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[54] **ENCLOSED SURGE DIVERTER**

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[51] **Int. Cl.** **H02h 1/04**

[58] **Field of Search** ..... 315/35, 36, 36 X; 317/61, 317/61.5, 62, 70; 328/9 X

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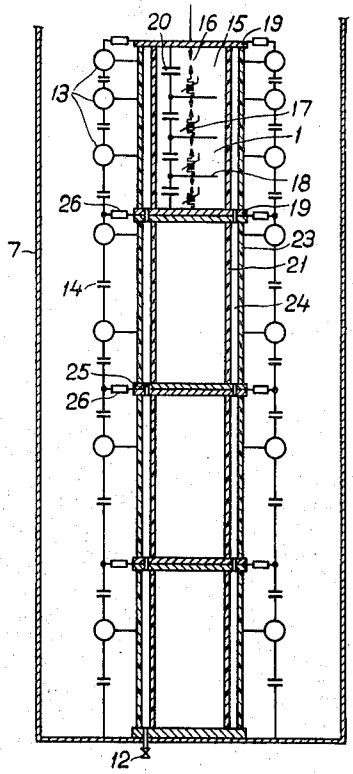
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[57] **ABSTRACT**

A surge diverter is mounted in an inner casing of electrically insulating material which is enclosed in an outer housing of electrically conducting material which is connected to earth. In the space between the inner casing and the housing a number of grading rings in the form of toroid rings are fastened to the inner casing at a distance from it. The grading rings are arranged at a distance from each other which increases counting from the top of the diverter.

5 Claims, 2 Drawing Figures



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Fig. 1

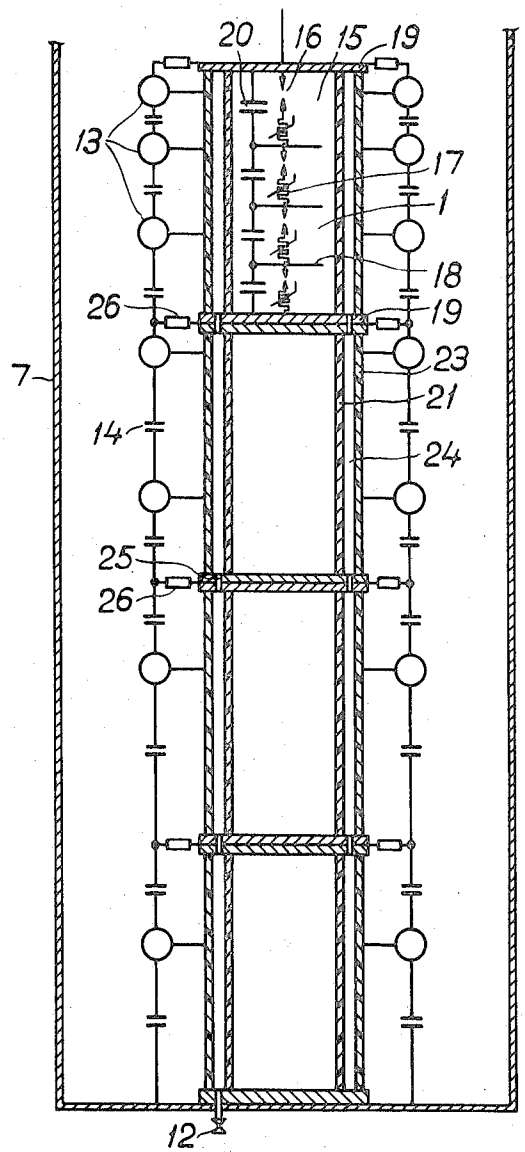
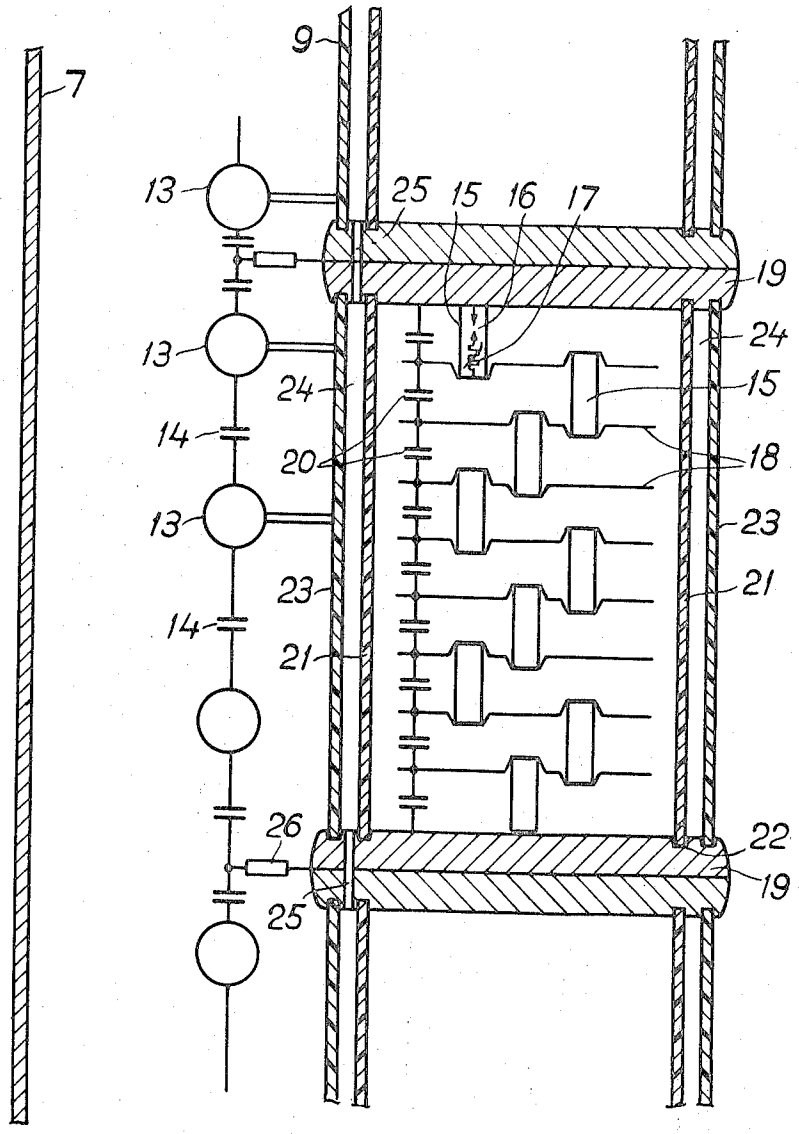


Fig. 2



ENCLOSED SURGE DIVERTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to enclosed surge diverters.

2. The Prior Art

In some places, where the risk of pollution is great, there is a need to enclose certain electrical apparatus. Enclosed surge diverters are also of interest in high-voltage switchgears in order to obtain semi-protected apparatus and a construction of small volume. Semi-protection is obtained by earthing the enclosing housing, which is therefore made of electrically conducting material. In such enclosed plants, either known insulating liquids such as oil or insulating gas such as air, nitrogen or electronegative gases are used as electrical insulant between the voltage conducting parts and the earthed housing, preferably under a certain overpressure.

SUMMARY OF THE INVENTION

The present invention relates to an enclosed surge diverter which is mounted inside an earthed housing of electrically conducting material. The diverter itself, which, at least at high operational voltages, is constructed of a number of diverter modules stacked on top of each other, is enclosed in an inner tube of insulating material. A number of field and voltage grading rings are arranged outside the inner tube and attached to it. Capacitors are connected between the rings and form an outer grading chain. This outer grading chain is first of all intended for obtaining a satisfactory field configuration, that is a guarantee for an acceptable voltage stability of the apparatus. Besides the outer grading chain, a grading chain is also arranged inside the insulating tube with the main object of grading the voltage between successive partial gaps, of which the diverter consists. The outer field grading chain may be either completely free from the inner chain, or they may be connected together at least through one of the joint attachments which separate different module units. Depending on the impedance level in the outer grading chain, this connection can be effected either directly or through an impedance element.

An enclosed surge diverter as above, in which the interior of the diverter is not directly connected with the insulant which is responsible for the voltage stability towards earth, can be characterised as follows:

1. Two fundamentally separate control systems for field and voltage distribution.

This distribution offers the following advantages:

— By dimensioning the outer system with regard to the field configuration, the total requirement of control capacitors is reduced.

— Two separate control systems make it possible to avoid great capacitances directly in parallel with the ignition gap of the diverter, which is favorable for keeping a well-defined breakdown voltage.

— Two separate control systems make it possible to choose different potential distribution, for the outer and the inner grading chains. In this way the field configuration is improved without the corresponding increase in the demand for control capacitors.

2. The field grading is achieved by placing the grading rings either at a constant distance from each other, or at a distance from each other which is substantially

in inverse proportion to the voltage towards earth. In the latter alternative the need of grading rings is the least possible, while at the same time the rings are utilized efficiently, in this way making it possible to utilize substantially one and the same ring dimension for the construction. Parameters such as ring and pipe diameters will have a secondary importance for minimizing the need of control capacitors.

3. The possibility of being able to connect the two control systems together by means of impedance elements, capacitors, non-linear resistors or combinations of these, at joint attachments located between module units, offers the following advantages:

— The low impedance level of the outer chain of grading rings has very little influence on the function of the ignition voltage.

— The voltage distributions in the two grading chains accompany each other, even if the temperature is not the same inside the diverter itself as in the insulant. This is important, since the temperature coefficient in high-voltage capacitors is great. Even some 10° can give considerable radial voltages.

— Since in particular the inner grading chain is difficult to adapt in practice to the desired voltage distribution using a reasonable number of capacitor types kept in stock, a considerably increased liberty of choice is obtained when connecting the two chains over an impedance element. Within reasonable limits a current exchange between the inner and the outer systems may provide the desired potential distribution without obvious disadvantages.

By introducing a resistive component in the connecting impedance, it is also possible to regulate the dependence of the ignition voltage on the curve form of the applied voltage. It may, for example, be favorable to make the interior of the diverter more weakly capacitively graded. At normal frequency sufficient grading current for linear voltage division is then added from the outer chain. In connection with a rapid overvoltage condition, however, this contribution of grading current is not added, and therefore the ignition voltage of the diverter decreases, relatively speaking.

4. Design of construction details as auxiliary electrodes.

— By shaping joint attachments between module units as field grading electrodes, grading rings only have to be positioned in connection with actively voltage absorbing parts in the diverter itself.

— In a practical arrangement of the outer system of grading rings with their grading capacitors connected in series and in parallel, connecting points with well-defined potential are automatically obtained. Some of these may suitably be given a shape which promotes the field configuration. Since these so-called auxiliary electrodes are positioned nearest the center of the diverter, no advanced electrode shapes are required here for this field improvement.

— The holders for grading rings which may be used for suitably shaped as concentric, conducting surfaces between the grading ring and the outer insulating tube.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings FIG. 1 shows a preferred embodiment of the invention. FIG. 2 shows in more detail a part of a diverter according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the diverter according to FIGS. **1** and **2,** the external, metallic housing constituting the enclosure of the diverter is designated **7.** The diverter proper, which is of standard type, consists of four equal module units and is designated **1.** Each module contains a number of diverter elements **15,** each one comprising a number of spark gaps **16** in series with non-linear valve resistors **17** in known manner. Alternatively, the diverter elements **15** may consist of spark gaps only or of valve resistors only. Each diverter element is attached between assembly plates **18,** and the modules terminate at either end in a joint attachment **19,** with the help of which the modules are fixed to each other in a known manner. For the voltage grading within the module there is a grading chain of a number of series-connected capacitors **20,** which are attached between the assembly plates. The ends of the chain are attached to the joint attachments which are of metal. The entire interior as described is enclosed in a polyester tube **21,** which is attached to the joint attachments at its ends in a gas-tight manner, for example by engaging into a circular slot **22** in the joint attachments. A second polyester tube **23,** which is concentric with the tube **21,** is arranged outside the tube **21** and is attached to the joint attachments in a similar manner. An annular space **24** is created between the two tubes. These spaces are connected to each other by holes **25** in the joint attachments. At the end of the diverter a valve device **12** is arranged, said valve device **12** opening when the pressure in the spaces rises, for example because of an explosion in one of the diverter modules. The interior of each module communicates with the space through channels and pressure relief valves in the joint attachments. These constructions are well known and are therefore not shown here.

The outer grading chain consists of a number of toroid-formed grading rings **13** and capacitors **14** connected between them. The grading rings are arranged at variable distances and are closest to each other at the top of the diverter, where the voltage with respect to earth is highest. The further down the rings are positioned, the longer is the distance between them, that is the distance between two successive rings is substantially in inverse proportion to the voltage of the rings with respect to earth. The rings are attached to the insulating tube **23** and are thus supported by this tube. The outer grading chain is electrically connected to the joint attachments **19** and, accordingly, also to the inner grading chain, through impedance elements **26.** These impedance elements may consist of capacitors or resistors or both. The capacitors **14** which are present between two rings consist, for known reasons, of a number of partial capacitors. In this way it will be possible to determine the capacitance between each ring in the best way, and also to choose the connecting point for the impedance elements **26,** so as to obtain the best balance between the two grading chains.

The interior of the diverter, that is the space in the inner insulating tube **21,** may be filled with nitrogen gas or some electronegative gas. The space between the housing **7** and the outer insulating tube **23** may be filled with another insulant, for example transformer oil. Since the space **24** between the two insulating tubes **21** and **23** acts as a barrier between the two insulants and since this space can easily be connected to the atmosphere in the event of overpressure, one of the insulants is safely prevented from penetrating into the space of the second insulant if a fault should occur in the diverter. The construction also offers the greatest possible option when choosing an insulant.

We claim:

1. Enclosed surge diverter (**1**) comprising a gas and fluid-tight inner casing of electrically insulating material, an outer housing (**7**) connected to earth surrounding said inner tube casing and formed of electrically conducting material, a plurality of field and voltage grading rings (**13**) in the space between the inner casing and the outer housing, said grading rings being in the form of toroid tubes fastened on the inner casing and spaced at a distance from it, in which the grading rings are spaced at progressively greater distances from each other as the distance from the top of the diverter increases.

2. Surge diverter according to claim **1,** in which the distance between the grading rings increases substantially in inverse proportion to the voltage with respect to earth.

3. Surge diverter according to claim **1,** in which capacitors (**14**) are connected between the grading rings (**13**), the capacity of the capacitors decreasing with decreasing voltage between the rings and earth, said grading rings and capacitors constituting an outer grading chain.

4. Surge diverter according to claim **1,** the surge diverter (**1**) inside the inner casing being provided with an inner grading chain consisting of capacitors (**20**), in which impedance elements (**26**) connect said outer grading chain and said inner grading chain.

5. Surge diverter according to claim **1,** in which said inner casing comprises an inner tube (**21**) and an outer tube (**23**) with an annular space (**24**) between the tubes and a valve mechanism (**12**) connecting said space with the atmosphere.

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