

Description

Device for setting a defined electric potential on a ferrite core of an inductive component and/or for reducing damping of the inductive component by losses induced by its magnetic field.

The present invention relates to a device for setting a defined electric potential on a ferrite core of an inductive component and/or for reducing damping of the inductive component by losses induced by its magnetic field, according to the precharacterizing clause of Patent Claim 1.

Problems can arise in inductive components both because of an undefined electric potential on the ferrite core of the component and by damping of the component by losses, for example eddy-current losses, induced by its magnetic field. This is the case, for example, with inductors for tuned circuits of inductive proximity switches. Inductive proximity switches or sensors of this type contain, as active element, an inductive system consisting of an electrical winding and a ferrite core, which is designed as a pot-type core. The magnetic fields produced by the electric current flowing in the winding is guided and directed by the pot-type core in such a way that it emerges from the core on only one side. If there is an object made of electrically conductive or magnetically permeable material close to this side, that is to say the active face of the proximity switch, then the magnetic field becomes deformed. An electrical switching signal of the proximity switch is derived from this deformation or influence.

For the operation of a proximity switch, it is essential for the ferrite core to be at a defined electric potential. Since ferrites have a poor electrical

conductivity (which is per se desirable as regards losses in the core), customary methods for defining potential, for example soldering electrical conductors to it, are out of the question.

5 An attempt has been made to overcome this problem by bringing a piece of metal into contact under pressure with the surface of the ferrite core. However, this has the disadvantage that, because of differing surface properties of ferrites, undefined surface resistances
10 occur. The scatter in the contact resistance between the ferrite and the conductor is in this case relatively large. A standard deviation of some 1.8 k Ω can occur.

 A further problem with inductive proximity switches arises when a metal tube, in particular a
15 stainless-steel tube, is used as the housing. The eddy currents induced in a housing tube of this type cause premature damping of the coil system of the proximity switch and thereby reduce the maximum switching range. In order to reduce the damping of the coil system which
20 these eddy currents cause, a copper ring may be arranged between the coil system and the housing, with the result that the eddy-current losses are substantially reduced because the electrical conductivity of copper is orders of magnitude higher than that of the housing material
25 customarily used. The premature damping of the coil system is thereby lowered and, as a consequence of this, the possible switching range of the proximity switch is also increased. With regard to this type of design of inductive proximity switches, reference may be made to
30 "Sensoren in der Automatisierungstechnik" [Sensors in automation technology] by G. Schnell, Vieweg Verlag, Brunswick 1991, pages 5 to 10.

 In this case, however, the disadvantage arises that the relatively large tolerances of the ferrite
35 (about 2 to 3%) always lead to a gap between the metal ring and the ferrite wall. As a result, an undesired leakage flux is caused and the

switching range is reduced. Since the metal ring needs to have a particular minimum thickness, the overall dimensions of the proximity switch are furthermore increased, in view of the above-mentioned tolerances of the ferrite.

5 The object of the present invention is to provide a way of setting the potential and/or reducing damping of inductive components, which does not have the above-mentioned disadvantages.

10 In the case of a device of the type mentioned at the start, this object is achieved according to the invention by the measure of the characterizing part of protective Claim 1.

Refinements of the invention constitute the subject-matter of sub-claims.

15 The invention will be explained in more detail below with reference to the illustrative embodiments represented in the figures of the drawing, in which:

Figure 1 shows a first embodiment of a ferrite core with a metal layer bonded on; and

20 Figure 2 shows a further embodiment of a ferrite core with a metal foil bonded on.

Figure 1 schematically shows a ferrite core 1 with a central hole 2, as may be used for an inductor of an inductive proximity switch.

25 According to the invention, a metal layer 3 is bonded to this core 1 using an electrically conductive adhesive which, in the operating temperature range of the inductive component, adheres and is thermally stable (the adhesive has not been shown in Figure 1 for the sake of clarity). An adhesive of this type, with extremely high conductivity, high adhesion and thermal stability is
30 known per se and available commercially.

The metal layer 3 may be a copper plate of circular design and with predetermined diameter. Naturally, other shapes, for example rectangular shapes, of different size are also possible.

5 The measure taken according to the invention has the following advantages:

 There is very good adhesion of the metal layer to the ferrite surface.

10 The contact resistance between the electrically conductive metal layer and the ferrite is relatively low. Empirical measurements of the contact resistance between a copper plate having a diameter of 6 mm and ferrite give a value of 3.67 k Ω as compared with a value of 5.39 k Ω in the case of the hitherto used method of pressing on a
15 metal plate.

 An electrical connection can be made by thermal methods, for example by soldering.

 The scatter in the contact resistance between ferrite and the surface of the metal layer is small.
20 Measurements of the contact resistance between a copper plate having a diameter of 6 mm and ferrite have given a standard deviation of 0.56 k Ω as compared with a value of 1.83 k Ω in the known method.

 According to a further embodiment of the innovation, according to Figure 2 where the same parts as in Figure 1 are given the same reference numbers, a metal foil 20 is bonded to the surface of the ferrite core 1 by using an adhesive 21. This makes it possible to gain good control over the problem of the above-explained damping
25 of the inductive system by eddy currents. By virtue of the adhesive 21, the metal foil 20 is applied virtually directly to the surface of the ferrite core. This affords the advantage of avoiding the tolerance problems which occur in the known measure of using a metal ring.
30 Furthermore, it is possible to apply very thin layers, measuring as little as
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a few tens of micrometres. Practical thickness values are, for example, from 0.01 to 0.1 mm.



Patent Claims:

1. Device for setting a defined electric potential on a ferrite core (1) of an inductive component and/or for reducing damping of the inductive component by losses induced by its magnetic field, in the form of a metal layer (3; 20) provided on the ferrite core (1), characterized in that the metal layer (3; 20) is bonded to the ferrite core (1) by means of an electrically conductive adhesive (21) which, in the operating temperature range of the inductive component, adheres and is thermally stable.
2. Device according to Claim 1, characterized in that a copper layer is used as the metal layer (3; 20).
3. Device according to Claim 1 and/or 2, characterized in that a metal plate is provided as the metal layer (3).
4. Device according to Claim 3, characterized in that the metal plate (3) is of circular design.
5. Device according to Claim 1 and/or 2, characterized in that the metal layer (20) is bonded to the ferrite core in the form of a foil.