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Weigel et al.

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[54] **FILTER CHOKE**

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May 31, 1972 Germany 2226512

[52] **U.S. Cl.** ..... **333/70 CR**, 333/70 S, 333/79

[51] **Int. Cl.** **H03h 7/06**

[58] **Field of Search** ..... 333/70 CR, 70 S, 79; 307/105; 336/58, 59, 94

[56] **References Cited**

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[57] **ABSTRACT**

A filter choke capable of handling high power levels and including a coolant-filled tank, a choke coil and an active resistance element which is connected in parallel with the choke coil. The active resistance element and the choke coil are both arranged within the tank. The choke coil is constructed in the form of tubular coils. The active resistance element includes two coils, as one piece, constructed in the form of a tubular coil and wound in respectively opposite directions so that the active resistance element is magnetically neutral. The choke coil is concentrically disposed within the active resistance element.

5 Claims, 7 Drawing Figures

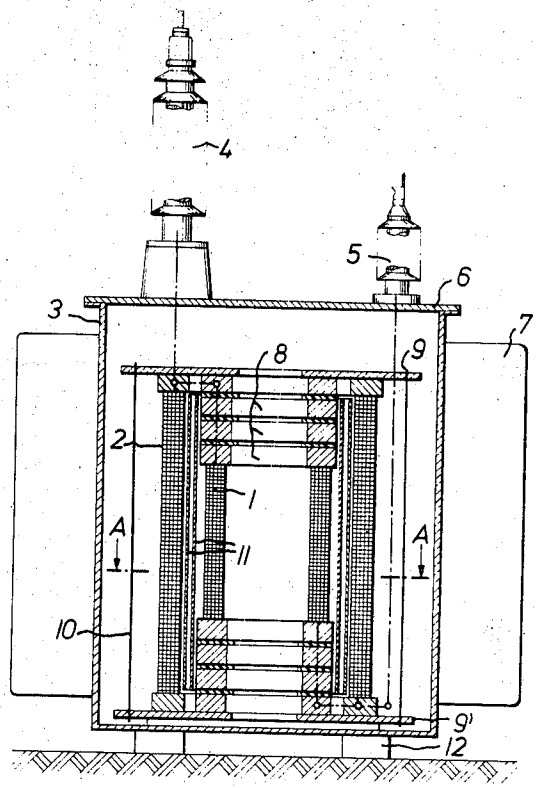


FIG.1

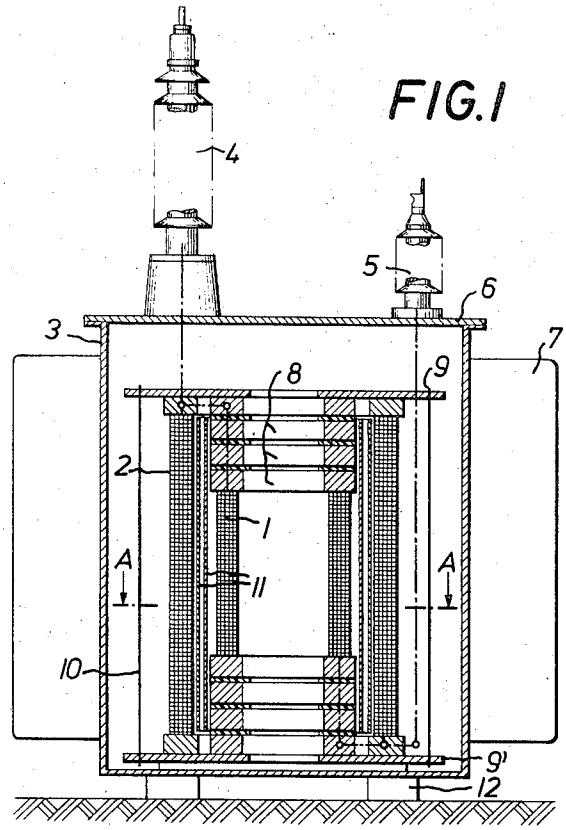
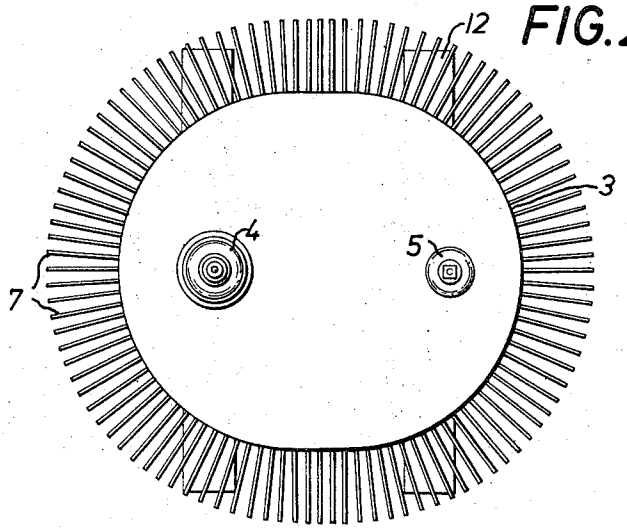


FIG.2



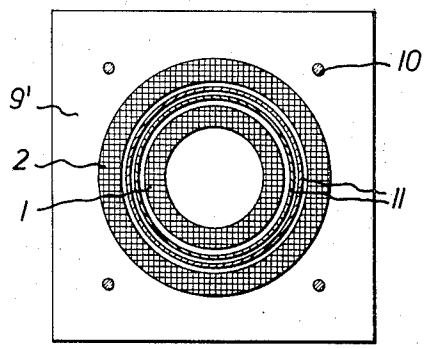


FIG. 3

FIG. 4a

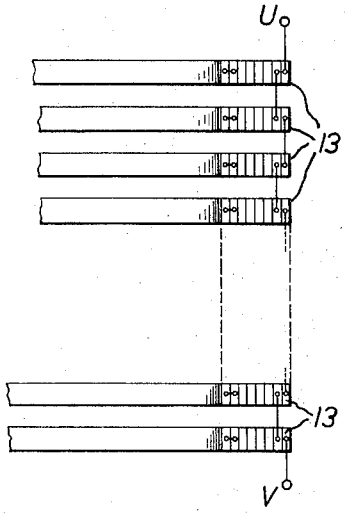


FIG. 5a

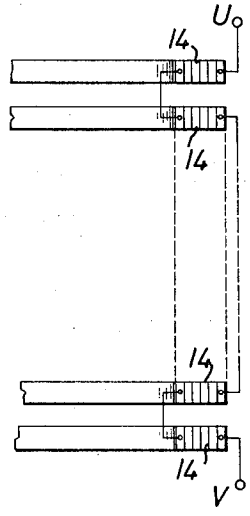


FIG. 4b

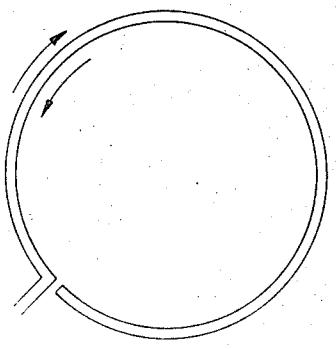
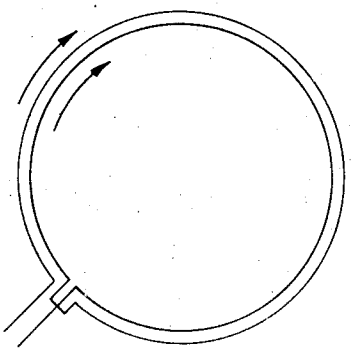


FIG. 5b



FILTER CHOKE

BACKGROUND OF THE INVENTION

The present invention relates to filter chokes capable of handling high power outputs and including a choke coil and a parallel connected active resistance element both of which are contained in a coolant-filled tank.

During the transmission of high electrical outputs through the use of, for example, high voltage direct current, filter chokes are required to suppress the harmonics. The filters, therefore, have to be designed to be capable of handling high power outputs. Since the employed active material can be satisfactorily utilized only if it is intensively cooled, such electrical components are usually built inside coolant-filled tanks. The coolant which is preferably utilized in such tanks is transformer oil which simultaneously serves as an insulating material. In view of the low power outputs previously handled by such filter chokes, the effective utilization of space and material was a comparatively insignificant problem so that the choke coil and the active resistance, which is connected in parallel with the coil, could be arranged next to one another in the same tank. This solution, however, is both unsatisfactory and very uneconomical when higher power outputs must be handled because of the considerable space and material requirements involved.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a filter choke for handling higher outputs which optimally utilizes the employed material and the space it occupies.

This objective is accomplished according to the present invention in that the choke coil and the active resistance element are provided as annular coils with the active resistance element including two coils wound in respectively opposite directions, i.e. the active resistance element is a double wound coil, so as to be magnetically neutral and that the choke coil is concentrically disposed within the active resistance element.

In accordance with an advantageous embodiment of the present invention, the choke coil is centered within the active resistance element by being clamped between a set of insulating rings and the choke coil and the active resistance element are held in position in the coolant-filled tank by a compression device. The choke coil and the double wound coil of the active resistance can be constructed of disc coils, with the disc coils of the active resistance being made of a nonmagnetic material.

A further embodiment of the present invention provides that the upper ends of the coils which are perpendicularly arranged within the tank, are connected with the high-voltage terminal and the lower ends of the coils are connected with the low-voltage terminal.

The filter choke according to the present invention is highly advantageous since it permits the filter choke to be constructed as a very compact structure and makes effective utilization of the employed materials. These advantages are obtainable because the active resistance element which spatially encloses the choke coil is double wound and made of a nonmagnetic material so that the resistance element will neither build up a magnetic field itself nor noticeably influence the magnetic field traversing the choke coil. Furthermore, the windings of the active resistance element simultaneously serve as an electrical shield for the choke coil.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational, cross-sectional view of a filter choke according to the present invention.

FIG. 2 is a top plan view of the filter choke shown in FIG. 1.

FIG. 3 is a cross-sectional view along lines A—A of the filter choke shown in FIG. 1.

FIG. 4*a* shows the connection of the disc winding of the active resistance.

FIG. 4*b* is a current flow diagram for one of the disc coils shown in FIG. 4*a*.

FIG. 5*a* shows the connection of the disc winding of the choke coil.

FIG. 5*b* is a current flow diagram for one of the disc coils shown in FIG. 5*a*.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As shown in FIGS. 1 and 3, a choke coil 1, which is constructed of disc coils, is concentrically disposed within an active resistance 2, which is also constructed of disc coils. The choke coil 1 and the active resistance 2 are electrically connected in parallel. Insulating rings 8 are utilized to center and hold the choke coil 1 in place within the active resistance 2. Both the choke coil 1 and the active resistance 2 are arranged within a coolant-filled tank 3. The double winding of the resistance disc coil providing two windings which are wound in respectively opposite directions about the coil is shown in FIG. 4.

The choke coil 1 with its associated insulating rings 8 and the coils of the active resistance 2 are maintained in place by a compression force applied in an axial direction by upper and lower plates 9 and 9', connected together by tension rods 10.

The disc coils which are utilized for constructing the active resistance 2 are double wound and made of a nonmagnetic material so that current passing through the active resistance 2 neither generates a magnetic field nor noticeably influences a foreign magnetic field, i.e. the active resistance is magnetically neutral.

The disc coils utilized for the active resistance and the choke coil 1 are described in detail below with respect to FIGS. 4 and 5, respectively.

As shown in the detail sectional view of FIG. 4*a*, the active resistance 2 is constructed of a plurality of bifilarly wound disc coils 13. One half of the windings of each disc coil 13 is wound in one direction while the other half of the windings is wound in the opposite direction so that the disc coils 13, both individually and collectively, are unable to create any magnetic flux, i.e. the active resistance is magnetically neutral. The respective directions of the current in the windings of the disc coils 13 are indicated by the arrows on the current flow diagram of FIG. 4*b*.

The choke coil 1 is also constructed of a plurality of disc coils 14, as shown in the sectional view of FIG. 5*a*. The inner ends of each pair of adjacent disc coils, 14, are interconnected so as to form a double coil disc. These double coil discs are electrically connected in series and form the choke coil 1. The current in all of the disc coils flows in the same direction as shown by the current diagram of FIG. 5*b*, thereby creating a magnetic field.

Furthermore, even though the structure of the coils in the form of disc coils provides a favorable voltage distribution which is identical in both coils, it is advantageous to provide insulating cylinders 11 in the annular gap between the choke coil 1 and the active resistance 2.

The lower plate 9' of the compression device is disposed on the bottom of the tank 3. The side walls of tank 3 are provided around the entire perimeter with heat exchange fins 7 for cooling the coolant contained in the tank 3, which coolant, for example, can be transformer oil. As shown in FIGS. 1 and 2, the top of tank 3 is covered by a cover 6 which is provided with a high-voltage terminal 4 for connection to the high-voltage line and a low-voltage terminal 5 for connection to the low-voltage line. The tank 3 is supported on legs 12. Both tank 3 and its associated cover 6 are preferably made of aluminum sheets or of steel sheets with aluminum shielding.

The high-voltage terminal is connected to the upper end of the choke coil 1 and the active resistance 2 so that the high voltage is applied at the furthest possible distance from ground in order to help eliminate arcing problems. The low-voltage terminal, however, can be connected to the lower end of the choke coil 1 and the active resistance 2 since with low voltages arcing is less likely. The electrical connections between the high-voltage terminal 4 on the one hand and the choke coil 1, the active resistance 2 and finally the low-voltage terminal 5 on the other hand are shown by dot-dash lines in FIG. 1.

In specific practical embodiments of the invention, the number of windings in the various coils, the wire sizes, and the number of disc coils will be selected according to well-known formulas on the basis of the anticipated current and voltage levels and the desired inductance value for choke coil 1.

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.

We claim:

1. In a filter choke capable of handling high power outputs and including a coolant-filled tank, a choke coil and an active resistance element connected in parallel with the choke coil, the active resistance element and the choke coil both being arranged within the tank, the improvement wherein said choke coil is in the form of annular coils, said active resistance element includes two coils in the form of annular coils wound in respectively opposite directions so as to be magnetically neutral, and said choke coil is concentrically disposed within said active resistance element.

2. A filter choke as defined in claim 1 further comprising: two insulating rings, one of said insulating rings being positioned adjacent one axial end surface of said choke coil and the other of said insulating rings positioned adjacent the other axial end surface of said choke coil for centering said choke coil within said active resistance; and compression means holding said active resistance and said choke coil with said insulating rings in said tank.

3. A filter choke as defined in claim 2 wherein both said choke coil and said coils of said active resistance element are constructed of disc coils.

4. A filter choke as defined in claim 3 wherein said disc coils of said active resistance element are made of a nonmagnetic material.

5. A filter choke as defined in claim 4 wherein said active resistance element and said choke coil are arranged within said tank so as to be adapted to be vertically oriented and further comprising a high-voltage terminal connected to the upper ends of said choke coil and said active resistance element and a low-voltage terminal connected to the lower ends of said choke coil and said active resistance element.

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