

May 7, 1963

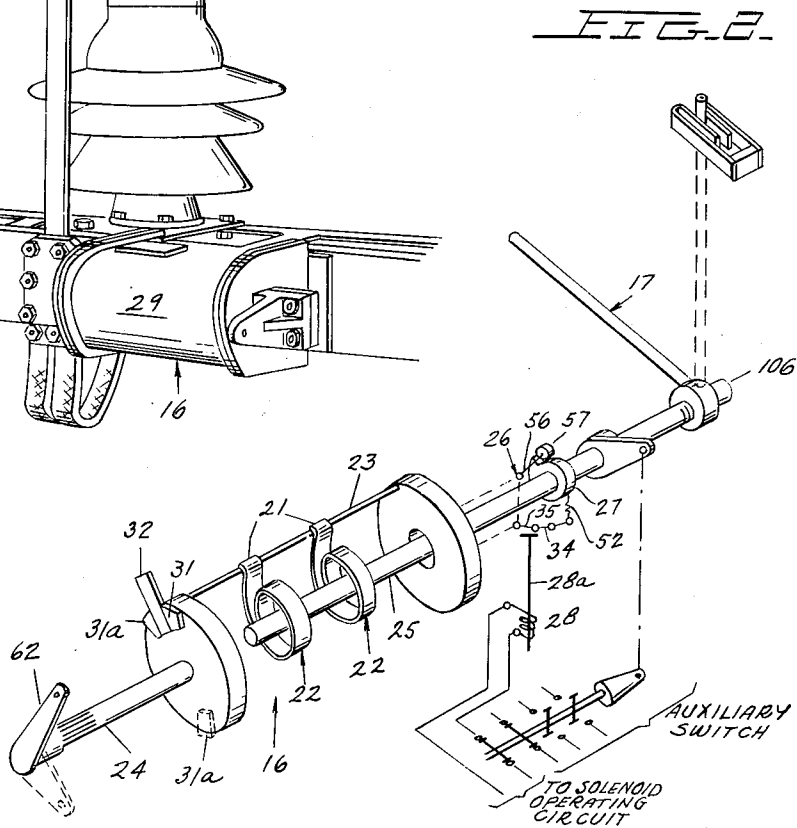
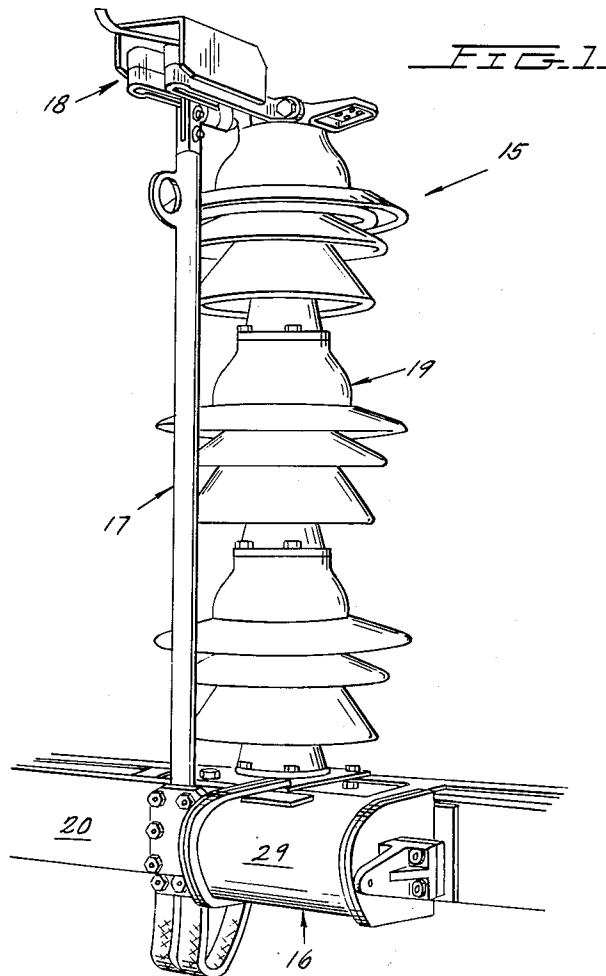
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3,089,006

AUTOMATIC HIGH SPEED GROUNDING SWITCH

Filed March 14, 1960

5 Sheets-Sheet 1



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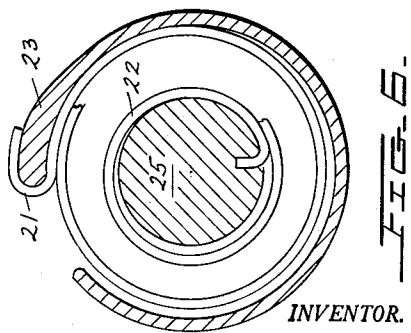
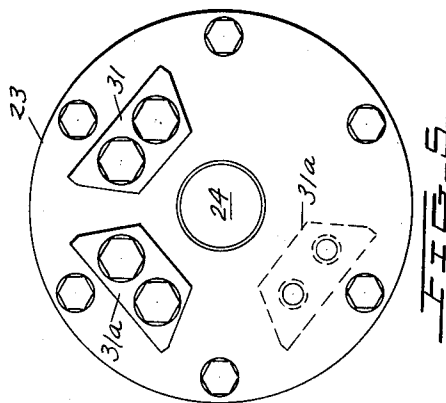
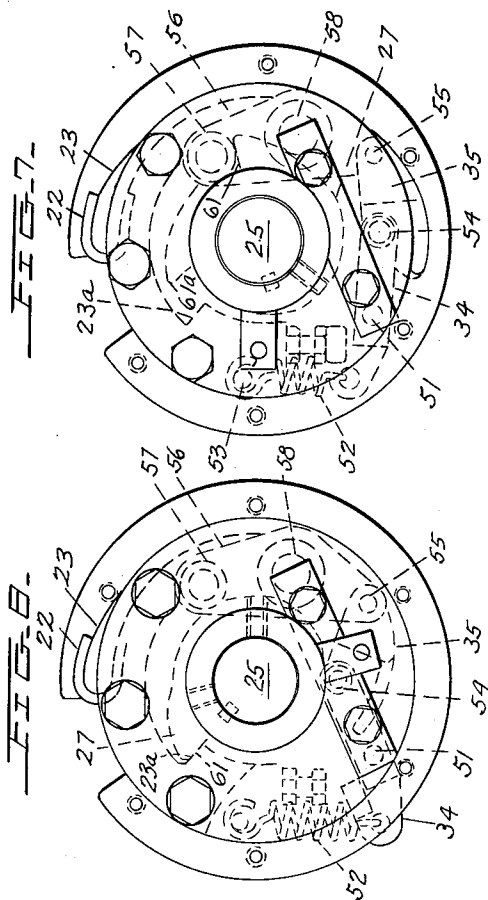
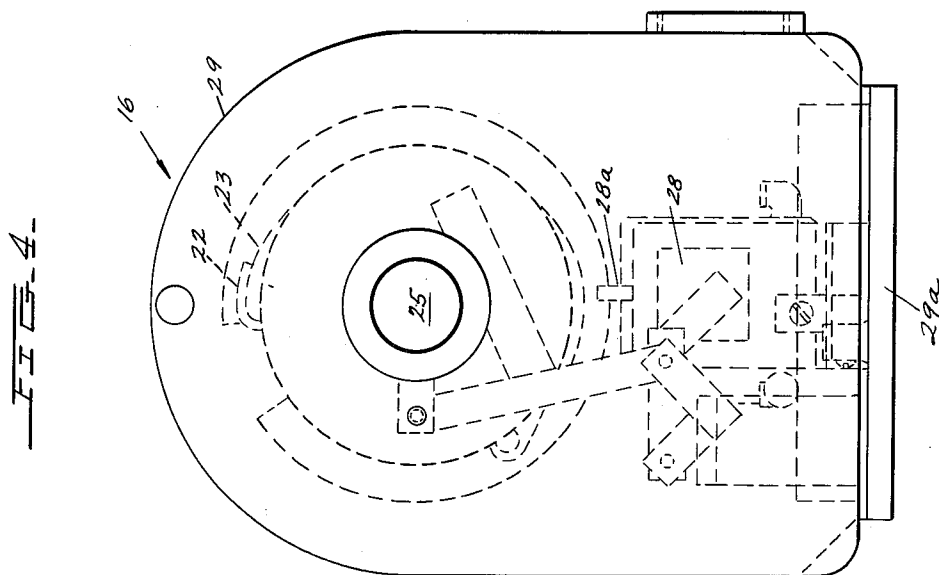
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AUTOMATIC HIGH SPEED GROUNDING SWITCH

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5 Sheets-Sheet 3



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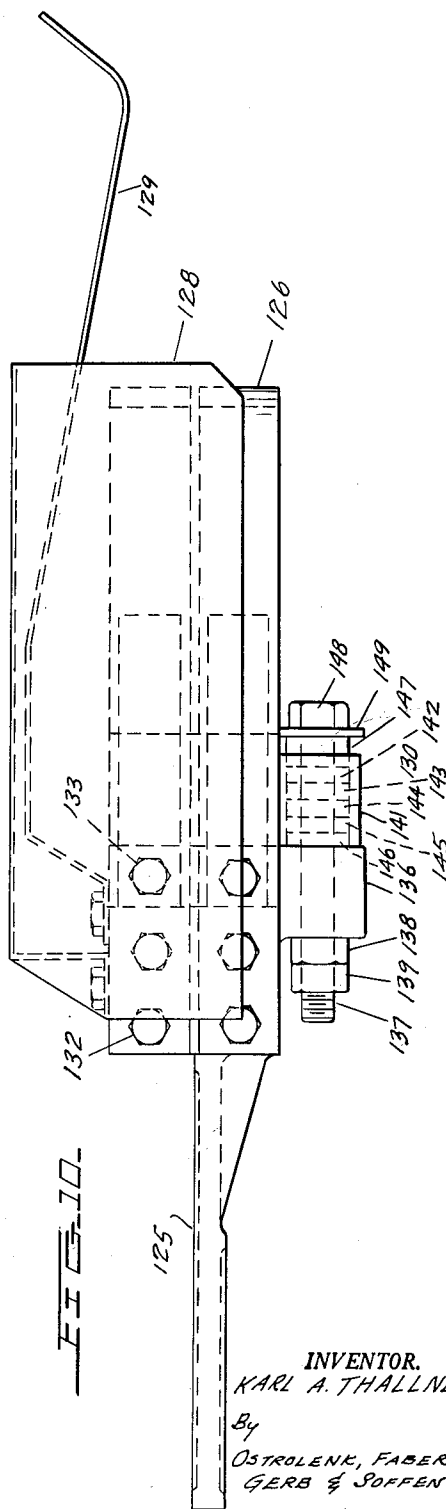
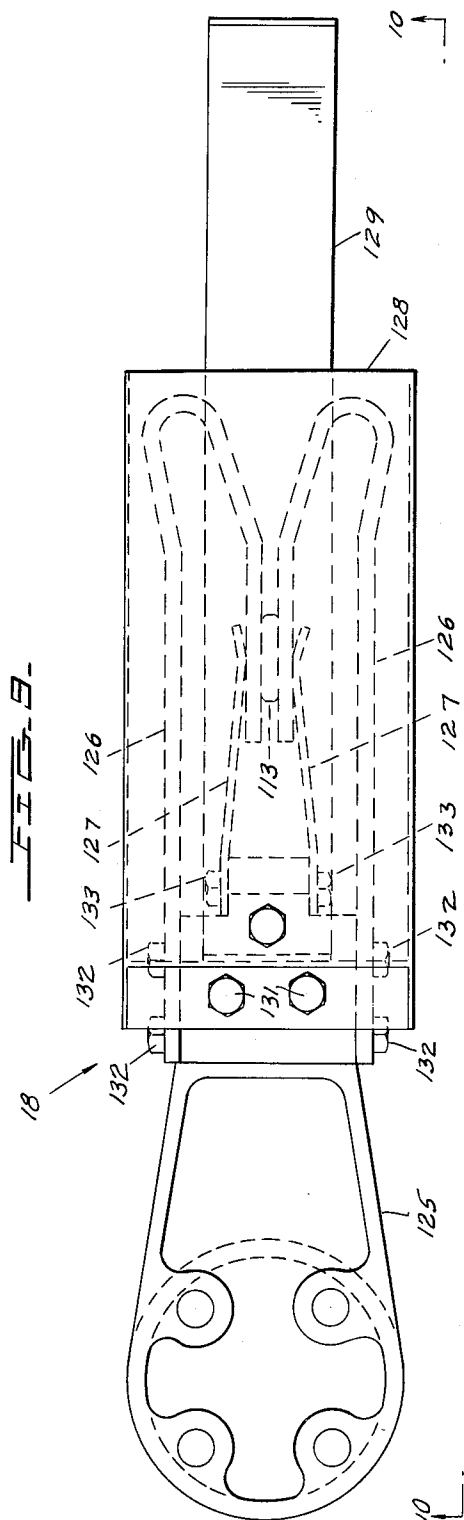
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AUTOMATIC HIGH SPEED GROUNDING SWITCH

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5 Sheets-Sheet 4



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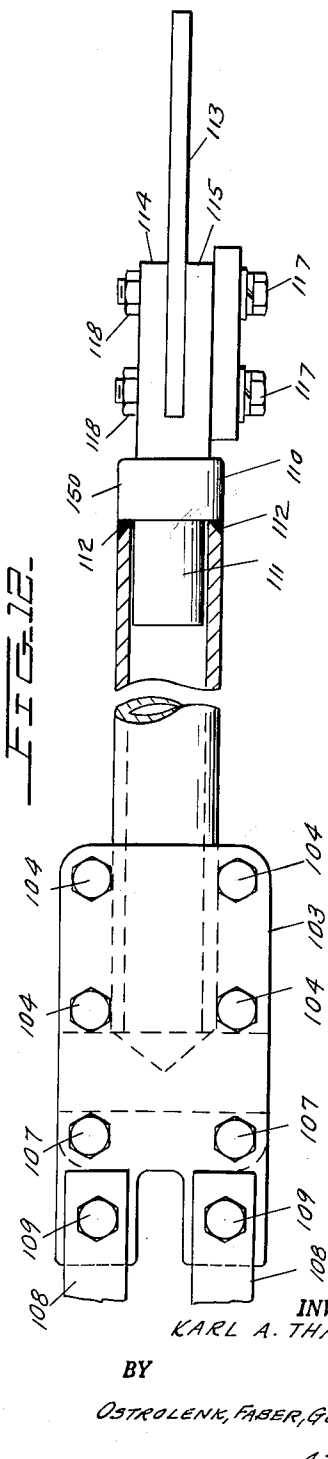
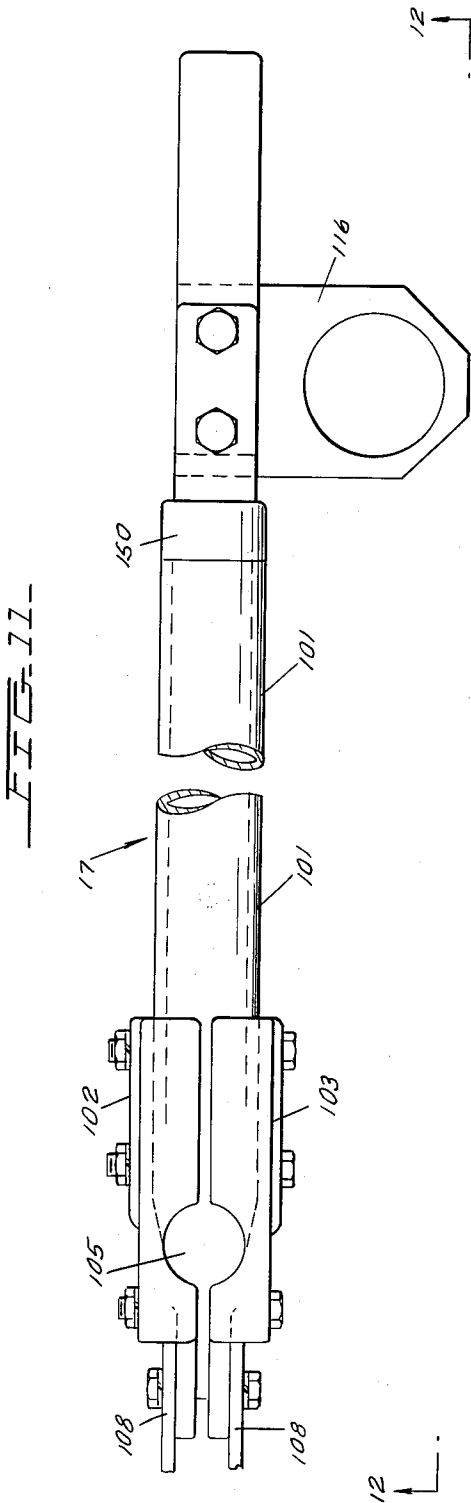
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AUTOMATIC HIGH SPEED GROUNDING SWITCH

Filed March 14, 1960

5 Sheets-Sheet 5



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AUTOMATIC HIGH SPEED GROUNDING SWITCH
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8 Claims. (Cl. 200—48)

The instant invention relates to grounding switches in general and more particularly to automatic high speed grounding switches having a novel operating mechanism and a novel construction such that the contacts are readily replaceable.

Automatic high speed grounding switches are usually spring-closed switches, either single pole or three-pole which are normally held open by a solenoid-operated latch, and which trip closed to establish a deliberate ground fault. They are most commonly used to provide reliable and economic protection for large power transformers located some distance from a circuit breaker. For this application it is generally felt that high speed grounding switches provide a more reliable and more economical means for tripping a remote breaker than either carrier or microwave relaying.

In the prior art the operating mechanisms for automatic grounding switches were of relatively large outside dimensions thereby requiring special mounting structures. The mechanisms comprised a plurality of parts which were inconvenient to install and lacked adequate weather protection. The construction of the swing blade and jaw were such that they had to be replaced completely when excess burning took place after closing.

The instant invention provides a compact construction for an automatic high speed grounding switch which is reliable and is readily adapted to existing switch bases or structural members. Further, the switch blade and jaw are of such a construction that excessively burned parts may be inexpensively and conveniently replaced.

The device of the instant invention is made especially compact by utilizing clock springs to store energy for high speed closing. The term "clock" spring as herein-after utilized refers to a coil spring whose turns are wound one inside the other so as to lie in a single plane.

A latch roller type means is utilized to maintain the mechanism in the open position. The mechanism is released through the operation of a solenoid plunger which acts upon the knee of a toggle associated with the latch so that the latch roller means is rapidly moved to its unlatched position.

As the switch blade moves to the closed position the kinetic energy thereof must be arrested very rapidly. Because of this the instant invention includes a novel shock absorbing means comprising a plurality of Teflon washers stacked in a steel tube. As the switch blade engages the stationary contact jaw the blade strikes a member which causes the washers to be compressed. The washers absorb the closing shock by compressing readily and are slow to return to their original shapes after deformation thereof so that rebound does not occur. A stack of washers is provided instead of a single member of Teflon since the stack enables greater frictional force to be established in that a greater surface area inside the steel tube is engaged by the stack of washers than would be engaged by a single member.

The switch blade is clamped to the knurled end of the operating mechanism output shaft protruding from the mechanism housing whereas the prior art has utilized a key means or means passing through drilled holes to establish the angular position of the switch blade upon the output shaft of the operating mechanism. With the construction of the instant invention the angular position of

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the switch blade can readily be adjusted in the field without the necessity of drilling holes.

Another feature of the instant invention comprises a switch blade construction wherein the portion of the switch blade which engages the stationary contact jaw is bolted in place so as to be readily replaceable. This is in contrast to prior art devices in which it was necessary to replace the entire switch blade after the contact portion thereof has been burned.

Accordingly, a primary object of the instant invention is to provide an automatic high speed grounding switch having a novel operating mechanism which is reliable and fast operating.

Another object is to provide a novel grounding switch mechanism having a fast operating latching mechanism.

Still another object is to provide a grounding switch operating mechanism in which the rotating parts are light weight and possess a small radius of gyration thereby contributing to fast closing speed.

A further object is to provide a grounding switch mechanism which is completely weather protected.

A still further object is to provide a novel grounding switch mechanism which can be reset either by a hook stick or a remote handle.

Yet another object is to provide an automatic high speed grounding switch including novel means to absorb mechanical shock present as the switch blade engages the stationary contact jaw.

Still another object is to provide an automatic high speed grounding switch in which the switch blade is provided with a contact which is readily replaceable.

These as well as other objects of the instant invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIGURE 1 is a perspective view of an automatic high speed grounding switch constructed in accordance with the teachings of the instant invention.

FIGURE 2 is a schematic illustration of the switch of FIGURE 1.

FIGURE 3 is a side elevation of the switch operating mechanism.

FIGURE 4 is an end view of the operating mechanism.

FIGURE 5 is an end view of the operating mechanism showing the stop placement for crank or hook stick operation.

FIGURE 6 is a cross-section taken through line 6—6 of FIGURE 3 looking in the direction of the arrows and illustrates the spring wound one full turn with the mechanism latched.

FIGURE 7 is an end view showing the mechanism latched.

FIGURE 8 is an end view showing the mechanism unlatched.

FIGURE 9 is a plan view of the jaw assembly.

FIGURE 10 is a side elevation of the jaw assembly of FIGURE 9 looking in the direction of arrows 10—10.

FIGURE 11 is a side elevation of the movable blade assembly.

FIGURE 12 is another side elevation of the movable blade assembly looking in the direction of arrows 12—12 of FIGURE 11.

Now referring to the figures, high speed grounding switch 15 generally comprises a spring operating mechanism 16, blade assembly 17 secured at its lower end to mechanism 16, and jaw assembly 18 which is engaged by the upper end of blade assembly 17 when switch 15 is closed. Jaw assembly 18 is mounted to the top of insulator mechanism 19 in a manner well known to the art while column 19 is mounted to structural member 20. Operating mechanism 16 is also mounted to member 20 in a manner well known to the art.

Referring more particularly to the schematic of FIGURE 2, outer ends 21 of spiral or clock springs 22, which comprise operating mechanism 16, are secured to spring housing 23 which in turn is secured to input shaft 24. The inner ends of springs 22 are secured to output shaft 25 which also carries blade assembly 17. In the position of FIGURE 2, shafts 24, 25 are latched to one another by the latching mechanism 26. Latching cam 27 is keyed to shaft 25 and the other members of the latching system are mounted on the spring housing 23 as will be fully explained. Actuating solenoid 28 is mounted to the base 29a of the mechanism housing 29. In the position illustrated, input shaft 24 with stop 31 rests against element 32. Upon energizing solenoid 28 its plunger 28a will unlatch the toggle 34, 35 of latching system 26 and free output shaft 25 and the energy stored in springs 22 will rapidly bring blade assembly 17 to the closed position illustrated in the dotted lines of FIGURE 2.

Blade assembly 17 is comprised of an aluminum tube 101 with a two piece fitting 102, 103 clamped to the lower end of tube 101 by screw means 104. Fitting 102, 103 defines a circular aperture 105 which receives the knurled end 106 of operating mechanism output shaft 25 and is clamped thereto by screw means 107 and 104. Conducting braids 108 are connected at one of their ends to members 102, 103 by screw means 109 while the other ends are connected to a switch terminal (not shown).

The rounded end 111 of member 110 is inserted into the upper end of tube 101 and is fixedly secured thereto as by welds 112. The upper end of member 110 is bifurcated and receives a flat tinned copper bar 113 between arms 114, 115. Hook ring 116 is secured to member 110 by bolt means 117 which also passes through clearance holes in arms 114, 115 as well as clearance holes in bar 113. Nuts 118 cooperate with bolt means 117 to complete the connection. It is to be noted that copper bar 113 comprises a contact which is readily replaceable in that it is necessary to detach only two bolt means 117 for this replacement.

Jaw assembly 18 (FIGURES 9 and 10) comprises cast adapter 125, secured to the top of insulator stack 19, in a well known manner, copper contact fingers 126 with beryllium copper back-up springs 127, sleet hood 128, arcing horn 129 and shock absorbing means 130. Sleet hood 128 is secured to casting 125 at the top thereof by bolts 131. Contact fingers 126 are U-shaped members each having an elongated arm which is secured to casting 125 by bolt 132, one contact 126 on each side of casting 125. One end of each back-up spring 127 is secured by bolts 133 to casting 125 while the other end of each back-up spring 127 engages the short arm of a contact finger 126 biasing fingers 126 toward each other. In the closed position of switch 15 blade assembly contact 113 is disposed between the short arms of contact fingers 126 with springs 127 biasing these arms into good electrical contact with contact 113.

Shock absorber means 130 is mounted to casting extension 136 by bolt 137, adjusting nut 138, and lock nut 139. Shock absorber means 130 is comprised of a steel tube 141 having disposed therein a stack of Teflon washers 142-146. Washer 146 at one end of the stack abuts casting extension 136 while a member 147 abuts washer 142 at the other end of the stack. Head 148 of bolt 137 abuts steel washer 149 which in turn abuts member 147. Member 147 as well as housing extension 136 and the washers 142-146 and 149 are provided with apertures through which bolt 137 passes.

As blade assembly 17 moves to the closed position it does so at a very high speed so that it possesses a good deal of kinetic energy. When movable contact 113 reaches the closed position the portion 150 of switch blade member 110 strikes the head 148 of shock absorber means bolt 137. This causes the stack of Teflon washers 142-146 to be compressed and in causing this compression

the kinetic energy of the moving switch blade 117 is during a short travel arrested. Even though the switch blade energy has rapidly absorbed, contact rebound does not take place since the Teflon washers 142-146, while being readily deformed are slow to return to their natural shape.

Now referring more particularly to FIGURES 3-8 which illustrate the operating mechanism 16 in detail, it is seen that input shaft 24 is supported by a suitable bearing in the left end of mechanism housing 29 and output shaft 25 is supported in a suitable bearing right end of mechanism housing 29. The right end of shaft 24 is received by an aperture at the left end of shaft 25 with shafts 24, 25 being in axial alignment.

The latching mechanism including the latch release comprises toggle link 34 which is mounted at a point intermediate the ends thereof to fixed pivot 51. The left hand end of link 34 is engaged by tension spring 52 which is secured to pin 53. Thus, spring 52 biases toggle link 34 clockwise about stationary pivot 51. The right hand end of link 35 is connected at pivot 55 to crank 56 at one end thereof. Crank 56 is pivoted intermediate the ends thereof about stationary pivot 58 and carries at the other end thereof latch roller 57.

As illustrated in FIGURE 5, internal stop 31a is set so that mechanism 16 is adapted for hook stick operation. Thus, input shaft 24 is maintained against rotation with respect to housing 29. Mechanism 16 is loaded by moving blade assembly 17 from the closed position (FIGURE 1) to the open position indicated in the solid line of FIGURE 2. In so doing output shaft 25 is rotated in a clockwise direction with respect to FIGURE 8. During this motion cam 27 acting upon latch roller 57 causes toggle linkage 34, 35 to be moved over center. At the point where latch roller 57 passes latch surface 61 of cam 27 roller 57 falls behind surface 61 (FIGURE 7) being urged there by small spring 52. In the position of FIGURE 7 roller 57 is in latching position and operating springs 22 are fully loaded.

Switch closing is accomplished by energizing solenoid 28 so that the plunger 28a thereof engages knee 54 of toggle linkage 34, 35 to drive knee 54 to the other side of center against the force of small springs 52. This causes latch roller 57 to release cam 27 and permit shaft 25 to be rotated in a counterclockwise direction from the position of FIGURE 7 by operating springs 22. As mechanism 16 operates output shaft 25 to its most counterclockwise position (FIGURE 8) blade assembly 17 engages assembly 18 and switch 15 is closed. The jaw 18 provides the stop for the angular travel of the output shaft 25. Depending upon the adjusted open position of the switch blade 17, the cam 27 will be stopped in a position 61a after traveling the same number of degrees as the blade 23 indicated in FIGURE 7, thus avoiding an impact on the housing stop formation 23a, which stop is provided to resist the static moment of the pre-loaded springs 22 prior to the assembly of the three principal components comprising the automatic high speed grounding switch.

For operation of switch 15 by remote handle 62 secured to input shaft 24, internal stud 31a is moved to the dotted line position of FIGURES 2 and 5. This permits shaft 24 to be rotated approximately 105° relative to housing 29. Shaft 24 is rotated in one direction to wind springs 22 and to latch the mechanism and then in the opposite direction to open the grounding switch 15 and blade 17.

Thus, this invention comprises a novel construction for a high speed grounding switch. The switch is made extremely compact and lightweight by utilizing clock springs as the means for storing closing energy. Installation is simplified by including a clamping means to secure the switch blade to the knurled output shaft of the mechanism whereby the blade position may readily be adjusted. Servicing is simplified by providing the switch

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blade with a readily replaceable contact and a jaw structure whose parts are readily replaceable. Switch life is extended by providing a novel shock absorbing means comprising a stack of Teflon washers.

Although I have here described preferred embodiment of my novel invention, many variations and modifications will now be apparent to those skilled in the art, and I therefore prefer to be limited, not by the specific disclosure herein, but only by the appending claims.

I claim:

1. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; a shock absorbing means operatively positioned for engagement by said blade assembly as it moves into engagement with said jaw assembly; said shock absorbing means comprising a tube and disposed within said tube a plurality of deformable members arranged in a stack; said deformable members being comprised of material which required considerably more time to return to its normal shape than the time required to deform the material, said shock absorbing means being positioned directly in the path of movement of said blade assembly and adapted to abut said blade assembly prior to completion of said engagement operation and thereby cooperating with said switch blade assembly to permit rapid closure thereof while protecting said blade assembly from being damaged due to the impact of closure.

2. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; a shock absorbing means operatively positioned for engagement by said blade assembly as it moves into engagement with said jaw assembly; said shock absorbing means comprising a tube and disposed within said tube a plurality of deformable members arranged in a stack; said plurality of deformable members comprising Teflon washers closely fitted to said tube, said shock absorbing means being positioned directly in the path of movement of said blade assembly and adapted to abut said blade assembly prior to completion of said engagement operation and thereby cooperating with said switch blade assembly to permit rapid closure thereof while protecting said blade assembly from being damaged due to the impact of closure.

3. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; said mechanism including an output shaft to which said blade is mounted, an energy storing means connected to pivot said shaft, a latch mechanism including a toggle means having a movable knee for maintaining said storing means charged, and a first means for releasing said latch to permit storing means to operate said shaft; said first means being adapted to move in a linear direction substantially perpendicular to said shaft to move said toggle means movable knee to release said latch means; said energy storing means comprising a torsion spring spirally arranged about said shaft and having its inner end connected to said shaft.

4. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; said mechanism including an output shaft to which said blade is mounted, an energy storing means connected to pivot said shaft, a latch mechanism for maintaining said storing means charged, and a first means for releasing said latch to permit storing means to operate said shaft; said latch comprising a cam carried by said shaft and a cooperating roller in engagement therewith; said first means compris-

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ing a toggle linkage to which said roller is operatively connected; said linkage including a knee; means biasing said knee over center whereby said roller is urged toward latching position.

5. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; said mechanism including an output shaft to which said blade is mounted, an energy storing means connected to pivot said shaft, a latch mechanism for maintaining said storing means charged, and a first means for releasing said latch to permit storing means to operate said shaft; an input shaft axially aligned and independently rotatable with respect to said output shaft; said energy storing means comprising a torsion spring spirally arranged about said output shaft; said energy storing means having its inner end secured to said output shaft and its outer end secured to said input shaft.

6. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; said mechanism including an output shaft to which said blade is mounted, an energy storing means connected to pivot said shaft, a latch mechanism for maintaining said storing means charged, and a first means for releasing said latch to permit storing means to operate said shaft; an input shaft axially aligned and independently rotatable with respect to said output shaft; said energy storing means comprising a torsion spring arranged about said output shaft; said energy storing means having its inner end secured to said output shaft and its outer end secured to said input shaft; a housing; said input shaft extending through one end of said housing and said output shaft extending through a second end of said housing; stop means selectively securable in a first and a second position; said stop means when in said first position preventing rotation of said input shaft and when in said second position permitting limited rotation of said input shaft relative to said housing.

7. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; said mechanism including an output shaft to which said blade is mounted, an energy storing means connected to pivot said shaft, a latch mechanism for maintaining said storing means charged, and a first means for releasing said latch to permit storing means to operate said shaft; said output shaft having a knurled portion; means for clamping said blade assembly one end to said output shaft at said knurled portion.

8. A switch comprising a jaw assembly, a blade assembly pivoted at one end to move the other end into and out of engagement with said jaw assembly, and an operating mechanism for moving said blade assembly other end into and out of engagement; said mechanism including an output shaft to which said blade is mounted, an energy storing means connected to pivot said shaft, a latch mechanism for maintaining said storing means charged, and a first means for releasing said latch to permit storing means to operate said shaft; an input shaft axially aligned and independently rotatable with respect to said output shaft; said energy storing means comprising a torsion spring spirally arranged about said output shaft; said energy storing means having its inner end secured to said output shaft and its outer end secured to said input shaft; said blade assembly comprising an elongated member and a contact removably secured to said member at said other end; said output shaft having a knurled portion; means for clamping said blade as-

sembly one end to said output shaft at said knurled
portion.

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