure **10′** about midway between the top and bottom thereof. Upper **99** and lower **98** access doors provide convenient entrance to the interior of enclosure **10′** for maintenance purpose. Hand operated mechanism **11**, mounted near ground level to the outside of enclosure **10**, acts through rotating linkages **12**, through **19** and directional gear boxes **20** and **21** to simultaneously operate three identical switches **22**.

For the sake of simplicity, only one switch **22** and its coupling to its associated directional gear box **20** shall be described, it being understood that the other ganged switches **22** are substantially identical. Switch **22** comprises a jaw structure **24** mounted on a first conductor **25**, a contact structure **26** mounted on a second conductor **27**, and a movable blade **28** which is slidably positioned within contact structure **26**. Conductors **25** and **27** are positioned in axial alignment with a gap therebetween which is bridged by blade **28** when the switch **22** is in a closed position (Figure 4).

Contact structure **26** comprises a housing **32** which has mounted therein contact fingers **33** which are arranged in circular fashion to be in wiping contact with the outer surface of blade **28**. Garter spring **34** provides a biasing force to urge fingers **33** against blade **28**. Housing **32** is secured to hollow conductor **27** by means of bolts **31**, which also pass through flanges **30** of clamp **29** which is secured to the end of conductor **27**. Pinion **35** is positioned in housing **32** and is mounted for rotation on shaft **36** with teeth **35'** being in operative engagement with longitudinal gear rack **37** on the outer surface of blade **28**.

Jaw structure **24** is secured to hollow conductor **25** at the end thereof by means of bolts **38** which pass through flange **39** of clamp **40** which is secured to the end of conductor **25**. It is to be noted that blade **28**, jaw structure **24**, and conductors **25**, **27** are axially aligned.

When pinion **35** is rotated clockwise with respect to Figure 3, plate **28** will be projected from housing **32** into engagement with jaw structure **24** as in Figure 4. Jaw structure **24** includes a tapered guide means **41** at the entrance thereof to guide blade **28** between the circular arranged contact fingers **42** which are biased toward the longitudinal axis by garter spring **43** into engagement with the outer surface of blade **28**. Thus, an electrical path is completed between hollow conductor **25** through the contact fingers **42** of jaw structure **24**, blade **28**, contact fingers **33** of contact structure **26** to the hollow conductor **27**. If switch **22** is mounted with the longitudinal axis of conductors **25**, **27** in a vertical position with conductor **27** positioned below conductor **25**, a spring **44** is provided to counterbalance the weight of blade **28**. One end of spring **44** rests against abutment **45** which is welded or otherwise secured to conductor **27** and the other end of spring **45** rests against member **46** which is wedged into blade **28** thereby biasing blade **28** upward and in this manner lessens the force required to operate switch **22** to its closed position and the force required to maintain blade **28** in its projected position.

A rotating insulator **50** serves as the operative connection between rotating linkage **20** and pinion shaft **36**. Inserts **51** and **52** project from ends **53**, **54** respectively of insulator **50** and are secured thereto by means of die metal recess linings **55**. Pin **57** secures insert **52** to coupling **56** which is secured to shaft **36** by means of said screws **58** while pin **59** secures insert **51** to coupling **60** which is joined to output shaft **61** of gear box **20** by means of key **62** and screw **63**.

Shaft **64** of gear box **20** is driven by one of the rotating linkages **14—19** having splined ends (not shown) which mate with internal formations **64'** to thereby drive bevel gear **65**. Bevel gear **65** mates with a second bevel gear **66** keyed to output shaft **61** to thereby rotating insulator **50** which in turn rotates pinion shaft **36** to drive pinion **35** and operate switch **22**.

When switch **22** is closed, blade **28** bridges the gap between jaw structure **24** and contact structure **26**. To move switch **22** to its open position of Figure 3, pinion **35** is rotated counter clockwise with respect to Figure 3. Pinion **35** being in engagement with rack **37** will move blade **28** longitudinally to the right with respect to Figure 4 so that it telescopes within conductor **27** and once again a gap is formed between jaw structure **24** and contact structure **26**.

Referring more particularly to Figures 7–10, the second embodiment of this invention is illustrated as switch **100** which is connected as a disconnect switch for isolated phase bus of a type described in detail in copending application Ser. No. 353,301, filed May 6, 1953 and assigned to the assignee of the instant invention. Briefly, isolated phase bus comprises a hollow conductor **101** centered within a housing **102** and insulated therefrom by means of insulators **103**. Hollow conductor **101** is large enough to permit pinion **105** to be mounted therein. Contact structure **106** is secured to the end of hollow conductor **101** at flange member **101'** and a jaw structure (not shown) similar to jaw structure **24** of Figures 3 and 4 is secured to a second isolated phase conductor (not shown) which is in longitudinal alignment with conductor **101**. A gap between the jaw structure and contact structure **106** will be bridged by switch blade **107** when switch **106** is in its closed position.

Contact structure **106** includes a housing **108** inside of which concave rollers **109** are rotatably mounted on shafts **109'**. Rollers **109** are provided since the great weight of blade **107** makes a sliding bearing contact impractical. Resilient contact fingers **119**, which are secured to the outside of housing **108**, have the free ends thereof extending through openings in housing **108** into wiping contact with blade **107**. A rack **104** is secured to the inside of blade **107** together with strengthening members **108** which are positioned adjacent to longitudinal slots **129** and provide additional support for the walls of blade **107**.

Pinion **105** is mounted on shaft **110** which is journalled in bearings **111** of contact structure housing **108**. Pin **112** couples shaft **110** to rotatable insulator **103*a***, which extends from contact structure housing **108** to isolated phase bus housing **102**. Rotatable insulator **103*a*** is of substantially the same design as rotatable insulator **50** of Figure 2 and may be used to replace one of the insulator supports **103** in the region of switch **100**. A stub shaft **113** extends from the housing end of rotatable insulator **103*a*** and is later connected to the actuating means (not shown) for switch **100** which may be of the same construction as the actuating means for switch **22**.

It is to be noted that by mounting the rack **104** and pinion **105** within the blade **107**, the size of housing **108** may be substantially equal to the size of conductors **101** thereby providing a substantially uniform current distribution. In the same manner, isolated phase bus housing **102** need not be mis-shapened over the area into which blade **107** telescopes thereby simplifying electrostatic shielding at high voltages.

Although the present invention has been described with an exemplary form, it is to be understood that variations may be made within the broader spirit and scope of the invention, and it is not intended to be limited except as set forth in the following claims.

I claim:

1. An electric switch comprising a first structure, a second structure, a hollow elongated blade; said structures being fixed in axial alignment with a gap therebetween; said blade being disposed within said first structure and slideable along the axis thereof; said switch having a closed position wherein said gap is bridged by said blade and an open position wherein said gap is open; a rack secured to said blade and a pinion in operative engagement with said rack to move said blade along its axis and thereby operate said switch between said open and closed positions; said rack being positioned between the ends of said blade; both said rack and said pinion being disposed within said blade; said pinion having its axis of rotation positioned perpendicular to the longitudinal axis of said blade; said blade having a longitudinally extending slot; said pinion axis of rotation extending through said slot.

2. An electric switch comprising a first structure, a second structure, a hollow elongated blade; said structures being fixed in axial alignment with a gap therebetween; said blade being disposed within said first structure and slideable along the axis thereof; said switch having a closed position wherein said gap is open; a rack secured to said blade and a pinion having the teeth thereof in mesh with the teeth of said rack to move said blade along its axis and thereby operate said switch between said open and closed positions; an insulator having its axis in alignment with the axis of said pinion; one end of said insulator being in operative engagement with said pinion whereby a rotational force applied to the other end of said insulator will be effective to operate said switch; said rack being positioned between the ends of said blade; both said rack and said pinion being disposed within said blade; said pinion having its axis of rota-

tion positioned perpendicular to the longitudinal axis of said blade; said blade having a longitudinally extending slot; said pinion axis of rotation extending through said slot.

3. An isolated phase bus structure comprising a first hollow conductor, a second hollow conductor, a bus housing, a plurality of insulators, a switch; said conductors being in axial alignment with a gap therebetween; said insulators being positioned between said conductors and said housing to center said conductors within said housing; said switch comprising a hollow elongated blade, a jaw, and a contact structure; said jaw being secured to said second conductor at an end thereof; said contact structure being secured to said first conductor at an end thereof; said blade being slidably disposed within said contact structure to move longitudinally into and out of said first conductor in a telescoping manner; said switch being movable between an open and a closed position; said blade being positioned across said gap and in engagement with said jaw when said switch is in said closed position; a rack secured to and positioned within said blade and a pinion disposed within said blade in operative engagement with said rack; a rotatable insulator being interposed between said pinion and said housing whereby actuating power may be transmitted to said switch; said longitudinal axis being in alignment with the axis of rotation of said pinion; said blade having a longitudinally extending slot; means connecting said longitudinal axis and said axis of rotation; said means extending through said slot and being positioned perpendicular to the longitudinal axis of said blade.

4. An electric switch comprising a first structure, a second structure, a hollow elongated blade; said structures being fixed in axial alignment with a gap therebetween; said blade being disposed within said first structure and slideable along the axis thereof; said switch having a closed position wherein said gap is open; a rack secured to said blade and a pinion in operative engagement with said rack to move said blade along its axis and thereby operate said switch between said open and closed positions; said rack being positioned between the ends of said blade; both said rack and said pinion being disposed within said blade; said pinion having its axis of rotation positioned perpendicular to the longitudinal axis of said blade; said blade having a longitudinally extending slot; said pinion axis of rotation extending through said slot; said first structure including a plurality of conducting fingers having first ends thereof in wiping contact with the

exterior surface of said blade; said first structure also including resilient means and at least one opening through which said first ends are urged by said resilient means into contact with said blade.

5. An isolated phase bus structure comprising a first hollow conductor, a second hollow conductor, a bus housing, a plurality of insulators, a switch; said conductors being in axial alignment with a gap therebetween; said insulators being positioned between said conductors and said housing to center said conductors within said housing; said switch comprising a hollow elongated blade, a jaw, and a contact structure; said jaw being secured to said second conductor at an end thereof; said contact structure being secured to said first conductor at an end thereof; said blade being slidably disposed within said contact structure to move longitudinally into and out of said first conductor in a telescoping manner; said switch being movable between an open and a closed position; said blade being positioned across said gap and in engagement with said jaw when said switch is in said closed position; a rack secured to and positioned within said blade and a pinion disposed within said blade in operative engagement with said rack; a rotatable insulator being interposed between said pinion and said housing whereby actuating power may be transmitted to said switch; said insulators longitudinal axis being stationary; said longitudinal axis being in alignment with the axis of rotation of said pinion; said blade having a longitudinally extending slot; means connecting said longitudinal axis and said axis of rotation; said means extending through said slot and being positioned perpendicular to the longitudinal axis of said blade; said rack being positioned between the ends of said blade; said contact structure including a plurality of conducting fingers having first ends thereof in wiping contact with the exterior surface of said blade; said contact structure also including resilient means and at least one opening through which said first ends are urged by said resilient means into contact with said blade.

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