

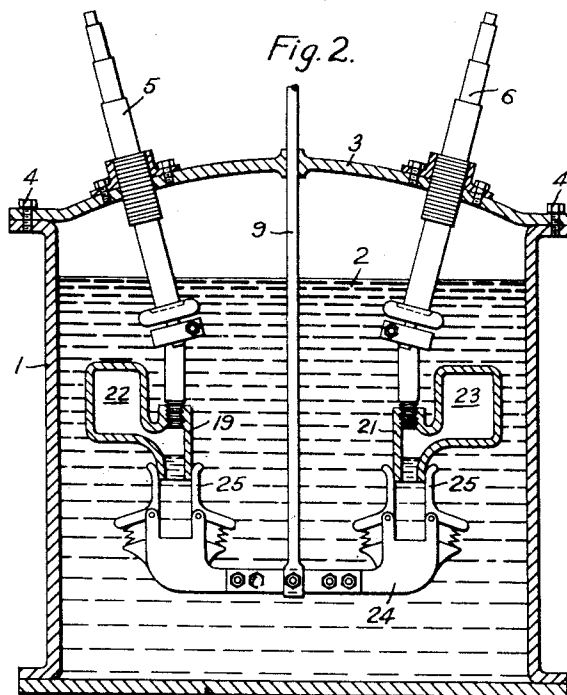
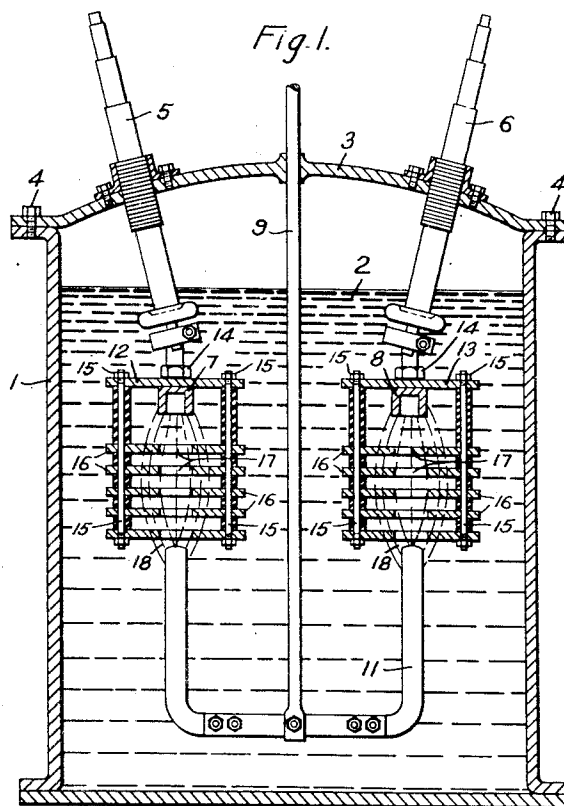
Feb. 28, 1933.

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1,899,643

OIL CIRCUIT BREAKER

Filed Dec. 3, 1929



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OIL CIRCUIT BREAKER

Application filed December 3, 1929. Serial No. 411,271.

My invention relates to circuit interrupters and particularly to circuit interrupters of the oil-immersed type.

One object of my invention is to provide an arc path, established in the above-mentioned type of structure, with means for retaining a portion of the quenching fluid in intimate engagement therewith throughout the length of the arc path.

Alternating current arcs established under oil, or in the presence of other suitable fluids, are extinguished within a shorter length of time than are arcs having like current and potential that are established in the absence of these fluids. I have discovered that the tendency for the arc to extinguish more readily in the gas bubble formed under the fluid, is due to the continuing decomposition of the fluid at the boundary of the bubble, and the continuing evolution of gas at a high rate. This gas passes turbulently into the arc space, and forms relatively cool centers into which ions from the current carrying portions of the arc space diffuse and recombine. This passing of the ions outwardly from the hot, highly ionized, current carrying portions of the arc space, into the intermingled, relatively, cold, and un-ionized gases, blown in turbulently from the decomposing fluid, continues during the extinction period following a current zero in its cycle of alternation, and causes the arc space to recover dielectric strength, more rapidly than would occur, if this blast of un-ionized gas from the bubble walls did not exist.

It is to be expected then, that in order to increase the tendency of the gases to extinguish the arc, the rate of generation of gas by decomposition of the fluid should be increased, and this gas should be passed turbulently through the arc stream.

It is another object of my invention to provide a chamber associated with an arc terminal of a circuit interrupter of the above-mentioned type, that shall receive the gas in

the bubble, formed about the arc, to reduce its size to a bubble of small diameter having its surface of oil close to the arc core.

It is a further object of my invention to provide means about the arc path of the above-mentioned structure that shall retain a portion of the quenching liquid available about the arc core as the gas bubble about the core is expanded beyond the means.

For a more complete understanding of the nature and objects of my invention, reference should be had to the following description, taken in conjunction with the accompanying drawing wherein:

Figure 1 is a detailed view, partly in section and partly in elevation, of a circuit interrupter embodying my invention;

Fig. 2 is a detailed view, partly in section and partly in elevation, of a circuit interrupter showing a somewhat different embodiment of the arc extinguishing device of Fig. 1.

My invention comprises, in general, a casing 1, containing an arc quenching liquid 2 and supporting a cover 3, that is clamped thereon by bolts 4. The cover 3 supports conducting bushings 5 and 6 in a well known manner, the portion of the bushings submerged in the liquid 2, being employed to support the stationary contact members 7 and 8, respectively. A lift rod 9, extends through the cover 3, and is attached exteriorly of the casing 1, to an operating mechanism (not shown) and supports on its opposite ends, within the casing 1, a conducting member 11 that bridges the stationary contact members 7 and 8 when the lift rod 9 is moved to its uppermost position.

Referring to Fig. 1, the contact members 7 and 8 have a supporting plate 12 and 13, respectively, attached to the members by bolts 14. The members 12 and 13 support, by means of bolts 15, a plurality of washers or plates 16 that are positioned transverse to the arc path between the bridging member

11 and the stationary contact members 7 and 8.

The washers 16 are provided with a central opening 17 and are constructed from a porous or fibrous material such as Fuller board. The material absorbs the quenching fluid and retains it in its pores where it is available in the vicinity of the arc after the gas bubble 18, that forms thereabout, has expanded beyond the opening 17 in the washer.

In the present arrangement of the fluid containing plates, when gas is generated by the arc the fluid is pushed away from the arc path by the large gas bubble 18 that forms thereabout. The plates 16 are supported with their central opening 17 aligned with the arc path, and as the bubble is expanded beyond the openings 17, the arc engages the exposed surfaces of the plates 16.

In Fig. 2 a somewhat different arrangement is illustrated for retaining the fluid in close proximity to the arc path. The terminals 19 and 21 of the circuit interrupter are hollow and are directly connected to the gas filled chambers 22 and 23, respectively. The lift rod 9, supports the bridging member 24 that is provided with spring pressed contact members 25 for engaging the terminals 19 and 21, respectively, to complete an electric circuit through the terminals 5 and 6.

The object, of so constructing and locating the chambers 22 and 23, is to provide receptacles for receiving the gases generated by the decomposition of the fluid in order to prevent the formation of large gas bubbles about the arc paths. This arrangement leaves the fluid surface of the bubble in intimate relation with the arc core, and fresh gas will be continuously liberated through the decomposition of the fluid.

The gas in the container 22 and 23, while maintained at the same pressure as the surrounding liquid 2, offers less resistance to the pressure of the gas in the bubble because of its relative lack of inertia. The development of the bubble takes place at a very rapid rate and because of the inertia of the liquid surrounding the chamber the pressure of the gas therein will react on the gas in the chamber and will move thereinto rather than displace the liquid 2, which could not be accomplished instantaneously because of its inertia.

The operation of my extinguishing device will now be explained. When the bridging member 11 of Fig. 1 is moved to its lowermost or open position, arcs will be established in the liquid 2 between its ends and the stationary contact members 7 and 8, respectively. The liquid 2 about the arc path will be continually decomposed by the heat of the arc and the gases so generated will move turbulently into the arc path, and mixing with highly ionized portions which are carry-

ing current, will withdraw ions, as a result of the diffusion, from the highly ionized parts into the un-ionized colder parts of the gas which have just been introduced into the space.

In structures heretofore employed in the art, because of the rapid accumulation of gas adjacent the arc, the surface of the gas bubble was quickly moved outwardly from the arc to a position, in which the liquid decomposes at a much reduced rate, and this gas, being spread over a larger section, was less effective in deionizing the current carrying portions of the arc.

In my present arrangement, as illustrated in Fig. 1, portions of the washers or plates 16, having holes 17 aligned with the arc path, are maintained adjacent to the arc and supply liquid in its immediate vicinity, even though the bubble has been expanded beyond the plates. The liquid retained by the plates 16 will be decomposed by the arc and fresh gases will be continually given off and pass turbulently through the highly ionized current carrying portions of the bubble.

By retaining the liquid in intimate engagement with the arc at all times, the gas evolution is accelerated, and the intermingling with the previously ionized gas is rendered more thorough and intimate. Hence, at the moment of current zero, there will be a very rapid deionization of the highly ionized portions of the arc path, because of the passage of the ions into the cold un-ionized intermingled gases. As a result of this rapid deionization of the current carrying path the arc does not reignite.

Referring to Fig. 2, as the bridging member 23 is moved to open position, an arc will be drawn between the contacts 25 and contacts 19 and 21, and the gas will be given off in the same manner as explained hereinbefore. In order to prevent the gas bubble from growing to an undesirable dimension that would materially lessen the rate of decomposition of the oil, I have provided chambers 22 and 23 for drawing off the gas as the pressure and size of the bubble increases and thereby retain the surface of the resulting small bubble in close proximity to the arc core. Thus, although the bubble around the arc remains small, there is an increased passage of gas through the arc.

It is to be understood that when the words "oil", "liquid", and "fluid" are employed in the specification that the broad interpretation thereof is intended and that oil, carbon tetrachloride and other well known arc quenching liquids, as well as gases, such as hydrogen, are intended to fall within the purview of the present invention.

It will thus be seen that I have provided a device for retaining a liquid in close proximity to an arc path in order that it may be available for decomposition by the arc, to

supply a gas to the arc path, for deionizing the current carrying portions of the arc space. This arrangement is novel in that fresh deionizing gases that pass through the arc core are given off at an increased rate.

My invention is further novel, in that, the receptacle provided for drawing off a portion of the generated gas, retains the gas until current zero, to reduce the size of the bubble about the arc, so that fresh gas may be liberated and rapidly passed into the arc path.

While I have described particular means comprising plates of insulating material to retain fluid in immediate proximity to the arc path, it will be recognized that this is only by way of illustration of general principles and that my invention is not limited to that particular device, but comprehends any means of retaining in spatial distribution along the sides of an arc path, a substance adapted to emit a vapor when in contact with an arc. In the case of fluid arc extinguishing agents, enclosures of high resistance material adapted to retain the fluid in channels or pockets or through capillary forces are effective. It will also be observed that the retained material may be a different substance from the insulating fluid surrounding the contacts; the latter may even be ordinary air in such case; and that solid substances, capable of furnishing vapor to the arc when brought in contact therewith may compose or be disposed upon the supporting walls. All similar embodiments of its fundamental principles are intended to be within the scope of the following claims.

I claim as my invention:

1. In an arc-extinguishing structure, a body of fluid, a plurality of plates having openings therein, means for causing an arc through said openings, said plates being of Fuller board for retaining said liquid by capillary attraction in contact with the arc and being spaced substantially uniformly along the whole length of the arc.

2. In a circuit interrupter, a body of liquid, means for causing an arc in said liquid, means of Fuller board positioned along the length of the arc path for retaining said liquid and feeding it into the arc path as said liquid is acted upon by the arc to supply gas to extinguish the arc, and venting means permitting lateral flow of said gas from said means of porous insulating material along the length thereof.

3. In a circuit interrupter, a container having a body of liquid therein, separable means for drawing an arc in said liquid, an arc extinguishing structure including a stack of plates of porous insulating material positioned substantially uniformly along the length of the arc path, said plates retaining said liquid and feeding it into the arc path as it is decomposed to continuously supply

gas to flow through the arc to extinguish it, and venting passages extending laterally from the arc path at points along substantially the whole length thereof, said venting passages being open at their outer ends permitting said gas to flow laterally away from said stack of plates, and said container having a cross-sectional area several times greater than the cross-sectional area of said stack of plates, whereby said container does not materially impede the lateral flow of gas from said stack.

4. In a circuit interrupter, a container having a body of liquid therein, separable means for drawing an arc in said liquid, an arc extinguishing structure including a stack of plates of porous insulating material positioned substantially uniformly along the length of the arc path, at spaced intervals, said plates retaining said liquid and feeding it into the arc path as the liquid at the surfaces of said plates adjacent the arc path is decomposed to continuously supply gas to flow through the arc to extinguish it, said spaces between said plates forming venting passages extending laterally from the arc path at points along substantially the whole length thereof, and said spaces being open at the outer edges of said plates permitting said gas to flow laterally away from said stack of plates and preventing high gas pressures being built up in said arc extinguishing structure, and said container having a cross-sectional area several times greater than the cross-sectional area of said stack of plates, whereby said container does not materially impede the lateral flow of gas from said stack.

5. In a circuit interrupter, a container having a body of liquid therein, separable means for drawing an arc in said liquid, an arc extinguishing structure including a stack of plates of porous insulating material positioned substantially uniformly along the length of the arc path, said plates retaining said liquid and feeding it into the arc path as the liquid at the surfaces of said plates adjacent the arc path is decomposed to continuously supply gas to flow through the arc to extinguish it, said arc extinguishing structure having venting passages extending laterally from the arc path at points along substantially the whole length thereof, and said ventilating passages being open at all times at the outer edges of said plates and there being a large space between the edges of said plates and said container permitting said gas to flow laterally away from said stack of plates and preventing high gas pressures being built up in said arc extinguishing structure.

6. In a circuit interrupter, an arc extinguishing structure including a plurality of plates of porous absorbent insulating material, aligned openings through said plates, means for drawing the arc with the portion

thereof which is initially drawn in said openings, a container having a body of liquid therein surrounding said arc extinguishing structure, venting means extending laterally from the openings through the plates in which the arc plays to an outer edge of the plates, and said container having a cross-sectional area several times greater than the area of said plates.

7. In a circuit interrupter, an arc extinguishing structure including a plurality of plates of porous absorbent insulating material, aligned openings through said plates, means for drawing the arc including a contact member movable through said openings, said contact member having substantially the same width as said openings, a container having a body of liquid therein surrounding said arc extinguishing structure, venting means extending laterally from the openings through the plates in which the arc plays to an outer edge of the plates, and said container having a cross-sectional area several times greater than the area of said plates.

8. In a circuit interrupter, a pair of contacts one of which is movable and between which the circuit through said interrupter is initially broken, an arc extinguishing structure including means of insulating material having an opening therethrough in which the arc caused by the initial break of the circuit plays, said means of insulating material having portions at the edge of said opening extending substantially to the path of movement of said movable contact member, an outer casing for the circuit interrupter enclosing said arc extinguishing structure, said outer casing having a cross-section several times greater than the cross-section of said arc extinguishing structure, said means of insulating material including portions of absorbent material along said opening for the arc, said absorbent material having retained therein a liquid which gives off a large volume of gas when acted upon by the arc, and ventilating means extending from said opening for the arc caused by the initial break of the circuit to the space enclosed by said outer casing.

9. In a circuit interrupter, a pair of contacts one of which is movable and between which the circuit through said interrupter is initially broken, an arc extinguishing structure including a stack of plates of insulating material, said stack having an opening therethrough in which the arc caused by the initial break of the circuit plays, said opening having portions of a width not substantially greater than the width of said movable contact member, an outer casing for the circuit interrupter enclosing said arc extinguishing structure, said outer casing having a cross-section several times greater than the cross-section of said arc extinguishing structure, some of said plates having portions of

absorbent material along said opening for the arc, said absorbent material having retained therein a liquid which gives off a large volume of gas when acted upon by the arc, and ventilating means extending from the portion of said opening at which the arc is initially formed to the space enclosed by said outer casing.

In testimony whereof, I have hereunto subscribed my name this 26th day of November 1929.

JOSEPH SLEPIAN.