May 4, 1943. W. K. PATZSCHKE ET AL 2,318,415

HIGH-FREQUENCY IRON CORE

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Fig. 1a.

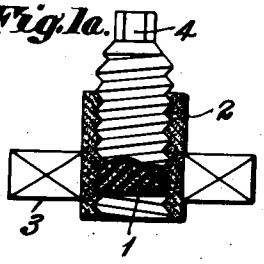


Fig. 1b.

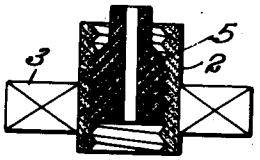


Fig. 1c.

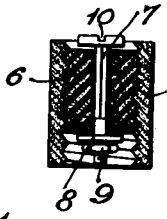


Fig. 1d.

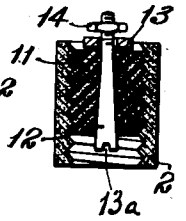


Fig. 2a.

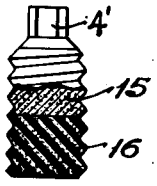


Fig. 2b.

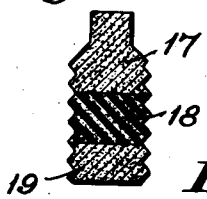


Fig. 2c.

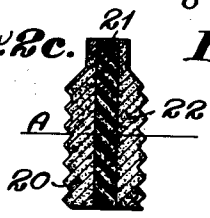


Fig. 2e.

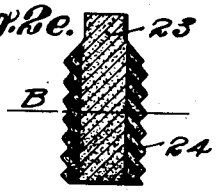


Fig. 2d.



Fig. 2f.



Fig. 3a.

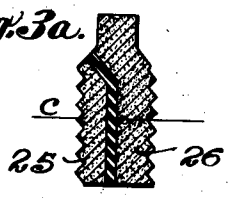


Fig. 3c.



Fig. 3e.

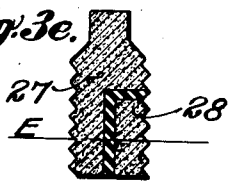


Fig. 3b.



Fig. 3d.



Fig. 3f.

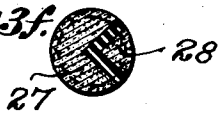


Fig. 3g.

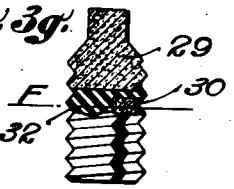


Fig. 3i.



Fig. 3h.

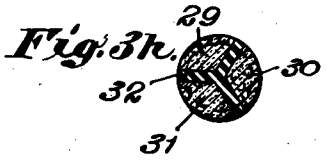


Fig. 3K.



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Fig. 4a.

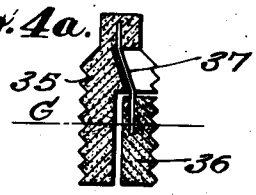


Fig. 4e.

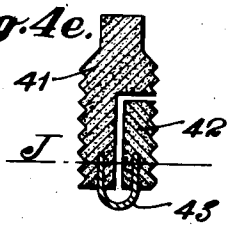


Fig. 4b.

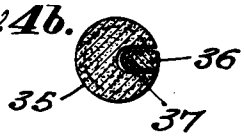


Fig. 4f.

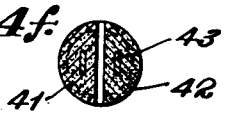


Fig. 4g.

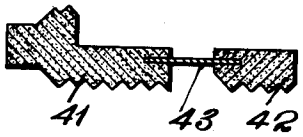


Fig. 5a.

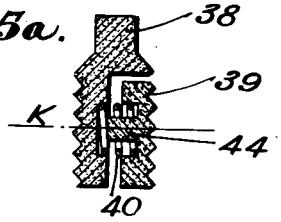
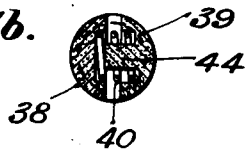


Fig. 5b.



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UNITED STATES PATENT OFFICE

2,318,415

HIGH-FREQUENCY IRON CORE

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Application July 31, 1940, Serial No. 348,942
In Germany July 31, 1939

5 Claims. (Cl. 171—242)

The invention deals with high-frequency iron cores which are provided with threads which enable them to be displaced along the axis of a tube provided with an internal thread. The core is made elastic in its entirety or partly and the diameter of the core, when the core is not screwed in, at those places of the thread where the elasticity causes it to yield, is slightly larger than the inner diameter of the guiding tube. This yielding ability may be achieved by using an elastic binder or also an elastic gasket.

The invention deals with iron-powder cores for high-frequency coils. Especially does it deal with such high-frequency iron cores which are provided with a thread and may be displaced along the axis in a tube provided with an internal thread, which tube, for example, may carry a coil, so that it becomes possible to tune the inductance of the coil.

According to the practice of the prior art, the tolerance between the diameters of such powder-material cores and the guiding tubes is such that it is not possible to achieve a reliable fit of the core inside the tube and the result is a certain amount of play therebetween. However, it is necessary in coils with powder-material cores, in order to keep their inductance strictly constant, that the core should not change its position even when vibrations occur. It has, therefore, been the tendency to employ an elastic tube for guiding the core. Difficulties, however, are also encountered with an elastic tube because in addition to acting as a guide for the core, it serves also to carry the coil.

According to the invention these drawbacks are eliminated by making the core elastic in its entirety or partly and by making the diameter of the core, when the core is not screwed in, at those places of the thread at which the elasticity causes it to yield, slightly larger than the inner diameter of the tube.

A few examples of the embodiment of the invention will be discussed in connection with the attached drawings. Figs. 1*a* to 1*d* represent powder-material cores which are designed to be elastic in their entirety. Figs. 2*a* to 2*f* represent iron-powder cores consisting partly of elastic material and partly of non-elastic material, Figs. 2*d* and 2*f* being transverse sections of Figs. 2*c* and 2*e*, respectively, on the lines A and B. Figs. 3*a*, 3*c*, 3*e*, 3*g* and 3*i* show iron-powder cores split longitudinally and provided with a gasket made of rubber, caoutchouc or the like, Figs. 3*b*, 3*d*, 3*f*, 3*h* and 3*k* being transverse sections thereof on the lines C, D, E, F and L, respectively. In Figs. 4*a* and 4*e* the parts of an iron-powder core are made elastic by springs which are sprayed in or pressed in, Figs. 4*b* and 4*f* being transverse sections on the lines G and J, respectively, and Fig. 4*g* being the normal arrangement of parts before taking the form shown in Fig. 4*e*, and Figs. 5*a* and 5*b* show an arrangement in which the core consists of two parts which are forced apart radially by a spiral spring, Fig. 5*b* being a transverse section on the line K.

In Fig. 1*a*, 1 represents a threaded core, which is made elastic in its entirety. It is guided by a tube 2 provided with an internal thread, which tube in turn carries the coil winding 3. The diameter of the core winding is slightly larger than the internal diameter of the tube 2 so that the core is pressed against the inner wall of the tube resulting in an elastic guidance of the core. The introduction of the core 1 into the tube 2 and, therefore, the regulation of the inductivity of the coil, is accomplished by rotation of the core, the end 4 being used for that purpose. As a binder for the iron particles there may be used an elastic material such as rubber, caoutchouc or "plexikum."

Fig. 1*b* shows a design in which the elasticity of the core is improved by designing it as a hollow core 5 with a bore along the axis.

The core 6 in Fig. 1*c* is so designed that it can be compressed along the axis so that the diameter of the core becomes variable. For this purpose the core 6 has an axial bore which receives the bolt 7 which is preferably made of insulating material but may also be made of metal. The bolt 7 is provided with a washer 8 and a nut 9 preferably made of the same material as the bolt 7. By tightening the nut 9, the core 6 is compressed in an axial direction so that it expands and presses against the inner wall of the tube 2 in a radial direction. It is of advantage to secure the bolt to the core 6, for example, by making the bolt 7 and the axial bore of the core 6 of rectangular cross section. This makes it possible to apply a screw driver to the slot 10 of the bolt in order to adjust the inductance by displacing the core 6 along the axis of the tube 2. The core may then be tightened in position more or less by means of the nut 9.

A uniform adjustment of the seat of the thread is obtained in an arrangement shown in Fig. 1*d*. In this arrangement the core 11 is provided with a conical bore along the axis in which a conical threaded pin 12 is inserted. This pin 12 is preferably made of non-elastic, magnetic material so

that the conical pin does not reduce the inductance. The threaded part of the conical pin 12 carries a nut 14 and a washer 13 which makes it possible to draw the pin 12 into the bore of the core 11 and thus cause the core 11, which is made of an elastic binder, to expand radially. The pressure of the core 11 against the internal thread of the tube 2 is regulated by means of the nut 14. It is advisable to prevent the conical pin 12 from turning relative to the core 11, for example, by designing the pin as well as the bore 11 with a rectangular cross section. This makes it possible to rotate the core 11 by means of the slot 13a and to thus regulate the inductance of the high-frequency coil.

Figs. 2a to 2e show examples of the invention in which the magnetic iron-powder core contains partly an elastic binder and partly a non-elastic binder. This offers the advantage that the part of the core, such as the end 4' which is engaged by suitable means for the purpose of making the core adjustment, may be made non-elastic, so that the softening and loss of shape of the core material during the adjustment is avoided. The passage from the elastic core material to the non-elastic material may be by steps or continuous, according to the method of manufacture of the core. The manufacture of the core may be achieved by a pressing process. But it is also possible to produce the individual parts separately by pressing or spraying and then by assembling them together. The separate parts may preferably be made to engage in such a way that they would be unable to rotate relative to each other.

Fig. 2a shows an iron-powder core manufactured in such a way. The part 15 having the end 4' with which the core adjustment is made is non-elastic in a radial direction, its diameter being equal or slightly less than the internal diameter of the threaded guiding tube. The end 16, on the other hand, which is still surrounded by the guiding tube even when the core extends only partly therein, consists of an elastic material and the diameter of the part 16 is accurately made slightly larger than the internal diameter of the tube. In Fig. 2b the two end portions 17 and 19 of the core are made non-elastic, and only the middle portion 18 contains an elastic binder. This facilitates the insertion of the core since it is only the middle portion 18 which has a diameter greater than the internal diameter of the tube.

Under certain conditions, special advantages may be obtained with the design shown in Fig. 2c, as for example, when a uniform yield is desirable along the length of the core. In this form the two segments 20 and 22 are semi-cylindrical in shape and are made of non-elastic high frequency iron powder, and the middle part 21 is made of elastic high frequency iron powder. The diameter of the core in this case is slightly larger than the internal diameter of the tube only in the direction in which the core is elastic, that is, in the direction at right angles to the abutting surfaces between the parts 20, 21 and 22. Fig. 2d shows a cross section along the line A in Fig. 2c.

If the core is to yield in all directions, it may be designed also as shown in Fig. 2e. In this arrangement the inner part 23 of the core is made of non-elastic, high frequency iron powder, whereas the cylindrical envelope 24 which carries the threads is made of elastically high frequency iron powder. Fig. 2f shows a cross section along the line B of Fig. 2e. The manufacture is facilitated when the mass 24 is sprayed on the cylinder 23, but the part 24 may also be pressed to achieve higher permeability.

Fig. 3 shows examples of design in which the core is subdivided into two or several non-elastic magnetic parts, and a gasket of an elastic non-magnetic material such as rubber, very soft rubber or the like is provided. The subdivision of the core is made along the axis of the core so that the core will yield in a radial direction. Fig. 3a shows a longitudinal cross section through a core which is divided in approximately two equal halves 25 and 26, whereas Fig. 3b shows a cross section along the line C in Fig. 3a. The elastic gasket is led out sideways so as to leave the end of the core, which is used for adjustments, non-elastic.

It may also be advisable to make only the middle part of the core elastic, instead of making it elastic all along its length. This is achieved by a design as shown in Fig. 3c, a cross section of which along the line D is shown in Fig. 3d. Figs. 3e and 3f show a design in which the core consists of two parts 27 and 28, of which the part 28 has the form of a cylindrical sector.

Figs. 3g and 3h show a core consisting of three parts 29, 30 and 31 separated by a gasket of elastic material 32. Fig. 3g shows a broken view of this modification. Fig. 3h is a cross section along the line F of Fig. 3g. In Figs 3i and 3k, where Fig. 3k represents a cross section along the line L in Fig. 3i, the plane of the elastic gasket makes an angle with the axis of the core. This increases the contact surface between the non-elastic core and the elastic gasket, which results in the advantage, among others, of increasing the strength of the joint between the two core parts 33 and 34.

In Figs. 4a and 4e are shown examples of the embodiment of the invention in which the core consists of several non-elastic parts which are held together by springs of non-magnetic material pressed in or sprayed in. The springs, which consist of bronze, may be made of round material or flat material. In Fig. 4a of which Fig. 4b is a cross section along the line G the core consists of two parts 35 and 36. The part 36 is guided into a slot of the part 35 and held in position by the spring 37.

In the modification of Figs. 4e, 4f and 4g an arrangement is shown in which the manufacture of the core is facilitated. As shown in Fig. 4g, the two parts 41 and 42 may be pressed or sprayed onto the spring 43 while the latter is straight. The spring 43 is then bent into a U-shape, as shown in Fig. 4e, so that the finished core takes the form shown in Fig. 4e. Fig. 4f is a cross section of Fig. 4e along the line J. It is advisable to have the diameter of the core increase with the distance from the spring, since the elasticity increases with the distance from the spring. But the diameter may also be made a maximum at the spring by using a weak spring.

Fig. 5a, of which 5b is a cross section along the line K, shows a modification in which the elasticity of the core is produced by a spiral spring 40 made of non-magnetic material, which is inserted between the non-elastic core parts 38 and 39 and forces these parts against the internal thread of the guide tube or coil form, shown in Fig. 1a at 2. In this case the parts 38 and 39 may both be provided with fingers 44 for guiding the spring instead of having only one part provided with such a finger as shown in the figure.

These arrangements have the advantage that the parts of the high frequency core may easily be taken apart.

In order to facilitate the insertion of the core within the guide tube, it is advisable to taper the entering end of the core. This means also, for example, that in Fig. 1 the lower end is to be tapered, or that in Fig. 2*b* the middle part 18 will only gradually have its diameter increased, compared to the internal diameter of the tube, beginning with the end which is first to enter the tube.

We claim:

1. In a high frequency inductance device, a bushing, a coil wound around said bushing and a core whose outer surface is unconfined being threaded in said bushing so that axial movement allows the core to assume various positions of adjustment, said core being composed at least in part of powdered magnetic material mixed with an elastic binding material so as to provide the finished core with elastic properties, the diameter of said core being slightly larger than the inner diameter of said bushing to thereby provide for the core being held in any of its adjustable positions with sufficient friction against the inner wall of the bushing while at the same time permitting axial movement of the core.

2. The arrangement described in claim 1, wherein the core is provided with an axial bore having an adjustable expansion bolt mounted therein, said expansion bolt being arranged to compress the core in an axial direction and to expand the same in a radial direction whereby the frictional contact between the core and the inner wall of the sleeve may be regulated.

3. A high frequency inductance device according to the invention defined in claim 1, wherein the core is composed of a plurality of parts and resilient means are provided between the several parts to normally urge said parts outwardly in a direction towards the bushing which cooperates with and surrounds the core.

4. A high frequency inductance device according to the invention defined in claim 1, wherein the core is composed of two substantially semicircular parts and an elastic medium is interposed between the flat surfaces of said parts.

5. A high frequency inductance device according to the invention defined in claim 1, wherein the core is composed of two substantially semicircular parts and an elastic medium is interposed between the flat surfaces of said parts, the elastic medium being constituted by a strip of rubber.

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