June 22, 1965 E. R. PERRY 3,190,990

EXPLOSIVE ACTUATED SWITCH

Filed Oct. 16, 1961 2 Sheets-Sheet 1

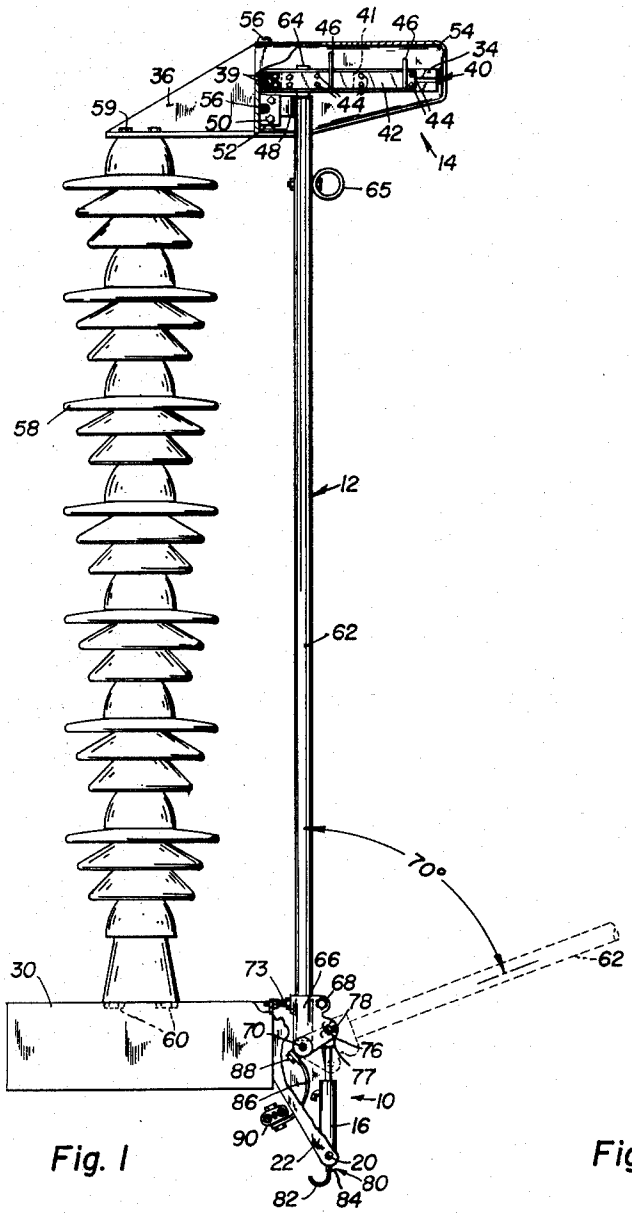


Fig. 1

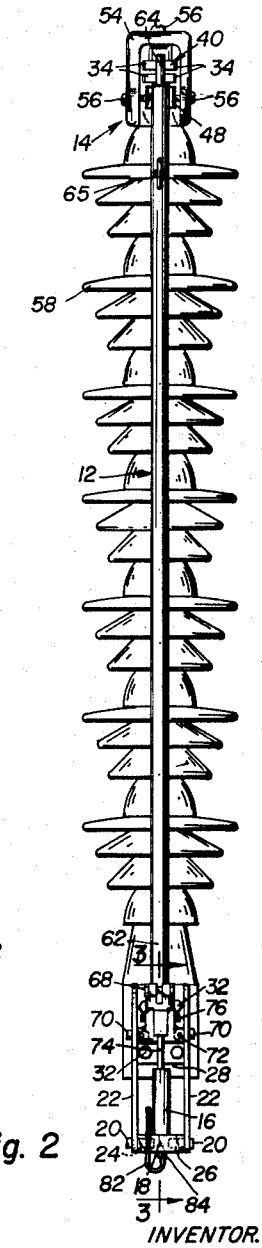


Fig. 2

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EXPLOSIVE ACTUATED SWITCH

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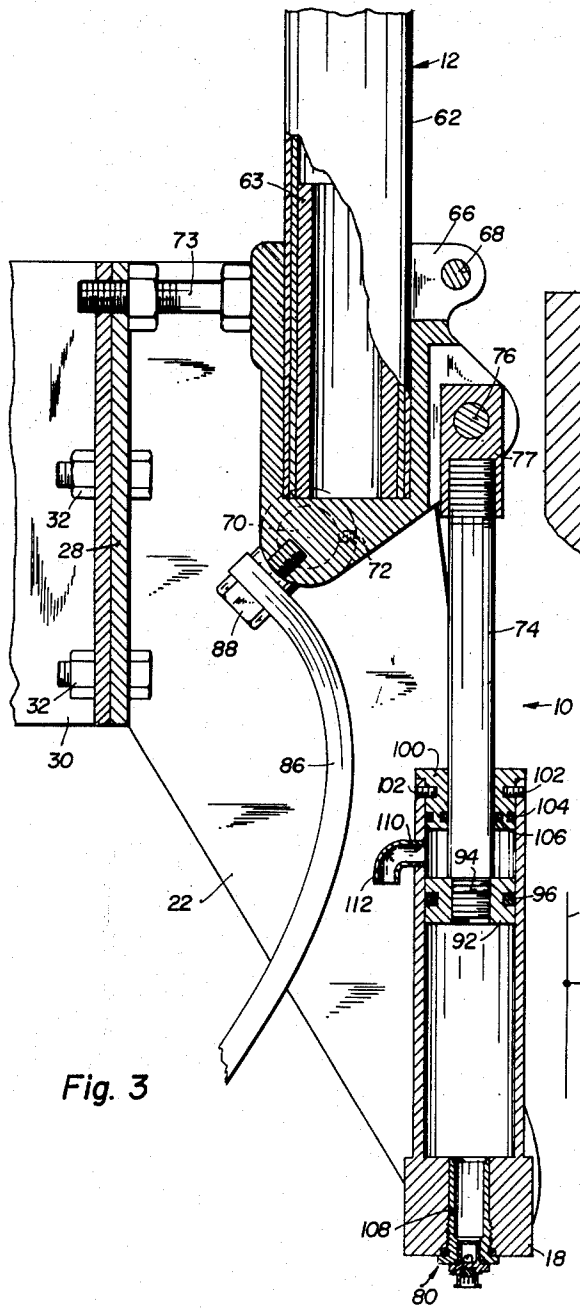


Fig. 3

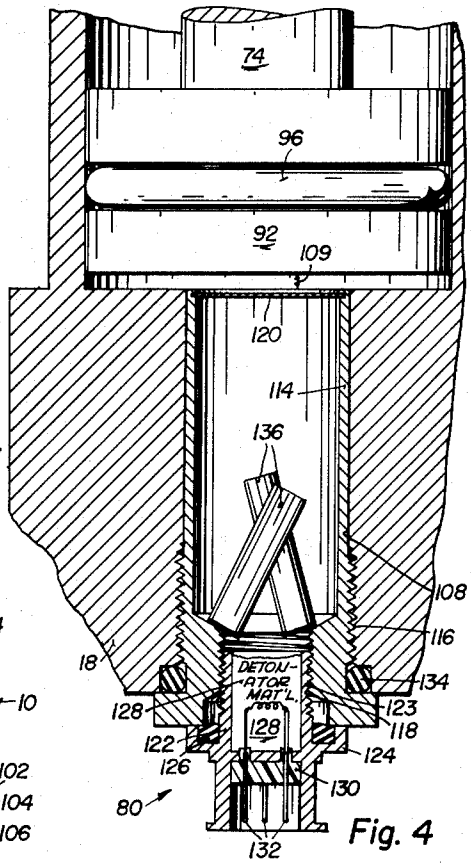


Fig. 4

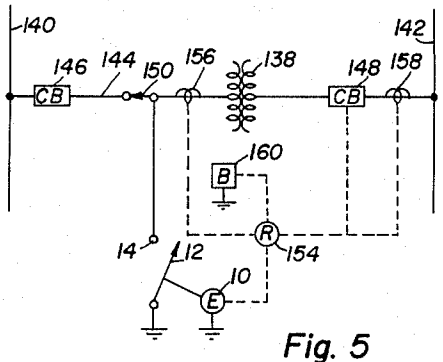


Fig. 5

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EXPLOSIVE ACTUATED SWITCH

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5 Claims. (Cl. 200—142)

The present invention relates generally to electrical switches, and specifically to an explosive actuated high voltage, short-circuiting switch, and an improved operating mechanism for electrical switches requiring rapid movement of a switch contact to open or close such switches properly.

The explosive actuated switch of the present invention is particularly useful as a high speed grounding switch for the protection of electrical transformers by deliberately short-circuiting to ground the high voltage transmission line supplying such transformers in the event of a transformer fault. This grounding of the transmission line immediately discontinues the supply of power to the transformer and causes automatic operation of a remote circuit breaker connected between the source of power and the high voltage transmission line for open-circuiting such line so that the destruction of such transformer is thereby avoided. The grounding switch is activated in response to a differential delay which compares the input and output current of the transformer and detects small fault currents in the transformer before they are large enough to operate the circuit breaker directly. Extensive damage to the transformer is thereby prevented by opening the circuit breaker before sufficient fault current flows to be detected directly by the circuit breaker. Sufficient fault currents to operate the circuit breakers directly are usually great enough to damage the transformer beyond repair. Closing of the grounding switch causes fault currents to flow in the transmission line of sufficient magnitude to actuate the remotely located power circuit breaker in order to open such circuit breaker and to disconnect the transformer from the power source.

Conventional grounding switches include a stationary switch contact, a pivoting switch blade and a spring operating mechanism which rotates such switch blade into engagement with such stationary contact when released by a solenoid tripped latch in response to an electrical signal from the differential relay. One such conventional short-circuiting or grounding switch is shown in U.S. Patent No. 2,712,577, issued July 5, 1955 to M. Stene. Switch blades for high voltage grounding switches operating in the neighborhood of 7.5 to 230 kilovolts are of substantial length, on the order of 1 to 7 feet. Also, since the switch blade is required to carry the short-circuit current of the high voltage transmission line for a period of several seconds, it must be of considerable cross-sectional area. This results in grounding switch blades of substantial mass so that even when extremely heavy closing springs are used in the conventional switch operating mechanism, these conventional grounding switches require a considerable length of time for completion of the switch closing movement of the switch blade through an angle of approximately 70 degrees. Therefore, when conventional grounding switches are used at the above mentioned voltages their best obtainable closing time appears to be approximately one-third of a second, or 20 cycles of the 60 c.p.s. A.C. voltage at 230 kilovolts.

Considerable damage can be done to a high voltage transformer by a fault current of only 20 cycles duration. The explosive actuated electrical switch of the present invention overcomes this disadvantage of conventional grounding switches by providing a switch closing time in

the order of 5 cycles at the above mentioned voltages by employing an explosive propellent material to operate the switch in place of the spring operating mechanism. In addition to fast closing times, the present grounding switch provides extremely efficient and reliable operation due to its small number of moving parts. Also, the explosive actuated switch operating mechanism of the invention avoids the use of solenoid operated latches and the other complicated apparatus of conventional operating mechanisms. This results in a more simple, compact and inexpensive construction. Furthermore, the electrical switch of the present invention has an improved stationary switch contact apparatus which absorbs the energy of the fast moving switch blade to prevent rebound of such switch blade and provide a good electrical connection between such switch blade and the contact jaws of such stationary switch contact.

The explosive propellent material used in the switch operating mechanism of the present invention is an extremely inert material which can be stored for years without affecting its operating characteristics substantially. Thus the grounding switch remains in an operable condition for a very long time without requiring any substantial maintenance. Also extremely simple testing means is provided for when it is desired to check the operable condition of the propellent material which will be explained in detail later.

Briefly, the electrical switch of the present invention includes a stationary switch contact, a movable switch blade adapted to engage such stationary contact by pivoting on a support member and an explosive actuated switch operating mechanism. This operating mechanism includes a hollow cylinder, a piston rod extending through one end of such cylinder with a piston mounted on one end of such rod for movement within such cylinder and the other end of such piston rod adapted to be connected to the movable switch blade outside such cylinder. The operating mechanism also includes a cartridge containing a charge of explosive propellent material supported to extend through the other end of the cylinder and positioned so that such propellent material will properly explode and exert a sufficient force to move the piston within such cylinder. It further includes an electrical detonator positioned to ignite such propellent material to cause it to explode automatically in response to an electrical signal in order to pivot the switch blade and operate the electrical switch.

Therefore, one object of the present invention is to provide an improved electrical switch in which an explosive charge is employed to actuate a switch operating mechanism.

Another object of the invention is to provide an improved operating mechanism for switches having a movable contact member in which operating mechanism an explosive propellent material is employed to move such switch contact and operate such switch.

A further object of the present invention is to provide an improved method of operating an electrical switch in which the explosion of an explosive propellent material is employed to cause movement of a movable switch contact to operate such switch.

Still another object of the invention is to provide an improved high voltage, short-circuiting switch having a stationary contact; a movable switch blade; and an explosive actuated switch operating mechanism including a hollow cylinder, a piston mounted for movement inside such cylinder on one end of a piston rod which extends through one end of such cylinder and is connected at its other end to the switch blade for rotation of such switch blade by movement of such piston, and a cartridge containing a charge of explosive propellent material and a detonator extending through the other end of such cylin-

der and positioned to move such piston within such cylinder when such propellent material is exploded thereby rotating such switch blade at extremely high speed and operating such high voltage switch.

A still further object of the invention is to provide an improved operating mechanism for electrical switches having movable contacts which is simple, compact and inexpensive in construction thereby enabling fast, efficient and reliable operation, requiring little maintenance and allowing simplified testing to assure its operable condition.

Additional advantages of the present invention will become apparent after referring to the detailed description of a preferred embodiment thereof and to the attached drawings, of which:

FIG. 1 shows a partially broken away side view of a high voltage short-circuiting switch made in accordance with a preferred embodiment of the present invention;

FIG. 2 is a front view of the switch of FIG. 1;

FIG. 3 shows a sectional view of the explosive actuated switch operating mechanism taken along the line 3—3 of FIG. 2;

FIG. 4 shows a sectional view of one embodiment of the explosive propellent cartridge and detonator used in the switch operating mechanism of FIG. 3; and

FIG. 5 is a schematic diagram of an electrical power circuit employing the grounding switch of the present invention.

One embodiment of an electrical switch made in accordance with the present invention is shown in FIGS. 1 and 2 to include an explosive actuated switch operating mechanism 10, a movable switch contact assembly 12 connected to the switch operating mechanism 10 for movement thereby and a stationary switch contact assembly 14 adapted to engage a portion of the movable switch contact assembly and form an electrical connection therewith. The switch operating mechanism 10 may include a hollow cylinder 16 attached at one end to a cylinder head 18 by welding or the like and supported for pivotable movement on a pair of pivot pins 20 which extend through a pair of holes in a pair of spaced, parallel support plates 22. These pivot pins 20 are fixedly secured inside a pair of bore holes 24 extending into the opposite ends of cylinder head 18 by means of a pair of set-screws 26. The pair of support plates 22 may be welded to a flat, rectangular support member 28 which is attached to a support beam 30 by four nut, bolt and lock washer assemblies 32 through such support member.

The stationary switch contact assembly 14 includes two pair of stationary contacts 34 which are suitable secured to a support bracket 36 at one end of such contacts by four nut, bolt and lock washer assemblies 39. The other ends of stationary contacts 34 form a pair of V-shaped slots 40 adapted to initially engage the switch blade portion of movable switch contact assembly 12 in a manner hereafter described. These stationary switch contacts 34 may each consist of a pair of laminated plates made of copper or other good electrically conducting material and may be provided with silver inserts to eliminate the possibility of nonconducting oxides forming to prevent good electrical contact. A pair of rubber back up springs 41 may be positioned in contact with the outer surface of the switch contacts 34 to provide a leaf-type back up spring for each stationary switch contact. Each of the stationary switch contacts 34 is secured to one end of a pair of support plate members 42 surrounding back up springs 41 by the bolt assemblies 39 and is spaced from the other portion of such support plate members by six adjustable stops in the form of three nut, bolt and lock washer assemblies 44 attached to each support plate member. The pair of support members 42 are also secured together by a pair of U-shaped brackets 46 welded thereto which determine the maximum spacing of the stationary switch contacts 34 from such support members.

A resilient stop member 48 of laminated rubber material or the like may be mounted near the end of stationary contacts 34 remote from the V-shaped slot by four bolts 50 to a support block 52 suitably secured to support bracket 36. This stop member 48 serves as a shock absorber to absorb the remainder of the kinetic energy of the switch blade in movable switch contact assembly 12 not absorbed by frictional engagement with stationary contacts 34, in order to stop such switch blade after automatic closing of the switch without bending the switch blade or allowing it to rebound sufficiently to reopen the switch. The entire stationary switch contact assembly 14 is covered by a hood casing 54 attached to support bracket 36 by means of three screws 56, which serves as an arcing horn and protects the switch contacts 34 from ice, snow, etc.

The stationary switch contact assembly 14 is rigidly mounted on the support beam 30 by support bracket 36 attached to one end of an insulator stack 58 by four nut and bolt assemblies 59, with the other end of said insulator stack being suitably secured to the support beam by means of four other nut and bolt assemblies 60. The movable switch contact assembly 12, also secured to support beam 30, includes a movable switch blade in the form of a hollow tubular rod 62 made of laminated aluminum or other strong light-weight material having a tubular stiffening plug 63 suitably secured inside one end of such rod and a switch blade contact 64 of solid copper or other good conducting material attached inside the other end of rod 62. A ring 65 may be mounted on switch blade rod 62 near contact 64 by a nut, bolt and lock washer assembly for manual opening of the grounding switch by means of a conventional hook stick. The other end of the switch blade rod 62 containing stiffening plug 63 is rigidly secured to a switch blade clamp 66 by means of a nut, bolt and lock washer assembly 68.

The blade clamp 66 is mounted for pivotal movement on a pair of pivot pins 70 which are rigidly secured to the blade clamp by means of a pair of setscrews 72 and extend through holes in support plates 22 for pivoting movement with respect to such support plates about the axis of pivot pins 70. An adjustable stop 73 in the form of a nut and bolt assembly may be secured to the support member 28 for limiting the pivotal movement of the switch blade rod 62 to an angle of about seventy degrees by engagement with a stop surface on blade clamp 66. The blade clamp is also connected to one end of a piston rod 74, which moves within the cylinder 16 in a manner hereafter described, by means of a single pivot pin 76 extending through a knuckle connector 77 attached to one end of piston rod 74 and through two blade clamp shoulders on either side of such knuckle connector with a pair of cotter pins 78, each secured in a hole on the opposite ends of pivot pin 76 outside of such clamp shoulders. Therefore, movement of the piston rod 74 within cylinder 16 causes the switch blade rod 62 to pivot about the pivot pin 70 during the operation of the explosive actuated switch operating mechanism 10.

The movement of piston rod 74 within cylinder 16 is accomplished by means of an explosive cartridge 80 in the switch operating mechanism 10 which extends through cylinder head 18 into the interior of the cylinder 16. Cartridge 80 may be exploded by any conventional means, including an electrical detonator squib which is connected to a source of electrical current by a flexible cable 82 and connector socket 84 in a manner hereafter described. This results in movement of piston rod 74 and pivoting of switch blade rod 62 until switch blade contact 64 engages stationary contacts 34 which may be electrically connected to a high voltage transmission line in any suitable manner. Closing of the grounding switch of the present invention short-circuits the transmission line to ground through switch blade contact 64 by means of a flexible electrical conductor 86 which has one end fastened to blade clamp 66 by means

of a pair of bolts 88 and its other end connected to ground by means of a ground clamp 90.

The explosive actuated switch operating mechanism is shown in greater detail in FIG. 3 to include a piston 92 secured to one end of the piston rod 74 by an O-ring 94 of rubber or other resilient material seated in a notch in the periphery of such piston rod. The piston 92 is in the form of a hollow, annular member whose inner surface engages O-ring 94 on the end of piston rod 74 which is of reduced diameter. A second O-ring 96 of polytetrafluoroethylene plastic, or other suitable sliding seal material, is provided in an annular groove in the external surface of piston 94 to provide a gas-tight seal between piston 94 and the inner surface of cylinder 16 while preventing seizure of the sliding surfaces during extended inoperative periods of time. The other end of piston rod 74 is screw-threaded into one end of the knuckle connector 77 outside of cylinder 16. A hole is provided through the other end of such connector for receiving the pivot pin 76 which pivotally connects the blade clamp 66 to the piston rod 74.

The piston rod 74 extends through one end of cylinder 16 which is sealed by a cylinder head 100 secured to such cylinder by a setscrew 102 extending through the cylinder wall into contact with the cylinder head. This cylinder head 100 is provided with a rubber O-ring 104 seated in an annular groove in the outer surface of such cylinder head which engages the inner surface of the cylinder wall, and also a second rubber O-ring 106 seated in an annular groove in the inner surface of cylinder head 100 which engages piston rod 74 to provide a good sliding seal therewith. The other cylinder head 18 is provided with a cylindrical passageway 108 through such cylinder head into the interior of cylinder 16. This passageway 108 may be partially screw-threaded for engagement with screw threads on the explosive propellent cartridge 80 which extends through passageway 108 so that the end of the cartridge casing terminates exactly at the end of cylinder head 18 which is attached to cylinder 16.

The piston 92 is supported by piston rod 74 so that it is spaced a small, predetermined distance 109 from the end of cylinder head 18 when such piston rod is inserted to its furthermost position in cylinder 16, as shown in FIG. 4, such distance being substantially less than the diameter of the cartridge casing 114. This creates a chamber between the end of the cylinder head 18 and the bottom of piston 92 and inside the cartridge casing for controlling the initial burning rate of the explosive propellent in cartridge 80. It should be noted that too small a chamber will result in accelerated burning and too rapid movement of switch blade rod 62 which may cause bending of such rod, whereas too large a chamber will result in too slow a movement of the switch blade rod or even a cartridge misfire because of insufficient heat and pressure generated by the igniting charge of the electrical detonator in cartridge 80, hereafter described in greater detail. When the explosive propellent charge in cartridge 80 is properly ignited the expansion of the propellent gases produces a high pressure on the back of piston 92 which forces the piston and piston rod 74 upward from the position shown at FIG. 4 to the position shown in FIG. 3, thereby pivoting blade clamp 66 with switch blade rod 62 and closing the grounding switch. A breather hole 110 is provided through one end of cylinder 16 adjacent cylinder head 100 to allow escape of any gases between piston 92 and cylinder head 100, and an elbow joint 112 may be screw-threaded into breather hole 110 so that it is positioned to prevent the entrance of moisture into cylinder 16. The propellent gases are retained within the cylinder to hold the switch blade in a closed position until the exploded cartridge is removed from the cylinder head 18.

One embodiment of the explosive cartridge 80 is shown in FIG. 4 to include a hollow, cylindrical cartridge casing 114 having an external screw-threaded portion 116 and an internal screw-threaded portion 118 with a thin

cap 120 of combustible material secured to the end of casing 114 remote from such screw threads by a shoulder on such casing end which is crimped over cap 120. An electrical squib detonator 122 in the form of a hollow cylindrical member having screw threads 123 on one end for engagement with the internal threads 118 of casing 114, is attached to the end of such cartridge casing remote from cap 120 by means of an intermediate shoulder portion in the form of a hexagonal bolt 124. The hexagonal shoulder is provided with an annular notch in the inner surface thereof for the receipt of a flat, rubber washer 126 to insure an hermetic or gas-tight seal between detonator 122 and casing 114. Fast burning detonator material 128 is packed in the end of detonator 122 which extends into cartridge casing 114 and supported by means of a plug 130 of electrical insulating material. A pair of electrical filaments are provided in the detonator material 128 and connected to electrical lead wires 132 which extend through insulator plug 130 in spaced, insulated relationship for igniting the detonator material. The detonator material 128 may be any suitable explosive which ignites when two amperes or more of electrical current flows through the low resistance filaments and lead wires 132 at from 6 to 250 volts A.C. or D.C. This characteristic of the detonator material and the filaments allows simplified testing of the continuity of the firing circuit at one ampere without igniting the detonator 122 and actuating the cartridge 80 so that removal of the cartridge is not necessary.

The cartridge casing 114 is secured inside passageway 108 in cylinder head 18 by means of external screw threads 116 and a rubber O-ring 134 positioned in an annular notch behind such external threads and in front of the connector end of casing 114 to form a gas-tight seal between such cylinder head and such casing. The explosive propellent material used to activate the switch operating mechanism of the present invention may be in the form of two cylindrical shaped charges 136 having conventional holes therethrough to provide uniform burning, which are positioned within the cartridge casing 114. This propellent material 136 may be any suitable inert explosive propellent material which can be stored for a long period of time without affecting its explosive characteristics. One suitable explosive propellent material which has been used successfully contains ammonium perchlorate in a polyvinyl chloride binder with a graphite coating thereon and is commercially available from the Propellax Chemical Corporation, of Edwardsville, Illinois.

In order to better understand the operation of the electrical grounding switch of the present invention, it will be described with reference to one example of an electrical power circuit in which it may be employed, as shown in FIG. 5. This electrical power circuit may involve the protection of a high voltage transformer 138 which is connected between a high voltage line or bus 140 at a first station and a low voltage line or bus 142 at a second station by a transmission line 144. A remote high voltage circuit breaker 146 is provided on the primary side of transformer 138 between high voltage bus 140 and such transformer, while a low voltage circuit breaker 148 is provided on the secondary side of transformer 138 between low voltage bus 142 and such transformer. A conventional air-break switch 150 may be provided between high voltage circuit breaker 146 and the primary of transformer 138, while the automatic grounding switch 12–14 of the present invention may be connected between transmission line 144 and ground adjacent to the primary side of transformer 138 remote from the high voltage circuit breaker 146. A differential relay 154 is connected across transformer 138 by current transformer windings 156 and 158 to transmission line 144 to sense any difference in the primary current and secondary current of such transformer due to an internal transformer fault. When such a difference or fault current occurs, differential relay 154 closes the relay contacts

which are connected between a battery 160 and cartridge 80 of the switch operating mechanism 10. The battery 160 may be a long life dry cell or any other source of energizing current which provides at least two amperes of electrical current at between 6 and 250 volts A.C. or D.C. to ignite the detonator 122 of the explosive cartridge 80. This causes the propellent material 136 to explode inside cartridge casing 114, thereby shattering cap 120 and moving the piston 92 upward in cylinder 16 so that piston rod 74 pivots blade clamp 66 about pivot pin 70. The pivoting of clamp 66 rotates switch blade rod 62 and closes switch blade contact 64 with stationary switch contacts 34 to short-circuit transmission line 144 to ground automatically causing high voltage circuit breaker 146 to open and disconnect the transformer 138 from the high voltage bus 140 in the manner previously described.

It should be noted that closing of the differential relay 154 also causes the low voltage circuit breaker 148 to open so that the transformer 138 is also disconnected from the low voltage bus 142 and is completely isolated from any source of destructive current. An auxiliary switch and indicating light (not shown) may be provided adjacent the automatic grounding switch of the present invention to indicate to the maintenance crew when such grounding switch is closed so that they may reset the grounding switch by manually opening the switch blade contact 64 by means of hook ring 65. After replacement or repair of the defective transformer 138 the empty cartridge casing 114 is removed from the cylinder head 18 to allow the propellent gases to escape, the switch blade is opened and a new explosive cartridge 80 is inserted within passageway 103 in cylinder head 18, thereby enabling another operation of the grounding switch. The stationary electrical contacts 34 and the movable switch blade contact 64 may also have to be replaced, as in conventional grounding switches, if they are severely pitted so that good electrical contact is no longer possible.

Typical examples of tested operating times for the high speed grounding switch of the present invention are as follows for the indicated voltages:

Voltage, kv.	Closing Time	Blade Length	Current, ka.	Angle, degrees	Torque, in lbs.
230	4.8 cycles—0.0815 sec-----	7′	40	70	6,000
161	4.6 cycles—0.0765 sec-----	5′8″	40	70	6,000
115	3.6 cycles—0.0600 sec-----	4′6″	40	70	6,000
69	2.4 cycles—0.0400 sec-----	3′2″	40	70	6,000

It will be obvious to one having ordinary skill in the art that various changes may be made in the details of the above-described preferred embodiment of the present invention without departing from the spirit of the invention. For example, the explosive actuated switch operating mechanism 10 may be used on electrical switches other than short-circuiting or grounding switches, and may even be employed in high voltage circuit breakers or other open-circuiting switches. Therefore, it is not intended to limit the scope of the invention to the above detailed description of a preferred embodiment thereof, but that scope should only be determined by the following claims.

I claim:

1. A high speed electrical ground switch, comprising:

a stationary switch contact assembly including a pair of contact plates forming the jaws of a stationary contact with a V-shaped slot formed between said plates at one end of said plates and with a portion of said plates extending substantially parallel from said slot toward the other end of said plates, and a resilient stop member positioned adjacent the end of the parallel portions of said plates; resilient backup means for said contact plates;

a movable switch contact assembly including a contact blade attached to one end of a tubular rod whose other end is mounted for rotation on a support member between a first position where said contact blade is remote from said stationary contact plates and a second position where said blade engages said jaws of said contact;

an insulator stack including a plurality of insulating spacer members attached to said support member of said movable switch contact assembly and to said stationary switch contact assembly; and

means for moving said movable contact rod between said first position and said second position to change the condition of said electrical switch between an open-circuit connection and a short-circuit connection, including a cylinder containing a piston having a piston rod pivotally attached to said other end of said contact rod, and a cartridge of explosive propellent material positioned within said cylinder so that the gases of said propellent material cause a sufficient force to be exerted upon said piston when said propellent material explodes to move said contact rod from said first position to said second position and to hold said contact rod in said second position.

2. A high speed electrical switch, comprising: a stationary switch contact assembly including a pair of contact plates forming the jaws of a stationary contact with a V-shaped slot formed between said plates at one end of said plates and with a portion of said plates extending substantially parallel from said slot toward the other end of said plates, and a resilient stop member positioned adjacent the end of the parallel portions of said plates; resilient backup means for said plates, a movable switch contact assembly including a contact blade attached to one end of a rod whose other end is mounted for rotation on a support member between a first position where said contact blade is remote from said stationary contact plates and a second position where said blade engages said jaws of said contact; an insulator stack including a plurality of insulating spacer members attached to said support member of said movable switch contact assembly and to said stationary switch contact assembly; and means for moving said movable contact rod between said first position and said second position to change the condition of said electrical switch between an open circuit connection and a short circuit connection, said means including an explosive propellent material supported so that when it explodes it causes a sufficient force to be exerted upon said rod to rotate said contact rod into engagement with said stationary contact plates and an electric detonator positioned to ignite said propellent material by heating in response to an electric current signal above a predetermined magnitude.

3. An electrical switch comprising: a stationary contact assembly including a first support, a pair of spaced apart contact plates forming the jaws of a stationary contact, said plates defining therebetween a V-shaped slot at one end and a straight slot at the other end, shock absorbing means positioned adjacent the portion of said plates defining said straight slot, and resilient means for urging said plates toward each other; a movable contact assembly including a second support, a rod having a contact blade thereon and mounted for rotation on said second support between a first position where said blade is remote from said stationary contact plates and a second position where said blade engages said contact plates; an insulator stack including a plurality of insulating members mounted between said first and second supports; and means for moving said rod between said first position and said second position, said means comprising an actuating member for moving said rod, an explosive propellent material positioned with respect to said actuating member whereby upon ignition of said material the gases of said material exert a sufficient force upon said actuating member to move said rod to its second position and to hold said contact rod thereat, and means for igniting said material.

4. An electrical switch comprising: a stationary con-

tact assembly including a first support, a pair of spaced apart contact plates forming the jaws of a stationary contact, said plates defining therebetween a V-shaped slot at one end and a straight slot at the other end, a resilient stop member positioned adjacent the end of said plates defining said straight slot, and resilient means for urging said plates toward each other; a movable contact assembly including a second support, a contact rod having a contact blade thereon and mounted for rotation on said second support between a first position where said blade is remote from said contact plates and a second position where said blade engages said contact plates; an insulator stack including a plurality of insulating members mounted between said first and second supports; and means for moving said contact rod between said first position and said second position, said means comprising an actuating member for moving said contact rod, an explosive propellent material positioned with respect to said actuating member whereby upon ignition of said material the gases of said material exert a sufficient force upon said actuating member to move said contact rod to its second position and to hold said contact rod thereat, and means for igniting said material.

5. An electrical switch comprising: a stationary contact assembly including a first support, a pair of spaced apart contact plates forming the jaws of a stationary contact, said plates defining therebetween a V-shaped slot at one end and a straight slot at the other end, a resilient stop member positioned intermediate said plates adjacent the end of said plates defining said straight slot, a casing partially surrounding said plates, and resilient means intermediate said casing and said plates for urging said plates toward each other; a movable contact assembly including a second support, a contact rod having a contact blade on one end and mounted at the other end for rotation on said second support between a first position where said blade is remote from said contact plates and a second position where said blade engages said contact plates; an insulator stack including a plurality of insulating members mounted

between said first and second supports; and means for moving said contact rod between said first position and said second position, said means comprising an actuating member for moving said contact rod, an explosive propellent material positioned with respect to said actuating member whereby upon ignition of said material the gases of said material exert a sufficient force upon said actuating member to move said contact rod to its second position and to hold said contact rod thereat, and means for igniting said material.

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