Feb. 5, 1963 E. O. SCHONSTEDT 3,076,930

ADJUSTABLE MAGNETIC CORE

Filed March 23, 1961

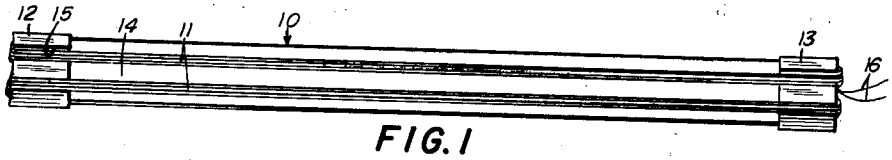

FIG. 1

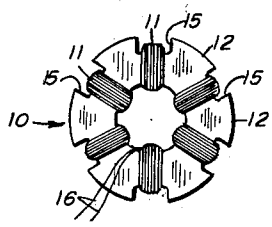

FIG. 2

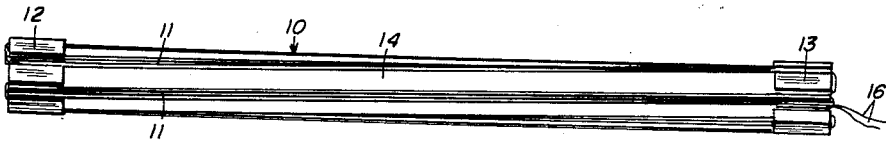

FIG. 3

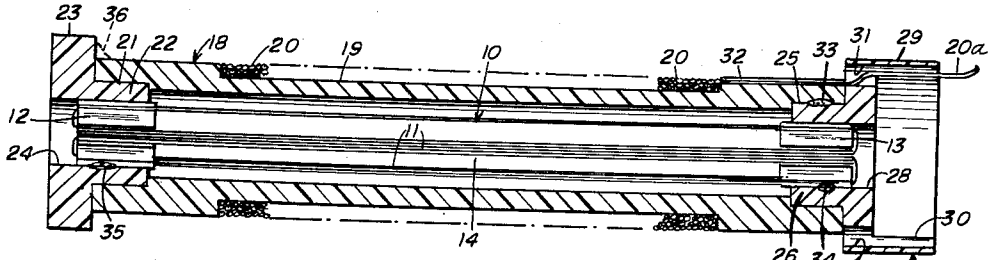

FIG. 4

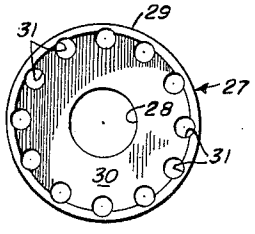

FIG. 5

INVENTOR

ERICK O. SCHONSTEDT

BY Spencer & Kaye

ATTORNEY

United States Patent Office 3,076,930
Patented Feb. 5, 1963

3,076,930

ADJUSTABLE MAGNETIC CORE

Erick O. Schonstedt, 9170 Brookville Road, Silver Spring, Md.

Filed Mar. 23, 1961, Ser. No. 97,942
3 Claims. (Cl. 324—43)

This invention relates to magnetic measuring devices and to improved magnetic cores which may be used in such devices, of the general type described in my copending applications Serial Nos. 749,953 filed July 21, 1958, now Patent No. 2,981,885 and 72,007, filed November 28, 1960, now abandoned and consists more particularly in new and useful improvements in an assembly of this nature designed to facilitate adjustment of the core winding to minimize objectionable amounts of net fundamental frequency flux which may be generated parallel to the longitudinal axis of the core.

An object of the invention is to provide a magnetic core and winding assembly which may be readily adjusted to optimum operating conditions.

Another object of the invention is to provide an assembly of this nature wherein the excitation winding may be adjusted by twisting about its axis after the core has been assembled.

A further object of the invention is to provide adjusting means for a magnetic core assembly which is simple in construction, easy to manipulate and may be readily secured in adjusted position with a minimum of inconvenience.

With the above and other objects in view which will appear as the description proceeds, this invention consists in the novel features herein set forth, illustrated in the accompanying drawings and more particularly pointed out in the appended claims.

Referring to the drawings in which numerals of like character designate similar parts throughout the several views:

FIGURE 1 is a plan view of the coil and core assembly of the invention;

FIGURE 2 is an enlarged end view of the core assembly;

FIGURE 3 is a plan view similar to FIGURE 1, illustrating an adjusted position of the core assembly;

FIGURE 4 is a longitudinal sectional view showing the embodiment of the core in a magnetic field sensor assembly; and

FIGURE 5 is an end view of said assembly.

As in my said copending applications, an exemplary embodiment of the invention comprises a non-magnetic hollow cylindrical form on which a hollow metal cylinder of permeable magnetic material such as "Permalloy" is applied. This latter cylinder which serves as the core element, may be either in the form of interwoven helical strips, oppositely wound as shown in my copending application Serial No. 749,953, or in the form of a metallic cylinder having a predetermined arrangement of peripheral openings, as disclosed in my copending application Serial No. 72,007.

Referring to the drawings which represent an adaptation of the core of the present invention for magnetometer use, it will be seen from FIGURES 1 and 2 that the core 10 is provided with a toroidal excitation winding 11 which may be made of insulated copper wire wound longitudinally through and over the core. This wire is preferably supported on the core by a pair of slotted plastic ferrules or sleeves 12 and 13 which fit over the ends of the refractory tube 14 on which the core element 10 is mounted. As shown in FIGURE 2, longitudinal, circumferentially spaced slots 15 receive the turns of the excitation winding 11, which pass over the

exterior of the core and are threaded through the core as shown in FIGURE 1. Each slot 15 may receive five turns, for example, and the turns may be wound one after another in one slot, then wound successively in the next slot, and so on. The ends 16 of the winding are preferably twisted together at one end of the tube 14 and then threaded through the tube and pulled out of the opposite end to insure that the winding will not loosen.

The ferrules 12 and 13 have concentric openings for passage of the turns of the excitation winding and are internally enlarged to receive the corresponding ends of the tube 14. The ferrules serve to hold the excitation winding in place and to prevent contact between the winding and the underlying tube 14, all as described in my said copending applications.

As also explained in said copending applications, occasionally, due to manufacturing tolerances or widely different magnetic characteristics of the core element, objectionable amounts of net fundamental frequency flux may be generated parallel to the longitudinal axis of the core. This flux can be minimized by twisting the turns of the excitation winding 11 in the proper direction by turning one of the ferrules 12 or 13 on the tube 14 relative to the other, about the axis of the core. The excitation winding then has a slight helical lay as shown in FIGURE 3. The result of this adjustment, which is permitted by making at least one of the ferrules movable on the supporting tube 14, is that a small amount of longitudinal flux is generated to oppose the existing longitudinal flux which may have been present due to imperfection in the manufacture of the core.

With the arrangements shown in my copending applications, it was necessary to effect this adjustment before the core was inserted in the final assembly and it is to an improvement which permits adjustment after assembly, that the present invention is addressed.

The core element 10 is inserted in a plastic tube or housing 18, the outer periphery of which is centrally recessed as at 19 to receive a pickup winding 20 which may comprise numerous turns of insulated copper wire wound in one or more helical layers about the axis of the tube 18. One end of the housing tube 18 is provided with an internal, annular recess 21 adapted to receive with a frictional, rotatable fit, the reduced neck 22 of a radially flanged end plug 23. The plug 23 is centrally apertured as at 24 to receive the ferrule 12 of the core element 10 when the latter is inserted in the assembly as shown in FIGURE 4. The opposite end of the housing tube 18 is similarly internally recessed at 25 to receive with a frictional, rotatable fit, the reduced neck 26 of a cup-shaped closure plug 27, the neck 26 being centrally apertured as at 28 to receive the ferrule 13 on that end of the core element 10.

The closure plug 27 is provided with a concentric cup-shaped recess 30 bounded by a cylindrical wall 29 and the base of the cup is provided with a series of annularly spaced openings 31 which extend axially in the form of recesses in the inner periphery of the cylindrical wall 29 to receive the ends 20*a* of the coil 20. This cup-shaped plug 26 which is shown purely for illustrative purposes, is designed primarily to act as an anchor for the wiring and can be filled with plastic or the like for sealing the wiring in place.

The outer periphery of the housing tube 18 at the end adjacent the cup-shaped closure plug 27 is preferably provided with one or more longitudinally extending slots 32 for receiving the ends 20*a* of the winding 20 which may be passed through selected openings 31 in the plug 27.

In assembling the unit, the cup-shaped closure plug 27 is inserted in the end of the housing tube 18 and its

neck portion 26 is cemented at 33 within the recess 25. The core element 10 is then inserted with its ferrule 13 disposed in the central opening 28 of the neck 26 where it is cemented as at 34. Thus, the ferrule 13 is held against rotation in the neck 26 and the latter is held against rotation in the recess 25 in the housing tube 18, establishing a fixed end for the assembly.

The opposite closure plug 23 is then inserted in the housing tube 18 with its central recess 24 receiving the opposite ferrule 12 which is cemented within the opening 24 as at 35. Thus, with the ferrule 13 secured against rotation in the housing tube 18, and the ferrule 12 secured to the closure plug 23 while the latter is still rotatable within the housing tube 18, an adjustment of the excitation winding 11 may be effected by simply rotating the closure plug 23 in one direction or the other.

It will be apparent that the coupling of any second harmonic components of the A.C. magnetic field with the pickup winding can be minimized by twisting the winding through rotation of the end of the closure plug 23 as illustrated in FIGURE 3. After the proper adjustment has been accomplished, the selected adjustment may be maintained by cementing the flange of the closure plug 23 as shown in dotted lines at 36 in FIGURE 4.

From the foregoing, it is believed that the invention may be readily understood by those skilled in the art, without further description, it being borne in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention as set forth in the following claims.

I claim:

1. An adjustable magnetic core assembly, comprising a magnetic core member having wound longitudinally thereon an excitation coil, wire supporting means at opposite ends of said core member for retaining the wires of said coil in radially spaced relation to said core member, at least one of said means being rotatably adjustable on said core member for twisting the windings of said coil, a housing for said core member, supports at opposite ends of said housing in gripping engagement with the respective wire supporting means of said core member, for mounting the latter concentrically within and in radially spaced relation to said housing, one of said supports being normally fixed against rotation with respect to said housing and the other being rotatable therein together with its gripped wire supporting means, whereby the wires of said coil may be twisted about the axis of said core member for adjustment.

2. An adjustable magnetic core assembly, comprising a core member including a central tube of non-magnetic electrical insulating material, ferrules of non-magnetic insulating material externally embracing the ends of said tube, a magnetic core element surrounding said tube between said ferrules, an excitation coil comprising a series of wires wound longitudinally on said tube and core element, through and over said ferrules and radially spaced by the latter from said core element, at least one of said ferrules being rotatably adjustable on said tube for twisting the windings of said coil about the axis of the tube, a core housing cylinder of non-magnetic insulating material, radially flanged closure plugs insertable in opposite ends of said housing, concentric openings in said plugs fixedly embracing respective ferrules on said core tube, one of said plugs being normally fixed against rotation in said housing and the other of said plugs being rotatable therein, whereby when the latter plug is rotated, the ferrule embraced thereby is rotated therewith to cause a twisting adjustment of said excitation coil with respect to the tube and core element.

3. An adjustable magnetic core assembly, comprising a core member including a central tube of non-magnetic electrical insulating material, ferrules of non-magnetic insulating material externally embracing the ends of said tube with a rotatable fit, a magnetic core element surrounding said tube between said ferrules, an excitation coil comprising a series of wires wound longitudinally on said tube and core element, through and over said ferrules and radially spaced by the latter from said core element, at least one of said ferrules being rotatably adjustable on said tube for twisting the windings of said coil about the axis of the tube, a core housing cylinder of non-magnetic insulating material, radially flanged closure plugs insertable in opposite ends of said housing, concentric openings in said plugs for receiving respective ferrules on said tube, said ferrules being cemented in respective openings, one of said plugs being cemented to said housing cylinder to prevent relative rotation and the other of said plugs being normally rotatable in said housing cylinder, whereby when the latter plug is rotated, the ferrule embraced thereby is rotated therewith to cause a twisting adjustment of said excitation coil with respect to the tube and core element, and means for fixing said last-named plug in adjusted position.

References Cited in the file of this patent

UNITED STATES PATENTS

2,981,885 Schonstedt ---------- Apr. 25, 1961