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(54) **SURGE ARRESTER**

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Description

The present invention relates to a surge arrester comprising a stack of a plurality of cylindrical arrester elements which are preferably made of metal oxide varistor material and which are arranged one after the other in the axial direction of the arrester elements between two end electrodes and surrounded by an elongated outer casing.

The outer casing of currently used surge arresters is usually made of porcelain. A porcelain casing has good electrical insulating properties and also has sufficient mechanical strength to take up, inter alia, the axially directed compressive force on the arrester elements, which is generated by springs and which is required to obtain good electrical contact between the elements. In arresters with a porcelain casing, however, some form of overpressure relief arrangement is required to avoid an explosion-like failure, if, for example in the event of a fault on an arrester element, a short-circuit arc is formed inside the arrester with an ensuing pressure increase.

Recently, for certain types of surge arresters, the porcelain casing has begun to be replaced by a protective casing of polymeric material, for example EPDM rubber. Such a casing is considerably less expensive, and because of the elasticity of the polymer material, the possibilities of a less dramatic process without any explosion hazard in the event of a surge arrester failure are improved. However, a polymer insulator casing must be supplemented by some form of mechanical stiffening to attain sufficient strength against bending and tensile stresses.

From US-A-4 404 614 a surge arrester with a polymer casing is previously known, in which a mechanical stiffening in the form of a glassfibre-reinforced plastic tube is arranged.

Also this surge arrester is provided with an overpressure relief arrangement of, in principle, the same type as that used in connection with surge arresters with a porcelain casing.

In the construction of surge arresters with polymer insulator casing and glassfibre-reinforced tube, but without an overpressure relief arrangement of the above-mentioned kind, there are contradictory demands on the glassfibre-reinforced tube: On the one hand the tube shall have sufficient strength against bending and tensile stresses, and on the other the tube shall easily crack up in case of an arrester failure. When using cross-wound glassfibre-reinforced tubes, too high a radial strength in the tube is obtained. The same thing occurs when a fibre is wound directly on the block stack and thereafter impregnated with thermosetting resin: With suitable strength in the axial direction, too high a strength in the radial direction is obtained to provide good failure properties. Attempts to solve the problem have been made by providing the tube with holes (see, e.g. EP-A-0 335 480) or longitudinal weakened portions in the form of ground slots etc., but this renders the manufacture more complicated and more expensive.

The object of the present invention is to obtain a surge arrester which is provided with polymer casing and which does not suffer from the above-mentioned drawbacks. This is achieved according to the invention by using, for mechanical reinforcement of the polymer casing, a fibre-reinforced plastic tube which is made by profile drawing, so-called pultrusion, whereby all reinforcement fibres extend in the axial direction of the tube.

A pultruded fibre-reinforced tube has a very high tensile strength. The required bending strength is obtained by choosing a suitable wall thickness and amount and type of reinforcement fibres. Despite the high tensile and bending strength, a relatively low strength in the radial direction is obtained. This permits a favourable failure process since the tube easily cracks up also at low short-circuit currents. In addition, pultruded tubes are very cost-effective.

The invention will be explained in greater detail by describing an embodiment with reference to the accompanying drawing, which shows in axial section a surge arrester designed according to the invention.

The surge arrester shown in the figure is primarily intended for use in distribution networks with operating voltages of up to about 40 kV. However, the same design principle may be used to advantage also in surge arresters for operating voltages of the order of magnitude of 100 kV and higher. The arrester shown comprises a stack of arrester elements 1 in the form of circular-cylindrical ZnO blocks, possibly with heat-absorbing spacers of metal, and an end electrode 2 in the form of a metal pellet at each end of the stack. The end electrodes 2 and the spacers, if any, may suitably be made of aluminium. The entire stack of ZnO blocks 1, end electrodes 2 and spacers, if any, is arranged in an elongated tube 4 of glassfibre-reinforced plastic, which in turn is surrounded by an insulating casing 3 made of polymeric material. The stack is axially fixed to the tube 4 by means of metal cases 5, which surround the end portions of the tube 4 and are fixed to the tube by pressing the cylindrical mantle part of the respective case into annular slots 6 in the tube. The figure shows, on opposite sides of the centre line of the surge arrester, the metal case 5 before and after the pressing of the mantle part into the annular slots.

The metal cases 5 are formed with a collar 7, which surrounds the respective end portion of the polymer insulator 3 and is fixed to the insulator by a surrounding indentation 8. Between the metal collar 7 and the insulator 3 there is a seal 9, for example in the form of an O-ring.

The pressing of the metal cases 5 onto the plastic tube 4, in certain types of plastic material, may be performed without the tube being provided in ad-

vance with the surrounding slots 6. In this case, the slots in the plastic material are formed directly in connection with the pressing of the metal cases.

To ensure that a sufficient contact pressure is maintained between the individual arrester elements 1 and between the stack of arrester elements and the end electrodes 2, a spring device in the form of a disc spring assembly 10 is arranged near the end electrodes.

The end electrodes 2 are provided with threaded fixing holes 11 for connection members.

The tube 4 is a glassfibre-reinforced tube of plastic material, for example polyester, polyvinyl ester, epoxy or a thermoplastic resin. The tube is made by profile drawing, so-called pultrusion. This is a method of production for fibre composites in which the raw materials included are continuously and automatically directly converted into a finished product. In tubes manufactured according to this method, all reinforcement fibres are arranged axially. This gives the tube very special properties, of which a high tensile strength in combination with a low strength in the radial direction are particularly important properties for the present invention. Tubes of this type are available on the market.

The outer insulating casing 3 may be an elastomer, for example an ethylene-propylene-terpolymer (EPDM rubber) which is fitted over the tube 4. It may also consist of shrinking plastic, for example a crosslinked ethylene-propylene polymer or crosslinked HD-polyethylene which is applied to the tube 4 by shrinking. The insulating casing 3 may also be formed directly on the tube 4 by casting or injection moulding.

To achieve an airless connection between the stack of ZnO blocks 1 and the tube 4, the gap between the stack and the tube may be filled with an electrically insulating compound, for example epoxy or silicone compound. Alternatively, the tube 4 may consist of a shrinkable plastic material and be applied on the ZnO stack by shrinkage.

ZnO blocks are usually manufactured in a number of different transverse dimensions (diameters) to make it possible to build surge arresters for different current ranges in an economical way. In a surge arrester according to the present invention, it may be an advantage from the manufacturing point of view if the pultruded tube 4 can be manufactured with one and the same outside diameter for all sizes of ZnO blocks. Tubes which are intended for the smaller blocks are thereby provided internally with a number of longitudinal bars for centering the blocks, the spaces between the bars then being filled with silicone compound or the like.

If a fault should occur inside the surge arrester with an ensuing short circuit, the tube 4 will burst in the longitudinal direction in a controlled manner at a relatively low internal overpressure. The risk of explosion causing personal danger is thereby eliminated.

Claims

1. A surge arrester comprising a stack of a plurality of cylindrical arrester elements (1), preferably made of metal oxide varistor material, which are arranged one after the other in the axial direction of the arrester elements between two end electrodes (2) and surrounded by an elongated outer casing (3), which consists of an insulator made of polymeric material, whereby for mechanical reinforcement a tube (4) of fibre-reinforced plastic is arranged between the stack of arrester elements (1) and the polymer insulator (3), **characterized in that** the fibre-reinforced plastic tube (4) is manufactured by profile drawing, so-called pultrusion, whereby all the reinforcement fibres extend in the axial direction of the tube (4).

2. A surge arrester according to claim 1, **characterized in that** the outer insulating casing (3) is applied to the fibre-reinforced plastic tube (4) by shrinking.

3. A surge arrester according to claim 1, **characterized in that** the outer insulating casing (3) is applied to the fibre-reinforced plastic tube (4) by direct forming on the tube by injection moulding or casting.

4. A surge arrester according to claim 1, 2 or 3, **characterized in that** between the plastic tube (4) and the stack of arrester elements (1) there is a gap filled with insulating compound, for example epoxy or silicone compound.

5. A surge arrester according to claim 1, 2 or 3, **characterized in that** the plastic tube (4) is applied to the stack of arrester elements (1) by shrinking.

6. A surge arrester according to any of claims 1-4, **characterized in that** the plastic tube (4) is internally provided with a number of longitudinal crests for centering the arrester elements (1), whereby the spaces between the crests are filled with an insulating compound, for example silicone compound.

Patentansprüche

1. Überspannungsableiter mit einem Stapel aus einer Vielzahl von zylindrischen Ableiterelementen (1), die vorzugsweise aus Metalloxyd-Varistor-Material hergestellt sind und die in axialer Richtung der Ableiterelemente hintereinander zwischen zwei Endelektroden (2) angeordnet sind und von einem langgestreckten äußeren Gehäu-

se (3) umgeben sind, welches aus isolierendem Polymermaterial besteht, wobei zur mechanischen Verstärkung ein Rohr (4) aus faserverstärktem Kunststoff zwischen dem Stapel aus Ableiterelementen (1) und dem Isoliergehäuse (3) aus Polymer angeordnet ist, **dadurch gekennzeichnet**, daß das faserverstärkte Kunststoffrohr (4) durch Zieh-Strangpressen, sogenannte Pultrusion, hergestellt ist, wobei alle Verstärkungsfasern sich in axialer Richtung des Rohres (4) erstrecken.

2. Überspannungsableiter nach Anspruch 1, **dadurch gekennzeichnet**, daß das äußere Isoliergehäuse (3) durch Aufschrumpfen auf dem faserverstärkten Kunststoffrohr (4) aufgebracht ist.

3. Überspannungsableiter nach Anspruch 1, **dadurch gekennzeichnet**, daß das äußere Isoliergehäuse (3) auf dem faserverstärkten Kunststoffrohr (4) durch direktes Anformen an dem Rohr mittels Spritzgießen oder Gießen aufgebracht ist.

4. Überspannungsableiter nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet**, daß zwischen dem Kunststoffrohr (4) und dem Stapel aus Ableiterelementen (1) ein Spalt vorhanden ist, der mit einer isolierenden Masse, zum Beispiel einer Epoxi- oder Siliconmasse, ausgefüllt ist.

5. Überspannungsableiter nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet**, daß das Kunststoffrohr (4) durch Aufschrumpfen auf dem Stapel aus Ableiterelementen (1) aufgebracht ist.

6. Überspannungsableiter nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet**, daß das Kunststoffrohr (4) innen mit einer Anzahl Längsstege zur Zentrierung der Ableiterelemente (1) versehen ist, wobei die Zwischenräume zwischen den Stegen mit einer isolierenden Masse, zum Beispiel einer Siliconmasse, ausgefüllt sind.

Revendications

1. Limiteur de surtension comprenant un empilement d'un ensemble d'éléments limiteurs cylindriques (1), de préférence en un matériau du type varistance à oxyde métallique, qui sont disposés l'un après l'autre suivant la direction axiale des éléments limiteurs entre deux électrodes d'extrémités (2), et sont entourés par un boîtier extérieur oblong (3), qui consiste en un isolant en un matériau du type polymère, dans lequel, pour le renfort mécanique, un tube (4) en matière plastique renforcée par des fibres est disposé entre l'empilement d'éléments limiteurs (1) et l' isolant en polymère (3), caractérisé en ce que le tube (4) en matière plastique renforcée par des fibres est fabriqué par une technique d'extrusion par étirage, encore appelée pultrusion, grâce à quoi toutes les fibres de renfort s'étendent dans la direction axiale du tube (4).

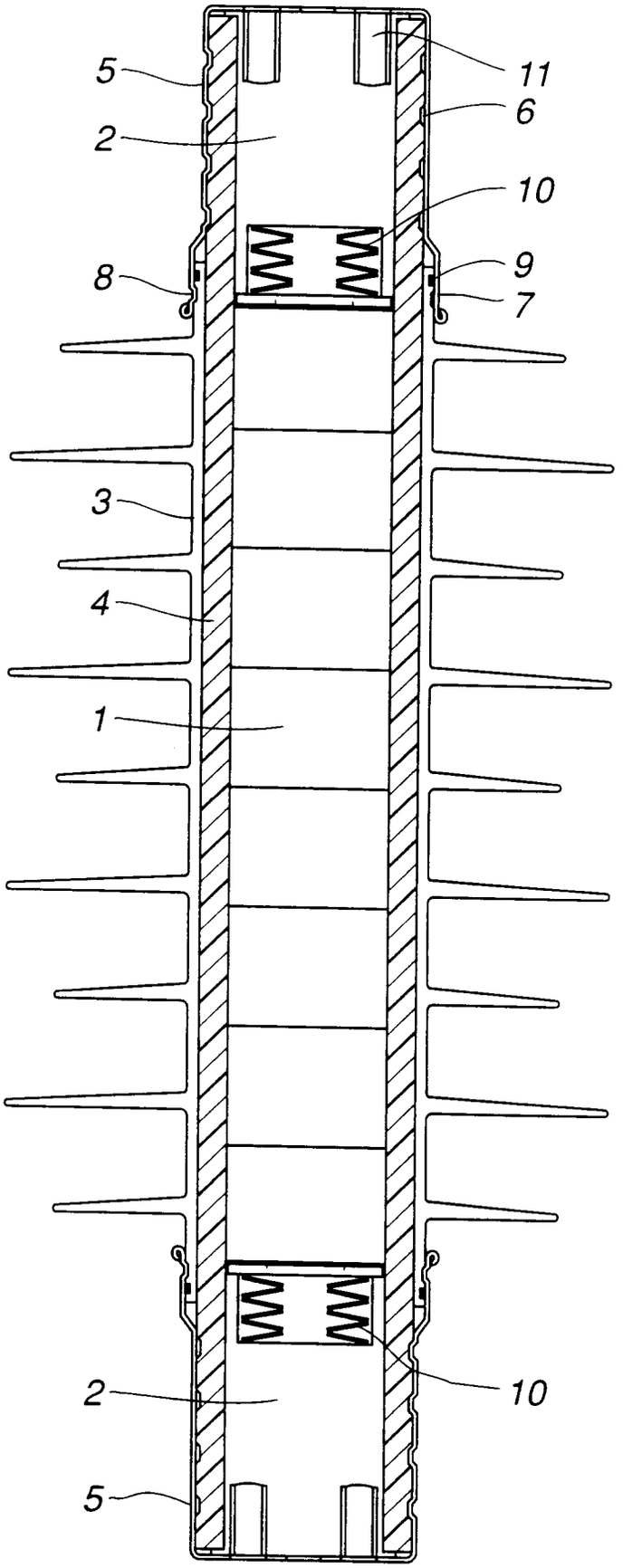
2. Limiteur de surtension selon la revendication 1, caractérisé en ce que le boîtier isolant extérieur (3) est appliqué par rétraction sur le tube (4) en matière plastique renforcée par des fibres.

3. Limiteur de surtension selon la revendication 1, caractérisé en ce que le boîtier isolant extérieur (3) est appliqué sur le tube en matière plastique (4) renforcée par des fibres, par formation directe sur le tube, en étant moulé par injection ou coulé.

4. Limiteur de surtension selon la revendication 1, 2 ou 3, caractérisé en ce que, entre le tube en matière plastique (4) et l'empilement d'éléments limiteurs (1), il existe un écartement rempli d'un composé isolant, par exemple un composé du type époxy ou silicone.

5. Limiteur de surtension selon la revendication 1, 2 ou 3, caractérisé en ce que le tube en matière plastique (4) est appliqué par rétraction sur l'empilement d'éléments limiteurs (1).

6. Limiteur de surtension selon l'une quelconque des revendications 1 à 4, caractérisé en ce que le tube en matière plastique (4) est muni intérieurement d'un certain nombre de nervures longitudinales destinées à centrer les éléments limiteurs (1), tandis que les zones entre les nervures sont remplies d'un composé isolant, par exemple un composé du type silicone.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