

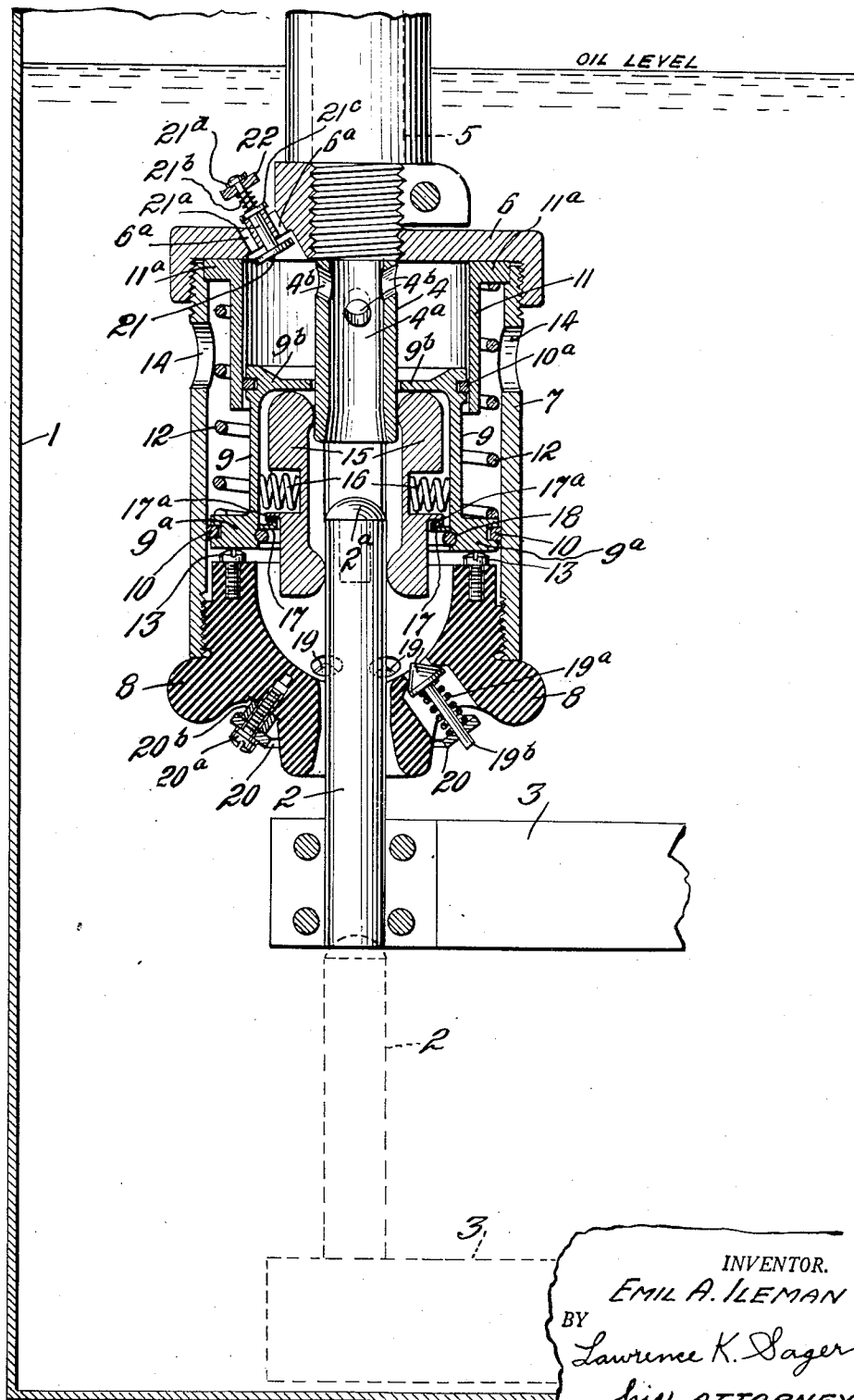
Oct. 9, 1945.

E. A. ILEMAN

2,386,611

CIRCUIT BREAKER

Filed April 27, 1943



UNITED STATES PATENT OFFICE

2,386,611

CIRCUIT BREAKER

Emil A. Ilemann, Bethlehem, Pa., assignor, by
mesne assignments, to Realty and Industrial
Corporation, Convent, N. J., a corporation of
New Jersey

Application April 27, 1943, Serial No. 484,687

19 Claims. (Cl. 200—150)

This invention relates to electric switches or circuit breakers wherein the contacts are opened and closed in an oil container or tank.

The invention is directed particularly to the contacts and to the parts associated therewith and is applicable to various types of oil circuit breakers having associated controls and operating mechanisms.

When the contacts are separated the arcs are extinguished by forcing the oil under pressure across and around the arcs so that they are quickly smothered and quenched in a confined space; and the greater the current to be interrupted the greater is the pressure of the oil and the greater the smothering and quenching action. Also auxiliary contacts are provided in such relationship to the fixed and movable contacts that a rapid separation of the contacts is obtained regardless of the rapidity of movement of the separable contact; and this separation is the more rapid the greater the value of the current to be interrupted.

The main object is to provide a structure which will effectively and quickly extinguish the arc when the circuit is ruptured. Another object is to cause the arcing to occur between surfaces that are not contact engaging surfaces and thereby avoid deterioration of the contacting surfaces. This insures good contact of the parts when the breaker is closed. Another object is to obtain a rapid separation of the contacts resulting from the formation of the arc. A further object is to obtain a quick resetting of the parts so that the breaker may be reclosed soon after the arcing is extinguished after opening the breaker. Further objects are to provide a compact form of structure which may be assembled conveniently and which will be durable and dependable under long continued use. Other objects and advantages will be understood from the following description and accompanying drawing showing one embodiment of the invention.

The drawing is a vertical section showing the fixed and movable contacts and associated parts. Although only one contact assembly is shown, it will be understood that two or more may be grouped together in an oil tank and the movable main contacts operated by a common means.

A portion of the oil tank 1 is indicated with the approximate oil level indicated at the top of the drawing. The main movable contact 2 is in the form of a circular rod and is provided at its upper end with a contact tip 2a of material adapted to withstand arcing. The movable contact is shown in its uppermost closed position

and is adapted to be moved downwardly by a cross bar 3 connected to its lower end to the indicated dotted position. This bar also may carry other similar movable contacts actuated by the rod connected thereto which in turn is controlled by the circuit breaker mechanism in any of the usual ways. The fixed contact 4 extends downwardly from the lower end of an upwardly extending conducting stud 5 which is suitably insulated from and passes outwardly through the top cover of the oil tank. The stud 5 is threaded at its lower end above the contact 4 and supports the metal chamber head 6 of the contact assembly. The fixed contact is of tubular form having a vertical central passage 4a; and at the upper end of the contact and just below the head 6 there is a series of openings 4b connecting the interior of the contact with the space under the head 6. These openings are angularly spaced around the upper portion of the contact 4.

An enclosing cylinder 7 has a screw threaded connection at its upper end with the inner portion of the rim of the head 6 and is supported thereby. The lower end of the cylinder is threaded at its inner portion and supports by a threaded engagement the base cap 8 of suitable insulating material. The movable contact 2 passes freely through a central opening in this base with some clearance between the contact and the base affording a restricted passage for the oil between the two parts.

A differential piston 9 is adapted to move vertically within the cylinder 7 and is provided at its lower end with an outwardly extending portion 9a which carries a piston ring 10. This ring engages the interior wall of the cylinder 7 in the upward and downward movement of the piston. The upper head 9b of the piston is of smaller diameter than the lower portion and carries a piston ring 10a which engages the interior surface of a downwardly extending cylindrical partition 11. The top portion of the piston closely approaches and surrounds the fixed contact 4 with sufficient clearance to permit free movement of the piston. The partition 11 is provided at its upper end with an outwardly extending flange 11a which seats in an interior notch in the upper end of the cylinder 7 and is held in fixed position thereby. A spring 12 is located within the cylinder 7 and envelops the partition 11 and the piston 9 and seats at its lower end against the top of the flange 9a and at its upper end against the underside of the flange 11a. This spring tends to hold the piston in its lowest position against the head of the screws 13 which

serve as stops and have a threaded engagement with the upper portion of the base 8. The upper portion of the cylinder 7 is provided with a series of angularly spaced openings 14 which serve as passages for the oil to and from the space in which the spring 12 is located.

A series of bridging contacts 15 is located within the piston 9 and forms a series of circumferentially arranged contact fingers which engage the fixed contact 4 at their upper ends and the movable contact 2 at their lower ends. The lower ends of the bridging contacts are rounded to facilitate the entrance of the movable contact within them when the breaker is moved to the closed position. The bridging contacts 15 are pressed inwardly against the fixed contact and against the movable contact by a series of springs 16 located in central openings in the back of the bridging contacts, the outer ends of the springs seating against the interior wall of the piston 9. The bridging contacts are held in position within the piston by a ring 17 which fits within the piston and is retained in place by a snap spring ring 18 which engages a groove in the piston. The ring 17 is provided with an upwardly extending lip 17a which engages notches formed in the bridging contacts 15 and thereby serves to limit the inward movement of the lower ends thereof when the movable contact 2 is moved downwardly out of engagement therewith.

A series of relief valves 19 is provided in the base cap 8 angularly spaced from each other for permitting the oil to pass outwardly through the base when the pressure within the arcing chamber exceeds a predetermined amount. The relief valves are inwardly pressed to normally close the openings in the base by springs 19a which envelop the stems 19b of the valves. The outer ends of the springs 19a are seated against a retaining ring 20 which is held in fixed position on the base by screws which have a threaded engagement with the base, one of these screws 20a being shown. A spacing sleeve 20b envelops each screw 20a and serves to properly position the ring 20. The stems 19b of the valves pass freely through and are guided by the ring 20. In the head 6 of the assembly is positioned one or more vent valves 21 which are normally open. This valve is in the form of a disk carried on the inner end of a stem 21a which is axially movable through an opening in the head; and when the valve is in its upper or outward position, the disk will close a series of openings 6a formed in the head. The valve stem is guided at its outer portion by a ring or strip 22 which is suitably supported in fixed position on the head 6. A spring 21b envelops the stem of the valve and is seated at its outer end against the strip 22 and at its inner end against a disk 21c fixed to the stem of the valve. The inward position of the valve is limited by a disk 21d fixed to the outer end of the valve stem, this disk engaging the strip 22 when the valve is open. The valve is adapted to move outwardly against the pressure of the spring 21b and close the openings 6a upon comparatively slight increase in pressure of the oil within the chamber enveloped by the partition 11; and upon the removal of such pressure, the valve is opened by the spring to permit the free passage of oil from the outside of the head to the upper chamber of the assembly.

The drawing shows the contacts and other parts in their position when the breaker is

closed. When the movable contact 2 is moved downwardly to open the breaker, there immediately starts a flow of oil from the upper oil chamber through the openings 4b and down through the opening 4a of the fixed contact to the increasing space between the downwardly moving contact and the fixed contact; and some oil may pass to this increasing space from between the contact segments 15 depending on how closely they are spaced from each other. The valve 21 permits passage of the oil from the tank to the upper chamber during the initial downward movement of the contact 2. When the movable contact 2 breaks connection with the lower ends of the bridging contacts 15, an arc is formed between the tip 2a and the lower rounded edges and lower ends of the bridging contacts 15. The formation of the arc and the vapors created thereby cause a pronounced increase in pressure in the arcing chamber above the base cap 8 and this increase in pressure on the lower surfaces of the piston 9 causes the piston to move upward rapidly against the pressure of the spring 12. This results in increasing the pressure of the oil in the upper oil chamber and the closing of the valve 21, forcing the oil through the openings 4b and the central opening 4a of the fixed contact into the lower arcing chamber. The piston will continue to move upwardly owing to the larger diameter of the under surfaces of the piston compared with that of the top surface of the piston. It results that the oil is forced under considerable pressure across the path of the arc between the tip of the movable contact and the lower ends of the bridging contacts which quenches and extinguishes the arcing within the lower arcing chamber.

The action is aided by the rapid separation of the contacts due to the fact that the upward movement of the piston carries the bridging contacts 15 along with it and thereby gives a quick break between the lower ends of the bridging contacts 15 and the tip of the movable contact 2. During this action some of the oil in the lower chamber will be forced out through the clearance space between the contact 2 and the base but when the pressure exceeds a predetermined amount, the pressure relief valves 19 will open and permit the oil to pass from the arcing chamber through the valve openings to the enclosing tank. This facilitates the flow of oil around and across the arc. During the upward movement of the piston in forcing the oil from the oil chamber into the arcing chamber, the oil chamber is, of course, reduced in size as the space of the arcing chamber is increased, thereby supplying a large quantity of oil for quenching the arc.

After the extinguishment of the arcing, the pressure in the arcing chamber is removed, permitting the valves 19 to close. Likewise the pressure in the upper chamber is removed which permits the valve 21 to open. The spring 12 then serves to restore the piston from its upper position to the position shown in the drawing, giving a quick return of the piston to a position where the bridging contacts may be fully reengaged by the movable contact 2 when it is raised from its lowest position. When the breaker is again closed, the contact 2 will engage the inwardly pressed contact fingers at their lower inner faces, the parts again assuming the position shown in the drawing. It will be apparent that contact engaging surfaces are not objectionably subjected to the effects of arcing which results in the preservation of such surfaces for securing good con-

tact engagement between the parts, the arcing occurring at the lower rounded edges or lower ends of the contact segments. Also the slidable engagement of the bridging contacts with the fixed and movable contacts tends to keep the surfaces clean. Likewise the arcing is effectively and rapidly extinguished in the arcing chamber of the enclosing casing, accompanied by a quick break of the contacts during the opening movement and the parts are quickly restored to the normal position in readiness for reclosure of the breaker.

Although a particular embodiment of the invention has been disclosed, it will be understood that various changes and modifications may be made without departing from the scope of the invention.

I claim:

1. An oil circuit breaker comprising a fixed contact having a passage therethrough, a movable contact for completing an electrical connection with the fixed contact when the breaker is closed, an enclosing casing, a differential piston within the casing for forming an oil chamber at one end of the casing and an arcing chamber at the other end of the casing, said piston comprising a top portion and a bottom portion larger than that of the top portion, whereby said piston is movable upon the formation of the arc in the arcing chamber in a direction to force the oil from the oil chamber first through the fixed contact and then into the arcing chamber and across the arc, and a spring for returning the piston to its initial position.

2. An oil circuit breaker comprising a fixed contact, a movable contact, a bridging contact for interconnecting the fixed and movable contacts, an enclosing casing, a piston within said casing for forming an oil chamber and an arcing chamber in the casing, said bridging contact being carried by and movable with said piston, and said piston being movable upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc and to move said bridging contact in a direction away from the movable contact.

3. An oil circuit breaker comprising a fixed contact, a movable contact, a bridging contact for interconnecting said fixed and movable contacts, an enclosing casing, a piston within said casing for forming an oil chamber and an arcing chamber in the casing, said bridging contact being carried by and movable with said piston, and said piston being movable upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc and to move said bridging contact in a direction away from the movable contact, said fixed contact having an opening for the passage of the oil between said chambers.

4. An oil circuit breaker comprising a fixed contact, a movable contact, a bridging contact for interconnecting said fixed and movable contacts, an enclosing casing, a piston within said casing for forming an oil chamber and an arcing chamber in the casing, said bridging contact being carried by and mounted within and movable with said piston and slidably engaging said movable contact, and said piston being movable upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc and to move said bridging contact in a direction away from the movable contact.

5. A circuit breaker contact assembly adapted

to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof, a contact movable through the opposite end of the casing, and a differential piston forming an oil chamber and an arcing chamber in the casing and movable within the casing upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc upon the separation of the contacts, said piston comprising a top portion and a bottom portion larger than that of the top portion, said piston being movable in a direction away from said movable contact upon the separation of the contacts.

6. A circuit breaker contact assembly adapted to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof, a contact movable through the opposite end of the casing, a differential piston forming an oil chamber and an arcing chamber in the casing and movable within the casing upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc upon the separation of the contacts, said piston comprising a top portion and a bottom portion larger than that of the top portion, said piston being movable in a direction away from said movable contact upon the separation of the contacts, and a relief valve openable under pressure for passing oil from said arcing chamber to the outside of said casing.

7. A circuit breaker contact assembly adapted to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof, a contact movable through the opposite end of the casing, a differential piston forming an oil chamber and an arcing chamber in the casing and movable within the casing upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc upon the separation of the contacts, said piston comprising a top portion and a bottom portion larger than that of the top portion, said piston being movable in a direction away from said movable contact upon the separation of the contacts, and means for restoring said piston to its initial position after the arc is extinguished.

8. A circuit breaker contact assembly adapted to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof, a contact movable through the opposite end of the casing, a differential piston forming an oil chamber and an arcing chamber in the casing and movable within the casing upon the formation of the arc in the arcing chamber to force oil from the oil chamber into the arcing chamber and across the arc upon the separation of the contacts, said piston comprising a top portion and a bottom portion larger than that of the top portion, said piston being movable in a direction away from said movable contact upon the separation of the contacts, means for restoring said piston to its initial position after the arc is extinguished, and a valve biased to open position for passage of oil into said oil chamber during the movement of the piston to its initial position and closable upon increase of pressure in said oil chamber.

9. A circuit breaker contact assembly adapted to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof and having an opening for the passage of oil through said casing, a contact movable through the opposite end of the casing, a differential piston in

the casing, a plurality of bridging contacts within and carried by the piston connected with said fixed contact and having a slidable engagement with said movable contact when the breaker is closed, said piston dividing said casing into an oil chamber and an arcing chamber, and means for biasing said piston in a direction towards the arcing chamber, said piston being movable on the formation of the arc in the arcing chamber in a direction to force oil from the oil chamber first through the fixed contact and then into the arcing chamber and across the arc.

10. A circuit breaker contact assembly adapted to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof and having an opening for the passage of oil through said contact, a contact movable through the opposite end of the casing, a differential piston in the casing, a plurality of bridging contacts within and carried by the piston connected with said fixed contact and having a slidable engagement with said movable contact when the breaker is closed, said piston dividing said casing into an oil chamber and an arcing chamber, means for biasing said piston in a direction towards the arcing chamber, said piston being movable on the formation of the arc in the arcing chamber in a direction to force oil from the oil chamber first through the fixed contact and then into the arcing chamber and across the arc, and a pressure relief valve for passage of oil from said arcing chamber to the outside of said casing.

11. A circuit breaker contact assembly adapted to be immersed in oil comprising an enclosing casing, a fixed contact at one end thereof and having an opening for the passage of oil through said contact, a contact movable through the opposite end of the casing, a differential piston in the casing, a plurality of bridging contacts within and carried by the piston connected with the said fixed contact and having a slidable engagement with said movable contact when the breaker is closed, said piston dividing said casing into an oil chamber and an arcing chamber, means for biasing said piston in a direction towards the arcing chamber, said piston being movable on the formation of the arc in the arcing chamber in a direction to force oil from the oil chamber first through the fixed contact and then into the arcing chamber and across the arc, and a normally open valve for passage of oil from the outside of the casing into the oil chamber and closable upon increase of pressure in the oil chamber.

12. A circuit breaker contact assembly adapted for immersion in oil comprising, a casing for said assembly, said casing having an arcing chamber and an oil chamber, a fixed contact disposed in said chambers, said contact being adapted for flow of oil therethrough, a movable contact arranged for projection into said arcing chamber, a bridging contact for slidably engaging said fixed and movable contacts disposed in said arcing chamber, means for withdrawing the movable contact from engagement with said bridging contacts, and means for accelerating separation of said bridging and movable contacts and for quenching an arc resulting from said separation, whereby said arc is quickly extinguished.

13. A circuit breaker contact assembly adapted to be immersed in oil comprising, a casing for said assembly, said casing having an arcing chamber and an oil chamber, a fixed contact projecting through said oil chamber and into said arcing chamber, a movable contact arranged for projection into said arcing chamber, a movable brid-

ing contact for slidably engaging said fixed and movable contacts disposed in said arcing chamber, and means for accelerating the separation between said movable and bridging contacts upon withdrawal of said movable contact from engagement with said bridging contact, said means being responsive to pressure resulting from an arc between said movable and bridging contacts and being adapted for quenching said arc.

14. A circuit breaker contact assembly adapted for immersion in oil comprising, a casing for said assembly, said casing having an arcing chamber and an oil chamber, a fixed contact disposed in said chambers, said contact being adapted for flow of oil therethrough, a movable contact arranged for projection into said arcing chamber, a bridging contact for embracingly engaging said fixed and movable contacts disposed in said arcing chamber, and means for moving said bridging contact away from said movable contact and for forcing oil from the oil chamber through said fixed contact into the arcing chamber upon separation of said bridging and movable contacts, whereby an arc in said arcing chamber produced upon said separation is rapidly quenched.

15. A circuit breaker contact assembly adapted to be immersed in oil comprising, a casing for said assembly, said casing having an arcing chamber and an oil chamber, a fixed contact disposed in said chambers, a movable contact arranged for projection into said arcing chamber, a movable bridging contact for slidably engaging said fixed and movable contacts disposed in said arcing chamber, means for separating said movable contact from said bridging contact, and means for accelerating said separation and for directing oil from the oil chamber towards the movable contact, whereby an arc in said arcing chamber produced upon said separation is rapidly quenched.

16. A circuit breaker contact assembly adapted to be immersed in oil comprising, a casing for said assembly, said casing having an arcing chamber and an oil chamber, a fixed contact disposed in said chambers, said contact being adapted for flow of oil therethrough, a movable contact arranged for projection into said arcing chamber, a movable bridging contact for interconnecting said fixed and movable contacts disposed in said arcing chamber, a differential piston within said casing including a head thereof disposed in said oil chamber, said bridging contact being resiliently supported upon and movable with said piston, and means including said piston for forcing oil from the oil chamber into the arcing chamber upon separation of said bridging and movable contacts, whereby an arc in said arcing chamber produced upon said separation is quenched.

17. A circuit breaker contact assembly adapted to be immersed in oil comprising, a casing for enclosing said assembly, said casing having an oil chamber and an arcing chamber, a cylinder within said casing, a fixed contact in said casing, a movable contact in said casing, a bridging contact for slidably engaging said fixed and movable contacts, said bridging contact being movable axially, a piston intermediate said oil and arcing chambers for supporting said bridging contact, said piston comprising a top portion and a bottom portion of larger diameter than said top portion, said top portion being slidably engageable with said cylinder and said bottom portion being slidably engageable with said casing, and means including said piston upon interrup-

tion of said movable and bridging contacts for directing oil from said oil chamber towards said movable contact, whereby an arc produced upon said interruption is rapidly quenched.

18. A circuit breaker contact assembly adapted to be immersed in oil comprising, a casing for enclosing said assembly, said casing having an oil chamber and an arcing chamber, a cylinder within said casing, a fixed contact in said casing, a movable contact in said casing, a bridging contact for slidably engaging said fixed and movable contacts, said bridging contact being movable axially, a piston intermediate said oil and arcing chambers for resiliently supporting said bridging contact, said piston comprising a top portion and a bottom portion of larger diameter than said top portion, said top portion being slidably engageable with said casing, and means including said piston responsive to interruption between said movable and bridging contacts for contracting said oil chamber and for directing oil from said oil chamber towards said movable contact and across an arc developed upon said interruption, whereby said arc is rapidly quenched.

19. A circuit breaker contact assembly adapted to be immersed in oil comprising, a casing for

enclosing said assembly, said casing having an oil chamber and an arcing chamber, a cylinder within said casing, a fixed contact in said chambers, said contact having an axial bore and a plurality of radial openings, a movable contact adapted for projection into said arcing chamber, a bridging contact for slidably engaging said fixed and movable contacts, said bridging contact being movable axially away from said movable contact, a piston intermediate said oil and arcing chambers for resiliently supporting said bridging contact and for varying the areas of said chambers, said piston comprising a top portion and a bottom portion of larger diameter than said top portion, said top portion being slidably engageable with said cylinder and said bottom portion being slidably engageable with said casing, said piston being responsive to interruption between said movable and bridging contacts for contracting said oil chamber and for directing oil from said oil chamber through said fixed contact across an arc produced upon said interruption, whereby said arc is rapidly quenched, and means for restoring said chambers to their original sizes.

EMIL A. ULEMAN.