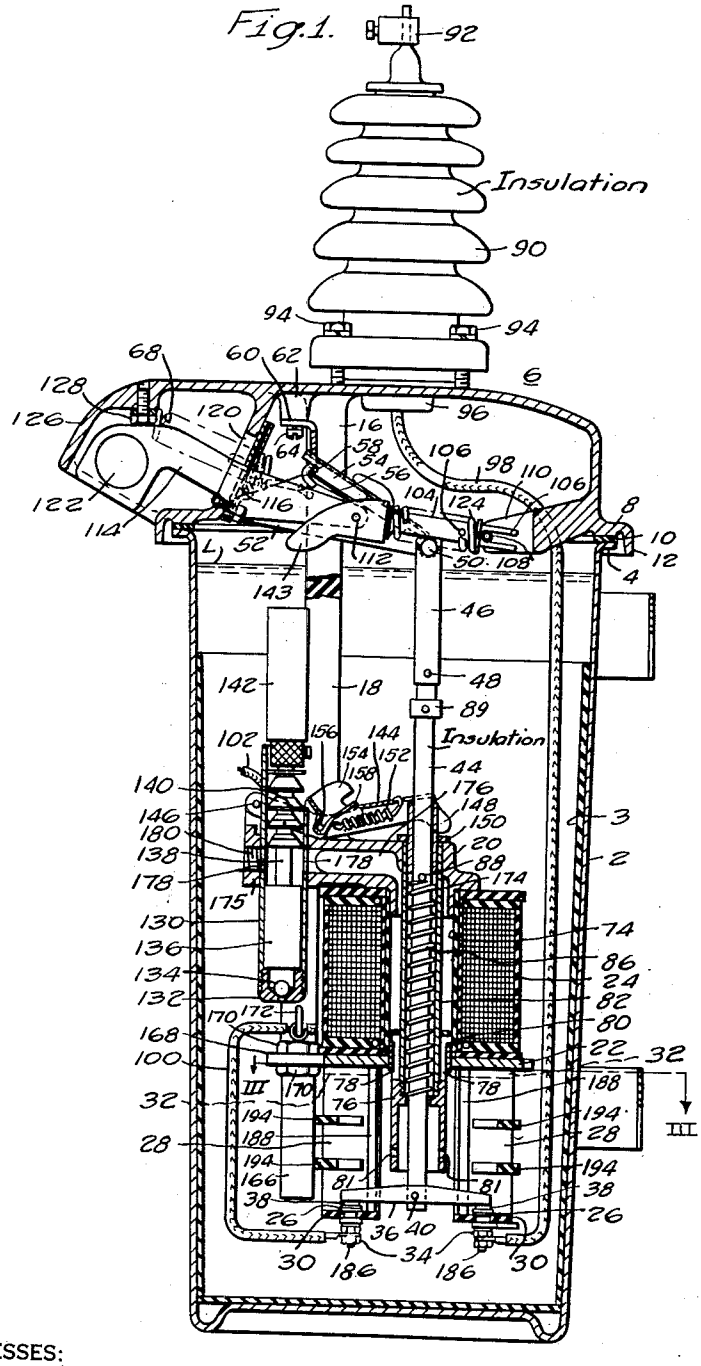
Nov. 20, 1951 J. M. WALLACE ET AL 2,575,738

CIRCUIT INTERRUPTER

Filed Dec. 28, 1946

2 SHEETS—SHEET 1

Fig. 1.



WITNESSES:

E. G. McCloskey.

A. T. Stratton

INVENTORS

James M. Wallace and

Joseph K. Kraft.

BY

F. W. Lyle,

ATTORNEY

Nov. 20, 1951 J. M. WALLACE ET AL 2,575,738

CIRCUIT INTERRUPTER

Filed Dec. 28, 1946 2 SHEETS--SHEET 2

Fig. 2.

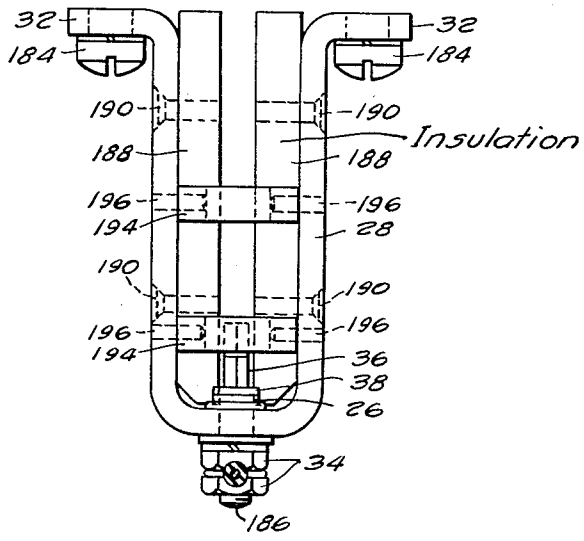
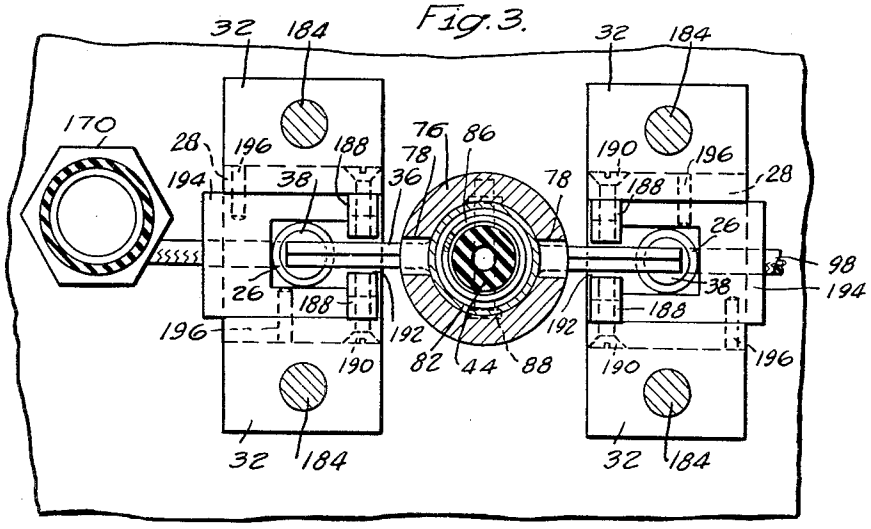


Fig. 3.



WITNESSES:

E. C. McCloskey.

R. T. Stratton

INVENTORS

James M. Wallace and

Joseph K. Kraft.

BY F. W. Lyle.

ATTORNEY

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UNITED STATES PATENT OFFICE

2,575,738

CIRCUIT INTERRUPTER

James M. Wallace, East McKeesport, and Joseph K. Kraft, Edgewood, Pa., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

Application December 28, 1946, Serial No. 718,942

14 Claims. (Cl. 200—150)

1

This invention relates generally to electric circuit interrupting devices, and more especially to means for extinguishing the arc drawn when such devices operate to open the circuit.

In many types of electric circuit interrupting devices, such as in automatic reclosing circuit breakers, it is desirable to close the circuit a few cycles after a circuit interrupting operation, and it is therefore necessary that the space between the arc extinguishing contacts be rapidly deionized so that no flashover will occur during closing of the contacts to prematurely energize the circuit. According to this invention a relatively simple stationary arc extinguishing structure is provided for efficiently extinguishing power arcs and arranged so that rapid reclosing of the circuit interrupting contacts can occur without danger of flashover before engagement of the contacts.

One object of this invention, therefore, is to provide for circuit interrupters adapted to be rapidly reclosed following a circuit interrupting operation, novel arc extinguishing means capable of rapid venting following arc extinction to prevent flashovers on reclosing the circuit.

Another object of this invention is to provide a novel arc extinguishing structure for electric circuit interrupting devices which is relatively simple in construction and economical to manufacture, yet is capable of efficiently extinguishing electric arcs and of rapidly deionizing the arc path.

Another object of this invention is to provide for circuit interrupters of the double break type, novel arc extinguishing means comprising individual arc extinguishing units for each break.

Another object of this invention is to provide for circuit interrupters of the double break type, arc extinguishing means comprising individual arc extinguishing units for each break, with each such unit cooperable with the contact structure of the interrupter in a novel manner.

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

Figure 1 is a substantially central vertical section view of a circuit breaker constructed in accordance with this invention.

Fig. 2 is an enlarged partial end view of the circuit interrupting portion of the breaker shown in Fig. 1, and

Fig. 3 is an enlarged partial transverse section view of the breaker shown in Fig. 1, taken substantially on the line III—III of Fig. 1.

The invention is herein illustrated as being embodied in an automatic reclosing circuit breaker mounted in a metal tank 2 having a closed bottom wall and an open top and adapted to be

2

filled with a liquid up to the level F, preferably an arc extinguishing liquid such as oil or the like. Preferably, the tank is adapted to be lined at least over the bottom wall and up to a point adjacent the open top of the container with a liner 3 of insulating material such as fiber, or the like. The upper end of tank 2 is provided with an outwardly extending flange 4 on which the flange 8 of a cover casting 6 is adapted to be seated, preferably, with a gasket 10 interposed therebetween. Flange 8 of cover casting 6 may be provided with an integral lip 12, and the cover may be secured to the tank in any desired manner, such for example, as by bolts (not shown) extending through openings in cover flange 8 and secured to suitably formed brackets on the tank.

The breaker contacts, arc extinguishing structure and the contact actuating mechanism are all adapted to be supported in tank 2 from cover casting 6 by means of a pair of integral supporting lugs 16 (only one of which is shown) depending from the top wall of the cover casting and adapted to engage spacer sleeves 18 of insulating material suitably secured to supporting lugs 16 and a supporting casting 20. A supporting plate 22 may be supported in a similar manner from casting 20, so that a solenoid coil 24 may be mounted between casting 20 and supporting plate 22, with the central opening in the coil aligned with openings provided in casting 20 and plate 22.

Spaced stationary contacts 26 of the breaker are each supported from plate 22 by a support 28 of insulating material, such as fiber, formed of U-shape, with the stationary contacts being mounted in openings provided in the base portions 30 of each support 28, and with the upper ends of each support 28 having laterally extending flanges 32 by means of which each support is secured to supporting plate 22, as by screws 184. As illustrated, each contact 26 is formed as the head of a bolt 186 to which a conductor may be secured, as by the nuts 34.

Stationary contacts 26 are adapted to be closed by engagement therewith of a bridging contact 36 having contact tips 38 at opposite ends thereof for engagement with the stationary contacts, respectively. Bridging contact 36 is supported substantially centrally thereof on a slidable contact actuating rod 44 by a pivot pin 40 for limited pivotal movement about a transverse axis. Contact rod 44 being mounted for longitudinal sliding movement through coil 24 and aligned openings in plate 22 and casting 20, it will be observed that bridging contact 36 is free to adjust itself to the stationary contacts by restricted pivotal movement about its pivotal mounting 40. Contact rod 44 should be of an insulating material such as fiber or a molded insulating material.

The supports 28 for stationary contacts 26 form arc extinguishing means for the arcs drawn be-

tween the ends of the bridging contacts 36 and stationary contacts 26, respectively, when the bridging contact is moved upwardly to open the circuit. It will be observed (Fig. 3) that the space between the legs of U-shaped supports 28 is relatively small, being only slightly larger than the contacts, and at the confronting sides of the arcing spaces between the legs of supports 28, respectively, strips 188 of insulating material, which may be of the same material comprising supports 28, preferably an insulating material capable of evolving an arc extinguishing gas when in proximity to an electric arc, such as fiber or synthetic resin, previously mentioned, are provided secured to each leg of each support 28 as by screws or rivets 190, to restrict the opening between the legs at these confronting sides of supports 28 to a narrow slot 192, only slightly larger than the width of bridging contact 36. The outer sides of the arcing space between the legs of supports 28 are open throughout the length of the legs, except for a pair of relatively widely spaced deionizing plates 194 positioned substantially transversely of the arcing space, being secured in supports 28 as by pins 196. Deionizing plates 194 are also substantially U-shaped in form with the connecting portions thereof positioned at the outer sides of the arcing spaces defined by each supporting member 28.

In the operation of the circuit interrupting and arc extinguishing structures described above, it will be apparent that when bridging contact 36 moves upwardly away from stationary contacts 26, that arcs drawn from each end of the bridging contact to the respective stationary contacts will be confined in supports 28, and the pressure developed by the arcs in the supports, due to the action of the arc on the arc extinguishing liquid filling tank 2, as well as on the insulating material comprising the insulating structures surrounding the arc, will cause the arc to move outwardly into engagement with the deionizing plates 194, because the outer side of each arcing space is much more freely vented than the inner sides thereof due to the restrictions formed by strips 188 at the inner sides. Because of strips 188, the arcs drawn may be forced to loop around deionizing plates 194 and will be extinguished by the restricting action of supports 28 and the pressures generated therein causing outward looping of the arc relative to the contacts and about deionizing plates 194. Because the outer sides of the arc space are freely vented through the length of the arc path, as a matter of fact this free venting occurs throughout the extent of contact opening movement, the arc space is almost immediately replenished with arc extinguishing liquid from container 2 so that the insulating value of the arc space is instantly restored to thereby prevent flashover during closing movement of the contacts, which would prematurely energize the circuit.

The upper end of contact actuating rod 44 has a connecting link 46 pivoted thereon as by a pivot pin 48, with the upper ends of these connecting links mounted on a common pivot pin 50 for a pair of toggle levers 52 and 54. Toggle levers 52 and 54 are both formed of sheet material, with lever 54 being bent to substantially channel form with outwardly extending flanges 56 adapted to be received at the free end thereof in recesses 58 provided in the spaced downwardly depending fingers of an angled supporting bracket 60 which, in turn, is secured as by a screw 64 to a lug 62 integral with the cover casting. A coil tension spring 66 has one end hooked into an opening provided in toggle lever 52, and has the opposite end thereof hooked over an integral spring support on the cover casting.

Solenoid coil 24 previously mentioned is adapted to be energized under certain conditions for automatically opening the circuit breaker contacts. The central opening through coil 24 preferably is provided with a cylindrical sleeve 74 in which a solenoid core 76 is adapted to be slidably mounted in a piston-like manner. Core 76 is in the form of a cylindrical sleeve having opposed slots 78 in the upper portions thereof adapted in the normal closed circuit position of the device illustrated in Fig. 1 to extend partly above and partly below supporting plate 22, by engagement of an exterior shoulder adjacent the upper end of the core with a sleeve 80 which has an external rib held between the sleeve 74 for the coil and supporting plate 22. The lower end of core 76 is provided with opposed openings 81, for a purpose to be hereinafter described.

A contact actuating sleeve 82 is telescoped over contact actuating rod 44 and its lower end is received in core 76 preferably being threadably mounted therein. A coil compression spring 86 is provided within actuating sleeve 82 on contact actuating rod 44 and is adapted to react between core 76 and a pin 88 extending transversely through actuating rod 44.

The circuit through the circuit breaker thus far described may now be traced from the point where it enters tank 2 through one of a pair of terminal bushings 90 (only one being shown), with each bushing secured to cover casting 6 as by bolts 94, and each being provided with a terminal fixture 92 at the upper end thereof mounted on a conductor element which extends through the bushing and emerges from a reduced extension 96 of the bushing seated in an opening provided in the top wall of cover casting 6, and proceeds by conductor 98 directly to one fixed contact 26 of the breaker. When the contacts are in engagement, the circuit then proceeds through bridging contact 36 to the other fixed contact 26, and then by way of a conductor 100 to one terminal of solenoid coil 24. The other terminal of coil 24 is adapted to be connected by a conductor 102 to the conducting means in the other terminal bushing 90. It will be apparent that solenoid coil 24 is connected in series in the circuit through the circuit breaker so as to be energized at all times dependent upon the value of the load current flowing in the circuit.

For any given rating of circuit breaker, solenoid coil 24 is designed to become sufficiently energized when the load current in the circuit exceeds its rating as to attract core 76 and move it upwardly within sleeve 74. Assuming the upper end of sleeve 74 to be closed so fluid cannot escape, core 76 will move upwardly relatively rapidly until the bottom of slots 78 reaches sleeve 80, whereupon there is no longer any vent for fluid contained in cylindrical sleeve 74, and it then becomes necessary upon further upward movement of core 76 to displace the liquid in sleeve 74 above the core through the relatively small clearance between the core and sleeves 74 and 80. Accordingly, opening movement of the core will be slowed up by the aforesaid dashpot action an amount determined by the current value of the overload, and, therefore, an inverse time-current characteristic on opening is obtained. Finally, when openings 81 clear the upper edge of sleeve 80, core 76 will no longer be

restrained by the dashpot action, and the final opening movement thereof may be relatively rapid. As soon as core 76 commences its upward travel, bridging contact 36 being held engaged by toggle spring 68 does not move, so that spring 86 is compressed until the energy stored in spring 86 is sufficient to overcome the force exerted by toggle spring 68, at which time contact actuating rod 44 will start to move upwardly. As soon as actuating rod 44 moves upwardly, the force exerted by toggle spring 68 begins to decrease and in a very short distance has substantially no value at all, so that the remaining major part of the circuit opening movement of bridging contact 36 occurs extremely rapidly due to expansion of spring 86.

However, flange 89 is provided on rod 44 to obtain a positive contact separation in the event there is any sticking or welding of the bridging contact to stationary contacts 26 by engagement therewith of actuating sleeve 82. In either case, it is apparent that toggle levers 52 and 54 will be moved to their on-center position, and bridging contact 36 will be moved by spring 86 to its full open circuit position.

When the breaker contacts have attained their full open circuit position, the parts associated therewith are biased to return by gravity. This closing bias is relatively light and will be opposed by the dashpot action of core 76. Accordingly, the return movement will be relatively slow until pivot point 50 moves below the line of action of toggle spring 68 when toggle levers 52 and 54 are in engagement, whereupon bridging contact 36 will be rapidly moved to effect a snap-action closing of the breaker contacts by toggle spring 68. Moreover, at about this same time the lower ends of slots 78 in core 76 will clear the lower edge of sleeve 80 so as to vent the dashpot comprising sleeve 74 and core 76.

In order to provide for maintaining the breaker contacts separated and to also provide for manual operation, spring means are provided for holding the breaker contacts open in response to the occurrence of a predetermined number of closely succeeding circuit interrupting operations, which means can be manually actuated. This means comprises a toggle lever 104 having a slot 106 at one end thereof for receiving a pin 108 mounted between spaced supporting arms 110 integral with cover casting 6. The other end of toggle lever 104 is pivoted, as by a pivot pin 112, to the adjacent end of a second toggle lever 114, and this, in turn, is mounted on a pivot pin 116 intermediate its ends on cover casting 6. A slot 120 is provided through the cover casting 6 for receiving the other end of toggle lever 114 which acts as a manual operating handle at the exterior of the circuit breaker casing, being provided with a hook eye 122 in its outer end. A coil compression spring 124 is mounted on toggle lever 104 and reacts between washers mounted on the toggle lever, one of which engages supporting pin 108, and the other of which engages a shoulder located adjacent pivot 112. Normally, toggle levers 104 and 114 are held with pivot 112 below the center-line connecting pins 108 and 116, with the outer end of lever 114 positioned in and beneath an integral hood 126 on cover casting 6, in engagement with an adjustable stop screw 128 mounted in the hood.

In the position of toggle levers 104 and 114 illustrated, they have no effect on operation of the circuit breaker as previously described, being normally inactive in this respect. However, the common pivot pin 112 of toggle levers 104 and 114 is extended at one side toward toggle levers 52 and 54 and in the normal position of the parts extends beneath the adjacent flange 56 of toggle lever 54. Accordingly, if it is desired to manually open the circuit breaker contacts, a hook stick or similar operating member may be inserted in hook eye 122 of toggle lever 114 and pulled downwardly to rotate the toggle lever in a counterclockwise direction about its supporting pivot 116 to move toggle levers 104 and 114 overcenter in an upward direction, and in doing this, the common pivot pin 112 engages the adjacent flange 56 of toggle lever 54 and moves it upwardly in a counterclockwise direction, thus carrying contact actuating rod 44 with it to separate bridging contact 36 from stationary contacts 26. The breaker contacts may then be closed only by manual operation of toggle lever 114 in the opposite direction, that is, by exerting an upward force on the outer end of the toggle lever to rotate it in a clockwise direction to move it and toggle lever 104 back overcenter to the full line position illustrated on the drawings.

An integrating mechanism for automatically moving toggle levers 104 and 114 upwardly over center and thus preventing reclosure of the circuit breaker only in response to a predetermined number of closely successive circuit interrupting operations, and at the same time for automatically controlling the circuit opening and closing times in a predetermined manner in any sequence of a plurality of closely successive circuit opening operations, is provided comprising a cylindrical tube 130 secured in casting 20, and this tube has a plug 132 threaded into the lower end thereof with the plug having a small central opening controlled by a ball-check valve 134, which permits flow of fluid into the lower end of tube 130 but prevents outflow. An integrating piston 136 is mounted in tube 130 and normally rests on the upper end of plug 132, being provided with a reduced extension 138 at the upper end thereof, having a plurality of spaced circular flanges 140 forming rack teeth thereon, and having an elongated extension 142 on the extreme outer end thereof which is positioned below an extension 143 on toggle lever 104. A pawl lever 144 is pivotally mounted at one end as at 146, this end of pawl lever 144 being split with legs located at each side of tube 130 and with pivot 146 supported on spaced supporting flanges integral with casting 20. Pawl lever 144 has a connecting web intermediate its ends, and at the other end thereof the sides of the lever are extended outwardly and laterally as at 148, to normally be in engagement with a washer 150 mounted on actuating tube 82 in engagement with a shoulder adjacent the outer end of this tube. Pawl lever 144 is normally biased into engagement with washer 150 by a coil tension spring 152 hooked over the remote edge of the web of the pawl lever at one end and anchored to an ear integral with casting 20 at its other end. Pawl lever 144 is provided with a pawl member 154 pivoted thereon as at 156, and biased by a spring 158 in a counterclockwise direction to a position wherein a portion of pawl member 154 engages the connecting web of pawl lever 144.

In order to control the opening and closing times of the circuit breaker contacts to provide for different opening and closing times on predetermined circuit opening and closing operations in any sequence of closely successive operations, as on continuing overloads, the dashpot formed by sleeve 74 and solenoid core 76 has a vent 174

at the upper end thereof which is annular in form being provided in casting 20 about actuating sleeve 82. Annular vent 174 communicates with a laterally extending passage 176 also formed in casting 20, so that fluid may escape from the upper end of sleeve 74 through annular vent 174 and passage 176, and then through a pair of opposed openings 178 in tube 130 from whence it may escape through a discharge opening 180, also formed in casting 20. The openings 178 in integrator tube 130 are aligned with passage 176 and discharge opening 180.

With the parts of the circuit breaker at their normal positions illustrated in Fig. 1, it will be apparent that when the circuit breaker operates to open the circuit, the upper end of dashpot sleeve 74 being open through annular vent 174, passage 176, openings 178 and discharge opening 180, solenoid core 76 will be moved very rapidly upwardly since the liquid in dashpot sleeve 74 above the core may be freely vented through the vent passages mentioned above, and consequently the initial circuit opening operation of the breaker will occur substantially instantaneously. As solenoid core 76 moves upwardly, washer 150 will be carried upwardly with actuating sleeve 82 and thus carry the free end of pawl lever 144 upwardly with it to move pawl member 154 into engagement with the upper one of flanges 140 on integrating piston 136, to thus carry the piston upwardly a predetermined distance throughout opening movement of sleeve 82. Integrating piston 136 is not, however, carried upwardly a distance sufficient to entirely remove reduced portion 138 thereof from between openings 178 in cylinder 130, so that the vent passageway from the upper end of dashpot cylinder 74 will not be blocked off by cylinder 130. When the breaker recloses following such a first circuit interrupting operation, such reclosure will also occur extremely rapidly because core 76 does not have any dashpot action in its dashpot sleeve 74 due to the upper vent for the sleeve still being open. Accordingly, the first opening and reclosing of the circuit breaker contacts will both occur substantially instantaneously with no time delay interposed due to the dashpot action of core 76 in dashpot sleeve 74. During reclosing of the breaker the first time, integrating piston 136 is left at the position to which it was advanced, since pawl member 154 is free to disengage the circular flanges 140, and if the breaker remains closed, integrator piston 136 will slowly reset to the position shown in Figs. 1 and 2, this resetting movement being relatively slow due to the necessity of displacing liquid drawn into the lower end of cylinder 130 by advancement of piston 136 during the opening operation, past the relatively small clearance between cylinder 130 and piston 136. If the breaker immediately reopens after a first opening and reclosing operation, pawl member 154 this time will engage the next lower circular flange 140 on the integrator piston 136 and raise the piston a further amount sufficient to bring the piston between side openings 178 in integrator cylinder 130, so that the integrator piston acts as a valve to close off the vent passage 174 from the upper end of dashpot cylinder 24. Inasmuch as the integrator piston 136 does not close the vent passage until bridging contact 36 is substantially at the end of its circuit opening movement, this second closely successive circuit opening operation will, like the first, occur substantially instantaneously with substantially no delay due to dashpot cylinder 74 and core 76. However, on the succeeding reclosing operation, integrator piston 136 having closed the vent at the top of dashpot cylinder 74, this reclosing operation will be delayed in the manner previously described by the dashpot action of core 76 in cylinder 74. This second reclosing operation will result in leaving piston 136 at the further advanced position described above, from which it eventually will reset in the manner previously described if the breaker remains closed, so that an overload appearing on the circuit at a later time will result in the breaker operating in the manner described above for the first and second closely succeeding circuit opening and closing operation. However, in the event the overload continues after the second closely succeeding circuit opening and closing operations, the breaker will again open, and this time the opening operation will be delayed by the dashpot action of core 76 in dashpot sleeve 74. The circuit closing operation of the breaker following the third opening will be delayed in the manner previously described. The breaker may then continue to open and reclose if the overload continues, with each opening and closing being delayed by the dashpot action of core 76 in dashpot sleeve 74 until finally pawl member 154 advances integrator piston 136 an amount sufficient to cause the upper extension 142 thereof to engage the extension 143 of toggle lever 104, and move this lever upwardly over center so that toggle spring 124 will maintain the contacts separated in the manner previously described.

In the preferred sequence of operations leading to the breaker contacts being maintained in open circuit position mentioned above, that is a sequence of four operations, it will be apparent that with the apparatus described above, the first two opening operations will occur substantially instantaneously and the second two opening operations will be delayed with an inverse time-current characteristic due to the dashpot action of core 76 in dashpot sleeve 74. Moreover, the reclosing times in any such sequence of four closely successive opening and closing operations will comprise a first substantially instantaneous closing operation, with the remaining circuit closing operations being delayed by the dashpot action of core 76 in dashpot sleeve 74.

If desired, a protective gap device 166 of the expulsion type may be provided to prevent operation of the breaker on voltage surges, with the outer tube of the protective device mounted intermediate its ends on an extension 168 of supporting plate 22 at the underside of solenoid coil 24, being secured thereto as by nuts 170 threaded on the tube of the protector device. One terminal 172 of the protective device may be connected with conductor 100 and one side of solenoid coil 24, with the other terminal of the protective device (not shown) connected with the other terminal of coil 24 and conductor 102. This arrester and its particular manner of mounting and connection with this type of apparatus is more particularly disclosed and claimed in the copending application of H. L. Rawlins and J. M. Wallace, Serial No. 694,074, on Overvoltage Protective Device, filed August 30, 1946, which subsequently issued as Patent 2,550,124 on April 24, 1951, and assigned to the same assignee of this invention. As stated above, the purpose of providing a protective device 166 connected in the manner described herein and in the aforesaid copending application is to provide a by-pass for solenoid coil 24 on voltage surges such, for example, as those due to lightning strokes, which are not

overloads on the circuit and, consequently, it is not desired that the breaker open on such surges.

From the foregoing, it is believed apparent that the structure disclosed herein provides in an automatic reclosing circuit breaker of the type having electrical means for causing opening of the breaker contacts and having the contacts biased to automatically reclose when the circuit is opened, with means for controlling the circuit opening and closing times of the breaker to provide predetermined fast and slow circuit opening and closing operations, and wherein the breaker contacts, preferably of the double break type, are provided with arc extinguishing means particularly designed of relatively few parts, but which is capable of very rapidly restoring the insulating value of the arc space as soon as the contacts have operated to interrupt the circuit, so that the instantaneous reclosing operation previously mentioned, may occur without danger of the contacts flashing over prior to their engagement, and thus causing previous energization of the circuit.

Our invention comprises the novel contact and arc extinguishing structures, particularly in an automatic reclosing circuit breaker wherein they have certain novel features of cooperation. Other features disclosed herein are not our invention, the particular integrator structure including the pawl actuating means therefor comprising the invention of J. M. Wallace, A. W. Edwards, and J. Kraft being disclosed and claimed in their copending application Serial No. 719,524, filed December 31, 1946, on Circuit Interrupters; and the particular toggle actuating mechanisms and contact spring arrangements for actuating the contacts are the invention of J. M. Wallace and H. L. Rawlins being disclosed and claimed in their copending application Serial No. 719,572, filed December 31, 1946, on Circuit Interrupter

Having described a preferred embodiment of the invention in accordance with the patent statutes, it is desired that this invention be not limited to this particular construction inasmuch as it will be apparent, particularly to persons skilled in this art, that many modifications and changes may be made in this particular structure without departing from the broad spirit and scope of this invention. It will be readily appreciated that the particular contact structure and arc extinguishing means therefor, comprising this invention is not restricted in use to the particular contact actuating mechanism disclosed herein, nor is it even restricted in use to automatic reclosing types of circuit breakers.

We claim as our invention:

1. In an automatic reclosing circuit breaker having separable contacts with electro-responsive means for separating said contacts to interrupt the circuit and means for substantially instantaneously reclosing the circuit following a circuit interrupting operation, the combination of arc extinguishing means for said contacts comprising relatively closely spaced solid flat walls of insulating material between which an arc is drawn by said contacts, a transverse closure at the top and bottom of said walls, the space between said walls being otherwise open at opposite sides for substantially the entire length of the arc path, except for at least one plate-like member extending transversely of said walls at one side of the arc path and relatively widely spaced from said closures, and the space between said side walls at the opposite side of the arc space being of less width so as to be more restricted, whereby the arc space is substantially freely vented along said one side thereof so that the arc products will be blown laterally from between said walls throughout the length thereof.

2. In an automatic reclosing circuit breaker having separable contacts with electro-responsive means for separating said contacts to interrupt the circuit and means for substantially instantaneously reclosing the circuit following a circuit interrupting operation, the combination of arc extinguishing means for said contacts comprising relatively closely spaced solid flat walls of insulating material between which an arc is drawn by said contacts, the space between said walls for substantially the entire length of contact travel at one side thereof being open so as to be freely vented, and the corresponding space between said side walls at the opposite side of the arc space being open but more restricted throughout substantially the entire length of contact travel, whereby the arc space is substantially freely vented along said one side thereof so that the arc products will be blown laterally from between said walls throughout the length of the arc.

3. In an automatic reclosing circuit breaker having a pair of line contacts and a bridging contact mounted on a reciprocable contact actuating member for movement into and out of engagement with said line contacts to close and open the circuit, with electro-responsive means for actuating said member in one direction to open the circuit and means for substantially instantaneously moving said member in the opposite direction to close the circuit, the combination of arc extinguishing means for said contacts comprising separate arc extinguishing units for each of said line contacts, each of said units comprising spaced solid flat walls of insulating material closely confining its line contact and receiving therebetween from one side the adjacent end of said bridging contact which is movable in the space between said walls throughout its circuit opening movement, the space between said walls at the opposite side of each unit being relatively freely vented throughout substantially the entire length of contact travel, and means restricting the opening of the space between said walls throughout the length thereof at said one side of each unit.

4. In an automatic reclosing circuit breaker including a container having an open top, a removable cover for said container, means supported from said cover including contact opening and closing means, contact supporting means at the remote end of said cover supported means comprising substantially U-shaped means of insulating material, means mounting the free ends of said contact supporting means at said remote end of said cover-supported means, stationary contact means supported in said contact supporting means adjacent the bight portion thereof, and cooperable contact means mounted for movement in said contact supporting means along the length thereof into and out of engagement with said stationary contact means.

5. In a circuit interrupting device, spaced solid flat walls of insulating material defining an arc passage which is open at opposite sides throughout substantially the entire length of the arc path, stationary contact means supported between said walls adjacent one end of said passage, movable contact means having an actuating part extending into said passage from one side thereof and carrying a contact member in said passage, said movable contact means being mounted for movement longitudinally of said passage to

actuate said contact member into and out of engagement with said stationary contact means, and means in said passage at said one side thereof for restricting the opening between said walls along said passage to substantially less than that at the opposite side of said passage.

6. In a circuit interrupting device, spaced solid flat walls of insulating material defining an arc passage which is open at opposite sides throughout substantially the entire length of the arc path, stationary contact means supported between said walls adjacent one end of said passage, movable contact means having an actuating part extending into said passage from one side thereof and carrying a contact member in said passage, said movable contact means being mounted for movement longitudinally of said passage to actuate said contact member into and out of engagement with said stationary contact means, a plurality of spaced relatively thin arc retaining plates extending transversely across the space between said walls at the opposite side of said passage, and means in said passage at said one side thereof for restricting the opening between said walls along said passage to substantially less than that at the opposite side of said passage.

7. In a circuit interrupting device, spaced solid flat walls of insulating material defining an arc passage which is open at opposite sides throughout substantially the entire length of the arc path, stationary contact means supported between said walls adjacent one end of said passage, movable contact means having an actuating part extending into said passage from one side thereof and carrying a contact member in said passage, said movable contact means being mounted for movement longitudinally of said passage to actuate said contact member into and out of engagement with said stationary contact means, and said walls having at said one side thereof inwardly projecting portions defining a narrow slot for said actuating part and for restricting the opening between said walls along said passage to substantially less than that at the opposite side of said passage.

8. In a circuit interrupter of the double break type, spaced stationary contact means, bridging contact means mounted for movement to and away from bridging relation with respect to said stationary contact means, an arc extinguishing structure for each of said stationary contact means each of said structures comprising spaced solid flat walls of insulating material defining an arc passage with its stationary contact means supported in said passage adjacent one end thereof which is open at opposite sides throughout substantially the entire length of the arc path, said bridging contact means having its ends extending into said passages, respectively, from the confronting sides thereof, said passages arranged in substantially parallel relation so that the aforesaid movement of the bridging contact means is in a direction longitudinally of said passages, and means in each of said passages at the confronting sides thereof for restricting the opening between said walls along the passages to substantially less than that at the opposite side of each passage.

9. In a circuit interrupter, substantially U-shaped contact supporting means of insulating material, means mounting the free ends of said contact supporting means, stationary contact means supported in said contact supporting means adjacent the bight portion thereof, and cooperable contact means mounted for movement in said contact supporting means along the length thereof into and out of engagement with said stationary contact means.

10. In a circuit interrupter, substantially U-shaped contact supporting means of insulating material, means mounting the free ends of said contact supporting means, stationary contact means supported in said contact supporting means on the bight portion thereof, and cooperable contact means mounted for movement in said contact supporting means along the length thereof into and out of engagement with said stationary contact means.

11. In a circuit interrupter of the double break type, spaced contact structures each comprising substantially U-shaped contact supporting means of insulating material, stationary contact means supported on the bight portion of each of said means of insulating material, means adjacent the free ends of said contact structures for mounting said structures in operative spaced parallel relation, and bridging contact means spanning said contact structures with the ends thereof received in each and mounted for movement longitudinally of said contact structures.

12. In a circuit interrupter of the double break type, spaced contact structures each comprising substantially U-shaped means of insulating material defining an arc passage, stationary contact means supported on the bight portion of each of said means of insulating material, means adjacent the free ends of said contact structures for mounting said structures in operative spaced parallel relation, bridging contact means spanning said contact structures with the ends thereof received in each and mounted for movement longitudinally of said contact structures, and means in each of said passages at the confronting sides thereof for restricting the opening between said walls along the passages to substantially less than that at the opposite side of each passage.

13. In a circuit interrupter, substantially U-shaped contact supporting means of insulating material, means mounting the free ends of said contact supporting means, stationary contact means supported in said contact supporting means adjacent the bight portion thereof, cooperable contact means mounted for movement in said contact supporting means along the length thereof into and out of engagement with said stationary contact means on a member which extends into said contact supporting means from one side thereof, and means extending inwardly from at least one leg of said contact supporting means along the length thereof at said one side to restrict the opening at said one side to substantially less than the opening at the opposite side of said contact supporting means.

14. In a circuit interrupter, substantially U-shaped contact supporting means of insulating material, means mounting the free ends of said contact supporting means, stationary contact means supported in said contact supporting means adjacent the bight portion thereof, cooperable contact means mounted for movement in said contact supporting means along the length thereof into and out of engagement with said stationary contact means on a member which extends into said contact supporting means from one side thereof, plate means extending transversely across the space between the legs of said contact supporting means at the opposite side thereof, and means extending inwardly from at

least one leg of said contact supporting means along the length thereof at said one side to restrict the opening at said one side to substantially less than the opening at the opposite side of said contact supporting means.

JAMES M. WALLACE.
JOSEPH K. KRAFT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
682,217	Merrick	Sept. 19, 1901
693,416	Merrick et al.	Feb. 18, 1902
1,899,605	Baker et al.	Feb. 28, 1933
1,914,137	Leeds	June 13, 1933
1,934,454	Spurgeon	Nov. 7, 1933
1,955,213	Whitney et al.	Apr. 17, 1934
1,991,909	Rawlins	Feb. 19, 1935
2,065,802	Graves	Dec. 29, 1936
2,100,102	Dyer et al.	Nov. 23, 1937
2,243,038	Ludwig	May 20, 1941
2,405,606	Rawlins et al.	Aug. 13, 1946

FOREIGN PATENTS

Number	Country	Date
661,181	Germany	June 13, 1928