

Aug. 25, 1970

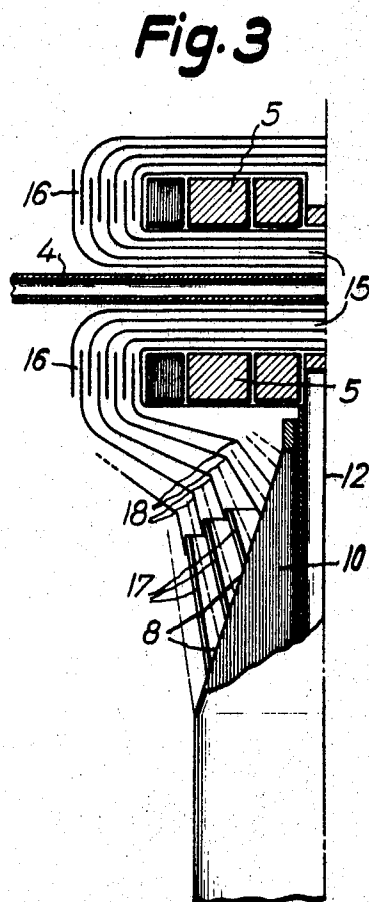
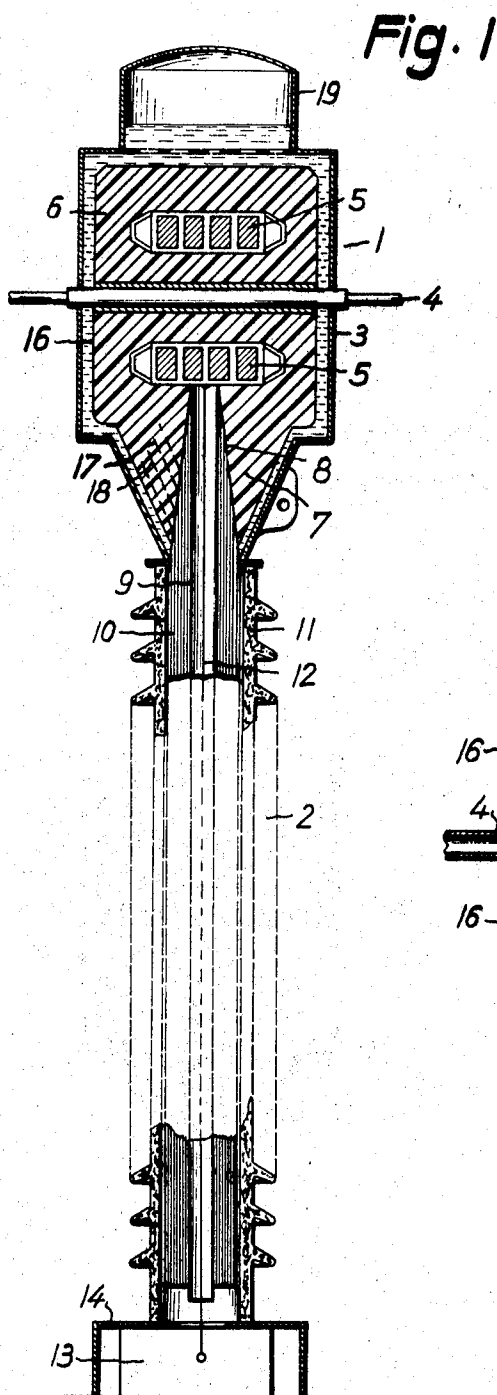
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3,525,908

SPREADER-TYPE CURRENT TRANSFORMER

Filed Nov. 28, 1967

2 Sheets-Sheet 1



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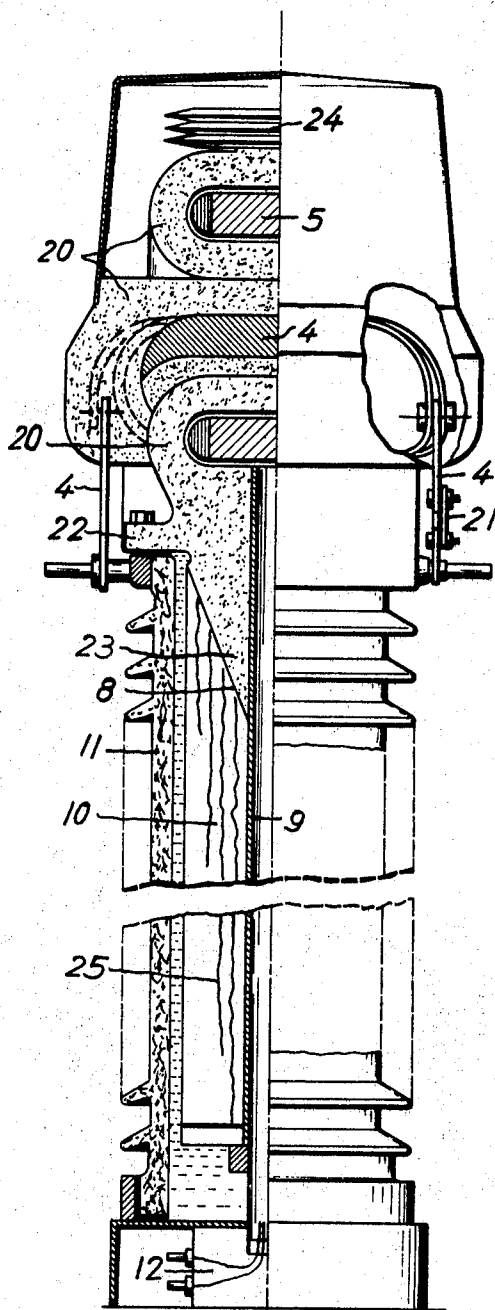
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Fig. 2



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SPREADER-TYPE CURRENT TRANSFORMER
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14 Claims

ABSTRACT OF THE DISCLOSURE

A spreader-type current transformer suitable for measuring current in a high-voltage line. The transformer includes an insulated head portion which contains the primary and secondary windings as well as the transformer core, and an elongated base portion, supporting the head portion, which includes the secondary winding leads surrounded by a feed-through capacitor. The head portion and the base portion are designed to be separately manufactured. They have coupling means for attaching themselves together which include abutting surfaces, on the head portion insulation and the feed-through capacitor, that are conically shaped to provide a low dielectric stress between the head portion insulation and the feed-through capacitor.

BACKGROUND OF THE INVENTION

The present invention relates to a current transformer of the bushing or spreader type suitable for handling the highest voltages; in particular, to a current transformer having its active elements arranged in an insulated head portion and its secondary winding leads, surrounded by a feed-through capacitor which serves as an insulator, in a base portion which supports the head portion.

Current transformers with high rated currents and voltages, high numbers of cores and high core power densities are often required in practice in certain fields of application. Such specifications are not obtainable, however, with the traditional cascade transformers.

When amperages are high one suitable type of construction is provided by the spreader current transformer. This transformer may have a primary conductor consisting of rods passing directly through the spreader head or, consisting of a few conductor turns.

A spreader current transformer is known in the prior art, for example, which has an iron core together with its secondary winding arranged at the upper end of a pin insulator. The external leads of its secondary winding pass through the base of the insulator to its lower end. The core, the winding and the leads are enclosed by a number of conducting jackets, wound one on top of the other like onionskins, and separated one from the other by layers of high-quality dielectric material. These jackets have open branches extending in the direction of the secondary winding leads, the ends of the branches being distributed over the entire length of these leads and provided with conducting or semiconducting rings.

The jackets, which serve to control the voltage, include, as a rule, conducting layers interspersed with alternate layers of kraft paper. Capacitor layers are employed for the same purpose in the branch region surrounding the winding leads.

These kinds of arrangements are, however, very expensive to fabricate. Not only is it impossible to mechanize their manufacture, but particular difficulties are also encountered in drying and impregnating the complex shapes made of kraft paper.

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SUMMARY OF THE INVENTION

An object of the present invention, therefore, is to design the insulation of the core, the winding as well as the secondary leads of a spreader-type current transformer so that it may be manufactured with a minimum of expense and so that the difficulties described above will be avoided.

This and other objects, which will become apparent in the discussion that follows, are achieved, according to the present invention, by making both the insulating member surrounding the transformer active elements and the feed-through capacitor member as individually manufactured units which may be coupled together. This is accomplished by providing the insulating member and the feed-through capacitor with matched coupling surfaces, which are conical, so that the dielectric stress between the coupled units is reduced to a minimum.

In one preferred embodiment of the present invention the dielectric stress is further controlled by making the insulating member as well as the feed-through capacitor of a plurality of layers of dielectric material which follow the contours of the equipotential surfaces. These layers are arranged at the coupling surfaces so that the layers of one individually manufactured unit pass into the layers of the other as uniformly as possible.

According to a particular feature of a high voltage spreader current transformer according to the present invention, having its insulating member wrapped as a plurality of layers of kraft paper which are feathered at the ends or faces of the transformer core, the insulating member coupling surface is shaped as a cone or funnel which opens outward toward the upper matched end surface of the feed-through capacitor. This insulating member surface is formed by a plurality of separate insulating barriers which are arranged concentrically to the transformer secondary leads, like shells, one inside the other, and which grip comb-like into the soft paper wrappings surrounding the active elements of the transformer.

According to another preferred embodiment of the present invention the insulating member surrounding the active elements of the transformer is made of casting resin. This insulating member casting is provided with a flange or flanges so that it may be directly attached, without use of additional constructional elements, to a support insulator which encases the feed-through capacitor. The coupling surface of the insulating member has in this case a cone-shaped projection which is matched to a funnel-shaped opening in the feed-through capacitor. A tube which passes through the center of the base portion of the transformer and contains the secondary leads extends into this cone-shaped projection to the secondary winding along its central axis.

The feed-through capacitor may, in principle, be of identical construction in both the preferred embodiments of the present invention. It is designed, in any case, so that it can be wound by machine. It may further be advantageous to construct the capacitor in a plurality of sections that can be coupled together.

It is possible to construct the insulating member in the head portion and the feed-through capacitor in the base portion of the current transformer, according to the present invention, of insulating materials having different dielectric strengths.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partly in cross section, of an embodiment of a spreader current transformer according to the present invention which is suitable for high voltages.

FIG. 2 is an elevational view, partly in cross section,

of an embodiment of a spreader current transformer according to the present invention which is suitable for intermediate high voltages.

FIG. 3 is a portion of an elevational view, partly in cross section, showing one embodiment of a joint between the member which insulates the active elements and the feed-through capacitor of a spreader current transformer suitable for high voltages.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Turning now to the drawings, there is shown in FIG. 1 a spreader-type current transformer having a head portion 1 and a supporting base portion 2. A rod 4 which forms the primary conductor passes through and projects from either side of a metal housing 3 that encloses the head portion 1. Inside the head portion 1 are found the cores and secondary windings generally indicated by 5 as well as the insulating member 6 which consists of windings of kraft paper. This insulating member 6 provides a joint between the head portion and the upper end of the base portion by means of a funnel-shaped socket 7.

In the axis of symmetry of the cone-shaped opening 8, formed by the socket 7, there is arranged a tube 9 around which is wrapped a feed-through capacitor 10. The feed-through capacitor 10 is dimensioned so as to almost entirely fill the support insulator 11. The feed-through capacitor 10 has a cone-shaped upper end, the dimensions of which exactly correspond to the cone-shaped opening 8 of the insulating member 6.

The secondary winding lead 12 passes through the middle of the tube 9. It runs from the secondary winding 5 through the entire length of the insulator 11 to the terminal plate 13 in the bottom portion 14 of the transformer.

FIG. 3 shows one embodiment of the joint between the insulating member 6 and the feed-through capacitor 10 of the transformer of FIG. 1 in greater detail. The primary conductor 4 is surrounded by insulation consisting of paper rolls or wrappings 15. These paper wrappings 15 are contoured and feathered at the face ends 16 of the cores and the secondary windings 5. Outer insulation consists of insertable barriers 18 which grip comb-like into the paper wrappings on one side and, on the other, project into a barrier system 17 which is arranged concentrically with the secondary leads 12 and abuts the feed-through capacitor 10. The dashed lines in the region of the barrier system designate further barriers which, for reasons of clarity, have not been included in the drawing.

The opening 8, visible in FIG. 3, is dimensioned so as to minimize the electrical stress in this area.

The joint between the insulation member of the head portion and the insulation member of the base portion is conically shaped because such a shape allows equipotential surfaces like the ones present with the applications described to be spaced farther apart from each other than, for instance, butt joints would do; i.e. the dielectric stress is distributed over the widest area possible without unduly complicating the design.

Both the support and the head element are filled with an insulating medium, shown in FIG. 1, and are connected with an expansion tank 19 by means of a connecting pipe, not shown.

In the embodiment shown in FIG. 2, the cores and the secondary windings 5 are embedded in an insulating member 20 which is made of a casting resin. The primary conductor 4 is, in this case, given a number of turns around the core and has several tapplings in order to change the number of turns of the primary circuit for getting different secondary voltage levels. The contact plate 21 enables these tapplings to be connected to the primary circuit.

The insulating member 20 is screwed down against the support element with flanges 22 which are formed as an

integral part of the insulting member casting. The end of the casting which faces toward the base portion of the transformer is provided with a cone-shaped extension 23 that is dimensioned to correspond to a funnel-shaped opening 8 in the feed-through capacitor 10. The capacitor plates 25 of the feed-through capacitor 10 terminate immediately in front of the opening 8 and are arranged in a manner as to give an equalized potential distribution along the outer surface of the porcelain support insulator 11.

In the central axis of the casting 20, the feed-through capacitor 10 and the porcelain support insulator 11, there is arranged a tube 9 which contains the secondary winding leads 12. This tube extends into the casting 20 and projects somewhat beyond the end of the insulator 11.

An insulating medium fills the area between the feed-through capacitor and the support insulator 11. This contained volume is connected by means of a pipe, not shown, to a bellows 24 which serves as an expansion tank.

The current transformers which are constructed according to the present invention exhibit a number of advantages. In the first place, fabrication of the transformer insulation is considerably simplified. Instead of the complicated insulating body which is constructed as a single piece, in the manner of the prior art, to insulate the core and the windings as well as the secondary leads, the insulation for the core and the windings constructed according to the present invention can be produced separately from the feed-through capacitor. Either feathered kraft paper insulation may be chosen for the head portion, in the manner of the prior art, or embodiments using a casting resin may be employed. The feed-through capacitor can furthermore be mechanically wound.

In the second place, it is possible to choose the most suitable type of insulation for the various components of the current transformer. This flexibility alone represents a considerable improvement over the current transformers of the prior art because the specific dielectric strength of each insulating member may be designed to meet specific requirements.

In the third place, the present invention makes possible the combination of various head portion embodiments with a single base portion (which example may be either an outdoor or an indoor bushing insulator) and vice versa. In view of the many required types or models of transformers, this flexibility also proves advantageous in practice.

It is also possible, finally, to combine fluid insulation, such as oil with casting resin insulation in such a way (as is illustrated, for example, in FIG. 2) that the casting resin portion tightly seals the oil chamber; this arrangement makes an additional enclosure for the components embedded in casting resin unnecessary.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. A spreader-type current transformer comprising, in combination:

(a) a head portion which includes the primary and the secondary elements and the cores of said transformer encased in a first insulator, said cores being of ring-type design; and

(b) a base portion which includes the external lead of said secondary portion and a feed-through capacitor surrounding said lead; said head portion and said base portion having coupling means for attaching themselves together, said means including surfaces, on said first insulator and on said capacitor which are conically shaped to provide a low dielectric stress between said first insulator and said capacitor, thereby to allow said head portion and said base portion to be separately manufactured.

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2. The current transformer defined in claim 1, wherein said first insulator and said feed-through capacitor include a plurality of laminated layers of material, said layers of said first insulator and said feed-through capacitor arranged substantially along equipotential surfaces of said transformer.

3. The current transformer defined in claim 2, wherein said layers of said first insulator at said surface on said first insulator are arranged approximately parallel with said layers of said feed-through capacitor at said surface on said feed-through capacitor.

4. The current transformer defined in claim 2, wherein said layers of said first insulator include sheets of kraft paper surrounding said secondary elements and said cores, and arranged so that an opening is provided for insertion of said primary elements, said sheets being feathered at both of said face sides of said cores.

5. The current transformer defined in claim 4, wherein said surfaces are conical in shape, are arranged concentrically with said lead and extend outward in the direction of said base portion.

6. The current transformer defined in claim 5, wherein said layers of said first insulator include a plurality of insulating barrier means forming said surface on said first insulator, said barrier means being arranged concentrically with said lead and interleaved with said sheets.

7. The current transformer defined in claim 1, wherein said first insulator is formed of casting resin and said feed-through capacitor includes a plurality of layers of material arranged substantially along equipotential surfaces of said transformer.

8. The current transformer defined in claim 7, wherein said base portion further includes a second insulator arranged around said feed-through capacitor, and said first insulator has at least one flange means formed thereon for attaching said first insulator to said second insulator.

9. The current transformer defined in claim 8, wherein said base portion further includes a tube surrounding said lead, arranged between said lead and said feed-through capacitor, and extending beyond said second insulator into said first insulator.

10. The current transformer defined in claim 9, wherein said surfaces are conical in shape, are arranged concentrically with said lead and extend outward in the direction of said head portion.

11. The current transformer defined in claim 1, wherein

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said first insulator and said feed-through capacitor include insulation material, said insulation material of said first insulator being of different dielectric strength than said insulation material of said feed-through capacitor.

12. The current transformer defined in claim 1, wherein said feed-through capacitor is constructed in a plurality of sections, said sections being arranged to be releasably coupled together.

13. A spreader-type current transformer comprising, in combination:

(a) a head portion which includes the primary and the secondary elements and the cores of said transformer enclosed in an insulator, said cores being of ring-type design; and

(b) a base portion which includes the external lead of said secondary portion and a feed-through capacitor surrounding said lead; said head portion and said base portion having coupling means for attaching themselves together, said means including surfaces on said insulator and said capacitor which are conically shaped to mate together to form an interface between the two surfaces, said interface having equal potential on each side thereof at each point of communication of said surface along said interface, thereby to provide a low dielectric stress between said insulator and said capacitor and to allow said head portion and said base portion to be separately manufactured.

14. The current transformer defined in claim 13 wherein said coupling means for said head portion and said base portion is releasable.

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