

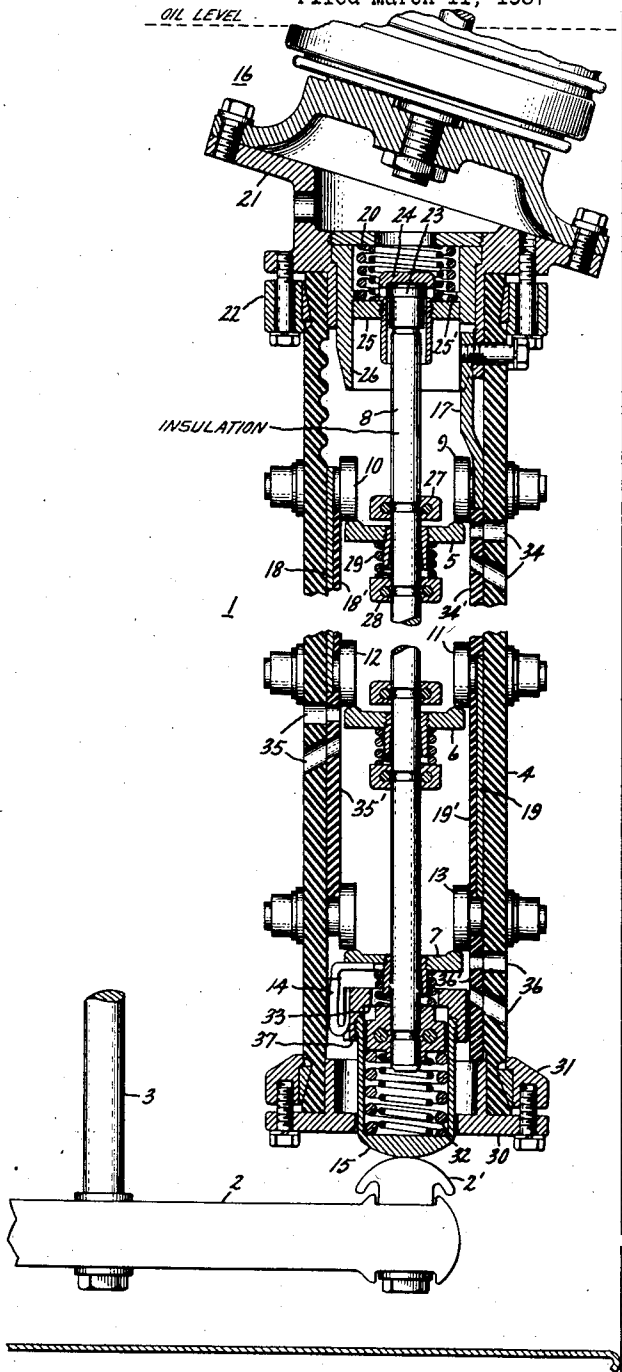
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HIGH VOLTAGE ELECTRIC CIRCUIT INTERRUPTER

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HIGH VOLTAGE ELECTRIC CIRCUIT
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eral Electric Company, a corporation of New
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8 Claims. (Cl. 200—150)

My invention relates to electric circuit inter-
rupters for high voltage power circuits, more par-
ticularly to high speed electric circuit breakers of
the liquid blast type for opening a high voltage
alternating current power circuit within a few
cycles.

In the operation of high speed circuit breakers
of the aforesaid type, the main problem is to
create an arc-interrupting liquid blast in as short
a time as possible after the tripping impulse
causing separation of the breaker contact struc-
ture. In a well-known form of oil blast breaker
the separation of the relatively movable contact
structure in response to the tripping impulse re-
sults progressively in two arcs in series, the first
of which is utilized as a pressure generating arc
for driving arc-extinguishing liquid through the
other arc. Accordingly in this form of circuit
breaker, although the interrupting action is posi-
tive and very reliable, the interrupting blast is not
made effective until the second arc has been
drawn. This is a particularly important consid-
eration where an interrupting time of but a few
cycles is specified for the breaker since, in addi-
tion to the time lost due to the inertia of the mov-
ing parts, the interrupting time is further length-
ened by the time required for the movable contact
structure to move through the distance necessary
for drawing of the second arc.

In this type of breaker it is also necessary that
the movable contact structure be separated in the
open circuit position from the fixed or coacting
explosion chamber structure so that the spaced
contacts are adequately isolated and insulated by
the liquid dielectric with respect to high voltages.
This isolating distance is considerably greater
than the amount of separation required for actual
arc interruption.

The principal object of my invention is the pro-
vision of an improved high speed electric circuit
interrupter of the liquid blast type which is effec-
tive to cause an arc-interrupting liquid blast
immediately upon initial separation of the rela-
tively movable contact structure and prior to the
isolating operation. More specifically, a further
object is the provision of an improved high speed
multiple-break oil circuit breaker of the explosion
chamber type wherein the arc-interrupting blast
is created and applied immediately upon initial
circuit opening movement and separation of the
contact structure, and wherein the fixed and mov-
able terminals are isolated within the oil breaker
casing substantially independently of the circuit
interrupting operation.

In accordance with a preferred embodiment of

my invention the contact structure is arranged to
form a plurality of breaks in series and is disposed
within an explosion chamber immersed in oil hav-
ing exhaust ports adjacent and immediately oppo-
site certain of said breaks. The breaks are formed
preferably simultaneously by uniform action of
the contacts under the influence of a main mov-
able contact member disposed exteriorly of the
explosion chamber. Upon initial contact separa-
tion arc pressure formed in the explosion cham-
ber drives oil through those arcs adjacent the
chamber exhaust ports and the circuit is inter-
rupted at these points. Further limited separa-
tion of the contacts within the explosion chamber
takes place and is followed by separation of the
main movable contact member from the contact
structure in the explosion chamber, so that an
isolating break exteriorly of the explosion cham-
ber is formed thereby. In the circuit closing
operation the movable contact member is raised in
the oil so as first to close the isolating gap and
then bias the contacts within the explosion cham-
ber into engagement.

My invention will be more fully set forth in the
following description referring to the accompany-
ing drawing, and the features of novelty which
characterize my invention will be pointed out with
particularity in the claims annexed to and form-
ing a part of this specification.

Referring to the drawing the single figure there-
of is an elevational view, partly in section, of one
pole of an oil circuit breaker embodying the pres-
ent invention.

The drawing illustrates one pole of an oil circuit
breaker of the type wherein a pair of fixed contact
structures, one of which is indicated at 1, are
interconnected by a bridging member 2 in the
closed circuit position. The bridging member 2 is
operated vertically by a lift-rod 3 for opening and
closing the breaker. The fixed contact structure
1 comprises essentially a pressure-confining
chamber which is formed, in the present instance,
by a cylindrical insulating member 4 composed of
a mechanically strong insulating material such as
fiber, for example. The chamber so formed is
substantially closed at its opposite ends and is
immersed in a suitable insulating and arc-extin-
guishing liquid such as oil.

For the purpose of forming a plurality of breaks
in series within the chamber, contact structure
mounted for limited movement is disposed therein
comprising contact bridging members 5, 6 and 7.
These contact members are each resiliently
mounted on an insulating operating rod 8 and
engage respectively pairs of fixed contacts suit-

ably mounted in the side walls of the insulating casing 4. More specifically, the contact member 5 coacts with contacts 9 and 10, the contact 6 with contacts 11 and 12 and the contact 7 with contact 13. The lower contact 7 is electrically connected through a flexible conductor 14, to a butt contact member 15 mounted at the lower end of rod 8 which is adapted to be engaged by the contact element 2' of the bridging member 2.

The circuit through the breaker in the closed circuit position beginning with the fixed terminal structure generally indicated at 16 comprises a conductor 17 interconnecting the terminal structure and the contact 9, contacts 5 and 10, conductor 18 interconnecting contacts 10 and 12, contacts 6 and 11, conductor 19 interconnecting contacts 11 and 13, contacts 7 and 15 which are interconnected by the flexible conductor 14, movable contact 2' and the main bridging member 2. The conductors 18 and 19 which extend along the inner walls of casing 4 are suitably insulated from the interior of the chamber by insulating strips 18' and 19' respectively.

The contacts 5, 6 and 7 which are mounted on the insulating operating rod 8 operate as a unit, the unit being normally biased by a spring 20 toward the open-circuit position. The breaker is held in the closed circuit position by the bridging member 2 which engages the lower end of the rod 8 through the butt contact 15, so as to bias the aforesaid contact unit upwardly against the bias of spring 20 into contact-making engagement.

Referring more particularly to the specific structure employed in the present instance, the fixed terminal structure at 16 comprises an adapter 21 which is connected in a well-known manner to the lower end of the lead-in conductor and bushing extending through the circuit breaker tank cover. The insulating cylinder 4 is suitably clamped as at 22 to the adapter so as to extend in vertical depending relation therewith. The casing 4 can also be secured in position if desired by insulating rods extending from the adapter to the lower end of the casing.

Secured to the upper end of the insulating rod 8 is a thimble 23 slidable in a piston-like manner within a vented cup-like member 24 which is biased by the spring 20 so as to be in abutting engagement with the thimble 23. The spring 20 is seated at one end on the adapter 21 and at the other end on a disk or piston member 25 which is secured to the member 24 and is guided in turn within a sleeve 26 which is supported in depending relation as illustrated from the adapter 21.

It will, therefore, be noted that the cup member 24, under the bias of spring 20, can urge the insulating rod 8 downwardly and that the insulating rod, if impelled downwardly by other forces, can operate without restraint by reason of the sliding connection between the members 23 and 24.

The bridging contact members carried by the rod 8 have limited movement as defined by the stop members 27 and 28 which are secured to the operating rod, and are normally biased by springs 29 towards the upper stop. This resilient connection is chiefly for the purpose of providing sufficient contact pressure and "wipe" at the contacts in order to compensate for slight inequalities in spacing of the contacts and in order to prevent excessive shock during the circuit closing operation.

The lower part of the casing 4 is substantially

closed by the butt contact 15 which is mounted on the rod 8 and an end cap 30 which is suitably secured at 31 to the insulating cylinder. The butt contact 15, which is formed as a cup-shaped member is also biased by springs 32 so as to have a limited "wipe" at 33 with respect to the operating rod 8. Accordingly, the springs 32 allow over-travel of the butt contact 15 without necessarily affecting the contacts within the arc chamber.

For the purpose of utilizing the arc pressure generated within the chamber immediately upon initial separation of the contacts there are provided exhaust ports in the chamber walls opposite certain of the breaks, so that the arc pressure created within the chamber at other breaks is effective to drive oil through the exhaust ports for interrupting the arc at those points. In the present arrangement a pair of diverging ports 34 for splitting the arc into two sections are located adjacent and immediately opposite the break between the contacts 5 and 9 so that arc pressure within the casing tends to drive two jets of oil transversely across the arc at said break. Similarly, exhaust ports are disposed at 35 and 36 opposite the breaks at the contacts 6 and 12 and at the contacts 7 and 13 respectively. The ports within the chamber are faced with suitable arc-resisting insulating material indicated at 34', 35' and 36' respectively. Accordingly the arc pressure generated at the breaks 5-10 and 6-11 is effective to drive oil from the arc chamber through the exhaust ports above described for interrupting the arc at a plurality of points. It shall be understood, of course, that the number of breaks, including the pressure generating breaks, can be varied to meet the interrupting requirements of the breaker.

Since the interrupting operation above described takes place immediately after the main bridging member 2 has dropped but a short distance, it will be apparent that the time of separation of the two butt contacts 2' and 15 is immaterial insofar as the speed of circuit interruption is concerned. Further lowering of the bridging member 2 in accordance with the circuit-opening operation results in separation of the aforesaid butt contacts when the stop member 37 secured to the operating rod 8 limits the lower travel of the contact unit at the end cap 30. The bridging member can then be separated the desired isolating distance within the oil from the fixed explosion chamber structure.

During the circuit-opening operation the disk or piston member 25 which is biased downward by the spring 20 serves also to drive oil through the exhaust ports of the explosion chamber. This auxiliary action is particularly helpful in the case of weak or moderate currents which are sometimes ineffective to create the desired blast pressure within the explosion chamber. In the case of large or short circuit currents the arc pressure created within the chamber tends to urge the operating rod 8 and the structure associated therewith downward through the opening in the end cap 30. In such cases the sliding connection between the rod 8 and piston 25 provides for independent downward movement of the rod 8 notwithstanding reverse movement of the piston 25 due to arc pressure. The upper movement of the piston is limited by a stop 25'. Accordingly the arc pressure at high currents may actually speed up the separation of the contacts and interruption of the circuit. This downward movement of the rod 8 can also be independent of the main bridging

ing member 2 by reason of the resilient connection at 32 between the rod and the butt contact 15.

It should be understood that my invention is not limited to specific details of construction and arrangement thereof herein illustrated, and that changes and modifications may occur to one skilled in the art without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electric circuit breaker of the liquid blast type comprising an arc-extinguishing liquid, relatively movable contact structure adapted to separate in said liquid to form a pressure-generating break and an interrupting break, piston structure for also projecting a stream of said liquid into an arc formed at said interrupting break upon separation of said contact structure, energy-storing means for operating said piston, and means associated with the movable contact structure for charging said energy-storing means during the circuit-closing operation prior to actual engagement of the contact structure whereby in case of a short circuit a liquid blast through said interrupting break is immediately available upon re-opening.

2. An electric circuit breaker comprising an arc-extinguishing liquid, relatively movable contact structure adapted to separate in said liquid including arc-interrupting contacts and isolating contacts, piston structure for projecting a stream of said liquid into an arc formed upon separation of said arc-interrupting contact structure, energy-storing means for operating said piston, and means connected to the movable contact structure of said isolating contacts arranged to cause charging of said energy-storing means and resetting of said piston in accordance with the circuit-closing operation prior to actual engagement of the arc-interrupting contact structure.

3. An electric circuit breaker comprising a casing containing an arc-extinguishing liquid, fixed and movable contacts arranged to separate in said casing to interrupt arcing, a piston disposed in said casing and operatively related to the movable contact structure, a spring associated with said piston for causing a blast of said liquid through an arc formed upon separation of said contacts, and isolating contact structure disposed exteriorly of said casing for depressing said piston and charging said spring during the circuit-closing operation prior to actual engagement of said arc-interrupting contacts.

4. An electric circuit breaker of the liquid blast type comprising a pressure-confining chamber containing an arc-extinguishing liquid, relatively movable contacts separable within said chamber to form a pressure-generating arc and an interrupting arc subject to a liquid blast, a piston independent of said contacts communicating with said chamber, a spring for biasing said piston in a direction also to cause a liquid blast through said interrupting arc independently of said pressure-generating arc, said piston being in free following relation to the movable contact structure, and means for actuating said movable contact structure to closed circuit position whereby said piston is returned to its spring-charged position prior to engagement of said contacts.

5. An electric circuit breaker of the liquid blast type comprising an arc-extinguishing liquid, relatively fixed contact structure immersed in said liquid including an insulating casing forming a pressure-confining chamber, a plurality of bridg-

ing contacts mounted for limited movement within said chamber, each bridging contact coacting with fixed contact structure mounted in said casing to form two breaks in series, means for interconnecting said fixed and movable contacts to form a plurality of breaks in series in the circuit within said chamber, said casing having exhaust ports adjacent and opposite certain of said breaks so that arc pressure created within said chamber is effective to drive arc-extinguishing liquid through the arcs at said breaks, an insulating member on which said bridging contacts are mounted for uniform movement therewith, spring means biasing said insulating member in a direction to open the circuit at said breaks, a contact member mounted with respect to said insulating member and electrically connected in series with said contacts, and a main movable breaker member operable in the arc-extinguishing liquid exteriorly of said chamber for engaging said last-named contact and biasing said insulating member against said spring means towards closed circuit position, initial opening movement of said main member causing interruption of the circuit within said chamber prior to separation of said member and its coacting contact.

6. An electric circuit breaker of the liquid blast type comprising an insulating casing forming a pressure-confining chamber containing an arc extinguishing liquid, relatively movable contacts separable within said chamber, said chamber having an exhaust port adjacent and opposite a break formed by separation of said contacts so that arc pressure created within said chamber upon opening of the circuit is effective to drive liquid through the arc at said port, a contact-actuating member connected to said contact structure, arc pressure in said chamber tending to move said actuating member toward open circuit position, a piston for augmenting the arc pressure in said chamber, and spring means for biasing said piston in a direction to create pressure in said chamber, said piston and actuating member being in free abutting relation so that said spring means normally biases said actuating member toward open circuit position and so that arc pressure within said chamber is effective to accelerate opening of said contact structure notwithstanding reverse movement of said piston.

7. An electric circuit breaker of the liquid blast type comprising an arc extinguishing liquid, relatively fixed contact structure immersed in said liquid including an insulating casing forming a pressure confining chamber, a plurality of bridging contacts mounted for limited movement within said chamber, each bridging contact coacting with fixed contact structure mounted in said casing to form two breaks in series, means for electrically interconnecting said fixed and movable contacts to form a multiplicity of breaks in series in the circuit within said chamber, said casing having an exhaust port adjacent and opposite one break at each bridging contact so that arc pressure created within said chamber is effective to drive arc extinguishing liquid through the arcs at said breaks, said exhaust ports alternating at opposite sides of said chamber, an insulating member with respect to which said bridging contacts are mounted for substantially uniform movement therewith, spring means biasing said insulating member in a direction to open the circuit at said breaks, a contact member mounted with respect to said insulating member

and electrically connected in series with said contacts, and a main movable circuit breaker member operable in the arc-extinguishing liquid exteriorly of said chamber for engaging said last-named contact and biasing said insulating member against said spring means towards closed circuit position whereby initial opening movement of said main member causes interruption of the circuit within said chamber prior to separation of said member and its coacting contact.

8. An electric circuit breaker of the liquid blast type comprising an arc extinguishing liquid, relatively fixed contact structure immersed in said liquid including insulating chamber structure forming pressure confining means, a plurality of bridging contacts mounted for limited movement within said pressure confining means, each bridging contact coacting with fixed contact structure mounted in said insulating structure to form two breaks in series, means for electrically interconnecting said fixed and movable contacts to form a multiplicity of breaks in series in the circuit within said pressure confining means, said casing having an exhaust port adjacent and opposite one break at each brid-

ing contact so that arc pressure created at the other break within said pressure confining means is effective to drive arc extinguishing liquid through the arcs at each of said exhaust port breaks, an insulating member with respect to which said bridging contacts are mounted for substantially uniform movement therewith, spring means biasing said insulating member in a direction to open the circuit at said multiplicity of breaks, a contact member mounted with respect to said insulating member and electrically connected in series with the contacts in said pressure confining means, and a main movable circuit breaker member operable in the arc-extinguishing liquid exteriorly of said pressure confining means for engaging said last-named contact and biasing said insulating member against said spring means towards closed circuit position whereby initial opening movement of said main member causes interruption of the circuit within said pressure confining means prior to separation of said member and its coacting contact.

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