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ADJUSTABLE INDUCTANCE

Filed June 28, 1930

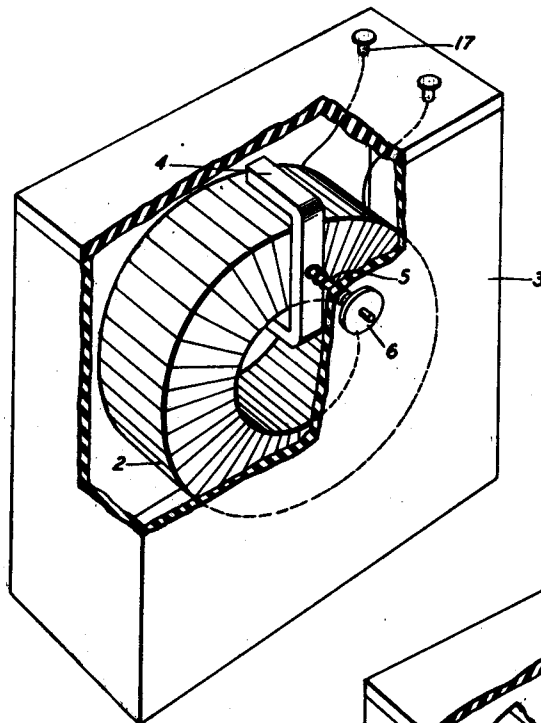
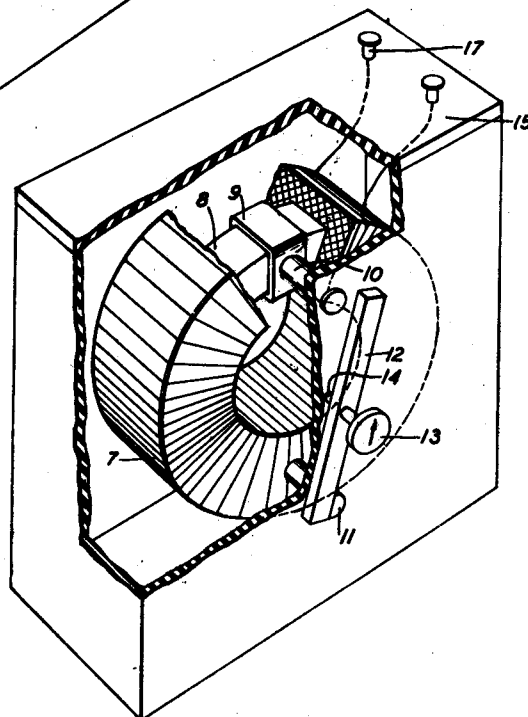


FIG. 1

FIG. 2.



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ADJUSTABLE INDUCTANCE

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This invention relates to adjustable inductances and more particularly to toroidal or other closed core coils the inductance of which may be varied.

5 Toroidal coils having cores of magnetic material have found application in a large number of places as loading coils, filter coils, transformers, etc., due to their inherent high efficiency, small external field, small size and
10 low cost as compared to solenoid or air core coils. However, such coils have not been used to any great extent in places where the value of the inductance is critical because of the difficulty encountered in adjusting the
15 inductance of the coils to the required accuracy.

The present invention has as an object the construction of a toroidal type coil having a magnetic material core so that its inductance
20 may be varied continuously over a desired range.

Another object of the invention is to so construct such coils that their inductance may be varied as stated, after they have been permanently encased.

25 It is well known that if the reluctance of the magnetic circuit associated with a coil is varied, the inductance of the coil will also be varied. Various means have heretofore
30 been suggested for varying reluctance, such as varying the width of air gaps.

In general when a magnetic material is subjected to a uni-directional biasing flux, having any direction relative to the direction of
35 the alternating flux set up by the main coil winding, the permeability of the magnetic material will first increase a small amount and then decrease considerably with increasing biasing flux. The percentage change obtainable depends upon the kind of material
40 and the amount of biasing flux. If air gaps are present, the amount of change is reduced accordingly.

45 In accordance with the present invention the reluctance of the magnetic circuit is varied by varying the permeability of the magnetic material through the use of a uni-directional magnetic flux. This uni-directional or biasing flux may be obtained from a
50 permanent magnet or an electromagnet. In

order to avoid undesirable reactions of different nature on the constants of the main coil winding it is necessary to arrange the members producing the biasing flux so that there is substantially no magnetic coupling
55 between the winding and the flux producing means. This may be done by introducing the biasing flux at points on the main core which have substantially the same alternating magnetic potential produced by the main winding.
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The invention will be better understood from the following description taken in connection with the attached drawing forming a part thereof and in which Fig. 1 illustrates the use of a permanent U-shaped magnet and Fig. 2 illustrates the use of a permanent bar magnet.
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In Fig. 1 is shown a toroidal coil 2 having a magnetic material core not shown with its enclosing case 3. Associated with the coil is a permanent U-shaped magnet 4. Permanently fixed to magnet 4 is a screw-threaded rod 5 which extends through one face of the enclosing case 3. A knurled knob 6, or equivalent, is provided with a screw thread to cooperate with the thread of rod 5 and is arranged to be movable about its axis, but to remain fixed in position relative to the face of the case.
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By turning knob 6, rod 5 and magnet 4 are caused to move relatively to the coil 2 and toward or away from the front of the casing. As magnet 4 moves away from coil 2 less of its flux penetrates the core of the coil thereby causing a reduction in its reluctance with the attendant change in the inductance of coil 2. When magnet 4 is caused to move in the opposite direction the reluctance of the core and the inductance of the coil are varied in the opposite sense.
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In Fig. 2 a part of coil 7 is shown broken away, exposing core 8 near the point where a yoke or band 9 having an extending stud 10 is fastened to core 8. A similar arrangement at a diametrically opposite point of the coil provides a stud 11. The studs 10 and 11 need not be attached to the core by means of bands 9 but may be formed as part of the core,
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screwed into tapped holes provided in the core or in any other suitable manner.

A permanent bar magnet 12 provided with a knob, or equivalent, 13 is arranged so that it may be turned about shaft 14 which is permanently fixed to the face of case 15.

The action in this case is similar to that in the case of Fig. 1, that is, at the magnet 12 is caused to approach studs 10 and 11 more of its flux is impressed upon core 8 with the attendant change in reluctance of the core and inductance of the coil. Of course, as the magnet 12 is turned away from studs 10 and 11 the reverse effect as to inductance of coil 7 is caused. It is understood that the flux due to magnet 12 divides and passes through each half of the core 8.

In the case of both Fig. 1 and Fig. 2 substantially no magnetic coupling occurs between magnet 12 and winding 17 since, as pointed out above, the biasing flux is introduced at points on the main core which have substantially the same alternating magnetic potential produced by the main winding.

Terminals 17 are provided on the outside of the case to which the ends of the winding are connected to permit the introduction of the coil into a work circuit. The number of terminals will of course depend upon the number of windings on the core.

The enclosing case is filled with an impregnating compound after the coil is placed therein. This compound moisture proofs the coil and also insulates it.

In a coil built in the general form of Fig. 2, but consisting of two balanced windings, that is, one winding on each half of a permalloy dust core, an adjustment range of plus or minus 3% of the inductance was obtained with negligible effect on the resistance.

What is claimed is:

1. An inductance device comprising a toroidal coil, a magnetic material core therefor, means for impressing upon said core a uni-directional external magnetic field, and means to vary the inductance of said coil, comprising means to vary the strength of said uni-directional field.

2. In an inductance device, a toroidal core of magnetic material, a winding thereon, a uni-directional external magnetic field associated with said core, and means to vary the inductance of said coil, comprising means to vary the lines of force of said uni-directional field which are impressed on said core.

3. In an inductance device, a toroidal core of magnetic material, a winding thereon, a permanent magnet associated with said core, and means to vary the inductance of said coil, comprising means to vary the magnetic flux of said permanent magnet which is impressed on said core.

4. In an inductance device, a closed core of magnetic material, a winding thereon, a magnet producing a uni-directional magnetic

field, and means to vary the inductance of said coil, comprising means to vary the position of said magnet relatively to the magnetic field of said core.

5. In an inductance device, a toroidal core of magnetic material, a winding thereon, projections of magnetic material extending from said core, a permanent magnet, and means to change the position of said magnet relatively to said projections.

6. In an inductance device, a toroidal core of magnetic material, a winding thereon, a case enclosing said core and said winding, projections extending from said core and protruding through said case, a permanent magnet mounted on the outside of said case, and means to alter the position of said permanent magnet relatively to said core projections.

7. An inductance device as claimed in claim 4 in which said magnet is a U-shaped permanent magnet the limbs of which embrace a portion of the winding on said closed core.

In witness whereof, I hereunto subscribe my name this 27th day of June, 1930.

FREDERICK J. GIVEN.