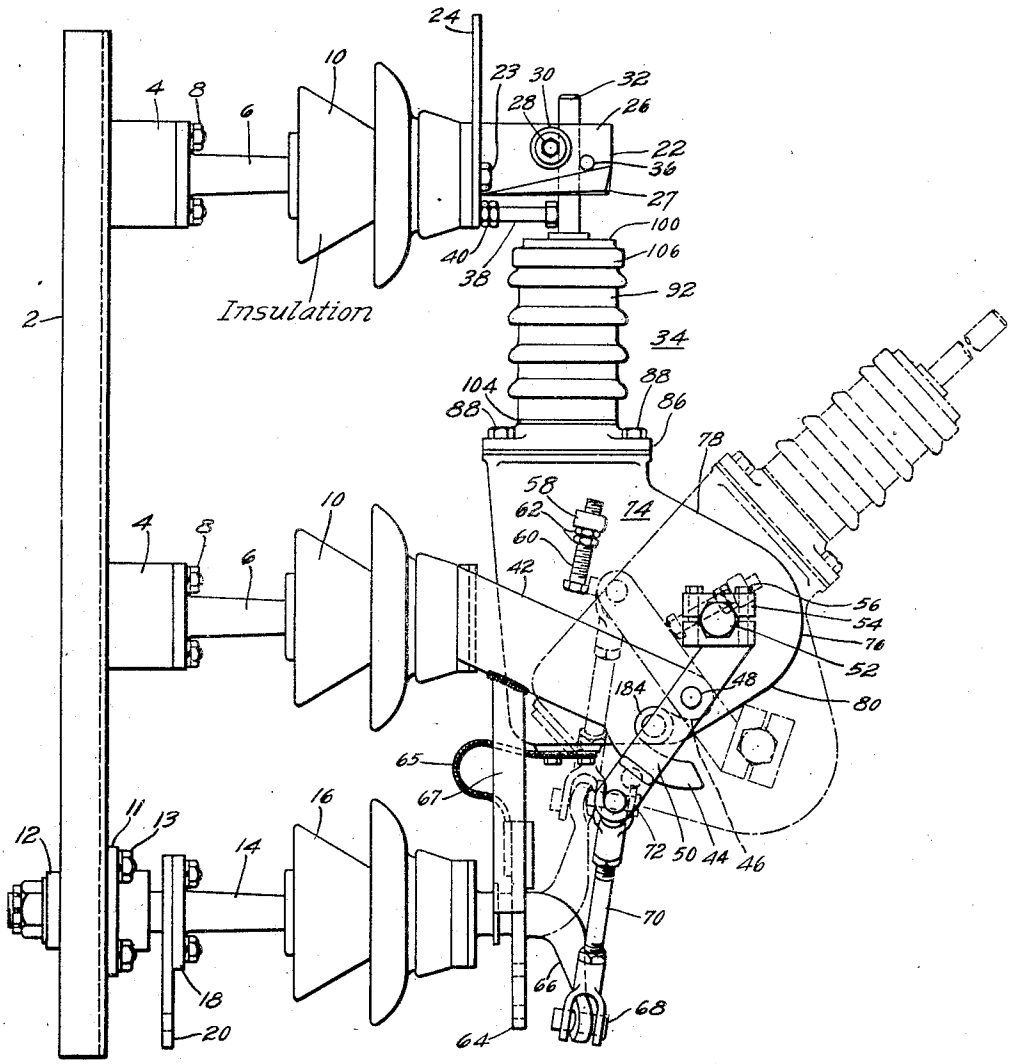
June 9, 1942. J. M. WALLACE ET AL 2,286,131

DISCONNECTING SWITCH

Filed Sept. 20, 1939 5 Sheets-Sheet 1

Fig. 1.



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DISCONNECTING SWITCH

Filed Sept. 20, 1939 5 Sheets-Sheet 2

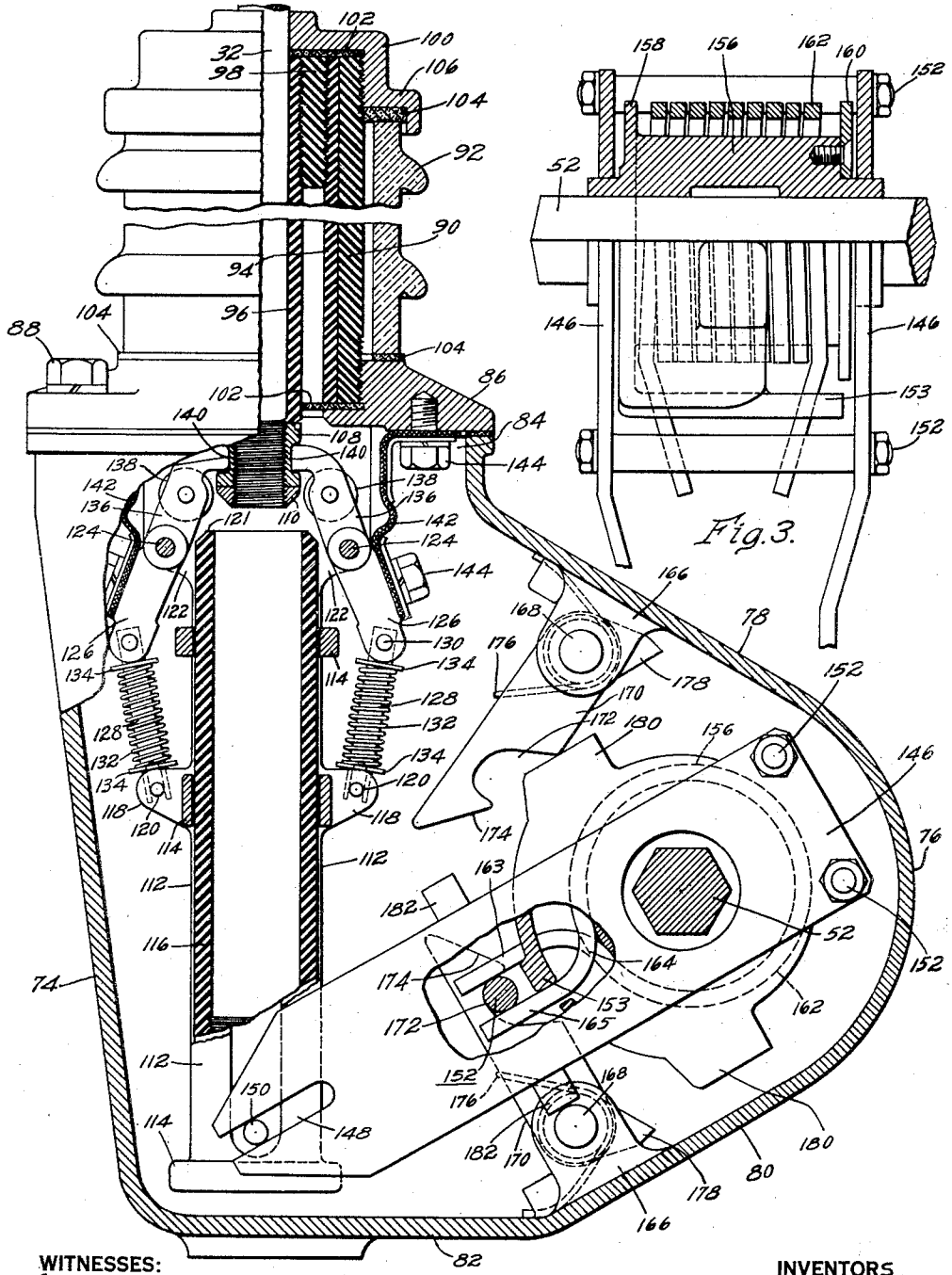

Fig. 2.

Fig. 3.

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DISCONNECTING SWITCH

Filed Sept. 20, 1939 5 Sheets-Sheet 3

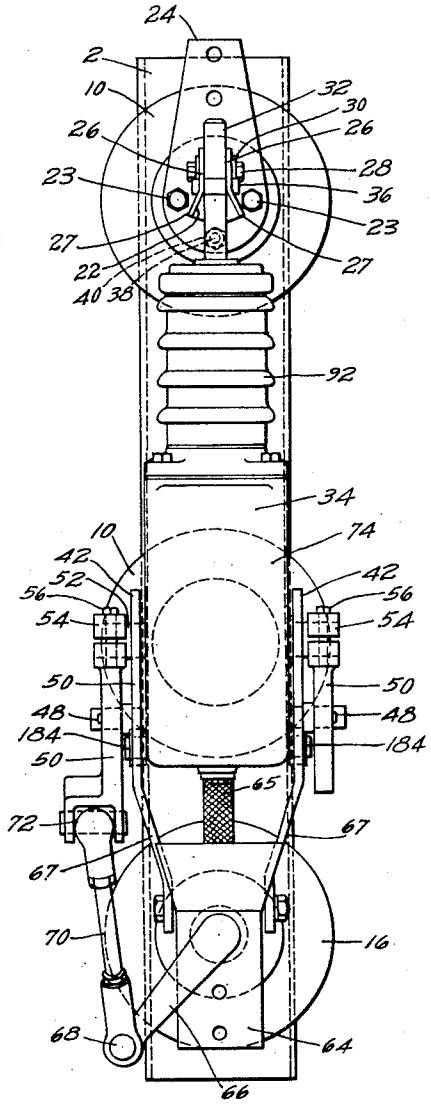

Fig. 4.

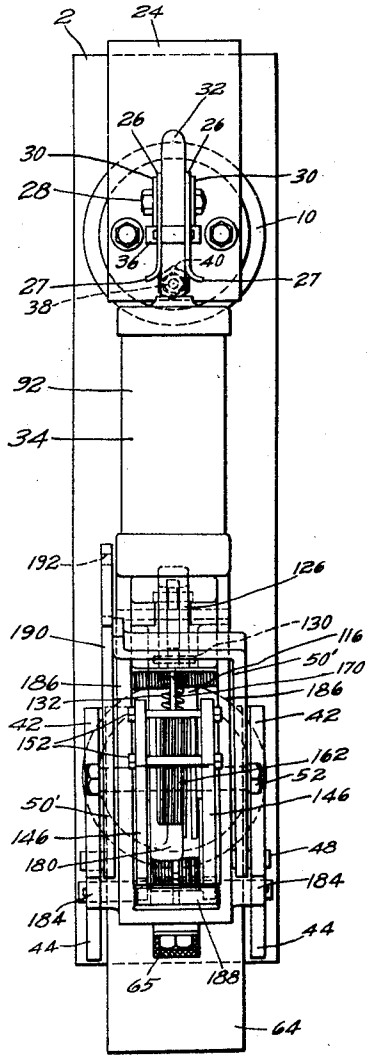

Fig. 6.

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DISCONNECTING SWITCH

Filed Sept. 20, 1939 5 Sheets-Sheet 4

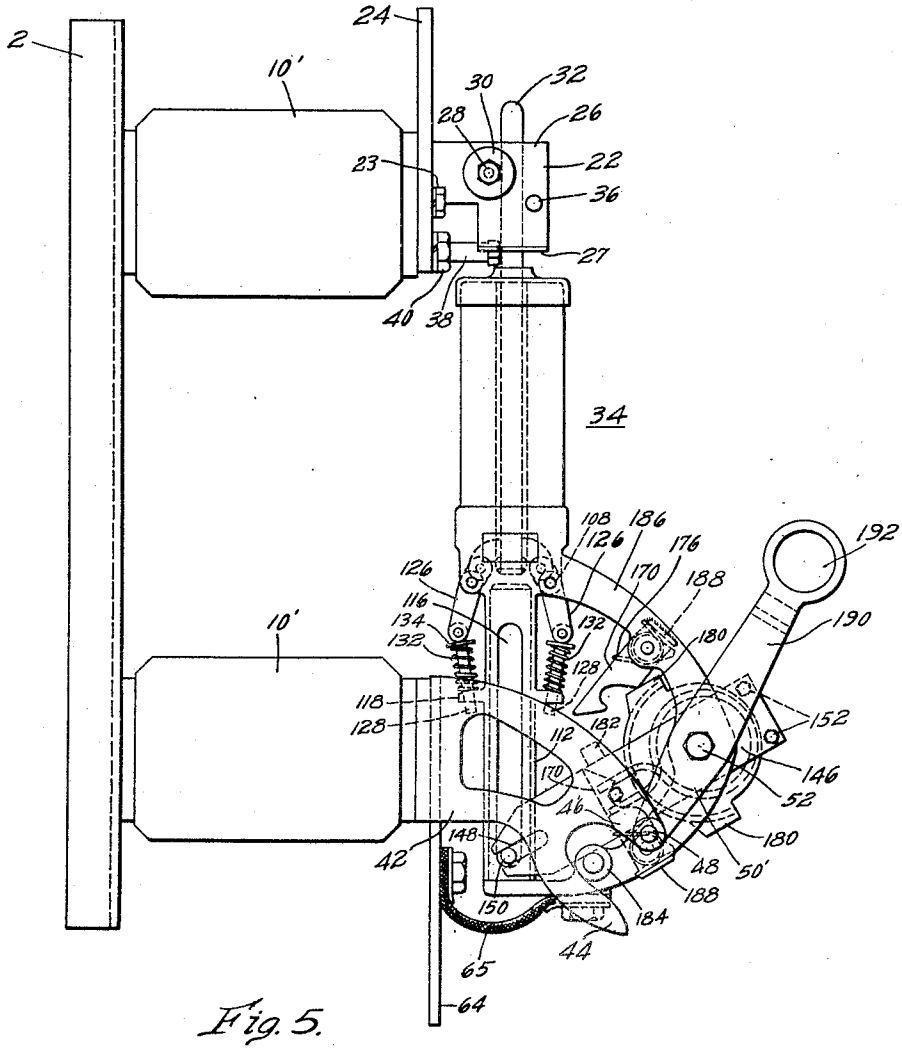

Fig. 5.

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DISCONNECTING SWITCH

Filed Sept. 20, 1939 5 Sheets-Sheet 5

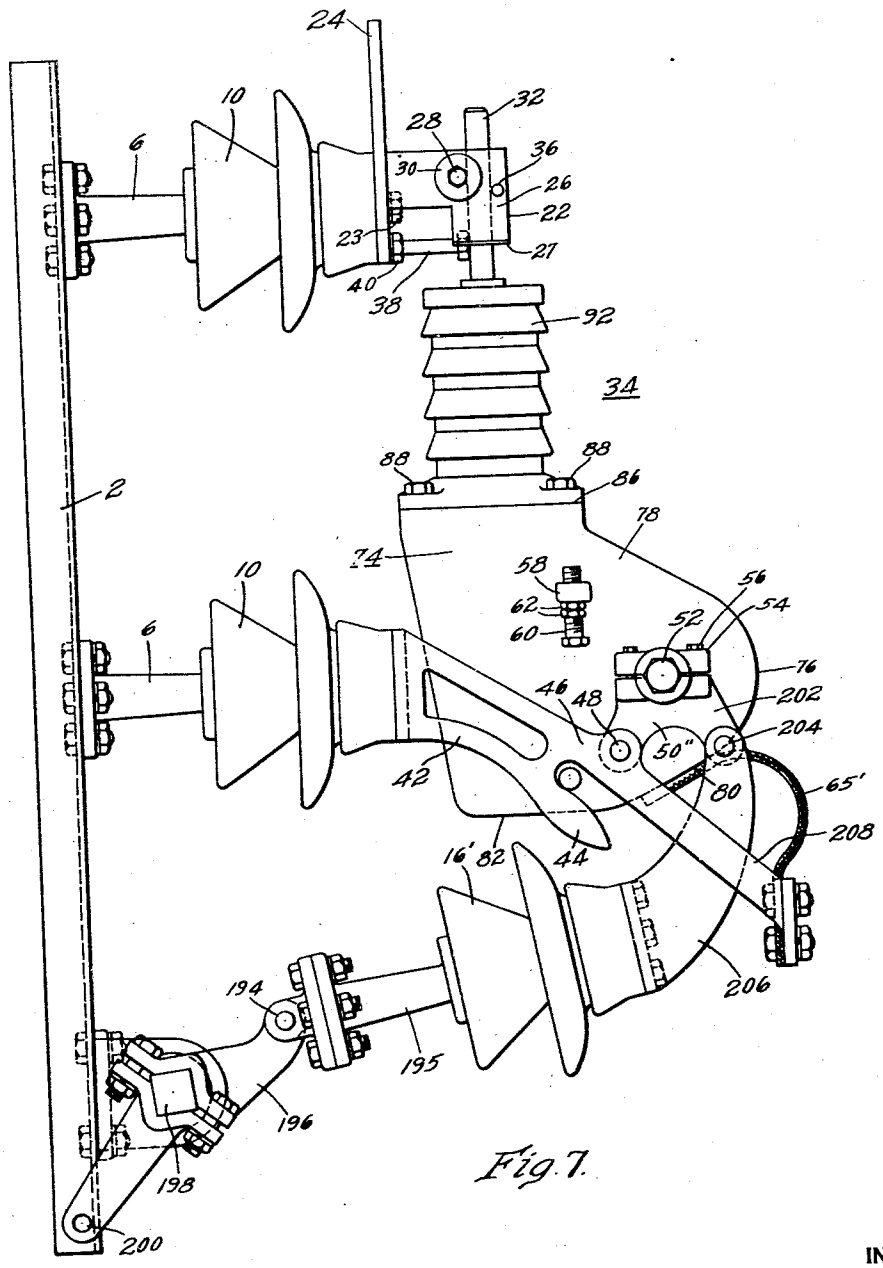

Fig. 7.

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Patented June 9, 1942

2,286,131

UNITED STATES PATENT OFFICE

2,286,131

DISCONNECTING SWITCH

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Application September 20, 1939, Serial No. 295,730

38 Claims. (Cl. 200—48)

Our invention relates to electric switches, and particularly to high voltage disconnecting switches which are adapted to open a circuit under load.

Disconnecting switches have been long known and used in the art in relatively high voltage circuits for isolating circuits from their source of energy for switching, testing, servicing and other purposes. Such switches were not designed, however, to interrupt currents of any appreciable magnitude.

With the advent of modern transmission systems employing much higher voltages, and the interconnection of long transmission lines and circuit, the charging current of such lines may be of considerable magnitude. Furthermore, it is often necessary to disconnect circuits from their associated networks while the circuit is under load.

It is therefore an object of our invention to provide a disconnecting switch which is capable of efficiently interrupting line charging currents and load currents.

In opening high voltage circuits under load, arcing is a serious problem which must be overcome to obtain safe and reliable operation. We have, therefore, provided a movable switch contact member with a means for interrupting a circuit through the member and extinguishing the resulting arc, before the contact member is removed from the circuit. Tests have shown that quick make and break are very desirable for the contacts of a high voltage switch of this type to prevent undue erosion of the contacts, and excessive wear on the interrupting parts. Various schemes have been proposed and tried, but a commercially practicable device was not readily obtained from the schemes tried until a snap action of the contacts was adopted.

A further object of our invention therefore, is to provide a disconnecting switch having a movable contact blade which includes novel snap action contacts for opening the circuit through the blade.

Another object of our invention is to provide a movable disconnecting switch blade with separable contacts and arc extinguishing means both operated with a snap action, to open the circuit through the blade.

Another object of our invention is to provide a manually operable disconnecting switch having a movable contact blade which includes snap action contacts for interrupting the circuit through the blade, and an operating member for actuating the snap action contacts at a predetermined speed irrespective of the speed at which the operating member is moved.

It is another object of our invention, to provide an operating member for a disconnecting switch which upon movement thereof in one direction, operates to sequentially open the contacts in the switch at a speed independent of the speed at which the operating member is moved, and then removes the blade from the circuit.

Another object of our invention is to provide a switch operating member which upon movement thereof in one direction first operates to build up a source of potential energy, then releases the same when the energy attains a predetermined value to operate switch contacts with a quick make or quick break action.

A still further object of our invention is to provide a disconnecting switch blade having a plurality of motions, one being a movement relative to a fixed contact while the blade is in engagement therewith and while the circuit through the blade is being opened or closed, and another motion wherein the blade moves toward or away from the fixed contact.

Another object of our invention is to provide novel means to effect a quick make and/or break of a movable switch contact.

Another object of our invention is to provide novel means to effect a snap action opening movement of a movable switch blade and to simultaneously project a dielectric between the open switch contacts.

Another object of our invention is to provide a novel load disconnecting switch suitable for either indoor or outdoor installation.

Another object of our invention is to provide a disconnecting switch blade with a novel opening movement.

These and other objects will become more apparent after consideration of the following detailed description of preferred embodiments taken in connection with the attached drawings, in which:

Figure 1 is a side view of one embodiment of our invention;

Fig. 2 is a longitudinal sectional view through the movable blade of our novel disconnecting switch;

Fig. 3 is a detailed view, partially in elevation and partly in section showing the spring mounting for actuating the blade contacts;

Fig. 4 is a front view of the device as shown in Fig. 1;

Fig. 5 is a side view corresponding to Fig. 1 showing a modification of our invention;

Fig. 6 is a front view of the device shown in Fig. 5; and

Fig. 7 is a side view of still another embodiment of our invention.

In general, our invention comprises a disconnecting switch blade movably mounted on one insulator and having a terminal engaging a fixed contact on a second insulator. The blade carries additional contacts in the circuit through the device, and, when the switch is opened, the blade is first moved relatively to its cooperating fixed contact while being maintained in engagement therewith while at the same time a source of potential energy is stored on the blade which after a predetermined movement of the blade is suddenly released to open the contacts carried on the blade with a snap action before the blade is removed from the circuit; thereafter, the blade terminal is moved in a direction away from its associated fixed contact. On closing movement of the switch the reverse action takes place, that is, the blade is first moved into engagement with its cooperating fixed contact and then is moved relatively thereto while being maintained in engagement therewith and while potential energy is again stored on the blade and the contacts carried on the blade are closed with a snap action. In order to provide for interruption of currents of appreciable magnitudes, arc extinguishing means is provided for the arc formed when the contacts on the blade are opened.

In the embodiment shown in Figs. 1, 2, 3 and 4, the switch is shown as being mounted on a fixed support 2 having the insulator supports 6 and 14 mounted thereon. Insulator supports 6 include bases 4 seated on the support 2 and secured thereto as by means of the bolts 8. The insulator supports 6 carry insulators 10 at their outer ends for supporting the disconnecting switch blade. The insulator support 14 is mounted in a bearing 12 secured in the support 2 as by the bolts 13 passing through a flange 11 on the bearing and into the support 2. The insulator support 14 is rotatable in the bearing 12 and has secured to a flange 18 provided thereon an operating part 20 which is apertured for the reception of a hook stick operating member, or a link from a remote control operating means (not shown). The insulator support 14 carries at its outer end an insulator 16 for supporting mechanism for operating the switch blade to its open and closed positions. On the outer end of the upper insulator 10 is secured a fixed contact 22 which includes the outwardly extending spaced sides 26 and a laterally extending terminal portion 24. The contact is secured to the insulator by any suitable means, such, for example, as by the bolts 23. The sides 26 of the fixed contact have their edges facing the disconnecting switch blade flared outwardly as at 27 to guide the blade terminal between the sides of the fixed contact. The sides of the fixed contact are bolted together by a bolt 28 having the resilient washers 30 located between the head of the bolts and its associated nut and the sides 26 of the fixed contact, respectively. This bolt serves as a positioning means for the blade terminal and also prevents undue separation of the contact sides. A pin 36 spaced outwardly of the bolt 28, also extends through the sides 26 of the fixed contact and the blade terminal is received in the contact between the pin 36 and the bolt 28. A stop bolt 38 is threaded into the terminal portion 24 of the fixed contact and is provided with the lock nuts 40 to adjustably secure the same in any desired position relative to the fixed contact.

The lower insulator 10 carries a U-shape support 42 with the closed end of the U mounted on the outer end of the insulator and with the legs of the U extending outwardly therefrom. The outer ends of the legs of the support 42 are notched to provide two projections 44 and 46 on each leg. A pivot pin is provided for each projection 46 to pivotally mount an operating lever 50, intermediate the ends thereof and the movable blade assembly or arc extinguishing structure 34 is pivotally mounted on a shaft 52, which shaft has hexagonal outer ends to which one end of each operating lever 50 is securely clamped, for example, as by the clamping portion 54 which is bolted to the lever 50 as by the bolts 56. A lug 58 is provided on one side of the blade 34 and is provided with a threaded aperture for the reception of a stop bolt 60 positioned to be engaged by the operating lever 50. The stop bolt is provided with lock nuts 62 to adjustably secure the same in the position in which it is desired that it be engaged by the operating lever 50.

The insulator 16 is secured to adjacent insulator 10 by the tie bars 67 and carries at its outer end a terminal portion 64 of suitable conducting material, such, for example, as copper, and at the outer side of the conducting terminal portion 64, a crank 66 is integrally secured thereto, and is pivoted at its outer end by a pin 68 to one end of an adjustable link 70 which has its other end secured to the free end of the operating lever 50 by a universal joint 72.

In the operation of the structure thus far described, and considering the blade as shown in the full line position of Figs. 1 and 4, when the insulator support 14 is rotated in a clockwise direction (Fig. 4) to rotate the operating lever 50 in a clockwise direction, (Fig. 1), the disconnecting switch blade assembly 34 is moved outwardly and downwardly, pivoting on the shaft 52 which in turn moves about pivot pin 48, and the terminal 32 of the blade structure is slightly rotated in a counterclockwise direction while being withdrawn longitudinally from the fixed contact 22. This motion continues until the end of the terminal 32 clears the pin 36 whereupon the operating lever 50 engages the stop bolt 60 and pivots the entire blade structure 34 with the lever 50 about the axis of pin 48. In closing the switch the rotatable insulator 16 is rotated in the opposite direction to move the lever 50 in a counterclockwise direction, whereupon means to be hereinafter described within the blade structure causes the blade structure 34 to be rotated in a counterclockwise direction about the axis of pin 48 until the blade terminal 32 engages the stop bolt 38, whereupon the blade structure 34 is prevented from moving further and shaft 52 will rotate relative to the blade structure 34 and the blade terminal 32 will be moved generally longitudinally between the sides 26 of the contact 22 back to the position shown in full lines in Fig. 1.

The lower end of the blade assembly 34 comprises a hollow casing structure 74 (see Fig. 2), having a substantially flat inner wall portion and a rounded outer end wall 76 joined to the inner wall portion by the inclined side walls 78 and 80, respectively. The lower end 82 of the housing is closed and the upper end is open as at 84. An annular collar 86 is secured to the open upper end of the housing by the bolts 88 passing

through the collar and engaging in threaded apertures provided in the casing. Clamped between the collar 86 and an outer cap structure 100 is an outer insulating sleeve 92 made of any desired insulating material, preferably porcelain, glass or the like, and an inner supporting sleeve 90 having external threads at its opposite ends engaging internal threads provided on the collar 86 and engaging internal threads on the flange of cap 100, respectively. The supporting sleeve 90 has an insulating sleeve 94 closely engaging its inner wall, and the cap 100 is provided with a central aperture through which the blade terminal 32 passes to the interior of the housing. The blade terminal 32 carries a second insulating sleeve 96, the outer surface of which is spaced from the inner surface of the insulating sleeve 94, thus providing an annular space extending outwardly from adjacent the inner end of the blade terminal 32. An annular exteriorly and interiorly threaded spacing member 98 is provided between the insulating tubes 94 and 96 at their outer ends and is threadedly engaged with said tubes. The three insulating tubes 92, 94, and 96 have between their outer ends and a flange 106 on the cap 100 and collar 86, respectively, packing material 102 and 104 which may be of any desired compressible material, such, for example, as cork or a fibrous material. The insulating tubes 94 and 96 may be formed of any suitable gas-evolving insulating material, such, for example, as fiber, boric acid or the like. The blade terminal rod 32, which is formed of a conducting material, such as copper, has threadedly mounted on the inner end thereof, a replaceable contact part 108 of a material which is resistant to arcing, such, for example, as silver tungsten alloy. The contact 108 has an annular groove in which movable contacts may be received, and is maintained in position on the blade terminal 32 by a lock nut 110 threaded on the inner end of terminal rod 32.

The collar 86 is provided with a downwardly extending supporting structure for a movable insulating tube 116 of gas-evolving material such as fiber. The supporting structure includes spaced arms 112 forming a slotted tubular support about the insulating tube 116 and the arms being tied together by the integral encircling band structures 114. Opposed pairs of ears 118 and 122 are secured in spaced relation on the supporting structure for tube 116. The ears 118 carry a pivot pin 120 between them and the ears 122 carry a pivot pin 124 which in turn pivotally carries a contact lever 126 mounted between the ears 122. One end of the lever 126 is forked and pivotally connected to one end of a second lever 128 as by the pin 130. The opposite end of the lever 128 is slotted to telescope over the pivot pin 120 between the ears 118. A coil spring 132 surrounds the lever 128 with its ends bearing against washers 134 which engage the forked end of lever 126 and the ears 118 respectively. Contact lever 126 has an extended portion 136 carrying an intermediate rotatable roller 138 formed of a suitable insulating material, such as fiber, and has a laterally extending end portion terminating in a contact surface 140 engaging in the annular groove of the replaceable contact sleeve 108 on the blade terminal 32. The blade housing 74 is electrically connected to the terminal portion 64 on the rotatable insulator 16 by means of a flexible conductor 65 suitably secured to the terminal portion 64 and to the housing 74, and the movable contact levers 126 are electrically connected to the housing by the flexible conductors 142, respectively, secured in position as by the bolts 144. The flexible conductors 65 and 142 may be of any suitable flexible conducting material, such, as for example, as copper. Although we have disclosed a pair of movable contacts 126 and tubular arc extinguishing means 94, 96 and 116, it is obvious that any desired number of movable contacts could be employed with the tubular arc extinguishing structure. However, if only one contact be used, the arc extinguishing structure need not be of tubular form, but could be composed of spaced substantially flat insulating plates, between which a flat insulating plate corresponding to the tube 116 could be moved to extinguish the arc.

It is now apparent that the circuit through our disconnecting switching starting with the terminal portion 24 extends through the fixed contact 22, through the blade terminal 32, the movable contact levers 126, through the flexible conductors 142, to the blade housing 74, thence through the flexible conductor 65 to the other terminal 64.

In the operation of the circuit interrupting contacts 126, it can be seen that when the movable insulating tube 116 is moved upwardly as viewed in Fig. 2, it will first engage the rollers 138 on the lever 126 with its beveled end 121 and thereby move the contacting portions 140 away from the fixed contact 32. The arc resulting from the separation of these contacts will be forced into the annular space between the insulating tubes 94 and 96 by movement of the tube 116 into this space. The arc is thereby attenuated and drawn out and finally extinguished. The clearance between tubes 94, 96 and 116 is so small that the arc will be forced into intimate engagement with the tubes causing the formation of a relatively large quantity of gas which will be expelled into the housing 74 to extinguish the arc. The housing 74 is large enough to accommodate the expelled gas, and to also act as a cooling medium to condense the gas, so that the device may be entirely closed and yet not develop dangerous pressures within the same.

It should be noted that the movable contact surfaces 140 are urged into engagement with the fixed contact 108 by what is in effect a spring toggle mechanism constituted by the levers 126, 128, and spring 132. This toggle however, has its motion limited entirely to one side of its dead center position. The limits are established in one direction by engagement of the contacting portions 140 with the fixed contact 108. As the contacts are moved away from each other and from the fixed contact, the toggle approaches dead center position but is prevented from reaching this position by engagement with the tie ring 114. It is, therefore, apparent that relatively lesser force is required to move the contacts away from the fixed contact 108 the further away these contacts are moved from the fixed contact. Also, relatively little force will be exerted by the roller 138 on the outside of the fiber tube 116 when the contacts are opened, due to the fact that the toggle will then be near its dead center position and very near to an unstable condition. This is advantageous since the insulating tube is made of fiber, which is a good, inexpensive insulating material but has relatively low strength.

Rotatably mounted on the shaft 52 adjacent

opposite sides of the interior of the casing 74 are the switch operating levers 146 having slotted outer ends 148 to slidably receive pins 150 projecting from opposite sides of the movable insulating tube 116. A pair of bolts 152 connect the operating levers 146 at their outer ends and a third bolt connects the levers at an intermediate portion. A spring barrel support 156, shown in detail in Fig. 3, includes an integral end flange 158 and a detachable end flange 16. The barrel has its outer ends hexagonal in shape and apertured to receive the shaft 52 so as to be movable therewith, and a coil spring 162 is coiled about the spring barrel between the flanges thereof with the coils thereof spaced from the barrel to prevent the spring from going solid on the barrel when the spring is tensioned. The ends of the spring are brought out at the one side of the barrel and are crossed as at 164 and then extended outwardly in spaced parallel relation to engage opposite sides of the intermediate operating lever bolt 152. Also engaged between the ends of the spring is a projection 153 which forms an extension from and is integral with the spring barrel and which is disposed parallel to but spaced from, the bolt 152. On the inclined side walls 78 and 80 of the blade housing there are provided opposed pairs of ears 166, between each pair of which is received a latch member 170. Each latch member 170 is pivotally mounted with respect to the ears by means of a pin 168 extending through the latch member and ears. Springs 176 have an intermediate portion coiled about the pivot pins 168 with one end of each spring bearing against one latch member and the other end bearing against the housing walls 78 and 80, respectively, to continuously urge the latches in an outward direction. Each latch is provided with an inner extension 178 adapted to engage the adjacent inner wall of the housing to limit movement of the latches under the influence of the springs 176. The bolt 152 on the operating levers 146 is normally received in one of the notches 172 provided in the latches, and the spring barrel 156 is provided with a pair of laterally extending latch releasing portions 180. As shown in Fig. 2, upper latch releasing portion 180 has operated to engage and thereby release the upper latch. The operating levers 146 are also provided at opposite edges with laterally projecting stop lugs 182 adapted to act as bumpers to engage the pivot pins 168 to limit the movement of the operating levers and insulating tube 116 under the influence of spring 162.

In the operation of this embodiment of our invention, it will be seen that when the rotatable insulator 16 is rotated in a clockwise direction to move the operating lever 50 in a clockwise direction as viewed in Fig. 1, the spring barrel 156 and the projection 153 integral therewith will be moved in a clockwise direction relative to the blade housing 74, since the housing is pivoted on shaft 52 and the spring barrel is fixed thereto, thereby moving the end 163 of spring 162 in a clockwise direction to tension the spring, since the other end 165 of the spring is maintained fixed relative to the housing by virtue of its engagement with bolt 152 secured relative to the housing by the lower latch 170. Since the housing pivots on the shaft 52, the blade terminal 32 is given a slight rotational movement while being longitudinally withdrawn from between the sides 26 of the fixed contact 22 as heretofore described. Before the blade terminal 32 is withdrawn from beneath pin 36 on the fixed contact the lower latch release lug 180 on the spring barrel will engage the lower latch 170 to release the bolt 152 on the operating levers 146, and inasmuch as by this time, the spring 162 has been placed under considerable tension, the operating levers 146 will be suddenly forced in a clockwise direction relative to the blade housing 74, and thereby move the insulating tube 116 to open the movable contacts 140, and project the tube 116 between the contacts 140 and 108, and into the annular space between the insulating tubes 94 and 96. This movement of tube 116 being under the influence of a suddenly released, highly tensioned spring will give a quick break of contacts 140 from the fixed contact 108 as well as providing a quick drawing out of the resulting arc. This action may be deemed a snap action. Coincidentally, as described heretofore, engagement of the arc with the walls of the insulating tubes, causes release of an arc extinguishing gas with an expulsion action into housing 74, to insure extinction of the arc before the blade terminal 32 is removed from contact 22. At the end of the motion of the operating members 146 under the influence of the released spring 162, the stop lugs 182 will engage the upper latch pivot pin 168 to stop the movement thereof. The bolt 152 on the operating levers meanwhile has engaged the cam surface 174 on the upper latch member 170 to depress the latch and allow the bolt 152 to enter the notch 172 of this latch thereby preventing the operating levers 146 from returning or rebounding from the housing wall 78. As the insulating member 16 is further rotated in the same direction the blade terminal 32 will be withdrawn from beneath the pin 36 at which time the operating lever 50 will engage the stop bolt 60 to pivot the entire blade assembly 34 about the axis of pivot pin 48 to move the blade terminal 32 away from its associated fixed contact to the dotted line position shown in Fig. 1.

It is therefore apparent that the circuit is first opened within the switch blade assembly, and the resulting arc is drawn out and extinguished, before the switch assembly is moved out of the circuit.

To close the switch the insulator 16 is rotated in the opposite direction, that is, in a direction to move operating lever 50 in a counterclockwise direction. Since in this movement, the blade assembly is free to pivot about the axis of pivot pin 48, the stiffness of spring 162, by virtue of the fact that the operating levers 146 are latched by the upper latch 170 to the casing wall 78 will cause movement of the blade assembly about the axis of pivot pin 48 to bring the blade terminal 32 into engagement with the stop bolt 38. When this point is reached, further movement of the operating lever bolt 152 is prevented and from this point on the extension 153 on the spring barrel will move the end 165 of the spring away from the end 163 thereby tensioning the spring. This movement will continue together with a movement of the blade terminal 32 in between the sides 26 of the fixed contact 22 until near the end of movement of the insulator 16 in this same direction, when the upper lug 180 on the spring barrel will engage the upper latch 170, which is mounted on the wall 78 of the blade housing, to release the bolt 152 from the latch, thereby enabling the spring end 163 to move the pin 152 and operating levers 146 to withdraw the insulating tube 116 from the annular space

between the insulating tubes 94 and 96, from between the movable contacts 136 and the fixed contacts 108, allowing the spring toggles to move the contact surfaces 140 into engagement with the fixed contact 108, all this movement being accomplished with a quick snap action due to the sudden release of spring 162, to provide a quick make, or closing of the circuit by the movable contacts 136 in the switch housing, and after the switch assembly 34 is in the circuit.

Although we have disclosed a spring for effecting snap action movement of the contacts 136, it is obvious that any other means capable of storing energy could be employed such for example as a fluid system for storing energy, or a gravity means, such as an elevatable weight.

On opposite sides of the blade assembly housing 74 are provided rollers 184 to engage in the slot between the extensions 44 and 46 of the blade support 42. In the opening movement of the blade these rollers ride up the inner side of the extensions 44, and, as the blade is opened, they ride over the end of the extensions and down the outer sides thereof as shown in dotted lines in Fig. 1. The purpose of these rollers is to prevent motion of the blade assembly longitudinally toward the fixed contact 22 during switch-closing movement, before the blade terminal 32 is aligned with its fixed contact, i. e. before terminal 32 engages stop bolt 38. This might occur in the event that the spring 162 is too flexible, or becomes weakened after repeated operations, so that it does not cause the blade assembly to pivot about pin 48 with the operating lever 50, during initial closing movement. However, it is obvious that by choosing a durable spring having substantial stiffness, these rollers may be dispensed with.

In the embodiment of our invention shown in Figs. 5 and 6, there is depicted a disconnecting switch suitable for indoor insulation which is identical, in most respects, with the embodiment heretofore described, and like reference characters are used to identify like parts. This embodiment differs from that previously described, in the substitution for the blade assembly housing 74, of the U-shaped members 186 on which are carried the shaft 52, latch supports, and extensions 112 for guiding the movable insulating tube 116. The U-shaped supports 186 have cross plates 188 securing them together by any suitable means, such for example, as by welding, and which plates carry the supporting ears 166 for the latch members 170.

The switch of this embodiment requires but two supporting insulators rather than the three of the first embodiment described. In this structure, the insulators 10' are secured directly to the support 2. Also, in this embodiment, the operating lever 50' is extended from the pivot 48 in an opposite direction from that in which the lever 50 in the first embodiment is extended. The lever 50' has an outward extension 190 which terminates in an aperture 192 for the reception of a hook stick operating member.

The operation of this embodiment of our invention is identical with that of the embodiment previously described and hence will not be gone into in detail to avoid repetition.

It is merely necessary to insert a hook stick in the aperture 192 of the operating lever 50' to move the lever in the clockwise direction as shown in Fig. 5 to open the switch, and to close the switch the lever 50' is moved in the reverse direction. Thus it is seen that the lever 50' moves in the same directions for opening and closing movements of the switch as did the lever 50 described in connection with the first embodiment. The operation of the contacts carried by the switch blade assembly and the other parts thereon is identical with that described in the first embodiment.

In Fig. 7 of the drawings, we have shown another embodiment of our invention which is much like the embodiment shown in Figs. 1 to 4 and differs therefrom only by the provision of a slightly different operating means. Hence, like reference characters are used here to identify like parts.

This embodiment of our invention embodies three supporting insulators as does the device shown in Figs. 1 to 4. However, the operating insulator 16' is mounted for movement about a transverse rather than a longitudinal axis. The operating lever 50'' is modified to include an integral downwardly and outwardly extending portion 202 which is pivotally connected as at 204 with a lateral extension 206 secured to the operating insulator 16'. The insulator 16' has its supporting portion 195 pivotally connected as at 194 with an operating crank 196 which, in turn, is pivotally mounted as at 198 on the support 2 and has an oppositely extending operating part which includes an aperture 200 for pivotally receiving an operating means such, for example, as a hook stick, or an end of an operating link controlled from a remote point. The housing 74 is electrically connected by a conductor 65' to a terminal extension 208 on the leg 46 of the U-shaped support 42.

The operation of this form of our invention is identical with that of the first described form, and hence will not be gone into in detail again. It will be obvious, however, that movement of the lever 196 in a clockwise direction as viewed in Fig. 7 will move the inner end of the insulator 16' downwardly, thus exerting a pull on the extension 202 of the operating lever 50'' causing the operating lever to rotate about its fixed pivot 48 in a clockwise direction. This will cause opening of the switch with the parts within the switch casing 74 and the switch assembly 34 being operated in the same manner as in the embodiments heretofore described. It is likewise apparent that movement of the operating lever 196 in the opposite direction will move the operating lever 50'' in a counterclockwise direction and effect closing operations of the switch in the same manner described in connection with the other two embodiments.

It can therefore be seen that we have provided a disconnecting switch, the blade of which carries cooperating fixed and movable contacts for interrupting and closing the circuit through the blade while the blade itself is in the circuit, and operating means for the switch is provided to insure the circuit being made or broken while the switch is in the circuit, so that when the switch is moved out of engagement with its associated contact, the circuit will have been first interrupted in the blade per se. It is further apparent that we have provided a load break disconnecting switch having circuit interrupting means in the blade per se, which interrupting means are operated by a snap action to provide a quick make and break of the circuit. Simultaneously with the break of the circuit in the blade structure, we have provided an insulating means which is projected between the separated contacts in the blade and beyond the same with

a snap action to draw out and extinguish the resulting arc.

It is also apparent that we have provided a disconnecting switch which upon continued motion of an operating member to open the same, contacts within the blade are first separated with a snap action irrespective of the speed of operation of the operating member, and the arc resulting from such separation is quickly drawn out and extinguished, and thereafter the blade structure itself is removed from the circuit. Upon closing the switch the reverse action takes place, that is, the blade structure having an open circuit therethrough is first moved into the circuit, and thereafter with the same continuous movement of the switch operating member, contacts within the blade structure are closed with a snap action at a speed irrespective of the speed of the blade operating member.

Having described preferred forms of our invention in detail, in accordance with the patent statutes, we wish it to be understood that we do not desire to be limited to the embodiments particularly described herein, since it will be obvious, particularly to those skilled in the art, that many changes and modifications may be made therein without departing from the broad spirit and scope of our invention; for example, there are three types of operating means disclosed, that is, the rotating insulator type shown in Figs. 1 to 4; the hook-stick type shown in Figs. 5 and 6 and the pivoted insulator type shown in Fig. 7. Obviously, each type of operating means could be used with either the open or closed type or our switch, by merely changing the operating levers **50**, **50'** or **50''**.

Therefore, we desire that our invention be given the broadest possible interpretation and that it be limited only by what is expressly stated in the appended claims.

We claim as our invention:

1. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, a common operating member operable upon continuous movement in one direction to first break the circuit at said arc establishing contacts and to thereafter open said disconnecting contacts, and means between said operating member and said arc establishing contacts to first store energy and then release the same to cause separation of said arc establishing contacts with a snap action prior to opening of said disconnecting contacts upon movement of said operating member to open the circuit.

2. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, a common operating member movable to first break the circuit at said arc establishing contacts and to thereafter open said disconnecting contacts and means between said operating member and said arc establishing contacts to first store energy and then release the same to cause separation of said arc establishing contacts with a snap action prior to opening of said disconnecting contacts upon movement of said operating member to open the circuit, said operating member also being movable to close said circuit to first close said disconnecting contacts and to thereafter close said arc establishing contacts, and said means being actuated during said closing movement to first store energy, and then release the same to cause engagement of said arc establishing contacts with a snap action after engagement of said disconnecting contacts.

3. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, means adjacent said arc establishing contacts forming a narrow passage between walls of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc, a member adjacent said arc establishing contacts movable to elongate an arc established thereby into said passage, a common operating member movable to first break the circuit at said arc establishing contacts and force the arc into said passage, and to thereafter open said disconnecting contacts, and means between said operating member and said arc establishing contacts and said arc drawing member, to first store energy and then release the same to cause separation of said arc establishing contacts and elongate the resulting arc in said passage with a snap action, upon movement of said operating member to open the circuit.

4. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, a tubular member having an open end adjacent said arc establishing contacts, a second tubular member movable into the first tubular member to draw out an arc formed by said arc establishing contacts into the passage between said members, both of said members being formed of a material capable of evolving an arc extinguishing gas when in proximity to an electric arc, a common operating member movable to first break the circuit at said arc establishing contacts and draw the arc into said passage, and to thereafter open said disconnecting contacts, and means between said operating member and said arc establishing contacts and said second tubular member, to first store energy, and then release the same to cause separation of said arc establishing contacts, and the drawing out of the resulting arc in said passage with a snap action, upon movement of said operating member to open the circuit.

5. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device including a housing for arc establishing contacts connected in series with said disconnecting contacts, a common operating member movable to first break the circuit at said arc establishing

contacts and to thereafter move said housing to open said disconnecting contacts, and means in said housing and between said operating member and said arc establishing contacts to first store energy and then release the same to cause separation of said arc establishing contacts with a snap action upon movement of said operating member to open the circuit.

6. In a switch, in combination, a stationary contact, a contact movable into and out of engagement with said fixed contact, a spring toggle for urging said movable contact into engagement with said fixed contact, said toggle being limited for movement entirely on one side of its dead center position and being furthest from dead center position in the closed position of the contacts.

7. In a switch, in combination, a first contact, a movable contact formed on an extension of one lever of a spring toggle for continually urging the movable contact into engagement with the first contact, said toggle being limited for movement entirely on one side of its dead center position and being furthest from dead center position in the closed position of the contacts.

8. In a switch, in combination, a first contact, a movable contact formed on an extension of one lever of a spring toggle for continually urging the movable contact into engagement with the first contact, said toggle being limited for movement entirely on one side of its dead center position and being furthest from dead center position in the closed position of the contacts, and cam means to move said movable contact away from said first contact.

9. In a switch having a pair of terminals, a first contact having a plurality of contact surfaces connected to one terminal, a plurality of pivoted contacts connected to the other terminal and mounted on extensions of one lever of a spring toggle for urging each contact into engagement with a contact surface, said toggles limited for movement wholly on one side of their dead center positions and being furthest from dead center position in the closed positions of the contacts, and means movable between said one levers of the toggles to engage them to move then to the open contact position with a cam action.

10. In an electric switch, fixed and movable contacts, an operating member movable in one direction for moving said movable contact out of engagement with said fixed contact, resilient means stressed by said member during the first part of its movement and means actuated by said member at the end of the first part of its movement to release said resilient means to open said contacts with a predetermined snap action, irrespective of the speed of movement of said operating member, spaced walls of insulating material adjacent said contacts defining a slot open only at the end thereof adjacent said contacts, and an insulating member operated by the release of said resilient means to be projected substantially transversely through the arc formed when the contacts are opened, and into said slot, to draw out and extinguish said arc substantially instantaneously.

11. In a switch, in combination, a first contact, a movable contact formed on an extension of one lever of a spring toggle for continually urging the movable contact into engagement with the first contact, said toggle being limited for movement entirely on one side of its dead center position and being furthest from dead center position in the closed position of the contacts, spaced walls of insulating material adjacent said contacts defining a slot, an insulating member mounted for movement along a path in which it will first engage said one toggle lever to separate the contacts, and then move between the separated contacts and into the slot.

12. In a switch having a pair of terminals, a first contact having a contact surface connected to one terminal, a movable contact connected to the other terminal and resiliently urged into engagement with said contact surface, spaced concentric insulating tubes adjacent said contacts located with the plane of the space between the tubes surrounding said contact surface, and an insulating tube mounted to move in a path to first engage said movable contact to open the switch, and then move between the separated contacts and into the space between said concentric tubes, to sequentially open the switch, and draw out, and extinguish the resulting arc.

13. In a switch having a pair of terminals, a first contact having a plurality of contact surfaces connected to one terminal, a plurality of pivoted contacts connected to the other terminal and mounted on extensions of one lever of a spring toggle for urging each contact into engagement with a contact surface, said toggles being limited for movement wholly on one side of their dead center positions and being furthest from dead center position in the closed positions of the contacts, spaced concentric tubes adjacent said contacts located with the plane of the space between the tubes surrounding said fixed contact surfaces, and an insulating tube mounted to move in a path to first engage said one levers of the toggles to move them to the open contact position, and then move between the separated contacts and into the space between said concentric tubes, to open the switch and draw out and extinguish the resulting arc.

14. In a circuit interrupting device, a movable switch member including a pair of terminals, cooperating contacts carried by the member at least one of which is movable and connected to said terminals, respectively, operating means on said member for opening and closing said contacts, said means including a part mounted for movement in different directions to open and close said contacts, said part during the first part of its movement in either direction acting to store potential energy, and means actuated by said part adjacent the end of the first part of its movement, to release said stored energy to open said contacts with a snap action.

15. In a circuit interrupting device, a movable switch member including a pair of terminals, at least a part of said member being hollow to form a housing, cooperating contacts in said housing and connected to said terminals, respectively, operating means for opening and closing said contacts, said means including a part movable in different directions to open and close said contacts, said part during the first part of its movement in either direction acting to store energy in a source of potential energy in said housing, and means in the housing actuated by said part adjacent the end of the first part of its movement to release said stored energy to open said contacts with a snap action.

16. In a circuit interrupting device, a movable switch member including a pair of terminals, cooperating contacts carried by the member and connected to said terminals, respectively, operating means on said member for moving said contacts into and out of engagement with respect

to each other, said means including a part mounted for movement in different directions to open and close said contacts, said part during the first part of its movement in either direction acting to store potential energy, and means actuated by said part at the end of the first part of its movement to release said stored energy to open said contacts and operate an arc extinguishing member with a snap action.

17. In a circuit interrupter, a disconnecting switch member movably mounted on a support adjacent one end thereof, and having a terminal movable into and out of engagement with a first contact at its other end, cooperating contacts carried by the blade and in series with said terminal, means to move said member to interrupt its associated circuit with a first movement wherein said terminal moves relative to said first mentioned fixed contact but in engagement therewith, and a second movement wherein said terminal moves out of engagement with said first contact, means responsive to said first movement for storing energy in a source of potential energy, means positioned to be actuated at the end of said first movement to release said source of energy to open said cooperating contacts with a snap action.

18. In a circuit interrupter, a disconnecting switch means having a pair of terminals and having one terminal engaging a first contact at one end thereof, cooperating contacts carried by said means and in series with said terminals, means to move said switch means to interrupt its associated circuit, including a lever pivoted adjacent to the other end of said switch means and to a support, whereby the switch means has a first movement wherein said one terminal moves relative to said first contact but in engagement therewith, spring means tensioned between said lever and switch means during said movement, means actuated in response to a predetermined amount of said movement to release said spring means to actuate said cooperating contacts with a snap action, means on the switch means positioned to be engaged by said lever at the end of said first movement to remove said one terminal from its associated contact.

19. In a circuit interrupter, a disconnecting switch assembly having a pair of terminals and having one terminal engaging a first contact at one end thereof, cooperating contacts carried by the assembly and in series with said terminals, means to support and move said assembly to interrupt its associated circuit, including an operating link pivoted adjacent to the other end of the assembly and to a support, means for opening and closing said cooperating contacts including a member movable between two limiting positions in one of which the contacts are open and in the other of which the contacts are closed, automatic latching means for retaining said member at said limiting positions, spring means engaged between said member and link, means to release said latching means after a predetermined movement of said link, and means on the assembly adapted to be engaged by said link after said predetermined movement of the lever to move said one terminal away from its associated contact.

20. In a circuit interrupter, a disconnecting switch assembly having a pair of terminals and movably mounted on a support adjacent one end and having one terminal engaging a first contact at its other end, cooperating contacts carried by the assembly and in series with said terminals, means to move said assembly to interrupt its associated circuit, including a link pivoted to the assembly and to a support, means for opening and closing said cooperating contacts including a member movable between two limiting positions in one of which the contacts are open and in the other of which the contacts are closed, automatic latching means for retaining said member at said limiting positions, spring means engaged between said member and link, means to release said latching means after a predetermined movement of said link, and means on the assembly adapted to be engaged by said link after said predetermined movement of the lever to move said one terminal away from its associated contact, and means positively preventing disengagement of said one terminal and its associated contact until the end of said predetermined lever movement.

21. In a circuit interrupter, a disconnecting switch assembly having a pair of terminals and movably mounted on a support adjacent one end and having one terminal engaging a first contact at its other end, cooperating contacts carried by the assembly and in series with said terminals, means to move said assembly to interrupt its associated circuit, including a link pivoted to the assembly and to a support, means for opening and closing said cooperating contacts including a member movable between two limiting positions in one of which the contacts are open and in the other of which the contacts are closed, automatic latching means for retaining said member at said limiting positions, spring means engaged between said member and link, means to release said latching means after a predetermined movement of said link, and means on the assembly adapted to be engaged by said link after said predetermined movement of the link to move said one terminal away from its associated contact, said one terminal being elongated and the first contact associated therewith being formed to prevent lateral withdrawal of said terminal, the terminal being of such length as to be longitudinally withdrawn from said first contact at the end of said predetermined movement.

22. In a circuit interrupter, a disconnecting switch assembly having a pair of terminals and movably mounted on a support adjacent one end and having one terminal engaging a first contact at its other end, cooperating contacts carried by the assembly and in series with said terminals, means to move said assembly to interrupt its associated circuit, including a link pivoted to the assembly and to a support, means for opening and closing said cooperating contacts including a member movable between two limiting positions in one of which the contacts are open and in the other of which the contacts are closed, automatic latching means for retaining said member at said limiting positions, spring means engaged between said member and lever, means to release said latching means after a predetermined movement of said lever, and means on the assembly adapted to be engaged by said lever after said predetermined movement of the lever to move said one terminal away from its associated contact, said one terminal being elongated and the first contact associated therewith preventing lateral withdrawal of said terminal, the terminal being of such length as to be longitudinally withdrawn from said first contact at the end of said predetermined movement, and means preventing engagement of said cooperating contacts in the

circuit closing movement of the switch assembly until after said one blade terminal is engaged with its associated fixed contact.

23. In a disconnecting switch, the combination of a movable blade having one terminal thereof frictionally engaged by a stationary cooperating contact, circuit interrupting means including separable contacts on the blade for interrupting the circuit through said blade, and means for sequentially moving said blade and said one terminal relative to said contact but in engagement therewith while causing said interrupting means to open the circuit through the blade, and then moving the blade substantially laterally away from said contact.

24. In a disconnecting switch, the combination of a movable blade having one terminal thereof frictionally engaged between the spaced sides of a cooperating contact, confining means normally preventing lateral withdrawal of said blade terminal, means for sequentially withdrawing said blade and terminal from the region of said confining means, and then moving the same laterally away from the contact including pivoted supporting link means for said blade, means including a cam and follower for positively preventing any other sequence of blade movement at least in a circuit interrupting operation.

25. In a circuit interrupter, a disconnecting switch means having a pair of terminals and being movably mounted, one of said terminals when said means is moved engaging and disengaging a stationary disconnecting contact, cooperating arc establishing contacts carried by said means and connected in series with said terminals, operating mechanism to move said means to interrupt its associated circuit with a first movement wherein said one terminal moves relative to said disconnecting contact but in engagement therewith and a second movement wherein said terminal moves out of engagement with said disconnecting contact, and means responsive to said first movement to open said arc establishing contacts.

26. In a circuit interrupter, a disconnecting switch means having a pair of terminals and being movably mounted and having one terminal adapted to engage and disengage a disconnecting contact when said means is moved, cooperating arc establishing contacts carried by said means and connected in series with said terminals, operating mechanism to move said means to interrupt its associated circuit with a first movement wherein said one terminal moves relative to said disconnecting contact but in engagement therewith and a second movement wherein said terminal moves out of engagement with said disconnecting contact, and means responsive to said first movement to open said arc establishing contacts, the closing movements of said switch blade taking place in the reverse order of said opening movements, whereby the blade terminal engages the disconnecting contact before the circuit is closed by the arc establishing contacts on the blade.

27. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, a common operating member movable to first break the circuit at said arc establishing contacts and to thereafter open said disconnecting contacts, and means between said operating member and said arc establishing contacts to first store energy and then release the same to cause separation of said arc establishing contacts with a snap action prior to opening of said disconnecting contacts upon movement of said operating member to open the circuit, and independently of the movement of said operating member.

28. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, a common operating member operable upon continuous movement in one direction to first break the circuit at said arc establishing contacts and to thereafter open said disconnecting contacts, means between said operating member and said arc establishing contacts to first store energy and then release the same to cause separation of said arc establishing contacts with a snap action prior to opening of said disconnecting contacts upon movement of said operating member to open the circuit, and said operating member being operable upon continuous movement thereof in an opposite direction to first close said disconnecting contacts and thereafter close said arc establishing contacts, and said means responsive to said closing movement to first store energy, and then release the same to cause engagement of said arc establishing contacts with a snap action after engagement of said disconnecting contacts.

29. In a circuit interrupter, a pair of disconnecting contacts, an arc extinguishing device movably mounted and carrying one of said disconnecting contacts for movement into and out of engagement with the other of said disconnecting contacts, said arc extinguishing device having arc establishing contacts connected in series with said disconnecting contacts, a common operating member movable to first break the circuit at said arc establishing contacts and to thereafter open said disconnecting contacts, means between said operating member and said arc establishing contacts to first store energy and then release the same to cause separation of said arc establishing contacts with a snap action prior to opening of said disconnecting contacts upon movement of said operating member to open the circuit, and independently of the movement of said operating member, said operating member being operable upon continuous movement thereof in an opposite direction to first close said disconnecting contacts and to thereafter close said arc establishing contacts, and said means responsive to said closing movement to first store energy, and then release the same to cause engagement of said arc establishing contacts with a snap action after engagement of said disconnecting contacts and independently of the movement of said operating member.

30. In a switch, separable contacts, spaced concentric insulating tubes adjacent said contacts located with the plane of the space between the tubes surrounding the contacting surfaces of said contacts, and an insulating tube mounted to move in a path to move between said contacts when separated and into the space between said concentric tubes, and one of said contacts

being mounted on and having connecting means extending therefrom through the inner of said concentric tubes.

31. In a disconnecting switch, the combination of a movable blade having one terminal thereof frictionally engaging a relatively stationary cooperating contact, circuit interrupting means including separable contacts on the blade, and means for sequentially moving said blade and said one terminal relative to said contact but in engagement therewith while causing said interrupting means to open the circuit through the blade, and then moving the blade and interrupting means substantially laterally away from said contact to a position spaced therefrom, said means being operable to close the circuit to sequentially move said blade substantially laterally into engagement with said contact, and then move said blade relative to said contact while in engagement therewith while closing the contacts of said interrupting means.

32. In a disconnecting switch, the combination of a movable blade having one terminal thereof frictionally engaging a relatively stationary cooperating contact, circuit interrupting means including separable contacts on the blade, and means for sequentially moving said blade and said one terminal relative to said contact but in engagement therewith while causing said interrupting means to open the circuit through the blade, and then moving the blade and interrupting means substantially laterally away from said contact, said means being operable to close the circuit to sequentially move said blade substantially laterally into engagement with said contact, and then move said blade relative to said contact while in engagement therewith while closing the contacts of said interrupting means, and means positively preventing closure of said separable contacts until said blade terminal is in engagement with its cooperating contact.

33. In a disconnecting switch, contact means defining spaced contacting portions, movably mounted blade means having an end portion adapted to be frictionally received between said contacting portions, one of said means having limited area substantially line contacting portions for frictionally engaging the other of said means, and operating means for sequentially moving said blade means so that said end portion thereof has one movement substantially axially into and out of engagement with said contact means and in a direction paralleling said line contact portions, and another movement substantially laterally towards and away from said contact means.

34. In a switch having a pair of terminals, a first fixed contact having a plurality of contact surfaces connected to one terminal, a plurality of movable contacts connected to the other terminal and resiliently urged into engagement with said contact surfaces, respectively, and means of insulating material for simultaneously engaging said movable contacts for moving said movable contacts away from said contact surfaces with a cam action and interposing an insulating barrier between said first contact and said movable contacts to elongate the arc drawn between said contacts.

35. In a disconnecting switch, the combination of a movable blade having one terminal thereof frictionally engaged between the spaced sides of a cooperating contact, confining means normally preventing lateral withdrawal of said blade terminal, means for sequentially withdrawing said blade and terminal from the region of said confining means, and then moving the same laterally away from the contact in a circuit interrupting operation, and for moving said blade in a reverse sequence of movements in a circuit closing operation, and means including a cam and follower means for positively insuring said sequence of blade movements.

36. In a circuit interrupter, a pair of disconnecting contacts at least one of which is movable out of engagement with the other to insert a relatively large air gap in the circuit, an arc extinguishing device associated with one of said disconnecting contacts, said arc extinguishing device including arc establishing contacts, energy storing means for actuating said arc establishing contacts, common actuating means for said contacts operable upon continuous movement in one direction to move said movable disconnecting contact to open circuit position, said actuating means storing energy in said energy storing means during the first part of its movement in said one direction and thereafter releasing the same to cause separation of said arc establishing contacts with a snap action, said actuating means being operable upon continuous movement in an opposite direction to move said movable disconnecting contact into engagement with the other of said disconnecting contacts and acting during its movement in said opposite direction to store energy in said energy-storing means and thereafter release the same to cause engagement of said arc establishing contacts with a snap action, and said contacts connected in circuit in such a manner that the circuit is always made or broken at said arc establishing contacts to thereby relieve said disconnecting contacts from arcing.

37. In a circuit interrupter, a pair of disconnecting contacts at least one of which is movable out of engagement with the other to insert a relatively large air gap in the circuit, an arc extinguishing device associated with one of said disconnecting contacts, said arc extinguishing device including arc establishing contacts, energy storing means for actuating said arc establishing contacts, common actuating means for said contacts operable upon continuous movement in one direction to move said movable disconnecting contact to open circuit position, said actuating means storing energy in said energy storing means during the first part of its movement in said one direction and thereafter releasing the same to cause separation of said arc establishing contacts with a snap action, said actuating means being operable upon continuous movement in an opposite direction to move said movable disconnecting contact into engagement with the other of said disconnecting contacts and acting during the latter part of its movement in said opposite direction to store energy in said energy storing means and thereafter release the same to cause engagement of said arc establishing contacts with a snap action, and said contacts connected in circuit in such a manner that the circuit is always made or broken at said arc establishing contacts to thereby relieve said disconnecting contacts from arcing.

38. In a circuit interrupter, a pair of disconnecting contacts at least one of which is movable out of engagement with the other to insert a relatively large air gap in the circuit, an arc extinguishing device supported on one of said disconnecting contacts, said arc extinguishing

device including arc establishing contacts, spring means for actuating said arc establishing contacts, common actuating means for said contacts operable upon continuous movement in one direction to move said movable disconnecting contact to open circuit position, said actuating means storing energy in said spring means during the first part of its movement in said one direction and thereafter releasing the same to cause separation of said arc establishing contacts with a snap action, said actuating means being operable upon continuous movement in an opposite direction to move said movable disconnecting contact into engagement with the other of said disconnecting contacts and acting during its movement in said opposite direction to store energy in said spring means and thereafter release the same to cause engagement of said arc establishing contacts with a snap action, and said contacts connected in circuit in such a manner that the circuit is always made or broken at said arc establishing contacts to thereby relieve said disconnecting contacts from arcing.

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