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TANK CIRCUIT

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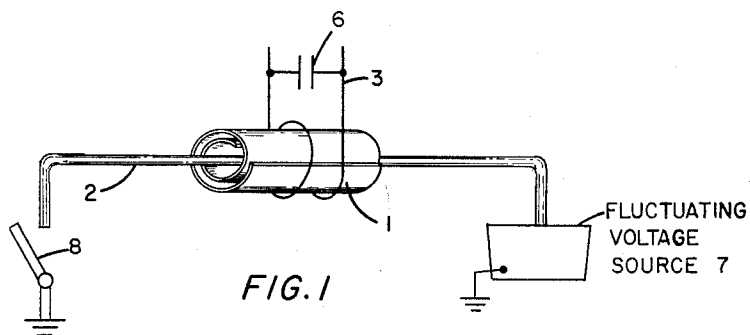
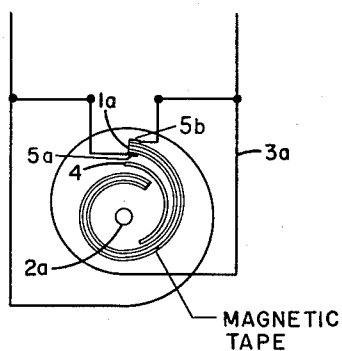


FIG. 1

SELF CONTAINED
TANK CIRCUIT
SUITABLE FOR
PARAMETRONS



MAGNETIC
TAPE

FIG. 2

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3,051,891

TANK CIRCUIT

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My invention relates generally to an element having inductive reactance and particularly to an inductive element which is also suited for use in a parametrically-excited resonant circuit.

As explained in the paper entitled "On the Application of Parametrically-Excited Non-linear Resonators" by Ei-ichi Goto appearing in the Journal of Electrical Communications Engineering of June, 1955, a parametrically-excited resonator may depend for sustained operation upon a non-linear inductive element, the value of which is periodically changed at a rate twice the resonant frequency of the resonator tank. It is possible to achieve such a varying inductance by providing two separate transformers having ferro-magnetic cores, the transformers' primaries being connected to a common source and their secondaries being connected in series opposition. However, necessity for such transformers adds unduly to the cost of building parametrically-excited resonators for practical application, and therefore detracts from the potential usefulness of parametrically-excited circuits taken as a class.

Accordingly, it is an object of my invention to provide a new and improved variable-value inductor.

Another object of my invention is to provide a new and improved variable inductor which is inexpensive to build.

Another object of my invention is to provide a new and improved variable inductor suited for use in parametrically-excited circuits.

Another object of my invention is to provide a new and improved electrically controlled variable-value inductor.

Another object of my invention is to provide a new and improved electrically controlled variable-value inductor having low cross-talk between input and output.

Another object of my invention is to provide a new and improved inductor-capacitor element.

Another object of my invention is to provide a new and improved inductor having the elements of a fixed capacitor.

I accomplish these and other objects in the preferred embodiment of my invention which is set forth in the following paragraphs. For the convenience of the reader, reference is made in the following description to the drawing attached to and forming a part of the present specification in which:

FIG. 1 shows a view of a variable inductor; and

FIG. 2 shows an end view of an inductor-capacitor element.

Referring to FIG. 1, my inductor is formed from a length of tape 1 of finite width rolled along its length to form a tube. Tape 1 comprises a backing of non-metallic material, such as paper, at least one surface of which has been coated or otherwise covered with a thin film of ferromagnetic material. The tube comprises at least one complete turn, so that when the outer end of the tape 1 of the tube is sealed to the body of the tube, the ferromagnetic material forms a substantially closed magnetic circuit which is cylindrical in form and may have a substantially round cross-section.

Means including at least one straight conductor 2 positioned to be substantially parallel and concentric with the axis of the tube formed by tape 1 and is used for conveying electrical current along the length of the cylindrical magnetic circuit. Electrical current passing along the

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length of the tube creates a field in the magnetic circuit of the tube which is substantially concentric with the axis of the tube.

I further provide an inductive coil formed from wire 3 comprising one or more turns around the tube formed by rolled tape 1. Such turns are substantially concentric with the tubular magnetic circuit. Because the magnetic field within the ferromagnetic material created by current flowing in the turns formed from wire 3 is parallel to the tube's axis and otherwise substantially orthogonal to the field formed by current flowing through conductor 2, the inductive coupling between the conductor 2 and wire 3 is effectively zero. Therefore, change in current flow through wire 2 does not induce current in wire 3 and vice versa. However, the aforementioned ferromagnetic tube has isometric characteristics, so that changes in the magnetic flux concentric with or parallel to the axis of the tube between non-saturated and saturated levels of the magnetic material by a change in current flow in either conductor 2 or wire 3, respectively, is effective for making a corresponding change in the inductive impedance presented by the turns of wire 3 around the tube, or conductor 2, respectively. The value of the inductance presented by the turns formed from wire 3 or by conductor 2 when no orthogonal field exists may be varied by changing the number of turns of wire 3 wrapped around the tube or the number of conductors 2 within the tube. This value also may be varied by changing the number of turns of tape (and hence, the effective thickness of the tube's magnetic material) used to form the tube. Capacitor 6 is connected across coil 3 to form a tank circuit and a fluctuating signal having twice the frequency of the resonant tank is applied to coil 2 by voltage source 7 when switch 8 is closed, thereby to set up parametric oscillations in the tank circuit as described in detail in the aforementioned article.

Referring to FIG. 2, I provide a modification of the above-described inductor which also includes the elements of a capacitor, so that by joining one of the windings to the capacitor, a self-contained tank circuit for use in a parametrically-excited resonator is formed. To this end, a length of tape 1a having a non-conducting backing material of uniform thickness is rolled along its length to form a tube. A conductor 2a is passed along the length of and substantially concentric with the formed tube to constitute a first winding. A second winding is formed by passing conductor 3a around the outside of the tube. Instead of having a single coating of magnetic material in the manner set forth in the preceding paragraphs, tape 1a of the FIG. 2 inductor has coatings of conductive magnetic material on both its opposed faces, each coating being electrically separated from the other by the non-conductive tape backing material. In order to separate the outward facing magnetic coating from the inward facing magnetic coating when tape 1a is rolled along its length and its outer end sealed against the tube body, I provide a length of sheet dielectric material 4. By providing an adhesive coating on both faces of sheet 4, sheet 4 also is used for sealing the outer end of tape 1a against the tube body.

With the non-conductive backing of tape 1a serving as the dielectric material, its opposed, conductive coatings serve as plates of capacitor, so that in addition to the function of serving as a magnetic circuit of variable permeability in the manner set forth in connection with the FIG. 1 inductor, the capacitor so-formed, which has predictable value, can be connected either in parallel or series with one of the windings of the inductor. In order to electrically connect the capacitive plates of the tape to the winding, I provide electrodes 5a and 5b connected to the outward and inward facing magnetic material coatings of tape 1a. Electrodes 5a and 5b are coupled appropri-

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ately to ones of wires 2a or 3a as the requirements of the inductor application dictate.

While I have shown and described a specific embodiment of my invention, other modifications will readily occur to those skilled in the art. I do not therefore desire my invention to be limited to the specific arrangement shown and described and I intend in the appended claims to cover all modifications falling within the spirit and scope of my invention.

What I claim is:

1. In a tank circuit, a tube comprising at least one closed turn of tape having a non-conductive body and conductive coatings on its opposite surfaces, at least one of said coatings containing magnetic material, means for separating the outward facing from the inward facing ones of said coatings, a coil positioned adjacent said tube and means for connecting at least one of said coatings to said coil.

2. A tank circuit comprising a roll of magnetic tape having a nonconductive body, said magnetic tape having conductive coatings on its opposed surfaces, means for separating the outward facing from the inward facing ones of said coatings, a first coil including at least one conductor substantially parallel to the axis of said roll for conveying electric current along the length of said roll, a second coil having its turns substantially concentric with the axis of said roll, and means for connecting said coatings to one of said coils, whereby the inductive coupling between said first and said second coils is substantially zero and the capacitor formed by said coatings and the one of said coils connected thereto may serve as a resonant circuit.

3. In a tank circuit, a tube comprising at least one closed turn of tape having a non-conductive backing, said tape having conductive coatings on its opposed surfaces, at least one of said coatings comprising magnetic material, means for separating the outward facing from the inward facing ones of said coatings, a first coil including at least one conductor substantially parallel to the axis of said tube for conveying electrical current along the length of said tube, a second coil having its turns substantially concentric with said tube, and means for connecting said coatings to one of said coils, whereby change in current flow through one of said coils not connected to said magnetic material sufficient to drive said magnetic material between non-saturated and saturated conditions is effective for changing the value of inductance presented

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by the other of said coils, the inductive coupling between said first and said second coils is substantially zero, and the capacitor formed by said coatings and the one of said coils connected thereto may serve as a resonant circuit.

4. In a tank circuit, a tube comprising at least one closed turn of tape having conductive coatings and a non-conductive body means including a length of sheet dielectric material having adhesive on the surface thereof for sealing the overlapping portions of said tape to said tube body and for electrically separating the inward facing one of said conductive coatings from the outward facing one of said conductive coatings, at least one of said conductive coatings containing magnetic material, a first coil including at least one conductor substantially parallel with the axis of said tube for conveying electrical current along the length of said tube, a second coil having its turns substantially concentric with said tube, and means for connecting the capacitor formed by said opposing coatings of said tape to one of said coils, whereby change in current flow through said conductor sufficient to drive the magnetic material of said tube between non-saturated and saturated conditions is effective for changing the value of inductance presented by said coil, the inductive coupling between said coils is substantially zero, and, one of said coils and the capacitor formed by said coatings may form a resonant circuit.

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