Oct. 30, 1956 H. J. LINGAL 2,769,063

CIRCUIT INTERRUPTING DEVICE

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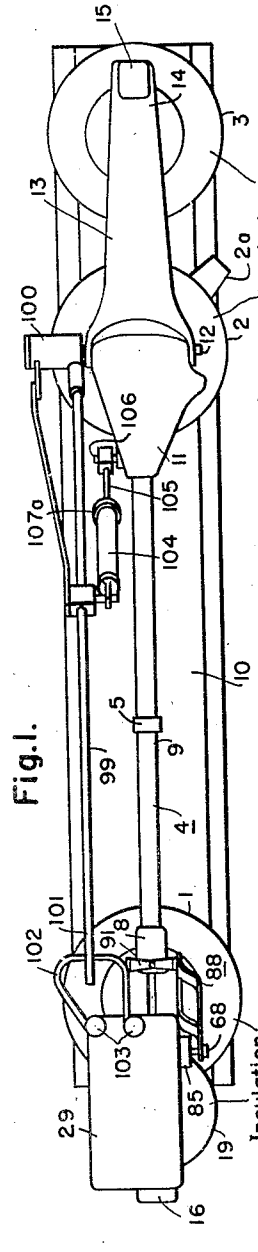


Fig. 1.

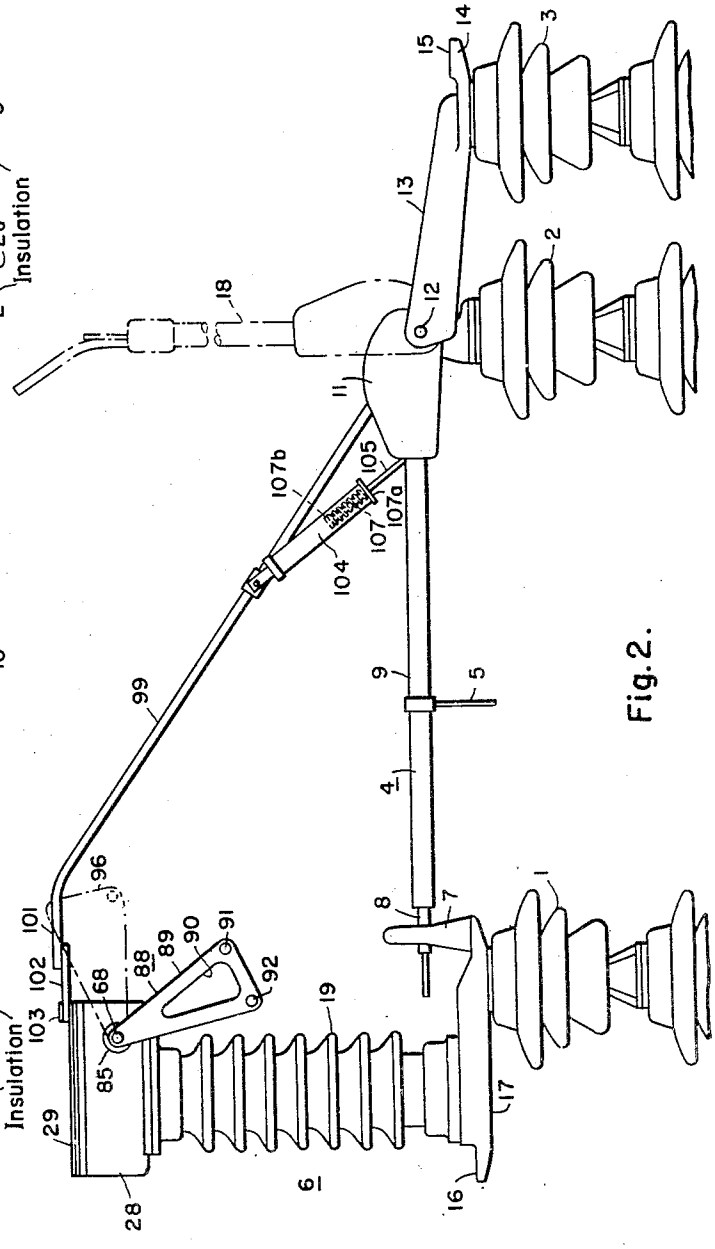


Fig. 2.

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Fig. 3.

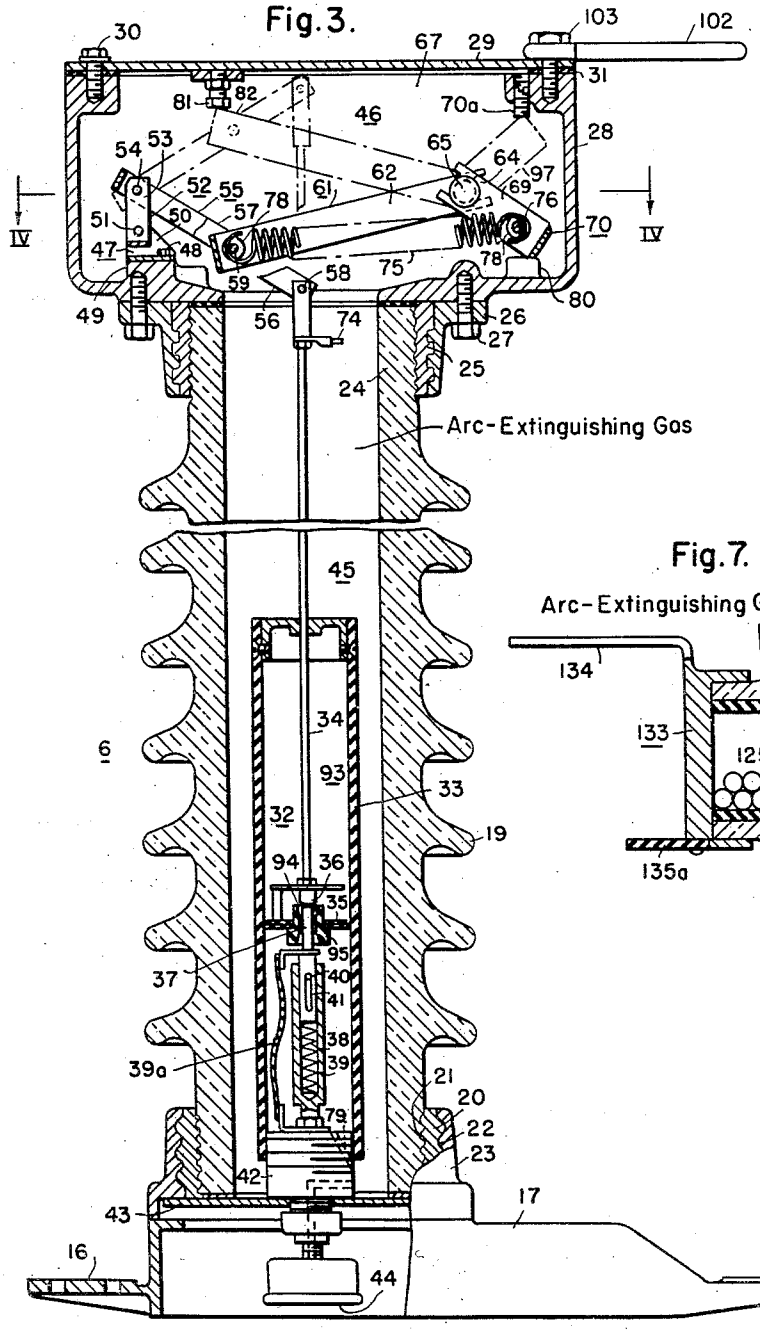


Fig. 7.

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CIRCUIT INTERRUPTING DEVICE

Filed Oct. 26, 1951 3 Sheets-Sheet 3

Fig. 4.

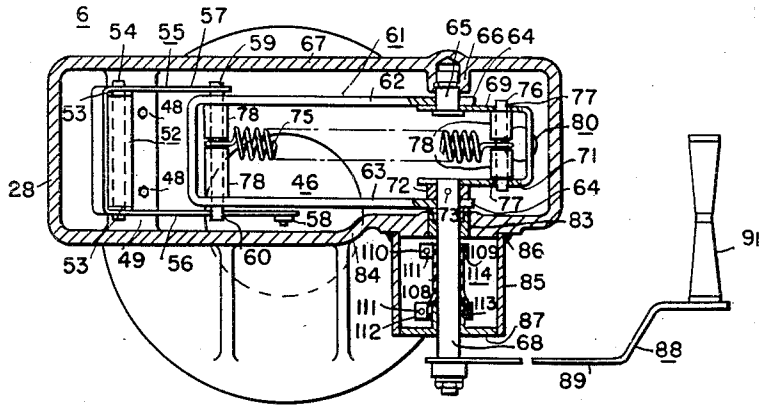


Fig. 6.

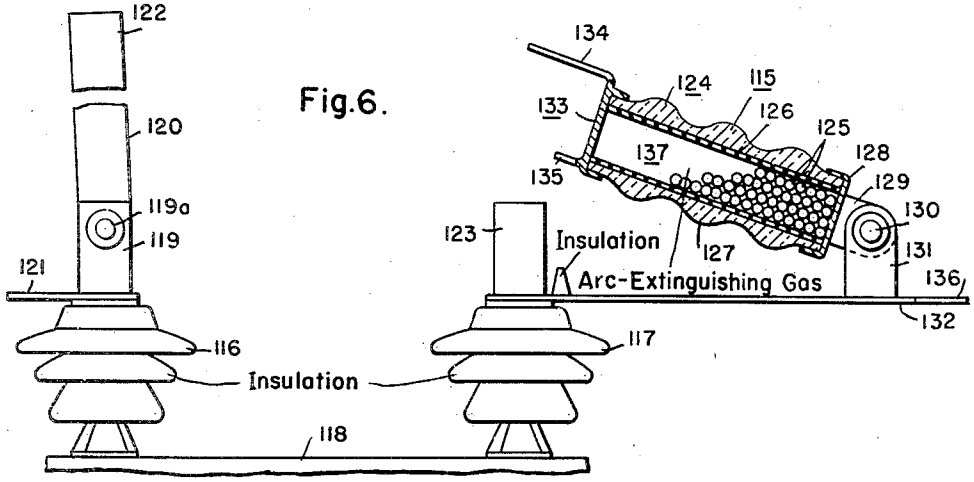
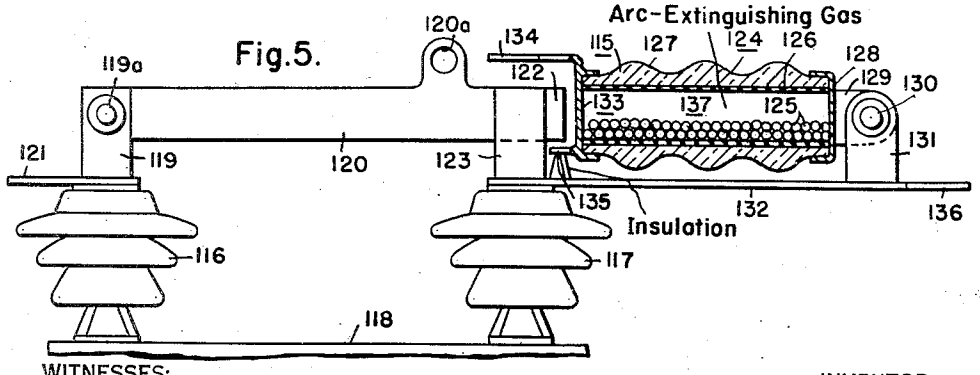


Fig. 5.



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United States Patent Office 2,769,063 Patented Oct. 30, 1956

2,769,063

CIRCUIT INTERRUPTING DEVICE

Harry J. Lingal, Pittsburgh, Pa., assignor to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application October 26, 1951, Serial No. 253,321

26 Claims. (Cl. 200—146)

This invention relates to circuit interrupting devices in general, and, more particularly, to disconnecting switches with particular relation to disconnecting switches that are adapted to be opened under load conditions. My application Serial No. 576,875 filed April 9, 1956, is a division of this application.

In many instances it is desirable to open a high voltage disconnecting switch while normal load current is flowing in the circuit in which it is connected. For example, in many installations, high voltage transformers are constantly connected to the high voltage line and infrequently require servicing. It is then necessary to disconnect such a high voltage transformer from the high voltage circuit, and during such disconnecting operation it is necessary to interrupt the magnetizing current flowing from the high voltage line into the high voltage transformer.

If this magnetizing current were drawn between the blade-shaped contact and the stationary jaw contact of a conventional disconnecting switch the contact surfaces would become pitted or eroded so that following only a few such operations the contact surfaces would not be suitable for carrying the full load current. Thus the switch members would become burned or fused because of the heat of the arc depending upon the amount of current in the circuit at the particular instant that the switch is opened.

There is also the possibility, under more severe circuit conditions, that a long arc may be sustained and establish itself between the switch and an adjacent circuit or ground when the attempt is made to interrupt the load current by a conventional disconnecting switch. It is a general purpose of my invention to provide an improved load-break disconnecting switch which will interrupt the load current interiorly within an arc interrupting structure and not exteriorly thereof at the open switch contacts.

A further object of my invention is to provide an improved and highly efficient load-break disconnecting switch in which the contact structure of the arc-extinguishing device is opened and closed by snap action.

Still a further object of my invention is to provide an improved operating mechanism for the arc-interrupting device of a load-break disconnecting switch.

Yet another object is to provide a load-break disconnecting switch in which the circuit is broken within the arc-interrupting device, and, during the closing operation, the circuit is made between the contacts of the arc-interrupting device and not at the switch contact members.

Still a further object of my invention is to provide a load-break disconnecting switch particularly suitable for interrupting high voltage circuits, in which use is made of the length of the arc-interrupting device for holding the voltage during high voltage operation.

A further object is to provide an improved snap-acting toggle mechanism for the arc-interrupting device of a load-break disconnecting switch.

A further object is to provide an improved load-break disconnecting switch particularly suitable for enclosing an arc-extinguishing gas in a sealed state, and to provide improved sealing structure to prevent escape of the gas.

Still a further object is to provide an improved and highly efficient load-break disconnecting switch which may be economically manufactured, simple to service and which will give a long trouble-free interrupting life.

Further objects of my invention will readily become apparent upon reading the following specification, taken in conjunction with the drawings, in which:

Figure 1 is a plan view of my improved load-break disconnecting switch, the contact structure being illustrated in the closed circuit position;

Fig. 2 is a side elevational view of the load-break disconnecting switch pictured in Fig. 1, the contact structure being shown in the closed circuit position, the figure also showing the fully open circuit position in chain lines;

Fig. 3 is a vertical sectional view, drawn to an enlarged scale, of the arc-interrupting device of the load-break disconnecting switch illustrated in Figs. 1 and 2, the contact structure being shown in the closed circuit position;

Fig. 4 is a sectional plan view taken substantially along the line IV—IV of Fig. 3, the contact structure being shown in the closed circuit position;

Fig. 5 illustrates a modified type of load-break disconnecting switch, the contact structure being illustrated in the closed circuit position;

Fig. 6 is a view similar to that of Fig. 5, showing the modified type of load-break disconnecting switch in the open circuit position; and

Fig. 7 is a fragmentary vertical sectional view through a portion of a modified type of load-break disconnecting switch, similar to that set out in Figs. 5 and 6, the contact structure being shown in the closed circuit position.

Referring to the drawings, and more particularly to Figs. 1 and 2 thereof, it will be observed that there are provided three stacks of insulator columns 1, 2 and 3 supported upon a suitable base structure 10 (Fig. 1). The insulator stacks 1, 2 and 3 may extend a considerable distance upwardly from the base structure 10 when the switch is utilized on a high voltage circuit. Preferably, the insulator columns 1 and 3 are fixed, whereas the insulator column 2 is adapted for rotating movement by a crank arm 2*a*, to effect thereby operation of the mechanism for the load-break disconnecting switch, generally designated by the reference numeral 4, and which is supported at the upper ends of the insulator columns 1–3.

Supported at the top of stationary insulator column 1 is an arc-extinguishing interrupting device, generally designated by the reference numeral 6. Also supported at the top of the stationary insulator column 1 is a relatively stationary jaw switch contact, designated by the reference numeral 7, and which cooperates with the contacting end 8 of a disconnecting switch blade 9, which is secured to a cam housing 11, the latter being pivotally supported by trunnions 12. The trunnions 12 extend inwardly from a housing casting 13, which has an extension 14 including a line terminal plate 15.

The other line terminal plate of the load-break disconnecting switch 4 is designated by the reference numeral 16, and constitutes an extension of a support casting 17 fixedly supported at the top of insulator column 1. Thus the circuit passes through the disconnecting switch 4 from line terminal plate 16, support casting 17, stationary jaw contact 7, movable contact 8 of switch blade 9, through the switch blade 9 to conducting cam housing 11, and thence through trunnions 12 and casting 13 to line terminal plate 15.

As is well known to those skilled in the art, suitable means are provided to effect upward swinging opening motion of the switch blade 9 about its pivot 12 to the

open circuit position, as indicated by the chain lines 18 of Fig. 2. In this position a long isolating gap in air is provided between the switch contacts at opposite potential. As shown in Figs. 1 and 2, the interrupting device 6 is mounted out of the space between the terminals 13, 15 and 16, 17 so that the isolating gap between them is not reduced, and the flashover voltage between live parts is maintained the same as in an ordinary disconnecting switch having the same insulator spacing.

Referring more particularly to Fig. 3, which more clearly shows theinternal construction of the arc-extinguishing interrupting device 6, it will be observed that this device includes a weatherproof porcelain casing 19, supported vertically upon the support casting 17. The engagement between the lower end of the porcelain casing 19 and the support casting 17 may be effected by a suitable cement 20, interposed between a lower corrugated portion 21 of the ceramic casing 19 and interiorly disposed corrugations 22 provided within an upstanding flange portion 23, the latter being secured by suitable means, not shown, to the casting 17.

At the upper end 24 of the weatherproof casing 19 is fixedly secured by cement 25 a mounting flange 26, the latter being secured by bolts 27 to a mechanism housing casting 28, the latter having a cover plate 29. Preferably, the cover plate 29 is secured by bolts 30 to the housing 28, a suitable gasket 31 being interposed therebetween to effect a gas-tight connection.

Disposed interiorly within the weatherproof casing 19 is an arc-extinguishing unit, generally designated by the reference character 32, and including an upstanding insulating cylinder 33 within which reciprocates a movable contact rod 34 having a piston 35 secured thereto and making a relatively close fit with the interior wall of the insulating cylinder 33.

A movable contact 36, secured to the lower end of the movable contact rod 34, makes abutting engagement with a relatively stationary contact 37, the latter being resiliently supported by means of a contact compression spring 38. The contact compression spring 38 is disposed within a stationary contact support tube 39, which has a stationary pin 40 extending therethrough near its upper end. The pin 40 extends through an elongated slot 41 provided near the lower end of the stationary contact 37, so that during the closing stroke the stationary contact 37 may move resiliently downwardly with respect to the support tube 39 and the pin 40, compressing the spring 38 for the requisite contact pressure between the stationary and movable contacts 37, 36, respectively. A flexible conducting strap 39*a* electrically interconnects the stationary contact 37 with a conducting base 42, hereinafter described.

I mount the support tube 39 upon a conducting base 42, which is secured, as by threaded engagement, to a conducting closure plate 43, the latter being secured by means not shown to the flange portion 23 of the support casting 17. Disposed at the lower end of the conducting base 42 is a pressure gauge 44, which may be visually observed from below the base structure 10 for the load-break disconnecting switch 4. Thus a station attendant may look upwardly from the base structure 10 for the load-break disconnecting switch 4, and observe the pressure registered upon the dial of the pressure gauge 44. This pressure gauge 44 indicates the gas pressure which is present within the interior 45 of the casing 19, the latter, as previously mentioned, having a gas-tight construction.

I prefer to fill the casing 19, by way of the gauge attachment 44, with a suitable arc-extinguishing gas, such as sulfur hexafluoride, or some other suitable arc-extinguishing gas which has preferably better interrupting properties than ordinary air. The remarkable interrupting properties of sulfur hexafluoride, and the theory pertaining to its interrupting performance, is set out and claimed in United States patent application filed July 19, 1951, Serial No. 237,502, by Harry J. Lingal, Thomas E. Browne, Jr., and Albert P. Strom and assigned to the assignee of the instant application, and issued on July 31, 1951, as Patent No. 2,757,261.

The movable contact rod 34 is moved upwardly within the insulating cylinder 33 by a snap-acting over-center toggle mechanism, generally designated by the reference numeral 46, and enclosed interiorly within the mechanism housing casting 28. This mechanism 46 includes a U-shaped bracket 47 secured by a pair of bolts 48 to a support portion 49 of the casting 28. The U-shaped bracket 47 has apertures provided in its upstanding legs 50 through which extends a pivot pin 51. Supported on the pivot pin 51 is a U-shaped link 52, the legs 53 of which have apertures provided at their upper ends. A pivot pin 54 extends through the apertures provided in the upper ends of the legs 53, and supports a U-shaped arm 55, the configuration of which is more clearly shown in Fig. 4. One leg 56 of the arm 55 is longer than the other leg 57, and is pivotally connected at its outer extremity, as at 58, to the upper end of the movable contact rod 34.

At the extremity of the other leg 57 of the arm 55 is an aperture, through which passes a pivot pin 59, the latter also extending through an aperture 60 provided intermediate the ends of the longer leg 56 of the arm 55.

The pin 59 supports a U-shaped toggle link 61 at the left-hand end thereof, as viewed in Fig. 3. The right-hand ends of the legs 62, 63 of the toggle link 61 are slotted, as at 64. The slot 64 of the upper leg 62 of the toggle link 61, as viewed in Fig. 4, is mounted upon a trunnion 65, the latter being journalled in a bearing portion 66 provided in the side wall 67 of the housing casting 28.

The slot 64 of the lower leg 63 of the toggle link 61, as viewed in Fig. 4, accommodates a crankshaft 68, more clearly shown in Fig. 4. The trunnion 65 also supports one leg 69 of a toggle link, generally designated by the reference numeral 70, the lower leg 71 of which has a collar 72 secured thereto, as by brazing, which is fixedly secured to the inner end of the crankshaft 68 by a key pin 73, as shown in Fig. 4.

Thus, rotation of the crankshaft 68 will effect rotation of toggle link 70 secured thereto, effecting thereby opening and closing of the contact structure associated with the arc-extinguishing unit 32.

Preferably a tension spring 75 is interposed between the pin 59 and a pin 76 extending through apertures 77 provided in the legs 69, 71 of the toggle link 70. Spacers 78 are employed encircling the pins 59, 76, to maintain the tension spring 75 at a relatively fixed location. A stop 80 is provided, constituting an upwardly projecting boss of the casting 28, which arrests clockwise rotation of the toggle link 70, as shown in Fig. 3. A second stop 81, which is preferably made adjustable, is provided extending downwardly from the cover plate 29 to strike the toggle link 61 during the opening operation, to arrest the same, as shown by the chain lines 82 in Fig. 3. An adjustable stop 70*a* is provided to arrest counterclockwise rotation of toggle link 70 during the opening operation. The tension spring 75, as more clearly shown in Fig. 3, tends to effect collapse of the toggle link 70 and toggle link 61 in the open and closed circuit positions of the interrupter, as indicated in Fig. 3.

It will be noted that the crankshaft 68 extends through a bearing portion 83 provided in the side wall 84 of the casting 28, and also extends through a laterally jutting gas-tight housing 85, more clearly shown in Fig. 4. The gas-tight housing 85 comprises, as shown, a cylindrical portion which may be welded, as at 86, to the side wall 84 of the casting 28. The housing 85 also includes an apertured closure plate 87 secured to the housing and through which the crankshaft 68 extends, to be externally rotated by a triangularly-shaped operating crank, generally designated by the reference numeral 88.

As more clearly shown in Figs. 1, 2 and 4, the operating crank 88 includes a plate 89 having a portion 90 removed therefrom to make it of lighter construction. Also the plate 89 has two triggers or engaging shafts 91, 92, as more clearly shown in Fig. 2, which are engaged during the opening and closing operations by the contact end 8 of the disconnecting switch blade 9.

Consequently, during the opening operation of the load-break disconnecting switch 4, the contact end 8 of the switch blade 9 engages the engaging shaft 91 of operating crank 88 to effect thereby rotation of crankshaft 68 to effect an extension of the tension spring 75 when the toggle link 70 is moved counterclockwise, as viewed in Fig. 3. When the pins 59, 76 and crankshaft 68 are on a straight line the mechanism 46 is in its fully extended condition. Further counterclockwise rotation of crankshaft 68 will effect collapse of the toggle link 70 and toggle link 61, as indicated by the chain lines 82 of Fig. 3. The result will be a snap-opening motion of the movable contact 36 upwardly away from the relatively stationary contact 37 and a compressing of the gas within the region 93 on the upper side of the piston 35. The piston 35 will consequently compress the gas within the region 93 and compel it to flow through the nozzle 94 of an orifice member 95, through which the load current arc is drawn. The flow of the compressed gas through the orifice member 95 will effect extinction of the arc drawn between contacts 36, 37, the hot gases passing out one or more vents 79 through the base 42.

After operating crank 88 has been snapped to its upper position, as viewed by the chain lines 96 of Fig. 2, the location of the engaging shaft 91 in this position is clear of the line of movement of switch blade 9; and switch blade 9 continues to move to the fully open circuit position of the switch, as indicated by the chain lines 18 of Fig. 2.

During the closing operation the contact end 8 of switch blade 9, in moving in a counterclockwise direction about pivots 12, as viewed in Fig. 2, will strike engaging shaft 92, which at this time is in the line of movement of switch blade 9.

The switch blade 9 will hence strike engaging shaft 92 to forceably effect clockwise rotation of operating crank 88 and hence also of crankshaft 68, to thereby effect clockwise rotation of toggle link 70 from its chain line position 97, as viewed in Fig. 3, to its full line position as viewed in Fig. 3. As in the opening operation, so in the closing operation the tension spring 75 is first extended and then effects collapse of the toggle link 61 and the toggle link 70 to effect a snap-closing motion of the contacts 36, 37.

To enable the electrical circuit to pass through the arc-extinguishing interrupting device 6 following separation of the contact end 8 of the switch blade 9 from the stationary jaw contact 7, I provide an auxiliary conducting contact arm 99 pivotally mounted about a pivot 100, which is in registry with the pivot axis 12. As more clearly shown in Fig. 2, the free end 101 of the auxiliary contact arm 99 makes contacting engagement with a stationary U-shaped contact or terminal 102 fixedly secured by bolts 103 to the cover plate 29 of the housing 28. Means are provided to bias the auxiliary contact arm 99 toward the switch blade 9, in this instance including a spring tube 104 within which is a compression spring 107. The compression spring 107 is seated at its lower end, as viewed in Fig. 2, against a cap 107*a* of the spring tube 104. The upper end of the compression spring 107 is seated against an apertured spring plate 107*b* secured to the free end of a spring rod 105. The lower end of the spring rod 105 is pivotally mounted at a movable pivot 106 of the cam housing 11, more clearly shown in Fig. 1 of the drawings. Fundamentally, the spring tube 104 acts somewhat as a tension spring to bias the two arms 9, 99 together. Also the switch blade 9 has a laterally extending hook 5 which engages the arm 99 during the opening operation to carry the latter therewith to the fully open position.

From the foregoing description, it will be readily apparent how the load-break disconnecting switch 4 operates. However, to recapitulate, in the closed circuit position of the device the electriral circuit therethrough includes line terminal plate 16, support casting 17, stationary jaw contact 7, movable contact 8 of switch blade 9, through the switch blade 9 to conducting cam housing 11, and thence through trunnions 12 and casting 13 to line terminal plate 15.

A separate circuit in parallel to that mentioned is available in the closed circuit position of the device. It includes line terminal plate 16, support casting 17, conducting flange portion 23, plate 43, conducting base 42, flexible conductor 39*a*, stationary contact 37, movable contact 36, movable contact rod 34, flexible conductor 74 to the mechanism housing 28, through terminal 102 and auxiliary contact arm 99 to cam housing 11, and thence through trunnions 12 and casting 13 to line terminal plate 15. Since the second parallel circuit through the interrupting device 6 contains more resistance than the main circuit directly through the switch blade 9, practically all the current flows through the first-mentioned circuit including switch blade 9.

To open the switch 4 from the closed circuit position thereof suitable means, not shown, effects counterclockwise rotation of the crank arm 2*a* and hence insulator column 2, as viewed in Fig. 1. This rotating movement of insulator column 2 actuates a cam interiorly within cam housing 11 in a manner more fully disclosed in United States Patent 2,436,296, issued February 17, 1948, to Howard W. Graybill and Paul Olsson and assigned to the assignee of the instant application. The first portion of the cam motion effects a twisting, or axial rotation of the switch blade 9 so that any ice formed between the stationary and movable contacts 7, 8 may be broken free.

Following such initial twisting motion of the switch blade 9, the cam motion taking place within the cam housing 11, as set out in the aforesaid patent, causes clockwise rotative movement of the switch blade 9 about the pivot 12, as viewed in Fig. 2. When the contacting portion 8 of switch blade 9 separates from stationary jaw contact 7 the electrical circuit is then forced to take the second parallel path previously mentioned through the arc-extinguishing interrupting device 6. This circuit includes line terminal plate 16, support casting 17, conducting flange portion 23, plate 43, conducting base 42, flexible conductor 39*a*, stationary contact 37, movable contact 36, movable contact rod 34, flexible conductor 74 to the mechanism housing 28, through terminal 102 and auxiliary contact arm 99 to cam housing 11, and thence through trunnions 12 and casting 13 to line terminal plate 15.

Continued clockwise rotation of switch blade 9 brings the free end 8 thereof into engagement with engaging shaft 91 to effect thereby counterclockwise rotative motion of operating crank 88 and hence opening motion of the mechanism 46, as previously described. This will effect opening of the contact structure 36, 37 and extinction of the arc drawn therebetween through the orifice member 95 by a flow of gas, which is compressed above the piston 35 within the region 93.

When this arc is extinguished, the electrical circuit through the load-break disconnecting switch 4 is interrupted. Continued clockwise movement of switch blade 9 causes hook 5 to strike arm 99 and brings the blade 9 and arm 99 to the open circuit position, as shown by the chain lines 18 of Fig. 2. It is to be noted that the spring tube 104, being equivalent to a tension spring, maintains the auxiliary contact arm 99 in contact with contact 102 until struck by hook 5 of blade 9.

To effect a closing of the switch 4, it is merely necessary to cause, by a suitable mechanism, clockwise rotative

movement of crank arm 2*a* and hence the insulator column 2, as viewed in Fig. 1. This will cause through the cam motion taking place within the cam housing 11, first counterclockwise rotative movement of the switch blade 9, as viewed in Fig. 2, the auxiliary contact arm 99 being moved therewith by functioning of the spring tube 104 and gravity.

Near the end of the closing stroke the contact arm 99 strikes the stationary contact 102. Further movement causes a separation to occur between the switch blade 9 and the contact arm 99, with the contact end 8 of switch blade 9 striking engaging shaft 92 of operating crank 88, which at this time is in the path of movement of switch blade 9. The contact 8 will strike engaging shaft 92 and will effect thereby clockwise rotation of operating crank 88 to effect closing movement of the mechanism 46 disposed interiorly within mechanism housing casting 28. This will effect snap-action closing engagement between the contacts 36, 37 to bring about closing of the electrical circuit through the load-break disconnecting switch 4 prior to the closing of the contacts 7, 8.

Finally, the contact 8 of switch blade 9 engages jaw contact 7, and the final movement of the cam mechanism within cam housing 11 is to effect an axial twisting motion of switch blade 9 to bring about firm contacting engagement between contacts 7, 8. This final closing movement between contacts 7, 8 will effectively short out the shunting circuit extending around contacts 7, 8 by way of contact arm 99 and contacts 36, 37 disposed interiorly within arc-extinguishing interrupting device 6. Because of the lower resistance between contacts 7, 8 practically all of the load current carried by the switch 4 will pass between the contacts 7, 8, and not through the shunting circuit extending through the interrupting device 6 and the auxiliary contact arm 99.

As mentioned previously, I desire to make the arc-extinguishing interrupting device 6 gas-tight to prevent any leakage of the gas, such as sulfur hexafluoride, existing under some pressure, say one or two atmospheres absolute, within the casing 19. However, to effect actuation of thet mechanism 46 from a point exteriorly of the extinguishing device 6, it is necessary to prevent leakage of gas along the crankshaft 68. An important feature of my invention is the means for preventing such leakage of gas along the crankshaft 68, and this includes a sleeve 108 of rubber, or synthetic rubber, clamped to the crankshaft 68 at the point 109 by a U-shaped clamp 110, the legs of which may be forced together by a bolt 111. To prevent any frictional forces coming into play, preferably the external surface of the crankshaft 68, beneath the sleeve 108, is coated with a dry lubricant, such as graphite. Also the lower end of the sleeve 108, as viewed in Fig. 4, is secured by a clamp 112 to a flange portion 113 forming an integral part of closure plate 87. Another clamping bolt 111 may be employed to secure the two legs of the U-shaped clamp 112 into firm engagement.

With this construction, it will be observed that should there occur any leakage of sulfur hexafluoride gas along the crankshaft 68 past the bearing portion 83, this gas will merely collect in the region 114 within housing 85, and will not be able to escape either past the flange portion 113 or axially along the crankshaft 68. Moreover, any pressure existing within the region 114 will not tend to deform the sleeve 108 of resilient material inasmuch as any compression of the latter will be resisted by the crankshaft 68 itself.

Thus there has been disclosed a gas-tight or liquid-tight seal 108, which will permit rotation of the shaft 68 through an arc of about 120°, which is the maximum usally required in circuit interrupter mechanisms. It brings about a tight seal and yet offers little resistance to shaft rotation. Further, relatively large pressures can be held without leakage, loss or harm to the seal because movement of the elastic tube walls is limited by the shaft which it surrounds and seals.

Referring to Figs. 5 and 6 of the drawings, it will be observed that I show a modified type of load-break disconnecting switch, generally designated by the reference character 115, including a pair of stationary columns 116, 117 mounted upon a suitable base 118. The upper end of insulator column 116 supports a hinge contact 119 and a disconnecting switch blade 120, pivotally mounted, as at 119*a*, to the hinge contact 119. A line terminal 121 is formed by an extension of hinge contact 119.

Suitable means, such as a manually operated hook-stick engaging a hook-eye 120*a*, may be provided to cause engagement of the free contacting end 122 of switch blade 120 with a jaw contact 123, the latter being supported at the upper end of insulator column 117.

Associated with the jaw contact 123 is a pivotally mounted rotatable arc-extinguishing device, generally designated by the reference numeral 124, and including a plurality of conducting metal balls 125 disposed interiorly within an insulating tube 126, such as fiber. The insulating tube 126 is, in turn, surrounded by a weather-proof casing 127 formed of a suitable ceramic weather-proof material, such as porcelain. A closure cap 128 is provided at the right-hand end of the extinguishing device 124, and the cap 128 has a tongue extension 129, which is pivotally supported at 130 on a hinge contact 131. The hinge contact 131 is mounted upon a horizontally extending conducting plate 132, which is, in turn, supported at the upper end of the insulator column 117.

At the left-hand end of the extinguishing device 124 is a second closure cap, generally designated by the reference numeral 133, and having integrally formed actuating portions 134, 135.

In the closed circuit position of the load-break disconnecting device 115, as viewed in Fig. 5, the electrical circuit therethrough includes line terminal 121, hinge contact 119, disconnecting switch blade 120, jaw contact 123 and conducting plate 132 to the second line terminal 136, which preferably constitutes an extension of the conducting plate 132.

To effect opening of the load-break disconnecting switch 115 suitable means, not shown, effects counterclockwise rotative motion of switch blade 120, as viewed in Fig. 5. This causes contacting engagement between the free end 122 of switch blade 120 and the actuating portion 134 of closure cap 133. Such engagement between free end 122 of switch blade 120 and actuating portion 134 causes clockwise rotative movement of arc-extinguishing device 124 about the pivot 130. Meanwhile the conducting balls 125 maintain contact between the closure caps 128, 133. Finally, the contact end 122 of switch blade 120 separates from jaw contact 123 so that the circuit now extends through the extinguishing device 124 by way of the conducting actuating portion 134, closure cap 133, conducting balls 125 to line terminal 136 by way of hinge contact 131.

Further upward swinging movement of switch blade 120 effects rolling motion of all the balls 125 toward the pivoted end of the extinguishing device 124, as shown more clearly in Fig. 6. The circuit is, consequently, broken within the region 137 interiorly within insulating tube 126, which preferably contains a suitable arc-extinguishing gas, such as sulfur hexafluoride. Further opening movement of switch blade 120 brings the latter to the open circuit position, as shown in Fig. 6.

To effect closing of the disconnecting switch 115, the switch blade 120 is rotated in a clockwise direction, as viewed in Figs. 5 and 6. It finally makes contact with the actuating portion 135, and, in striking the extinguishing device 124, the balls 125 are thrown into a bridging relationship between closure caps 128, 133 so that the circuit is made during the closing operation within the

extinguishing device **124**, and not at the stationary jaw contact **123**.

Further movement effects contact engagement between the free end **122** of switch blade **120** and jaw contact **123** to thereby short out the extinguishing device **124** because of the lower resistance between the contacts **122**, **123**.

In certain instances, it may be desirable to effect contact closure between the contacts **122**, **123** and not through the extinguishing device **124**. In such an event a modified extinguishing device, generally designated by the reference numeral **138**, is provided, as pictured in Fig. 7. In the modified extinguishing device **138**, the actuating portion **135***a* is formed of insulating material, so that during the closing stroke the stroking of the contacting end **122** of switch blade **120** with actuating portion **135***a* will not complete the circuit through the extinguishing device **138**. The circuit will only be closed by actual engagement between contacts **122**, **123**. Otherwise the extinguishing device **138** is identical with the extinguishing device **124**, previously described; consequently a further description of the operation thereof appears unnecessary.

From the foregoing, it will be apparent that I have provided an improved load-break disconnecting switch in which the electrical circuit is interrupted through an auxiliary arc-extinguishing interrupting device and not at the disconnecting switch blade contacts. Thus the switch blade contacts are maintained free from pitting and erosion and are capable of good contacting engagement in the closed circuit position of the device, in which position the extinguishing unit is shorted out of the circuit. The devices are simple and economical to make and will give long operational life.

Although a certain gas has been suggested for use in the extinguishing device **32** of Figs. 1–4 and the extinguishing devices **124**, **138** of Figs. 5–7, nevertheless other extinguishing gases may well be employed. I have moreover shown an arrangement for providing a gas-tight seal preventing escape of the gas lengthwise of an operating shaft, and I have shown how the mechanism and the contact structure may be opened and closed with a snap action preferably employing a suitable piston for facilitating extinction of the arc by means of a blast of compressed gas.

Although I have shown and described specific structures, it is to be clearly understood that the same were merely for the purpose of illustration, and that changes and modifications may readily be made therein by those skilled in the art, without departing from the spirit and scope of the appended claims.

I claim as my invention:

1. A load-break switch including a pair of spaced terminals, a relatively stationary switch contact on one of said terminals, a disconnecting switch blade bridging the switch terminals in the closed circuit position and adapted to be moved into and out of swinging engagement with the relatively stationary switch contact, an arc-extinguishing interrupting device having one end thereof disposed adjacent said relatively stationary switch contact and having the other end thereof extending away from said relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal carried on said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal thereon, means for causing the opening movement of the switch blade to operate said mechanism, and an independent auxiliary contact arm remaining relatively stationary during the initial movement of the switch blade and subsequently movable at least during a portion of the opening operation with the switch blade and electrically interconnecting the relatively stationary terminal of the interrupting device with the other terminal of the switch spaced therefrom.

2. A load-break switch including a pair of spaced terminals, a relatively stationary switch contact on one of said terminals, a disconnecting switch blade bridging the switch terminals in the closed circuit position and adapted to be moved into and out of swinging engagement with the relatively stationary switch contact, said switch blade being mounted for rotary movement about an axis extending along the length of the blade for making and releasing pressure engagement with said relatively stationary switch contact, means for causing said rotary movement of the switch blade at the end of its swinging movement into closed circuit position to make said pressure engagement and at the beginning of its swinging movement away from closed circuit position to release said pressure engagement, an arc-extinguishing interrupting device having one end thereof disposed adjacent said relatively stationary switch contact and having the other end thereof extending away from said relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal carried on said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal thereon, means for causing the opening movement of the switch blade to operate said mechanism, and an auxiliary contact arm remaining in engagement with said relatively stationary terminal on the interrupting device during the rotary movement of the switch blade and during the initial swinging movement of the switch blade until after separation of the contacts in the interrupting device and said auxiliary contact arm being subsequently movable at least during a later portion of the opening operation with the switch blade to disengage the relatively stationary terminal on the interrupting device, and said auxiliary contact arm electrically interconnecting the relatively stationary terminal of the interrupting device with the other terminal of the switch spaced therefrom to provide an auxiliary current path through the switch during both said rotary and initial swinging movements of the switch blade and being spaced from the relatively stationary terminal of the interrupting device when the switch is in open circuit position.

3. A load-break switch including a pair of spaced terminals, a switch contact on one of said terminals, disconnecting switch blade means bridging the switch terminals in the closed circuit position of the switch, means for moving said switch blade means into and out of swinging engagement with said switch contact, an arc-extinguishing interrupting device mounted on the terminal having said switch contact thereon and out of the space between the spaced terminals, said interrupting device having a tubular insulating member supported at one end on the terminal having the switch contact thereon, a mechanism housing supported entirely by the other end of said tubular insulating member, both said tubular insulating member and said mechanism housing being stationary relative to the terminal on which the interrupting device is mounted, an operating arm outside said mechanism housing and having a shaft extending pivotally into the mechanism housing, said operating arm being pivotally movable in opposite directions about the axis of said shaft during opening and closing movement of the switch blade means, a pair of interrupting contacts one of which is movable within said tubular insulating member, a spring mechanism in said mechanism housing and connected to said shaft and operated by pivotal movement of said operating arm, said spring mechanism in the housing being connected to said movable interrupting contact, auxiliary contact means operable by said switch blade means and completing an

electrical connection with said mechanism housing and the movable interrupting contact independently of said operating arm and the spring mechanism in the housing when the switch is closed, the spring of said mechanism holding the movable interrupting contact in engagement with the other interrupting contact when said operating arm and said switch blade means are in closed position and also during the first part of the movement of the switch blade means and operating arm in opening direction, said spring mechanism in the housing acting during further pivotal movement of the operating arm in opening direction to actuate the movable interrupting contact to disengage the other interrupting contact with a snap action at a speed independent of the speed of movement of the operating arm and switch blade means, said spring holding said interrupting contacts in separated position when the operating arm and switch blade means are in open position and moving said interrupting contacts to engaged position with a snap action upon pivotal movement of the operating arm in closing direction during closing movement of the switch blade means.

4. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure including a rotatable shaft, said mechanism including a snap-opening and a snap-closing device to effect snap action of the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening and closing movements of the switch blade to effect rotation of the shaft and hence actuation of the mechanism, an auxiliary contact arm independent from the switch blade and movable at least during a portion of the opening operation with the switch blade, said auxiliary independent contact arm remaining substantially stationary during the initial portion of the switch opening operation and electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact following separation of the switch blade from said one relatively stationary switch contact.

5. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, a movable independent conducting auxiliary bridging contact arm, said movable independent conducting auxiliary bridging contact arm remaining relatively stationary during separation of the switch blade from one relatively stationary switch contact and electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact, and the switch blade picking up the independent auxiliary contact arm subsequently in the switch opening operation to cause it to move therewith.

6. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and pivotally mounted on one switch contact, said switch blade being arranged to be swung about said one switch contact into and out of engagement with the other relatively stationary switch contact, an arc-extinguishing interrupting device having one end thereof disposed adjacent said other relatively stationary switch contact and having the other end thereof extending away from said other relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said other relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, and an auxiliary movable contact arm independent from the switch blade and pivotally mounted adjacent said one switch contact and electrically interconnecting the relatively stationary terminal with said one relatively stationary switch contact following disengagement of the switch blade from the other relatively stationary switch contact.

7. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and pivotally mounted on one switch contact, said switch blade being arranged to be swung about said one switch contact into and out of engagement with the other relatively stationary switch contact, an arc-extinguishing interrupting device having one end thereof disposed adjacent said other relatively stationary switch contact and having the other end thereof extending away from said other relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said other relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, an auxiliary movable independent contact arm pivotally mounted adjacent said one switch contact and movable at least during a portion of the opening operation with the switch blade, said auxiliary movable independent contact arm electrically interconnecting the relatively stationary terminal with said one relatively stationary switch contact, and remaining relatively stationary while the switch blade separates from said other relatively stationary switch contact during the opening operation.

8. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one rela-

tively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, an auxiliary independent contact arm movable at least during a portion of the opening operation with the switch blade and electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact, means biasing the independent auxiliary contact arm toward the disconnecting switch blade, and the independent auxiliary contact arm remaining relatively stationary during the initial portion of the switch opening operation while the switch blade separates from said one relatively stationary switch contact.

9. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure including a rotatable shaft, said mechanism including a snap-opening and a snap-closing device to effect snap action of the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening and closing movements of the switch blade to effect rotation of the shaft and hence actuation of the mechanism, an auxiliary contact arm independent from the switch blade movable at least during a portion of the opening operation with the switch blade and electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact, and means biasing the auxiliary contact arm toward the disconnecting switch blade.

10. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the seperable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, a movable conducting auxiliary contact arm independent from the switch blade and electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact, said contact arm being pivotally mounted adjacent said other relatively stationary switch contact, and means biasing the auxiliary contact arm toward the disconnecting switch blade.

11. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and pivotally mounted on one switch contact, said switch blade being arranged to be swung about said one switch contact into and out of engagement with the other relatively stationary switch contact, an arc-extinguishing interrupting device having one end thereof disposed adjacent said other relatively stationary switch contact and having the other end thereof extending away from said other relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said other relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, an auxiliary movable contact arm independent from the switch blade pivotally mounted adjacent said one switch contact and electrically interconnecting the relatively stationary terminal with said one relatively stationary switch contact, and means biasing the auxiliary contact arm toward the disconnecting switch blade.

12. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent and mounted on said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts one of which is carried on a rod of conducting material movable longitudinally of the interrupting device, mechanism for actuating the contact structure including a pivoted linkage in the interrupting device and a rotatable shaft extending externally of the interrupting device and having an operating crank secured to the external end thereof, said crank having two spaced shafts at the end thereof by which the crank may be engaged one of which shafts is in the line of motion of the end of the switch blade on opening and the other of which is in the line of motion of the end of the switch blade on closing, and said two spaced shafts with the end of the rotatable shaft forming a triangular arrangement.

13. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a relatively stationary terminal disposed adjacent said other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, a mechanism for actuating

the contact structure including a rotatable shaft extending externally of the interrupting device and having an operating crank secured to the external end thereof, said crank having two spaced engaging shafts at the end thereof one of which is in the line of motion of the end of the switch blade on opening and the other of which is in the line of motion of the end of the switch blade on closing, and an auxiliary contact arm independent from the switch blade movable at least during a portion of the opening operation with the switch blade and electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact.

14. A load-break switch including a pair of spaced terminals, a switch contact on one of said terminals, disconnecting switch blade means bridging the switch terminals in the closed circuit position of the switch, means mounting said switch blade means for rotation about its longitudinal axis to make and release pressure engagement with said switch contact, means for moving said switch blade means into and out of swinging engagement with said switch contact, an arc-extinguishing interrupting device mounted on the terminal having said switch contact thereon and out of the space between the spaced terminals, said interrupting device having a tubular insulating member supported at one end on the terminal having the switch contact thereon, a mechanism housing supported entirely by the other end of said tubular insulating member, both said tubular insulating member and said mechanism housing being stationary relative to the terminal on which the interrupting device is mounted, an operating arm outside said mechanism housing and having a shaft extending pivotally into the mechanism housing, said operating arm being pivotally movable in opposite directions about the axis of said shaft during opening and closing movement of the switch blade means, a pair of interrupting contacts one of which is movable within said tubular insulating member, said interrupting contacts being electrically connected respectively to the terminal having the switch contact thereon and to said mechanism housing, a mechanism including an over-center spring in said mechanism housing, said mechanism being connected to said shaft and operated by pivotal movement of said operating arm, said mechanism moving one of said interrupting contacts to engage the other interrupting contact during movement in closing direction before said switch blade means engages said switch contact, said mechanism stressing said over-center spring during movement of said shaft by opening movement of the switch blade means before any movement of the movable interrupting contact in opening direction, said spring then moving over center and initiating separating movement of the interrupting contacts with a snap action at a speed independent of the speed of movement of said shaft by said switch blade means.

15. A load-break switch including a pair of spaced terminals, a switch contact on one of said terminals, disconnecting switch blade means bridging the switch terminals in the closed circuit position of the switch, means for moving said switch blade means into and out of swinging engagement with said switch contact, an arc-extinguishing interrupting device mounted on the terminal having said switch contact thereon and out of the space between the spaced terminals, said interrupting device having a tubular insulating member supported at one end on the terminal having the switch contact thereon, a mechanism housing supported entirely by the other end of said tubular insulating member, both said tubular insulating member and said mechanism housing being stationary relative to the terminal on which the interrupting device is mounted, an operating arm outside said mechanism housing and having a shaft extending pivotally into the mechanism housing, said operating arm being engaged and moved by said switch blade means only after the switch blade means separates from the switch contact during opening movement and being engaged and moved by said switch blade means only prior to engagement of the switch contact by the switch blade means during closing movement and said switch blade means being disengaged from the operating arm in both the fully open and fully closed positions of the switch, said operating arm being pivotally movable in opposite directions about the axis of said shaft during opening and closing movement of the switch blade means, a pair of interrupting contacts one of which is movable within said tubular insulating member, a spring mechanism in said mechanism housing and connected to said shaft and operated by pivotal movement of said operating arm, said spring mechanism in the housing being connected to said movable interrupting contact, auxiliary contact means operable by said switch blade means and completing an electrical connection with said mechanism housing and the movable interrupting contact independently of said operating arm and the spring mechanism in the housing when the switch is closed, the spring of said mechanism holding the movable interrupting contact in engagement with the other interrupting contact when said operating arm and said switch blade means are in closed position and also during the first part of the movement of the switch blade means and operating arm in opening direction, said spring mechanism in the housing acting during further pivotal movement of the operating arm in opening direction to actuate the movable interrupting contact to disengage the other interrupting contact with a snap action at a speed independent of the speed of movement of the operating arm and switch blade means, said spring holding said interrupting contacts in separated position when the operating arm and switch blade means are in open position and moving said interrupting contacts to engage position with a snap action upon pivotal movement of the operating arm in closing direction during closing movement of the switch blade means.

16. A switch comprising, spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device including separable interrupter contacts electrically connected between one of said line terminals and a terminal of said device, a bridging contact arm substantially independent of the switch blade and mounted for movement into and out of bridging engagement with respect to the other of said line terminals and said device terminal, operating means operable in a switch opening operation to first move said switch blade out of bridging relation with said line terminals while said bridging contact arm is substantially stationary, and thereafter to separate the interrupter contacts, and finally to move said substantially independent contact arm out of bridging engagement with said other line terminal and said device terminal.

17. A switch comprising, spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device including separable interrupter contacts electrically connected between one of said line terminals and a terminal of said device, a bridging contact arm substantially independent of the switch blade and mounted for movement into and out of bridging engagement with respect to the other of said line terminals and said device terminal, operating means operable in a switch closing operation to first move said substantially independent contact arm into bridging engagement with respect to the other line terminal and the device terminal, and thereafter to close the interrupter contacts while said bridging contact arm is substantially stationary, and finally to close the switch blade into bridging engagement with respect to the line terminals.

18. A switch comprising, spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device including separable interrupter contacts electrically connected between one

of said line terminals and a terminal of said device, a bridging contact arm substantially independent of the switch blade and mounted for movement into and out of bridging engagement with respect to the other of said line terminals and said device terminal, operating means operable in a switch opening operation to first move said switch blade out of bridging relation with said line terminals while said bridging contact arm is substantially stationary, and thereafter to separate the interrupter contacts, and finally to move said substantially independent contact arm out of bridging engagement with said other line terminal and said device terminal, said operating means being operable in a switch closing operation to first move said substantially independent contact arm into bridging engagement with respect to the other line terminal and the device terminal, and thereafter to close the interrupter contacts while said bridging contact arm is substantially stationary, and finally to close the switch blade into bridging engagement with respect to the line terminals.

19. A load-break switch including a pair of spaced terminals, a switch contact on one of said terminals, disconnecting switch blade means bridging the switch terminals in the closed circuit position of the switch, means mounting said switch blade means for rotation about its longitudinal axis to make and release pressure engagement with said switch contact, means for moving said switch blade means into and out of swinging engagement with said switch contact, an arc-extinguishing interrupting device mounted on the terminal having said switch contact thereon and out of the space between the spaced terminals, said interrupting device having a tubular insulating member supported at one end on the terminal having the switch contact thereon, a mechanism housing supported entirely by the other end of said tubular insulating member, both said tubular insulating member and said mechanism housing being stationary relative to the terminal on which the interrupting device is mounted, an operating arm outside said mechanism housing and having a shaft extending pivotally into the mechanism housing, said operating arm being pivotally movable in opposite directions about the axis of said shaft during opening and closing movement of the switch blade means, said operating arm and shaft being stationary during the first part of the opening movement of the switch blade means until after the switch blade means has separated from said switch contact, a pair of interrupting contacts one of which is movable within said tubular insulating member, auxiliary contact means operable by said switch blade means completing an electrical connection with said mechanism housing and the movable interrupting contact during the time after the switch blade means has separated from said switch contact and until after the operating arm has been moved to cause separation of the interrupting contacts, said auxiliary contact means being moved by the switch blade means to break the electrical circuit to the interrupting contacts during the later part of the opening movement of the switch blade means, said interrupting contacts being electrically connected respectively to the terminal having the switch contact thereon and to said mechanism housing, a mechanism including an over-center spring in said mechanism housing, said mechanism being connected to said shaft and operated by pivotal movement of said operating arm, said mechanism moving one of said interrupting contacts to engage the other interrupting contact during movement in closing direction before said switch blade means engages said switch contact, said mechanism stressing said over-center spring during movement of said shaft by opening movement of the switch blade means before any movement of the movable interrupting contact in opening direction, said spring then moving over center and initiating separating movement of the interrupting contacts with a snap action at a speed independent of the speed of movement of said shaft by said switch blade means.

20. A switch comprising, spaced line terminals, a disconnecting switch blade mounted for rotation about its longitudinal axis and for swinging movement into and out of bridging engagement with respect to said line terminals, a switch contact on one of said line terminals engageable by said switch blade, operating means for rotating said switch blade about its longitudinal axis after it has been moved to engage the switch contact to cause pressure engagement therewith, a circuit interrupting device having a terminal thereon and including separable interrupter contacts electrically connected between one of said line terminals and said terminal of the interrupting device, an auxiliary contact member electrically connected to the switch blade and to the other of said line terminals and movable to engage and disengage said interrupting device terminal, said operating means in a switch opening operation first rotating said switch blade about its longitudinal axis to release the pressure engagement with the switch contact and then beginning swinging movement of the switch blade out of bridging relation with said line terminals and causing separation of the interrupter contacts, said auxiliary contact member remaining in engagement with said interrupting device terminal during rotation of the switch blade about its longitudinal axis and until the interrupter contacts have separated, said switch blade then moving the auxiliary contact member to separate from the interrupting device terminal and moving to full open position, and said interrupting device including an interrupting chamber in which one of the interrupter contacts is moved and the circuit interrupting arc is extinguished without any external arc being drawn.

21. A load-break switch including a pair of spaced stationary switch terminal members, a switch contact on one of said terminal members, disconnecting switch blade means pivoted on the other of said terminal members and bridging the terminal members in the closed circuit position and pivotally movable into and out of swinging engagement with said switch contact, an arc-extinguishing interrupting device including an interrupter chamber housing of insulating material and a mechanism housing at one end of the interrupter chamber housing, the other end of the interrupter chamber housing being mounted on said terminal member carrying the switch contact, said arc-extinguishing interrupting device being mounted out of the space between the terminal members, contact structure for said arc-extinguishing interrupting device including a pair of separable interrupting contacts enclosed therewithin, one of said interrupting contacts being on a contact rod movable axially of its length within the interrupter chamber housing of insulating material, a mechanism within the interrupting device for actuating said contact rod and including a rotatable shaft having only one end extending externally of the mechanism housing through one side thereof and said shaft extending in a direction generally at right angles with the length of said contact rod, operating crank means at the external end of said shaft, said crank means having two spaced portions at which the crank is engaged and operated, both of said spaced portions having a common plane of movement, a single extension on said switch blade means for alternately engaging each of said spaced portions and operating said crank means in opposite directions, one of said portions on the crank means being in the line of motion of said extension on the switch blade means during its opening movement and the other said portion on the crank means being in the line of motion of the same said extension on the switch blade means during its closing movement, and the said two spaced portions on the crank means and the shaft thereof forming a triangular arrangement mounted on the shaft at one side of the interrupting device, an auxiliary contact surface carried on said mechanism housing, and an auxiliary contact portion engaging said auxiliary contact surface prior to the engagement of the extension on the switch blade means with said crank means during the opening movement of

the switch blade means and thereby completing an electrical circuit between the spaced stationary switch terminal members through said interrupting contacts after said switch blade means has separated from said switch contacts, and said auxiliary contact portion separating from the auxiliary contact surface carried on the mechanism housing after separation of the interrupting contacts in the interrupting device by movement of said crank means.

22. A load-break switch including a pair of spaced relatively stationary switch contacts, a disconnecting switch blade bridging the switch contacts in the closed circuit position and adapted to be moved into and out of swinging engagement with one of the relatively stationary switch contacts, an arc-extinguishing interrupting device having one end thereof disposed adjacent said one relatively stationary switch contact and having the other end thereof extending away from said one relatively stationary switch contact, contact structure for said arc-extinguishing interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary terminal disposed adjacent the other end of the arc-extinguishing interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one relatively stationary switch contact, means electrically connecting the other separable contact of the interrupting device to the relatively stationary terminal, means for causing the opening movement of the switch blade to operate said mechanism, and a movable conducting auxiliary contact arm independent from the switch blade electrically interconnecting the relatively stationary terminal with the other relatively stationary switch contact, the switch blade having a hook to pick up the independent auxiliary contact arm during the opening operation so that the latter will move therewith to the fully open circuit position.

23. A switch comprising, spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device including separable interrupter contacts electrically connected between one of said line terminals and a terminal of said device, a contact arm independent from the switch blade and mounted for movement into and out of bridging engagement with respect to the other of said line terminals and said device terminal, operating means operable in a switch opening operation to first move said switch blade out of bridging relation with said line terminals, and thereafter to separate the interrupter contacts, and finally to move said independent contact arm out of bridging engagement with said other line terminal and said device terminal, the switch blade having a hook to pick up the independent auxiliary contact arm during the opening operation so that the latter will move therewith to the fully open circuit position.

24. A switch comprising, spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device including separable interrupter contacts electrically connected between one of said line terminals and a terminal of said device, a bridging contact arm substantially independent of the switch blade and mounted for movement into and out of bridging engagement with respect to the other of said line terminals and said device terminal, operating means operable in a switch opening operation to first move said switch blade out of bridging relation with said line terminals while said bridging contact arm is substantially stationary, and thereafter to separate the interrupter contacts, and finally to move said substantially independent contact arm out of bridging engagement with said other line terminal and said device terminal, and means biasing the switch blade and the substantially independent contact arm together.

25. A load-break switch including a pair of spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device having one end thereof disposed adjacent one line terminal and having the other end thereof extending away from said one line terminal, contact structure associated with the circuit interrupting device including a pair of separable contacts, a mechanism for actuating the contact structure, a relatively stationary device terminal disposed adjacent said other end of the circuit interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one line terminal and the other separable contact to the device terminal, means for causing the opening movement of the switch blade to operate said mechanism, an independent auxiliary contact arm remaining relatively stationary during the initial movement of the switch blade and subsequently movable at least during a portion of the opening operation with the switch blade, said auxiliary contact arm interconnecting the device terminal with the other spaced line terminal, and means biasing the auxiliary contact arm toward the disconnecting switch blade.

26. A load-break switch including a pair of spaced line terminals, a disconnecting switch blade mounted for movement into and out of bridging engagement with respect to said line terminals, a circuit interrupting device having one end thereof disposed adjacent one line terminal and having the other end thereof extending away from said one line terminal, contact structure associated with the circuit interrupting device including a pair of separable contacts, a mechanism including a crank arm disposed adjacent said other end of the circuit interrupting device for actuating the contact structure, a relatively stationary device terminal disposed adjacent said other end of the circuit interrupting device, means electrically connecting one of the separable contacts of the interrupting device to said one line terminal and the other separable contact to the device terminal, means for causing the opening movement of the switch blade to rotate said crank arm to actuate the mechanism, an independent auxiliary contact arm remaining relatively stationary during the initial movement of the switch blade while the latter rotates the crank arm and subsequently movable at least during a portion of the opening operation with the switch blade, and said auxiliary contact arm interconnecting the device terminal with the other spaced line terminal.

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