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2,285,128

INDUCTANCE DEVICE

Filed July 20, 1939

FIG. 1.

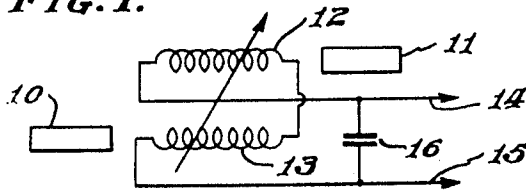


FIG. 2.

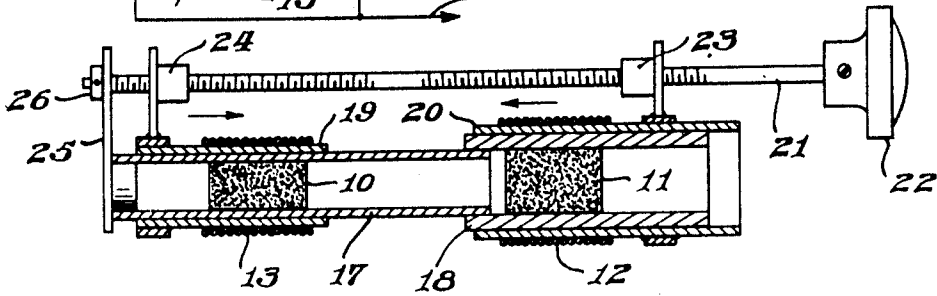


FIG. 3.

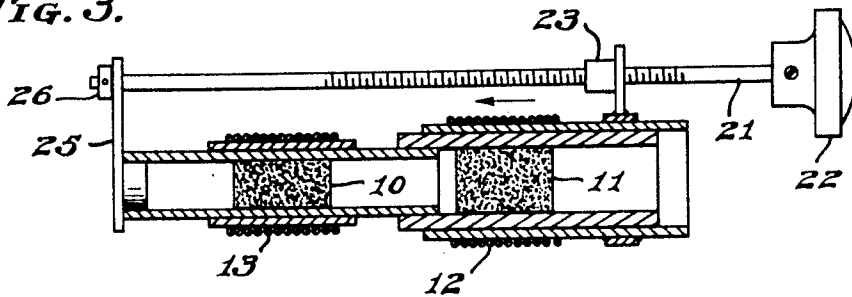


FIG. 5.

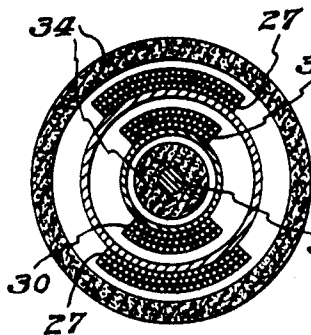
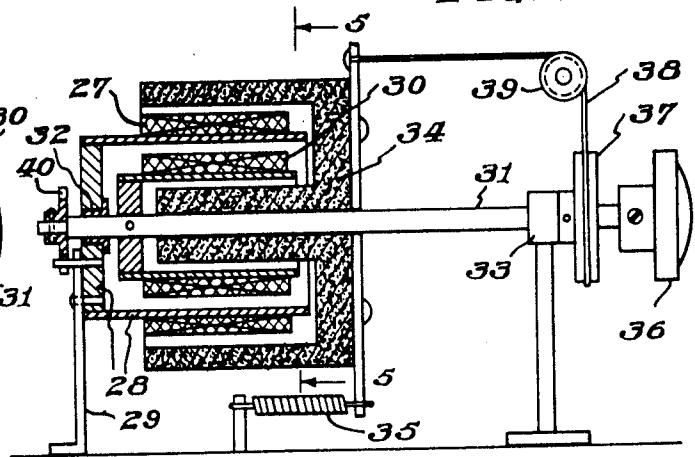


FIG. 4.



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UNITED STATES PATENT OFFICE

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INDUCTANCE DEVICE

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1 Claim. (Cl. 171-242)

This invention relates to inductance devices such as are utilized to tune an electrical circuit or the like, and has for its principal object the provision of an improved device and method of operation whereby an inductance variable over a comparatively wide range of values may be realized without objectionable decrease in the inductance-resistance ratio or "Q" of the device.

The desirability of means for securing a wide range of variation in inductance values has long been recognized. In achieving this result, difficulty has been encountered due to the decrease in the inductance-resistance ratio at some portion or portions of the inductance range. A low value of this ratio is undesirable for the reason that the resistance loss represents a waste of power. It is therefore desirable that the "Q," which is equal to $2\pi f L/R$, be maintained as high as possible for any given range in the values of the inductance L. The present invention makes available various means for producing this result.

In one form of the invention, a plurality of windings (1) are arranged to move axially with respect to one another, (2) are so connected as to produce opposed magnetic fields when they are concentrically disposed with respect to one another, and (3) are moved from a minimum inductance position, where they are concentrically disposed and operate with an air core, to a maximum inductance position where they are axially spaced apart and operate with an iron core.

In another form of the invention, one of the oppositely connected coils is fixed about a magnetic core and the other coil is movable axially from a maximum inductance position where it surrounds a magnetic core, through an intermediate inductance position where it surrounds an air core, to a minimum inductance position where it is concentrically disposed with respect to the fixed coil.

A further form of the invention involves the provision of concentrically arranged coils which are rotatable with respect to one another and are provided with magnetic core means which are moved away from the coils as the coils are moved from a position where their fluxes aid to a position where their fluxes oppose. Otherwise stated, the core means (1) are closely associated with the relatively rotatable coils when their fluxes aid and they are in the maximum inductance position, and (2) are spaced from the coils when their fluxes oppose and they are in their minimum inductance position.

The invention will be better understood from

the following description considered in connection with the accompanying drawing, and its scope is indicated by the appended claim.

Referring to the drawing,

Figure 1 is a wiring diagram illustrating the circuit connections of the improved inductance device,

Figure 2 illustrates a form of device including coils which are movable in opposite directions,

Figure 3 illustrates a device including fixed and movable coils, and

Figures 4 and 5 are different views of a device including relatively rotatable coils and an axially movable core member.

The wiring diagram of Fig. 1 illustrates a pair of magnetic cores 10 and 11, and a pair of coils 12 and 13 which are connected in series across electrical circuit terminals 14 and 15. A capacitor 16, connected in shunt to the series connected coils 12 and 13, may be provided to facilitate adjustment of the circuit tuning.

One suitable arrangement of the coils 12 and 13 with respect to the cores 10 and 11 is shown in Fig. 2. In this arrangement, the core 10 is mounted within a fixed tubular member 17, the core 11 is mounted within a fixed tubular member 18, the coil 13 is fixed to a tubular member 19 which is movable axially along the outer surface of the member 17, and the coil 12 is fixed to a tubular member 20 which is movable axially along the outer periphery of the member 18. It will be noted that the axially movable member 20 is of such diameter as to receive the coil 13 so that the two coils may be brought into concentric relation with one another.

For moving the coils 12 and 13 axially in opposite directions, there is provided any suitable means such as a rod 21, which is rotated by a control knob 22, has a right-hand screw threaded section arranged to cooperate with a nut 23 fixed to the carrier 20 of the coil 12, has a left-hand screw threaded section arranged to cooperate with a nut 24 fixed to the carrier 19 of the coil 13, and is fixed longitudinally in position by a bearing member 25 and a retaining collar 26.

With the coils 12 and 13 reversely connected as indicated by Fig. 1, these coils will provide a maximum inductance when they are spaced apart as illustrated by Fig. 2. As the control knob is rotated, the coils gradually approach one another until the coil 12 surrounds the coil 13 and the inductance is reduced to a minimum due to opposed fluxes in the air core common to the two coils. In the use of this form of the device, an inductance variation of approximately 10 to 1

has been secured with a one-inch movement of each coil.

The arrangement of Fig. 3 is similar to that of Fig. 2 except that the coil 13 is fixed about the core 10, and the coil 12 is movable from its illustrated maximum inductance position to a minimum inductance position where it surrounds the coil 13 and core 10. The inductance variation secured with this modification of the invention is of the order of 20 to 1.

The modification of Figs. 4 and 5 includes a coil 27 which is fixed to a stationary support 28—29, a coil 30 which is fixed to a shaft 31 rotatable in bearings 32—33, and a core member 34 which is movable along the shaft 31. The core member 34 is biased to its illustrated flux aiding and maximum inductance position by suitable means, such as a spring 35, and is moved away from the coils against the tension of the spring by rotation of a control knob 36 which operates (1) through the shaft 31 to rotate the coil 30 from a flux aiding to a flux opposing position, and (2) through the shaft 31, a pulley 37, a cord or belt 38 and a pulley 39 to move the core 34 from its illustrated maximum inductance position, where the fluxes of the two coils are in the same direction, to a minimum inductance position where the core is spaced from the coils and the fluxes of the coils are opposed. Since this movement of the coil 30 and core 34 in-

volves rotation of the coil through an angle of 180°, it is desirable to provide a cam member 40 for maintaining rotation of the coil within this angular range.

In the use of this modification of the invention, an inductance variation of the order of 100 to 1 has been realized. The use of this entire range, however, is not always advantageous, for the reason that the inductance-resistance ratio tends to decrease in the minimum inductance region of operation. A comparatively wide range of inductances may, of course, be realized if the operation is restricted to the high Q region.

It should be understood that the inductance ratio obtained in any particular case is determined to some extent by the characteristic and dimensions of cores and coils used.

I claim as my invention:

A variable inductance device including a pair of concentric inductance coils, a signal current supply connection through said coils, means for effecting relative rotary movement of said coils between flux opposing and flux aiding positions, movable core means positioned within said coils in the flux aiding position, and means for effectively withdrawing said core means from said coils in response to operation of said first-named means toward the flux opposing position.

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