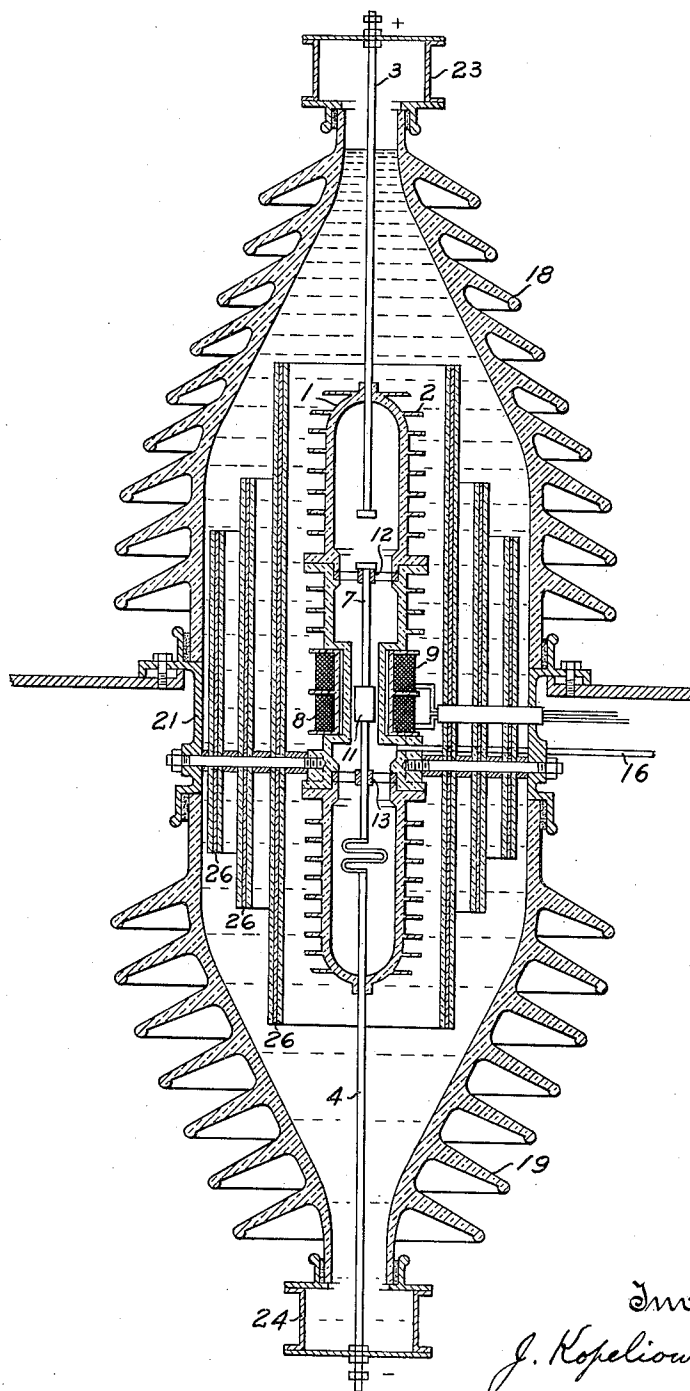


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ELECTRIC CIRCUIT BREAKER

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ELECTRIC CIRCUIT BREAKER

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This invention relates to improvements in electric circuit breakers and lead-in bushings and more particularly to circuit breakers in which the contacts interrupting the circuit are separated in a vacuum within casings formed of insulating material which are adapted for use as bushings for the terminals of high potential apparatus.

When circuit breakers; employing an interposed non-conductive fluid, such as oil, to aid in quenching the arc established upon separation of the contacts to interrupt an electric circuit; are used in high voltage lines the dimensions of a circuit breaker having sufficient capacity to interrupt short circuits become so large that the circuit breaker becomes very expensive and requires a large space. Due to the large size of such circuit breakers, it is impossible to mount the circuit breakers upon the tanks of high voltage apparatus such as transformers or even closely adjacent such tanks. Such circuit breakers also have other well known disadvantages which those skilled in the art have attempted to avoid by the use of circuit breakers without oil such as a circuit breaker in which the circuit is interrupted in a vacuum.

The difficulties in the construction and operation of circuit breakers operating in a vacuum and of such size that the structure may be used as a lead-in bushing are to be found not only in the maintenance of the vacuum at the desired value due to the continuous liberation of occluded gases from the materials of which the evacuated chamber is constructed but also in the difficulty of constructing a vacuum chamber of insulating material of sufficient size which will be gas-tight. Ceramic materials are usually used for the insulation of conductors at high voltages and it is necessary that the dimensions of a vacuum chamber for high voltages formed of such materials be such that the exposed surfaces will prevent flash-overs or glow discharges. It is, however, very difficult to construct a chamber of ceramic materials of sufficient size in such manner that the chamber will be continuously gas-tight and will therefore be capable of being maintained at a suitable vacuum.

It is therefore among the objects of the present invention to provide an electric circuit breaker in which contacts are separated within a vacuum maintained within an integral chamber of insulating material.

Another object of the invention is to provide a circuit breaker operating in an evacuated cham-

ber of such size that the chamber may be made integrally from ceramic materials.

Another object of the invention is to provide a circuit breaker in which the contacts are separated within an evacuated chamber of such size that the chamber may be arranged within an insulating casing in such manner as to materially increase the flash-over voltage of the vacuum chamber and to decrease the possibility of glow discharges therefrom.

Another object of the invention is to provide a combined circuit breaker and terminal bushing for high voltage apparatus in which the contacts interrupting the circuit are operated in an evacuated chamber which is arranged within an insulating casing in which the space between the evacuated chamber and the casing is filled with an insulating fluid and in which means are provided within the casing to secure potential distribution over the entire surface of the casing.

Objects and advantages other than those above set forth will be apparent from the following description when read in connection with the accompanying drawing forming a portion of the disclosure of the present invention which is a vertical sectional view illustrating one embodiment of the invention, in which a pair of contacts operate within an evacuated chamber which is arranged within an insulating casing filled with a suitable dielectric and provided with means to increase the flash-over voltages, and to secure potential distribution over the surface of the casing to obtain a structure operating as a circuit breaker and also adapted for use as a terminal bushing for high potential apparatus.

Referring more particularly to the drawing by characters of reference, the reference numeral 1 designates a gas-tight chamber of insulating material, such as a ceramic material, formed with a materially decreased central section for a purpose which will appear hereinafter. The outer surface of the chamber 1 is formed with ribs or skirts 2, which are effective to materially increase the flash-over or leakage path on the exterior of the chamber and thus reduce the danger of glow discharges therefrom. Conductors 3 and 4 are fused or otherwise sealed in gas-tight relation into the chamber 1, the conductor 3 forming the fixed contact for the circuit breaker structure. The conductor 4 is connected at the end thereof within the chamber 1 with one end of a flexible conductor 6. The other end of the flexible conductor is connected with one end of a rod 7 forming a contact movable into and out of contact with the fixed contact 3. Contact 7

is operated into and out of connection with contact 3 by the action of coils 8 or 9 which are arranged about the decreased central section of the chamber 1 and act upon an enlarged portion 11 on the movable contact 7, which enlarged portion serves as the armature of a solenoid formed by the coils 8, 9. The coil 9, upon energization thereof from a suitable source (not shown), causes upward or circuit closing movement of contact 7 and the coil 8 causes downward or circuit opening movement of contact 7. Movement of contact 7 is guided by walls 12 and 13 extending across the chamber 1. Such walls may be made integral with the chamber or may be separate therefrom and attached thereto as desired. Chamber 1 is evacuated by a suitable evacuating pump (not shown) through a tubular connection 16 between the chamber and the pump.

The chamber 1 and its contacts are enclosed within a casing or housing, the greater portion of which is formed by an upper and a lower insulating portion 18 and 19, respectively. The insulators 18 and 19 are preferably in the form of hollow substantially conical members such as are now used for the construction of oil filled bushings. The insulators are preferably skirted as shown to increase the flash-over distance and to prevent the occurrence of glow discharges, and are joined at the bases thereof by means of a flanged connecting member 21 into which the open base ends of the insulators are sealed in fluid-tight relation. The open ends of the insulators are closed in fluid-tight relation by means of similar top and bottom closures 23 and 24 through which conductors 3 and 4 extend and to which the conductors are secured. The end closures thus serve as terminals for the circuit to be controlled. The entire switch structure including the chamber 1 and the contacts 3 and 7 is thus enclosed within a fluid-tight casing formed substantially of insulating material which casing is filled with an insulating liquid or gas and for which the upper closure 23 forms an expansion chamber. Subjecting and maintaining the insulating fluid under pressure further increases the flash-over voltages of the entire structure.

It is desirable to control the potential distribution over the exterior surface of the casing which result is accomplished by the arrangement of a plurality of conductive cylinders 26 of different lengths about the evacuated chamber 1 and within the casing 18, 19. The cylinders 26 are spaced from the chamber, from the casing and from each other and the spaces are filled with the insulating fluid filling the casing. The cylinders are preferably embedded within insulation and thus form condenser layers which create a uniform potential gradient over the entire surfaces of the casing.

A circuit breaker such as disclosed may be operatively mounted either in the vertical position shown or in a horizontal position and may be employed for either indoor or out of door use. If desired the casing shown may be replaced by an integral casing of insulating material and the circuit breaker may then serve as the terminal of high voltage apparatus such as a transformer.

Due to the construction of the casing substantially of insulating material, the circuit breaker is especially adapted for mounting upon the tanks of high potential apparatus such as transformers thereby eliminating the necessity for special terminal bushings for such transformers.

Although but one embodiment of the present invention has been illustrated and described it

will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

The invention claimed is:

1. In combination, an oil-filled lead-in bushing comprising a pair of hollow insulating members with a flanged supporting ring interposed therebetween and secured thereto, and a vacuum switch within said lead-in bushing comprising an evacuated casing supported from said flanged supporting ring, and a pair of relatively movable contacts within said evacuated casing and supported thereby, said vacuum switch also comprising means for electromagnetically operating said relatively movable contacts.

2. In combination, an oil-filled lead-in bushing comprising a pair of hollow insulating members with a flanged supporting ring interposed therebetween and secured thereto, a vacuum switch within said lead-in bushing comprising an evacuated casing supported from said flanged supporting ring, and a pair of relatively movable contacts within said evacuated casing and supported thereby, said vacuum switch also comprising means for electromagnetically operating said relatively movable contacts, and a potential distributing shield of conductive material supported from said flanged supporting ring and interposed in spaced relation between said flanged supporting ring and said evacuated container.

3. In combination with an oil-filled lead-in bushing comprising a pair of hollow insulating members with a metal supporting ring interposed therebetween and a pair of terminal caps covering the remote ends of said insulating members, of a vacuum switch within said lead-in bushing comprising a three part evacuated container supported from said metal supporting ring in spaced relation thereto, the middle section of said evacuated container having an annular reduced portion, a pair of relatively movable contact members within said evacuated container and supported from the end sections of said evacuated container respectively, said vacuum switch also comprising a switch operating winding surrounding said annularly reduced portion.

4. In a combined circuit breaker and lead-in bushing, a metal mounting ring, a pair of hollow insulating members extending in opposite directions from said mounting ring and secured thereto, a pair of bushing terminal members secured to the remote ends of said hollow insulating members, a body of insulating liquid within said hollow insulating members, an evacuated casing of insulating material immersed in said liquid and supported from said mounting ring in spaced relation thereto, said evacuated casing having an annular constricted portion, a pair of relatively movable contact members arranged within said evacuated casing, and electrically connected with said bushing terminal members respectively, and a solenoid winding arranged in said annular constricted portion and operable upon energization thereof to relatively move said contact members.

5. In a combined circuit breaker and lead-in bushing, a flanged mounting ring of metal, a pair of hollow insulating sleeves extending in opposite directions from said flanged mounting ring and secured thereto, a pair of bushing terminal members covering the remote ends of said insulating sleeves, a body of insulating liquid within said hollow insulating sleeves, an evacuated container

of insulating material immersed in said liquid and supported from said flanged mounting ring in spaced relation thereto, a fixed contact arranged within said evacuated container and electrically
5 connected to one of said bushing terminal members, a movable contact arranged within said evacuated container and electrically connected to the other of said bushing terminal members, a magnetic core member within said evacuated container operatively connected to said movable contact, a solenoid surrounding a portion of said evacuated container adjacent said magnetic core member, and solenoid energizing conductors extending from said solenoid through said flanged
10 mounting ring.
6. In combination, a supporting member having a hole therein, a connecting member arranged coaxially of said hole and detachably secured to said supporting member, a pair of hollow conical
15 shaped insulating members extending in opposite directions from said connecting members and secured thereto, a pair of terminal devices secured to the remote ends of said insulating members, an evacuated container of insulating material arranged coaxial of said conical insulating members and secured to said connecting member, an evacuating conduit supported by said connecting member and in communication with the interior of said evacuated container, a body of insulating liquid within said hollow insulating members and completely surrounding said evacuated container, stationary and movable contact members arranged within said evacuated container and electrically connected with said terminal devices respectively, solenoid means for operating said movable contact, and a plurality of conductors extending from said solenoid means through said connecting member.

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