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ADJUSTABLE CORE TRANSFORMER OSCILLATOR

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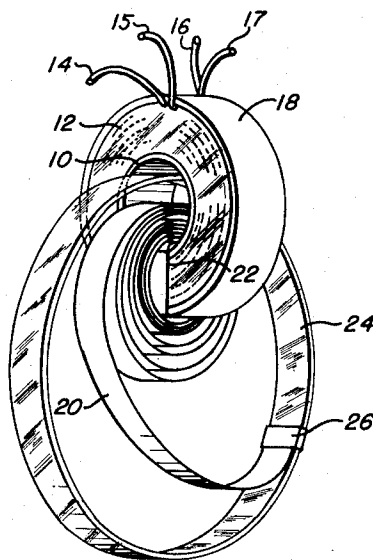


FIG. 1

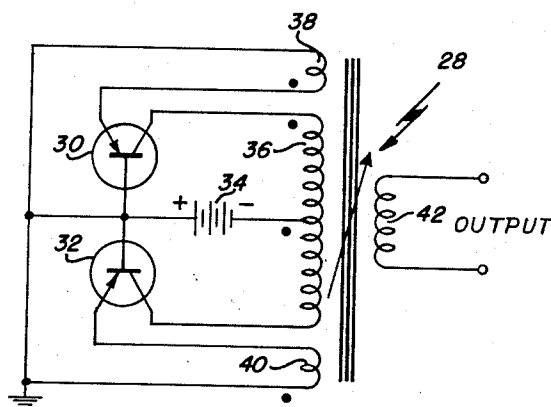


FIG. 2

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ADJUSTABLE CORE TRANSFORMER OSCILLATOR

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This invention relates to transformers, inductances and the like, and more particularly to transformers whose electrical characteristics are altered by adjusting the cross-sectional area of the transformer core structure.

In transformers and inductances in which the size of the air gap in the core material is varied in order to change the inductance without changing the number of turns, the adjustment point for maximum inductance occurs when there is the least possible air gap. In the region of least possible air gap, the inductance of the coil changes extremely rapidly, making accurately controlled settings for desired values of inductance difficult if not impossible to obtain. Thus, in core assemblies of this type, minute changes in the air gap result in large changes in inductance. It is, therefore, desirable to provide a transformer in which relatively large changes in inductance can be accurately controlled.

In accordance with the invention, a transformer is constructed of two loops coupled together like links in a chain. One of these loops is the electrical part of the transformer and comprises a toroidal bobbin or coil form upon which is wound the transformer coils or windings. The second loop consists of a multi-turn band or ribbon of magnetic core material. One end of the ribbon is secured to the inner surface of the coil form or bobbin and the other end is secured to a thin insulated ring, preferably of plastic material, larger than and concentric with the loops of core material. By winding or unwinding turns of the magnetic ribbon from the core of the transformer, the cross-sectional area and, consequently, the maximum flux of the transformer is changed. Rotation of the insulated ring in one direction winds turns of the ribbon core material tightly around the transformer windings to increase the cross-sectional area of the core material to provide a greater magnetic flux linkage. By rotating the insulated ring in the opposite direction, the ribbon core material is unwound from the transformer windings to decrease the cross-sectional area of the core material providing a decrease in flux linkage. In this manner, the number of turns of core material linking the coil or individual windings is accurately controlled by the angular position of the insulated ring, which is rotated to thread more or less turns of ribbon core material through the coil form depending upon the desired value of inductance.

The invention further discloses a basic transistor inverter circuit incorporating an adjustable core transformer in a high-efficiency transistor square wave generator circuit. In this circuit, each transistor is alternately switched into the conducting state and the transformer core saturates in alternate states at a frequency which is determined, in part, by the number of turns on the transformer primary, the saturation flux density, and the cross-sectional area of the core material; the latter being accurately controlled by the addition or subtraction of turns of core material linking the windings of the transformer.

The foregoing and other objects of the invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawing, wherein:

FIG. 1 is an isometric view of an adjustable core transformer made according to this invention; and

FIG. 2 is a schematic diagram of a transistor square

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wave generator incorporating a transformer constructed according to the teachings of this invention.

In FIG. 1 there is shown a bobbin or coil form 10, preferably constructed of a non-inductive material. Wound upon the coil form 10 are primary and secondary transformer windings 12 provided with terminals 14, 15, 16 and 17. These windings and bobbin form a first loop or the electrical part of the transformer. An outer band of insulated material 18 provides a protective shield for the windings but does not form a part of the invention. The second loop constitutes the magnetic core of the transformer and consists of a multi-turn band or ribbon of magnetic material 20. One end of the magnetic ribbon is secured by an adhesive to the coil form 10 at 22 and the other end is secured to an insulated supporting ring 24 by means of a fastener 26. When the supporting ring 24 is rotated in one direction, additional turns of ribbon core material are coiled around the transformer windings and the effective inductance of the windings is thereby increased. In this manner, a large change in inductance, for example 10:1 ratio of minimum to maximum inductance, is achieved by effectively changing the cross-sectional area. This general method of obtaining variations in inductance is applicable for various purposes. For example, the invention can be employed to vary the inductance of a single winding, such as a choke, or to modify the coupling between two windings. The ease and smoothness of rotating the supporting ring can be increased by enclosing the ring within three capstan type pulleys, not shown, or similar means which permits the supporting ring to rotate in a fixed path.

Referring to FIG. 2, an adjustable core transformer 28 is shown incorporated in a basic transistor inverter circuit. The collector electrodes of transistors 30 and 32 are connected to a source of voltage 34 by way of primary winding 36 of transformer 28. The emitter electrodes of transistors 30 and 32 are connected, respectively, to feedback windings 38 and 40 and thence to the base of each transistor and the positive side of the voltage source 34. Transformer 28 is provided with an output winding 42, although a square wave output can be obtained at the collector electrode of either transistor. Tuning of the transformer to change its inductance and, thus, its frequency, is accomplished by varying the number of turns of core material linking the windings in the manner previously described. In operation, each transistor functions as a switch. At each half-cycle, negative voltage from source 34 is switched from one end of the transformer primary to the other in the following manner: Current flows from the collector of transistor 30 through primary winding 36 to voltage source 34 causing the core material to saturate. At saturation, the change in current through the primary winding 36 no longer provides the change in flux necessary to supply voltage to feedback winding 38. Transistor 30 is cut off and the switching transient occurring at cut off causes transistor 32 to conduct by making its emitter potential positive with respect to its base. In this manner, a square wave is obtained at a frequency which depends upon the cross-sectional area of the core material interlinking the transformer windings. The aforementioned circuit can replace a more complex relatively high power square wave generator. In addition a higher inductance is obtained for a given amount of core material than heretofore. While the circuit shown in FIG. 2 operates over a frequency range of 50 cycles to 75 kilocycles, higher frequencies can be achieved by construction techniques known to the art.

This completes the description of the embodiments of the invention described herein. However, many modifications and advantages thereof will be apparent to persons skilled in the art without departing from the spirit

and scope of the invention. Accordingly, it is desired that this invention not be limited to the particular details of these embodiments disclosed herein except as defined by the appended claims.

What is claimed is:

1. In combination, a coil form adapted to support windings, at least a winding on said coil form, a multi-turn band of magnetic material interlinking said windings and adapted to operate as a core for said windings, and a ring concentric to said multi-turn band interlinking said winding and supporting said multi-turn band in a manner adapted to control the number of turns interlinking said windings.

2. In combination, a coil form adapted to support windings thereon, at least a winding on said coil form, a length of magnetic material interlinking said winding by at least a single turn and adapted to operate as a magnetic core for said winding, and a guide ring interlinking said winding and supporting said length of magnetic material in a manner adapted during rotation of said guide ring to cause additional turns of magnetic material to interlink said windings.

3. In combination, a coil form adapted to hold windings on the periphery thereof, a plurality of windings on said coil form, a ribbon of magnetic material having at least one turn interlinking said windings, one end of said ribbon being secured to said coil form, and a support ring concentric to said ribbon and interlinking said windings, the other end of said ribbon being connected to the inner surface of said support ring.

4. In combination, a coil form adapted to hold windings on the periphery thereof, a plurality of windings on said coil form, a ribbon of magnetic material having at least one turn interlinking said windings, one end of said ribbon being secured to said coil form, and a support ring interlinking said windings, the other end of said ribbon being connected to said support ring.

5. A square wave generator circuit comprising first and second transistor means, each having at least emitter, base and collector electrodes, an adjustable core transformer having a center-tapped primary winding, a potential source common to said first and second transistor means connected between base and collector electrodes thereof through the respective halves of said center-tapped primary winding, first and second feedback windings on said transformer connected between the emitter and base electrodes, respectively, or said first and second transistor means, and an output winding on said transformer, said core of said transformer comprising a multi-turn band of magnetic material interlinking each of said windings of said transformer in a manner adapted to permit additional turns to be coiled around said windings.

6. A square wave generator circuit comprising first and second transistor means, each having at least emitter, base and collector electrodes, an adjustable core transformer having a center-tapped winding, a potential source common to said first and second transistor means connected between base and collector electrodes thereof through the respective halves of said center-tapped winding, first and second feedback windings on said transformer connected between the emitter and base electrodes, respectively, of said first and second transistor means, said core of said transformer comprising a multi-turn band of magnetic material interlinking each of said windings of said transformer in a manner adapted to permit additional turns to be coiled around said windings.

7. A square wave generator circuit comprising first and second transistor means, each having at least emitter, base and collector electrodes, an adjustable core transformer having a center-tapped primary winding, a potential source common to said first and second transistor means connected between base and collector electrodes thereof through the respective halves of said center-tapped primary winding, first and second feedback windings on

said transformer connected between the emitter and base, respectively, of said first and second transistor means, each of said feedback windings being connected so as to apply positive feedback between said emitter and base electrodes of said transistor means, an output winding on said transformer, said core of said transformer comprising a multi-turn band of magnetic material interlinking each of the windings of said transformer, and a ring concentric to said multi-turn band and supporting said multi-turn band in a manner adapted to control the number of turns interlinking said windings.

8. In a square wave generator circuit including first and second transistor means, each having at least emitter, base and collector electrodes; an adjustable core transformer having a center-tapped primary winding, a potential source common to said first and second transistor means connected between said base and collector electrodes thereof through the respective halves of said center-tapped primary winding, first and second feedback windings on said transformer connected between the emitter and base, respectively, of said first and second transistor means, each of said feedback windings being connected so as to apply positive feedback between said emitter and base electrodes of said transistor means, an output winding on said transformer, the core of said transformer comprising a multi-turn band of magnetic material interlinking each of the windings of said transformer, and a supporting ring in register with said multi-turn band and adapted during rotation thereof to cause a predetermined number of turns of said multi-turn band to interlink the windings of said transformer.

9. In combination, a coil form adapted to hold windings on the periphery thereof, a plurality of windings on said coil form, a ribbon of magnetic material having at least one turn interlinking said windings, one end of said ribbon being secured to said coil form, and a support ring interlinking said windings and rotatable with respect to said windings, the other end of said ribbon being connected to said support ring, thereby to vary the inductance of said windings in response to rotation of said support ring.

10. A transistor switching circuit comprising first and second transistor means, each having at least an emitter, base and collector electrode, an adjustable core device having a center-tapped winding, and a potential source common to said first and second transistor means connected between the base and collector electrodes thereof through the respective halves of said center-tapped winding, first and second windings on said device connected between the emitter and base electrode, respectively, of said first and second transistor means to apply positive feedback to said transistors, said core of said device comprising a multi-turn band of saturable magnetic material interlinking each of said windings of said transformer in a manner adapted to permit additional turns to be coiled around said windings.

11. In combination, a form adapted to hold windings on the periphery thereof, a plurality of windings on said form, a ribbon of saturable magnetic material having at least one turn interlinking said windings, one end of said ribbon secured to said form, and a support ring interlinking said windings and rotatable with respect to said windings, the other end of said ribbon being connected to said support ring.

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