LIQUID RESISTANCE, ESPECIALLY FOR ELECTRICAL CIRCUIT BREAKERS

Fig: 1

Fig: 2

Fig: 3
This invention relates to liquid resistances and concerns more particularly the variable resistances intended for connection in parallel to the interrupting gap of electrical circuit breakers.

It is already known to increase the interrupting power of a circuit breaker by mounting a resistance in parallel with the interrupting gap. In this case it is advantageous to employ a resistance which is capable of limiting very quickly or even interrupting at the end of a very short time, the current which traverses it. For this purpose it has already been proposed to employ an absorbing resistance for electrical interrupters comprising at least one group of two electrodes connected by a liquid conductor of small depth, the contact surface with the liquid of the one or more electrodes of at least one of the two poles of the resistance being small relative to the average section traversed by the current in the liquid conductor, so that the ohmic value of the resistance increases strongly when the density of the current at this surface exceeds a predetermined value, causing the formation of a gaseous sheath between these electrodes and the liquid.

It is an object of the invention to improve this known device which has not provided the expected advantages.

According to the invention the liquid conductor of a group of conductors is disposed between two receptacles of insulating material in the form of a plate or dish, nested one into the other in such a manner as to leave between them only a thin layer of liquid.

In some cases, particularly in order to allow the insulating breaker time to operate, it may be useful to retard the disappearance of the gaseous bubble and/or to increase its volume.

According to another feature of the invention this may be obtained by adding to the conducting liquid bodies which, under the influence of the heat discharge by the current in the vicinity of the electrode, are decomposed into inert gases and which recombine with difficulty. In the same spirit one may also dispose, according to another feature of the invention, in the vicinity of the electrode solid bodies whose gaseous decomposition products provide the same effect under the action of heat.

In order to avoid having an arc created between adjacent electrodes of opposed polarity, one may interpose, according to another feature of the invention, between these electrodes, suitable partitions, for example baffles which avoid the direct contact of the gaseous bubbles which surround the electrodes.

Other arrangements pertaining to the invention and concerning in particular the form and the arrangement of the electrodes of the receptacles containing the conducting liquid, seals intended to retain the liquid and to evacuate the gas, and the like, will appear more clearly during the following description of several embodiments of the inventive concept without thereby limiting the generality of the invention to the specific details or elements of the embodiments selected for the purpose of illustration.

In the attached drawing:

FIG. 1 illustrates diagrammatically the application of the resistance according to the invention to a circuit breaker;

FIG. 2 shows an axial section through a resistance according to FIG. 1;

FIG. 3 shows a plan view of a sub-assembly according to an embodiment of the invention;

FIG. 4 shows a section of a sub-assembly according to another embodiment of the invention; and

FIG. 5 shows a section of a sub-assembly according to another embodiment of the invention.

FIGURE I illustrates diagrammatically a circuit breaker according to the invention, the main interrupter being illustrated at 11. This interrupter is shunted by the liquid resistance 12 comprising two electrodes immersed in a conducting liquid, the contact surface between these electrodes and the liquid being small relative to the average section traversed by the current in the liquid. The resistance 12 is connected in series with the insulting interrupter 13 which is in the closed position when the main interrupter is closed.

The operation is as follows:

When the main interrupter 11 opens and while an arc extends between the contacts, the voltage applied to the resistance 12 is too weak to cause the development of the gaseous sheath which insulates the electrodes. However, at the moment of the extinction of the arc, the arc voltage surges and causes an induct of current in the shunt circuit which causes an acceleration of the arc extinction and maintains the voltage at the terminals of interrupter 11 at a small value for a brief moment. This permits the de-ionization devices of interrupter 11 to build a di-electric barrier which is sufficient to prevent definitely any re-lighting of the arc. During this time the voltage continues its decrease to the terminals of resistance 12 and creates a current which increases until the moment where the gaseous insulating sheath appears around the electrodes of resistance 12, which causes the limitation or extinction of the current. The insulating interrupter 13 opens thereafter and permits thus a return to the initial stage of resistance 12. All this takes place as if at the breaking moment the main interrupter 11 were shunted by a resistance of small ohmic value becoming infinite or at least very large before the opening of the insulating interrupter.

It is evident that this type of operation is considerably affected by the value of the current traversing the circuit. In particular when the main interrupter must break a weak current this does not allow the formation of the gaseous sheath in the resistance 12 and the interrupter 13 must eliminate definitely this weak current. It is also necessary to employ an insulating interrupter whose breaking power may be limited to currents whose value is insufficient to cause the appearance of an effective gaseous sheath on the electrodes of the resistance.

FIGURES 2 and 3 represent in section and in plan view an embodiment of a resistance according to the invention. The resistance consists of a stack of receptacles 14 of insulating material of conical form nested one into the other in the manner of a stack of plates and containing each a certain quantity of conducting liquid L. The base of each receptacle is traversed in a tight manner by an electrode 15 disposed preferably eccentrically and in such a manner that one of the extremities is immersed in the liquid of its own receptacle while the other extremity is immersed in the liquid of the following receptacle. The eccentric arrangement permits a placement of one electrode alternately to the right and to the left of the median plane of the figure of the electrode permitting a minimum spacing of the electrodes with a minimum hindrance in height. In the case where the spacing of the electrodes will still be insufficient to avoid the formation of an arc jumping from one electrode to the other, it is advantageous to provide partitions 16, 17 of insulating material disposed preferably as baffles, and having the effect of ex-
tending the lines of flow of the current in the body of the liquid on the one hand, and to avoid the direct contact of the gaseous bubbles surrounding the electrodes on the other hand. In order to avoid that such partitions cause an extension of the current lines which would lead to an undesirable increase of the resistance, it would be advantageous to produce them by interposing between the electrodes a porous wall, such as the partition 25 depicted in FIG. 5, which is easily permeable to the liquid but which forms a screen for the gases.

For di-electric reasons it is advantageous to give to the extremities of the electrodes a convex form or a semi-spherical form which approaches very closely the natural form of bodies which are susceptible of liberating under the action of heat gases which recombine either with difficulty or only slowly. For example, an addition of colloidal carbon will produce during operation carbon monoxide which, in the presence of recombination which is slower and more incomplete than the oxygen. In a further example, an addition of ammonium sulphate will cause a release of nitrogen which will contribute effectively to the maintaining of a gaseous cover on the surface of the electrode.

It is also possible to dispose in the vicinity of the electrode a solid body whose gaseous decomposition products create the same effect under the action of heat. FIGURE 4 is a good example of this arrangement, the envelope 22 being made of a suitable gaseous material. In this case the edges of openings 23, 24 act under the effect of heat as an annular source of gas tending to maintain the gaseous bubble interposed between the liquid and the electrode.

It is appropriate to point out that each receptacle may contain more than one pair of electrodes. In particular if one desires to reduce the internal resistance of the device, each pole of a cell may comprise two or more electrodes connected in parallel.

Finally, in order to improve the evacuation of the gases which are released, one may provide electrodes in the vicinity of the surface of the liquid, and in such a way that they are immersed only partially in the liquid, in which case it would be advantageous to give them an elongate form.

What is claimed is:

1. An electrical device comprising at least one group of two electrodes respectively provided on two adjacent dish shaped electrically insulated receptacles each of said receptacles having generally the same size and shape and having walls defining a closed bottom flaring to define an open top substantially larger than said closed bottom, said receptacles being disposed one above the other, a liquid conductor in the lower of said receptacles, and said receptacles being sealed within the other with their bottoms and their electrodes in spaced relationship, the bottom of the upper receptacle being immersed in said liquid conductor to provide between said receptacles only a shallow depth of said liquid conductor which is substantially less than the height of said walls, and said electrodes extending into said liquid conductor so as to provide an electric current path between said electrodes through said liquid conductor.

2. Device according to claim 1, wherein said receptacles define at least in part a closed chamber therebetween.

3. Device according to claim 2, wherein said closed chamber containing said liquid is only partially filled with said liquid conductor.

4. Device according to claim 3, wherein said closed chamber is sealed for maintaining it under pressure.

5. Device according to claim 1, wherein a material susceptible of emitting a gas under the action of heat is disposed in said chamber.

6. Device according to claim 1 wherein said liquid conductor contains products which release a gas which recombines with difficulty under the action of heat.

7. Device according to claim 2 including seals disposed between parts of said nested receptacles located above said liquid conductor, said seals being impermeable to said liquid conductor but permeable to gas for allowing a gas exchange between said closed chambers and the atmosphere.

8. Device according to claim 1 wherein the walls of at least one of said electrically insulated receptacles are formed of a conducting material covered with an insulating material and comprising uncoated parts constituting electrodes.

9. Device according to claim 1 including baffle means interposed between said electrodes.

10. A device according to claim 1 in which the electrode provided on the upper receptacle traverses the bottom thereof.
11. A device according to claim 1 in which the electrode provided on the lower receptacle traverses the bottom thereof.

12. An electric resistance comprising a plurality of groups as set forth in claim 1, said groups being disposed one above the other and nested one in the other in such a manner that the lower receptacle of one group and the upper receptacles of the adjacent group nested thereunder constitute a group as set forth in claim 1, each of said electrodes being exposed to the exterior and interior of the respective receptacle.

13. An electric resistance according to claim 12, in which the electrodes of two successive receptacles are offset horizontally one relative to the other.