Nov. 21, 1944. F. E. FLORSCHUTZ 2,363,307

CIRCUIT INTERRUPTER

Filed May 27, 1943 2 Sheets-Sheet 1

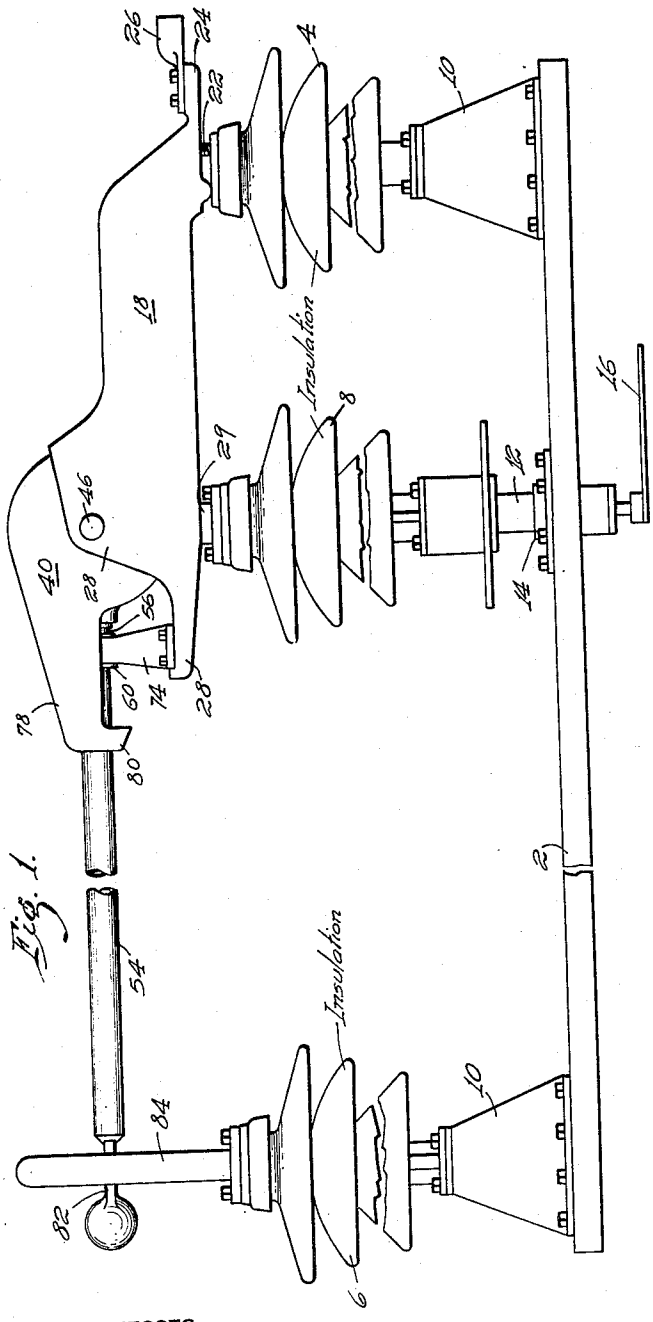


Fig. 1.

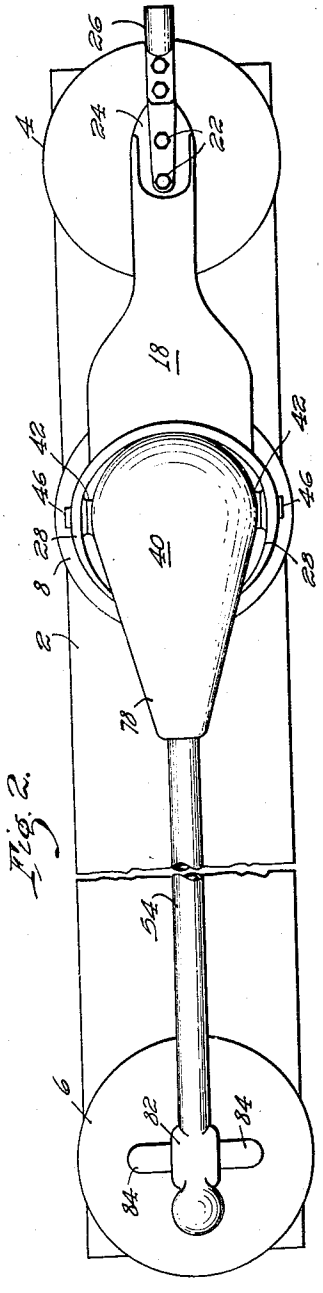


Fig. 2.

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CIRCUIT INTERRUPTER

Filed May 27, 1943 2 Sheets-Sheet 2

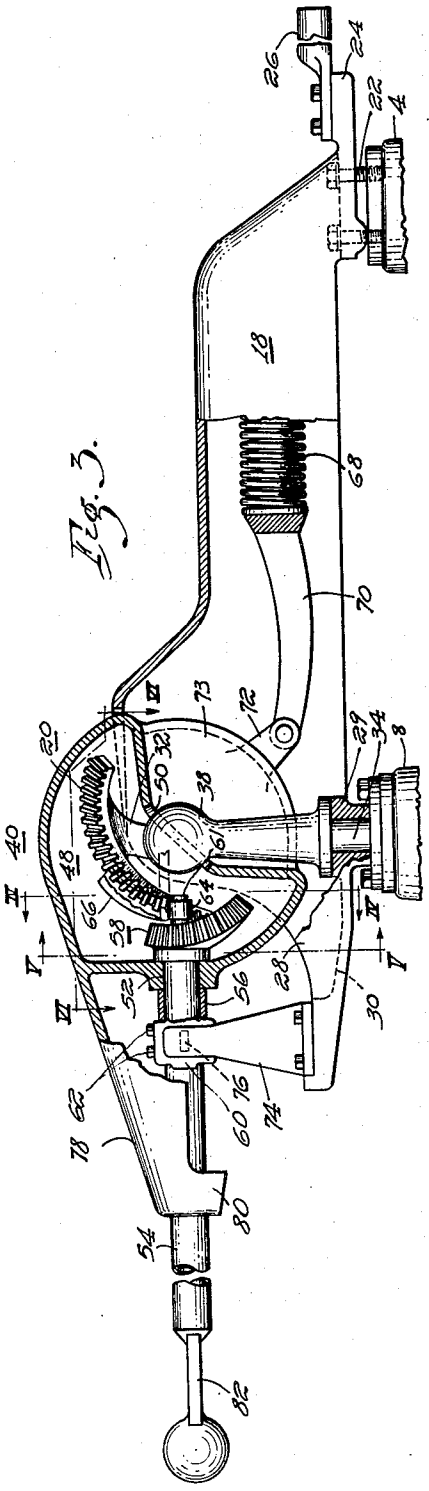


Fig. 3.

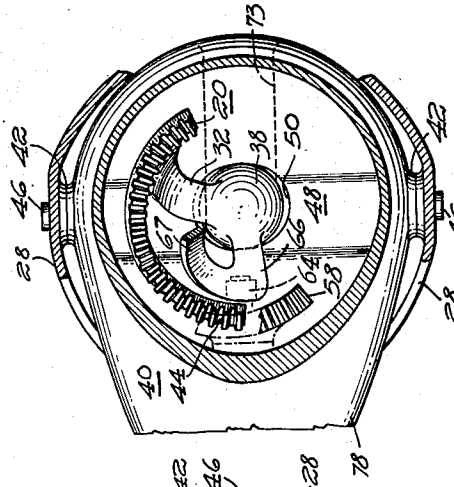


Fig. 6.

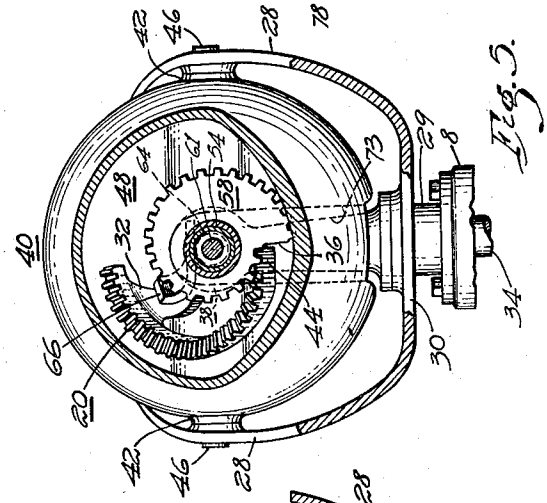


Fig. 5.

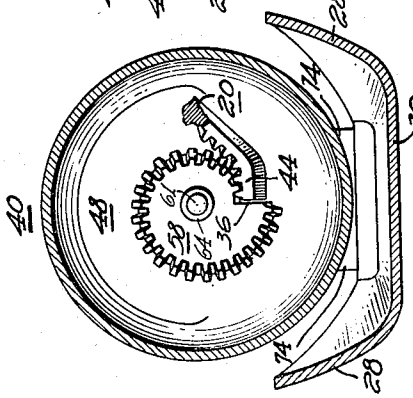


Fig. 4.

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UNITED STATES PATENT OFFICE

2,363,307

CIRCUIT INTERRUPTER

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Application May 27, 1943, Serial No. 488,622

13 Claims. (Cl. 200—48)

This invention relates generally to electric circuit interrupters, and more specifically to novel operating means for disconnect switches.

It is highly desirable that disconnect switches be operable to effect high pressure engagement of the contacts in closed circuit position. One effective and relatively simple way of accomplishing this is to provide a switch blade which is pivoted about a transverse axis for movement to and away from a position in proximity to one or more line contacts, and is rotatable about its longitudinal axis into and out of high pressure wedging engagement with the line contacts. Different modes of actuating and supporting switches of this type are disclosed and claimed in the copending applications of H. W. Graybill, Serial No. 433,552, filed March 6, 1942, now Patent No. 2,359,105, issued September 26, 1944, and H. L. Rawlins Serial No. 443,586, filed May 19, 1942, and both assigned to same assignee as the instant invention. The applications of Graybill and Rawlins disclose operating mechanisms capable of positive control of the movement of the switch blade about both axes of rotation. This is important in order to limit blade movement solely to rotation about its longitudinal axis during high pressure wedging engagement with a line contact to thereby utilize a relatively great mechanical advantage for this action without providing undue bending stress on the insulators supporting the switch. Positive control of the switch blade movements also has the advantage of insuring proper positioning of the blade relative to its longitudinal axis when adjacent the line contacts to permit rotation into high pressure engagement.

One object of this invention is to provide in a switch having a blade movable about two different axes, novel actuating means for positively controlling movement about such axes.

Another object of this invention is to provide a switch of the type having a blade rotatable into and out of high pressure engagement with a line contact and pivotally movable about a transverse axis toward and away from the line contact, with novel actuating means for rotating the blade without pivotal movement thereof and for positively controlling the rotative position of the blade at all times during its pivotal movement.

Still another object of this invention is to provide a novel mounting for a switch of the type described capable of protecting the operating mechanism from the weather.

These and other objects of this invention will become more apparent upon consideration of the following detailed description of a preferred embodiment thereof when taken in connection with the attached drawings, in which:

Figure 1 is a side elevation view of a disconnect switch constructed in accordance with this invention;

Fig. 2 is a top plan view of the switch shown in Fig. 1;

Fig. 3 is an enlarged elevation view partially in section, of the switch blade and support shown in Figs. 1 and 2;

Fig. 4 is a transverse section of the switch taken substantially on the line IV—IV of Fig. 3;

Fig. 5 is a transverse section of the switch taken substantially on the line V—V of Fig. 3; and

Fig. 6 is a section taken substantially on the line VI—VI of Fig. 3.

The switch structure and switch assembly shown on the drawings is similar to that disclosed in the above-mentioned copending application of Rawlins, differing therefrom mainly in the means for rotating and pivotally moving the switch blade, and in the enclosure for and manner of supporting the blade actuating means. Since the other parts of the switch assembly disclosed are particularly described and claimed in the aforesaid Rawlins application, such parts will not be specifically described in this application, and reference is hereby made to the Rawlins application for more specific disclosure thereof.

Referring to the drawings, the switch structure is shown as being mounted on a supporting base 2 which may be a metal channel or other structural shape. Three insulator stacks 4, 6 and 8 are adapted to be mounted on the supporting base 2, and for high voltage applications, these stacks may comprise a plurality of superposed porcelain insulators secured together, with the number of insulators in each stack being dependent upon the rated voltage of the switch. Insulator stacks 4 and 6 are adapted to be stationarily mounted on the supporting base, and to this end they are secured on mounting pedestals 10 which, in turn, are secured to base 2, for example, as by bolts or the like. The insulator stack 8 is mounted on an actuating shaft 12 adapted to be rotatably received in a bearing 14 supported by base 2, and the actuating shaft 12 may have an actuating crank 16 secured thereto, preferably below supporting base 2, as shown. An insulator bracing member and blade support 18 is adapted to span the outer end of insulator stacks 4 and 8, and this support may be in the

form of a casting generally of inverse U-shape in section. The end of bracing support 18 adjacent insulator stack 4 is secured to stack 4 as by bolts 22, and is provided with a flat terminal pad extension 24 to which a line conductor may be secured, for example, as by a terminal lug 26 bolted thereto. The other end of bracing support 18 has the top thereof cut away, so that the sides are extended as at 28 and connected at their outer ends by a connecting plate 30 integrally formed therewith. The connecting plate 30 is provided with a bearing portion 29 for receiving a shaft 34 secured to the outer end of rotatable insulator stack 8. It will be observed that bracing support 18 is secured at one end to stationary insulator stack 4, and at its other end provides a bearing support for rotatable insulator stack 8, thus acting as a brace for these two insulator stacks.

Shaft 34 mounted on the upper end of rotatable insulator stack 8 is provided with a generally spherical shaped portion 38 projecting through an aperture 50 into a compartment 48 formed within blade support 40. The blade support 40 is also preferably formed of a single casting, and is provided at opposite sides thereof with bearings 42 for receiving pivot pins 46 pivotally mounted in the extended sides 28 of bracing support 18. Pivot pins 46 thus pivotally mount blade support 40 on an axis passing through the axis of rotation of insulator stack 8, substantially at right angles thereto. Compartment 48 for enclosing the blade actuating mechanism is provided with the opening 50 previously referred to, for receiving the spherical portion 38 of shaft 34. Apertures 50 and spherical portion 38 of shaft 24 are positioned substantially at the intersection of the axis of insulator stack 8 and the pivot axis of blade support 40. The opposite side of compartment 48 is provided with a bearing aperture 52 for rotatably receiving one end of a tubular switch blade 54. Switch blade 54 is provided adjacent bearing aperture 52 with a contact ring 60 secured to the blade as by bolts 62 passing through the ring and blade. Between the contact ring 60 and bearing aperture 52, there may be provided a spacer ring 56 in order to limit longitudinal movement of the switch blade inwardly of compartment 48. The end of switch blade 54 within compartment 48 is provided with a pinion 58 of special design, to be hereinafter further described.

Rotary insulator shaft 34 is provided in compartment 48 with an integral extension 32 having a ring gear 20 integral therewith for cooperation with pinion 58. Pinion 58 is generally of spiral shape (Figs. 4 and 5) but it will be observed that from shoulder 36 on the pinion to approximately point 38, the teeth of the pinion are positioned on the arc of a circle, and the teeth depart from the arc of the circle only between point 38 and shoulder 36, proceeding in a clockwise direction from point 38, as viewed in Fig. 5. Segmental ring gear 20 similarly is provided with a flat horizontal portion 44 adapted to mesh with the circular portion 36—38 of the pinion, and the remainder of ring gear 20 is inclined in substantially helical form.

Upon rotation of insulator stack 8 in a counterclockwise direction as viewed in Fig. 6, the flat portion of ring gear 20 will first engage the circular portion 36—38 of pinion 58 to rotate the pinion, and consequently switch blade 54, about the longitudinal axis of the blade. This rotation of the blade is the sole movement resulting during this part of the rotation of insulator stack 8, there being no movement of blade support 40 about its pivots 46. However, as soon as pinion 58 has rotated to a position where the point 38 engages with teeth on the ring gear, then the inclination of the ring gear and the spiral form of the pinion cause the blade and blade support 40 to move upwardly about pivots 46. Such a movement could be obtained by merely inclining ring gear 20, and using a pinion 58 having teeth arranged in the arc of a circle, or conversely using a horizontal ring gear 20 and pinion having teeth arranged in spiral form. However, by using both a ring gear having teeth arranged in helical form, and a pinion with teeth arranged in a spiral path, greater movement is obtained about blade supporting pivots 46, while the gears themselves require relatively small space. Another advantage is, that as insulator stack 8 is rotated from the position shown on the drawings, the point of engagement of the teeth of pinion 58 and the teeth of ring gear 20 progresses from a point which is in the plane of blade movement (Figs. 4 and 5) to a point displaced from the plane of blade movement. This means that although it would be possible to disengage the teeth of the pinion and ring gear by lifting the blade in a clockwise direction from the position shown in Figs. 1 and 3, it becomes impossible to do so when the pinion is in engagement with the inclined portion of the ring gear, because the teeth of the pinion and gear will no longer be separable by movement in the plane of movement of the blade about pivots 46. In order to prevent possible separation of the pinion and gear in the position of the parts shown in Figs. 1 and 3, there is provided a guide roller 64 mounted on stub shaft 61 projecting axially from blade 54 and positioned inwardly of pinion 58. This roller is cooperable with a guide member 66 formed integral with spherical portion 38 of shaft 34. Guide 66 is provided with a generally horizontal portion to maintain the gear teeth in engagement during rotation of the switch blade about its longitudinal axis in the position shown on the drawings, and with a curved portion 67 extending for at least the first part of travel of roller 64 when the spiral portion of pinion 58 engages the inclined portion of gear 20. The curved part of guide 66 need not extend over the entire travel of roller 64, because the gear teeth themselves interfere and prevent disengagement of gear 20 and pinion 58 when the teeth on the spiral part of pinion 58 engage the teeth on the inclined part of gear 20, as previously described.

To summarize, in rotating insulator stack 8 from the position shown on the drawings, the first thing that occurs is purely rotational movement of the switch blade about its longitudinal axis, and thereafter the blade is both rotated and pivoted with blade support 40 about pivots 46 to a position substantially 90° in a clockwise direction from that shown in Figs. 1 and 3. Upon reverse rotation of insulator stack 8, the reverse operation takes place, that is, switch blade 54 is rotated and pivoted about pivots 46 back to the position shown in Figs. 1 and 3, and upon continued rotation of the insulator stack in the same direction, movement about pivots 46 ceases but rotation of the blade about its longitudinal axis continues for the extent of pinion teeth 36—38. Since the teeth of the pinion and gear are in engagement in all positions, it clearly follows that the angular position of the switch blade about its longitudinal axis is positively controlled at all

times. In other words, the movement of pure rotation of the switch blade about its longitudinal axis and the movement of the blade about a transverse axis (axis of pivot 46) is positively controlled so as to occur sequentially and substantially independent of each other. Furthermore, this result is obtained by a simple construction utilizing but a single pair of intermeshing gears.

A counterbalancing spring 68 may be provided within the U-shaped portion of support 18 for counterbalancing the weight of blade 54 and parts movable therewith. This counterbalancing spring construction may be similar to that of the above-mentioned Rawlins application, wherein a spring such as the spring 68 engages at one end with the closed outer end of support 18, and at its other end engages a cross bar intergral with spaced connecting rods 70. The other ends of connecting rods 70 (only one of which is shown) are pivotally secured to integral ears 72 on blade support 40. The ears 72 are located on the blade support at opposite sides of a re-entrant portion 73 adapted to accommodate shaft 34 during pivotal movement of the blade and support 40 about pivots 46.

This switch is also provided, like the Rawlins switch, with contact jaws 74 secured to connecting plate 30 and adapted to be engaged by opposed contact projections 76 on contact ring 60. The contact jaws 74 are located beneath an integral hood portion 78 on blade support 40, and the hood portion is provided at its outer end with a bearing 80 for pivotally supporting an intermediate portion of blade 54. The outer end of blade 54 is provided with a flattened contact portion 82 adapted to be received between spaced contact jaws 84 mounted on insulator stack 6.

In the closed position of the switch shown in the drawings, contact portion 82 of the blade and contact projections 76 thereof are adapted to be positioned transversely of their respective contact jaws so as to be in high pressure wedging engagement therewith. Now upon rotation of insulator stack 8 in a direction to open the switch, it will be observed that no vertical movement of the switch blade will occur until after the blade has rotated a considerable amount, to position contact portions 82 and 76 thereon at a considerable angle relative to their transverse closed circuit positions, so that they are rotated to a position substantially entirely out of engagement with their respective contact jaws and will offer substantially no opposition to subsequent pivotal movement of the blade and its support about pivot pins 46. Obviously, after rotation of blade 54 about its longitudinal axis to free contact portions 82 and 76 from wedging engagement with contact jaws 84 and 74, the blade may be readily moved vertically when the inclined portion of ring gear 20 engages the spiral portion of pinion 58, because there is no contact friction to resist such movement and the weight of the blade and associated parts is counterbalanced by spring 68. Furthermore, it will also be noted that because gear 20 and pinion 58 are always in engagement, contact portions 76 and 82 on the blade will always occupy a position relative to contact jaws 74 and 84 such that they may easily enter into and out of the space between the jaws, and in the final closed position of the switch will always be positioned transversely of the jaws into high pressure wedging engagement therewith. Because gearing is used to actuate the switch, the angular positions of contact portions 76 and 82 are always under positive control, so that ease of operation is always assured. This is especially important in order to avoid undue strain on the relatively tall insulator stacks necessary in high voltage applications. In this connection, it will be noted that the closing movement of the switch is substantially in a direction parallel with the longitudinal axis of insulator stack 6 and that no substantial force is exerted to cause any bending stress on the insulator structures. The high pressure engagement of the switch blade and contact jaws is due solely to rotation of the blade about its longitudinal axis, and this will obviously not cause any lateral stress on the insulators.

By the use of the gearing disclosed herein, a substantial rotation of the blade about its longitudinal axis is obtained in addition to a 90° rotation of the switch blade about a transverse axis, all by approximately a 90° rotation of insulator stack 8. Furthermore, the rotation of the blade about its longitudinal axis into and out of high pressure engagement with the switch contact jaws is accomplished without any vertical movement of the blade. This renders the switch very easy in operation because it is not necessary to overcome the high contact pressure upon attempted vertical movement of the switch blade.

From the foregoing, it is believed apparent that this invention provides a disconnect switch of the type wherein the blade is rotatably mounted about its longitudinal axis as well as about a transverse axis, for movement toward and away from a position in proximity to at least one line contact, and when in said position it is rotatable about its longitudinal axis into and out of high pressure engagement with the line contact. Furthermore, by the construction herein disclosed, this movement, including movement of the blade about its longitudinal axis without movement about its transverse axis by the use of novel gearing so as to positively control the angular position of the blade at all points in its movement, requires the blade to positively move about its different axis in predetermined sequence. There is also disclosed certain novel cooperation of such blade actuating mechanism and an enclosing housing therefor to effectively prevent the access of foreign matter to the mechanism, and wherein the housing at the same time operates to support the switch blade in its movement about a transverse axis.

Having defined a preferred embodiment of this invention in accordance with the patent statutes, it is desired that the invention be interpreted as broadly as possible in view of the prior art inasmuch as it will be apparent to those skilled in the art that many modifications and changes may be made in this particular structure without departing from the broad spirit and scope of this invention, as defined in the following claims.

I claim as my invention:

1. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis into and out of high pressure engagement with said line contact when in proximity thereto, means pivotally mounting said blade for movement about an axis at an angle to said axis of blade rotation for pivotal movement to and away from a position in proximity to said contact, rotatable actuating means for said blade, cooperating gear means on said blade and actuating means, each of said gear means having a portion shaped to be engaged at a point which is at a fixed distance from the longitudinal axis of said blade, for rotating said blade about its longitu-

dinal axis without movement of said blade about said pivot axis when said blade is in proximity to said contact, and at least one of said gear means having a portion shaped to engage the corresponding part of the other gear means at progressively increasing distances from the longitudinal axis of said blade to cause pivotal movement of said blade about said pivot axis at a point in said rotational movement of said blade where said blade is out of high pressure engagement with said contact.

2. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis into and out of high pressure engagement with said line contact when in proximity thereto, means pivotally mounting said blade for movement about an axis at an angle to said axis of blade rotation for pivotal movement to and away from a position in proximity to said contact, rotatable actuating means for said blade, cooperating interengaging means on said blade and actuating means for rotating said blade about its longitudinal axis without movement of said blade about said pivot axis when said blade is in proximity to said contact, and at least one of said interengaging means having an inclined portion to cause pivotal movement of said blade about said pivot axis at a point in said rotational movement of said blade when said blade is out of high pressure engagement with said contact, and said interengaging means remaining in engagement throughout said pivotal movement to positively control the angular position of said blade about its longitudinal axis.

3. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis into and out of high pressure engagement with said line contact, means pivotally mounting said blade for movement about an axis at an angle to said axis of blade rotation for pivotal movement to and away from a position in proximity to said contact, rotatable actuating means for said blade, cooperating gear means on said blade and actuating means, each of said gear means having a portion shaped to be engaged at a point which is at a fixed distance from the longitudinal axis of said blade, for rotating said blade about its longitudinal axis without movement of said blade about said pivot axis when said blade is in proximity to said contact, and each of said gear means having a portion shaped to engage the corresponding part of the other gear means at progressively increasing distances from the longitudinal axis of said blade to cause pivotal movement of said blade about said pivot axis at a point in said rotational movement of said blade where said blade is out of high pressure engagement with said contact.

4. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis into and out of high pressure engagement with said line contact, means pivotally mounting said blade for movement about an axis at an angle to said axis of blade rotation for pivotal movement to and away from a position in proximity to said contact, rotatable actuating means for said blade, cooperating gear means on said blade and actuating means having gear and pinion portions, respectively, for rotating said blade about its longitudinal axis without movement of said blade about said pivot axis when said blade is in proximity to said contact, and at least one of said gear means having an inclined portion shaped to cause pivotal movement of said blade about said pivot axis at a point in said rotational movement of said blade when said blade is out of high pressure engagement with said contact, and said inclined portion engageable with the other of said gear means to control rotation of said blade during said pivotal movement to insure proper positioning of said blade relative to said contact when in proximity.

5. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis so as to be rotatable into and out of high pressure engagement with said contact when in proximity thereto, means pivotally mounting said blade for movement about an axis at an angle to its longitudinal axis for movement of the blade to and away from a position in proximity to said contact, actuating means rotatable on an axis extending at an angle to said pivot axis and longitudinal blade axis, cooperating gear means on said blade and actuating means, at least one of said gear means having successive portions of different shape so that in a circuit closing operation said blade is first moved pivotally to a position in proximity with said contact, and is thereafter rotated about its longitudinal axis into high pressure engagement with said contact in response to continuous rotation of said actuating means in one direction.

6. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis so as to be rotatable into and out of high pressure engagement with said contact when in proximity thereto, means pivotally mounting said blade for movement about an axis at an angle to its longitudinal axis for movement of the blade to and away from a position in proximity to said contact, actuating means rotatable on an axis extending at an angle to said pivot axis and longitudinal blade axis, cooperating gear means on said blade and actuating means, at least one of said gear means having successive portions of different shape so that in a circuit closing operation said blade is first moved pivotally to a position in proximity with said contact, and is thereafter rotated about its longitudinal axis into high pressure engagement wtih said contact in response to continuous rotation of said actuating means in one direction, and cooperating means on said blade and actuating means for preventing disengagement of said gear means.

7. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis so as to be rotatable into and out of high pressure engagement with said contact when in proximity thereto, means pivotally mounting said blade for movement about an axis at an angle to its longitudinal axis for movement of the blade to and away from a position in proximity to said contact, actuating means rotatable on an axis extending at an angle to said pivot axis and longitudinal blade axis, cooperating gear means on said blade and actuating means, both of said gear means having successive portions of different shape, one portion of said gear means shaped to rotate said blade into and out of high pressure engagement with said contact without pivotal movement thereof when said blade is at a position in proximity to said contact, the teeth of said one portion of said gear means engageable at a point in the plane of pivotal movement of said blade, another portion of said gear means shaped to cause pivotal movement of said blade to and away from a position in proximity with said contact with the point of engagement of said other gear portions being displaced from the plane of

pivotal blade movement, whereby disengagement of said other gear portions is prevented.

8. In a switch, a contact, a switch blade mounted for rotation substantially about its longitudinal axis so as to be rotatable into and out of high pressure engagement with said contact when in proximity thereto, means pivotally mounting said blade for movement about an axis at an angle to its longitudinal axis for movement of the blade to and away from a position in proximity to said contact, actuating means rotatable on an axis extending at an angle to said pivot axis and longitudinal blade axis, cooperating gear means on said blade and actuating means, both of said gear means having successive portions of different shape, one portion of said gear means shaped to rotate said blade into and out of high pressure engagement with said contact without pivotal movement thereof when said blade is at a position in proximity to said contact, the teeth of said one portion of said gear means engageable at a point in the plane of pivotal movement of said blade, cooperating means on said blade and actuating means for preventing disengagement of said gear means at least when said one portion of said gear means is in engagement, another portion of said gear means shaped to cause pivotal movement of said blade to and away from a position in proximity with said contact with the point of engagement of said other portion of said gear means being displaced from the plane of pivotal blade movement, whereby disengagement of said other gear portions is prevented.

9. In a switch construction, fixed and rotary insulators, blade supporting means secured to said fixed insulator and having a bearing in which said rotary insulator is journalled, a blade supporting housing pivoted on said supporting means on a transverse axis of said rotary insulator, a longitudinally extending blade actuating shaft on said rotary insulator, said housing having an aperture located on the pivot axis of said housing for receiving said shaft, said housing having a re-entrant portion for receiving said shaft during pivotal movement of the housing, and blade means carried by said housing and adapted to be actuated by said shaft upon rotation of said rotary insulator.

10. In a switch construction, fixed and rotary insulators, blade supporting means secured to said fixed insulator and having a bearing in which said rotary insulator is journalled, a blade supporting housing pivoted on said supporting means on a transverse axis intersecting the axis of said rotary insulator, a longitudinally extending blade actuating shaft on said rotary insulator, said housing having an aperture located on the pivot axis of said housing for receiving said shaft, said shaft having a spherical portion in said aperture, said housing having a re-entrant portion for receiving said shaft during pivotal movement of the housing, and blade means carried by said housing and adapted to be actuated by said shaft upon rotation of said rotary insulator.

11. In a switch construction, fixed and rotary insulators, blade supporting means secured to said fixed insulator and having a bearing in which said rotary insulator is journalled, a blade supporting housing pivoted on said supporting means on a transverse axis intersecting the axis of said rotary insulator, a longitudinally extending blade actuating shaft on said rotary insulator, said housing having an aperture located on the pivot axis of said housing for receiving said shaft, switch blade means rotatably mounted on said housing and having an end extending into said housing, gear means on said blade and shaft within said housing, said gear means having engageable portions adapted to rotate said blade without pivotal movement of said housing upon rotation of said rotary insulator, and at least one of said gear means having an inclined portion to cause pivotal movement of the housing and blade.

12. In a switch, a contact, a switch blade mounted for pivotal movement toward and away from said contact, means also mounting said blade for rotation substantially about the longitudinal axis thereof, rotatable actuating means, cooperating gear means on said blade and actuating means, at least one of said gear means having one portion for causing rotation of said blade about its longitudinal axis without pivotal movement of the blade, and a differently shaped portion for causing pivotal movement of said blade upon continued rotation of said actuating means in one direction.

13. In a switch, a contact, a switch blade mounted for pivotal movement toward and away from said contact, means also mounting said blade for rotation substantially about the longitudinal axis thereof, rotatable actuating means, cooperating gear means on said blade and actuating means, each of said gear means having one portion for causing rotation of said blade about its longitudinal axis without pivotal movement of the blade, and a differently shaped portion for causing pivotal movement of said blade upon continued rotation of said actuating means in one direction.

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