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2,489,114

VARIABLE INDUCTANCE DEVICE

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Fig. 1.

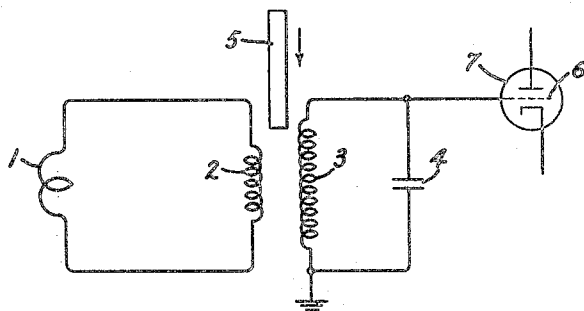


Fig. 2.

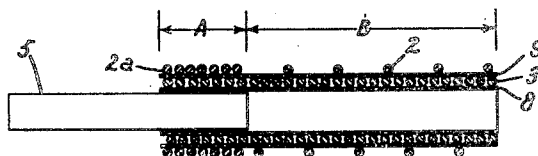


Fig. 3.

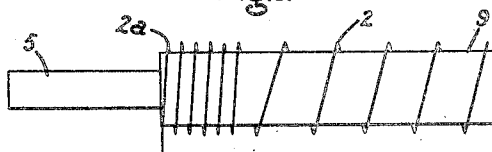


Fig. 4.

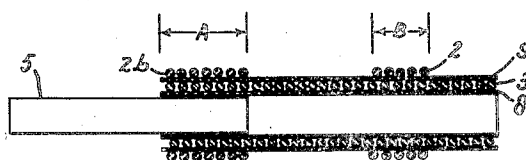
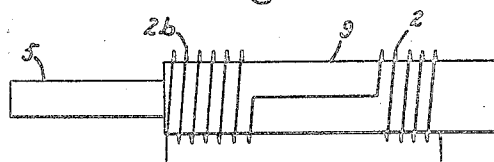


Fig. 5.



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UNITED STATES PATENT OFFICE

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VARIABLE INDUCTANCE DEVICE

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3 Claims. (Cl. 171-119)

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My invention relates to variable inductance devices and, more particularly, to permeability tuning of inductively coupled circuits, such as transformers and the like.

In circuits where the variable inductance of a permeability tuned resonant circuit is inductively coupled to a source of oscillations, it is known that the gain across the coupled circuits is a function of the coefficient of coupling between the coils. If the coupled coils are each uniformly wound, change in position of the tuning core effects a variation in coupling throughout the path of travel of the core, since most of the flux passes through the core.

Accordingly therefore, it is a general object of my invention to provide a new and improved inductively coupled circuit of variable permeability wherein means are provided for counteracting variations in coupling effected by movement of the magnetizable core.

It is a more specific object of my invention to provide, in a permeability tuned resonant circuit having its variable inductance element tuned by a movable magnetic core and inductively coupled to another circuit, means for ensuring a practical uniformity of the coupling coefficient throughout the range of movement of the tuning core.

It is still another object of my invention to provide, in a permeability tuned transformer having one of its windings connected in a resonant circuit, a second winding arranged to ensure practical uniformity of the coefficient of coupling throughout the range of movement of the tuning core.

My invention will be more fully understood and its various objects and advantages further appreciated by referring now to the following detailed specification taken in conjunction with the accompanying drawings, in which Fig. 1 is a schematic circuit diagram illustrating one application of a permeability tuned coupled circuit of the type to which my invention may be applied; Fig. 2 is a cross-sectional view of a transformer embodying my invention; Fig. 3 is an elevational view of the transformer shown at Fig. 2; Fig. 4 is a cross-sectional view of a transformer embodying my invention in another form; and Fig. 5 is an elevational view of the transformer shown at Fig. 4.

Referring now to the drawing, I have shown at Fig. 1 a typical permeability tuned resonant circuit in which the tuning coil is inductively coupled to a second coil which serves as a transformer primary winding. More specifically, I

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have shown at Fig. 1 an input stage of a radio receiving apparatus in which a receiving loop 1 is connected to supply radio frequency energy to a transformer primary winding 2. The winding 2 is inductively coupled to a secondary winding 3 across which is connected a capacitor 4. The tuning of the resonant circuit 3, 4 is controlled by a magnetizable core 5 relatively axially movable with respect to the coil 3. The radio frequency voltage appearing across the tuned circuit is supplied to the control electrode 6 of an electron discharge device 7, which may be a radio frequency amplifier or the like. It will be understood that the core 5 is axially movable into and out of one end of the coil 3 between a substantially retracted position and a substantially included position. The circuit 3, 4 is tuned to its highest frequency when the core 5 is fully retracted and to its lowest frequency when the core 5 is fully included.

I have discovered that when the primary winding of the transformer is uniformly wound, as schematically indicated at Fig. 1, a considerable variation in the coefficient of coupling is experienced throughout the path of travel of the tuning core. I have also discovered that such variation may be largely counteracted by concentrating an appreciable number of turns of the primary winding at that end of the secondary winding where the core enters the coil, the remainder of the primary winding being either openly distributed over the remainder of the secondary winding or concentrated at a point intermediate the concentrated section at the entrance end and the opposite end of the secondary winding.

At Figs. 2 and 3, I have shown one embodiment of my invention where a majority of the turns of the primary winding are concentrated at the entrance end of the secondary winding and the remainder of the primary turns are evenly distributed over the remainder of the secondary winding.

More specifically, I have shown at Fig. 2 a transformer comprising a secondary winding 3 wound upon a hollow cylindrical support 8 of suitable insulating material and provided with an axially moveable magnetizable core 5 shown in an intermediate partly included position. The core 5 may be formed of any suitable magnetizable material, but is preferably composed of a comminuted ferromagnetic material such as powdered iron or iron alloy. An insulating sleeve 9 encasing the secondary winding serves as a support for a coaxially wound primary winding 2 having a concentrated section A closely wound

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at that end of the secondary winding where the core 1 enters and a distributed section B uniformly and openly distributed over the remainder of the secondary winding. It will of course be understood that if the windings are otherwise insulated, the rigid sleeve 9 may be omitted. In a practical embodiment of my invention, I have found that, with a primary winding having twelve turns, approximately seven of the turns should be concentrated in the section A and five of the turns distributed throughout the section B. An elevational view of the transformer of Fig. 2 is shown at Fig. 3.

At Figs. 4 and 5, I have shown another embodiment of my invention wherein the section B of the primary winding, shown as distributed at Figs. 2 and 3, is concentrated at a point approximately three-fourths of the distance along the secondary winding from the core entrance end. In all other respects, the transformer shown at Figs. 4 and 5 is similar to that shown at Figs. 2 and 3 and like parts have been assigned the same reference numerals. The embodiment of Figs. 4 and 5 does not render the coefficient of coupling quite as uniform as that of Figs. 2 and 3, but may be desirable from the point of view of simplifying manufacturing practice.

Although I have shown the secondary winding 3 as uniformly wound by way of illustration, I wish to have it understood that such an arrangement is not necessary to the practice of my invention. Indeed, it may be preferable to wind the secondary non-uniformly and in such a manner that the visible tuning scale will be substantially linear. The coupling coefficient is controlled primarily by the relation between the core and the primary winding, whether the secondary be wound uniformly or in a manner providing a linear tuning scale.

While I have described only certain preferred embodiments of my invention by way of illustration, many modifications will occur to those skilled in the art and I therefore wish to have it understood that I intend in the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a radio receiver, a high frequency input circuit comprising a first winding having a pair of terminals, a loop antenna connected between said terminals, a second winding coupled to said first winding, said second winding comprising a coil of closely wound turns, a magnetizable core mounted for axial movement in and out of one end of said coil, said first winding comprising a second coil conductively isolated from and wound coaxially with respect to said

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first coil, said second coil having at least half of its turns concentrated at said one end of said first coil and the remainder of its turns spaced between said concentrated turns and the other end of said first coil, whereby the coefficient of coupling between said coils remains substantially constant as said core is moved into and out of said first coil.

2. In a radio receiver, a high frequency input circuit comprising a resonant circuit including a transformer having a secondary winding connected in said resonant circuit, a magnetizable core relatively axially movable into and out of one end of said secondary winding to tune said resonant circuit, a primary winding conductively isolated from and coaxially wound upon said transformer, said primary winding having a concentration of turns at said one end of said secondary winding and the remainder of its turns spaced between said concentrated turns and the other end of said secondary winding, and a loop antenna connected across said primary winding, the ratio of the number of said concentrated turns to the total number of turns of said primary winding and the spacing of said remainder of turns relative to said concentrated turns being such that the coefficient of coupling of said coils remains substantially constant as said core is moved into and out of said secondary winding.

3. In a radio receiver, a high frequency input circuit comprising a resonant circuit including a transformer having a secondary winding connected in said resonant circuit, a magnetizable core relatively axially movable into and out of one end of said secondary winding to tune said circuit, a primary winding conductively isolated from and coaxially wound upon said transformer and having at least half of its turns concentrated at said one end of said secondary winding and the remainder of its turns concentrated at a point intermediate said concentrated end portion and the opposite end of said secondary winding, and a loop antenna across said primary winding.

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