

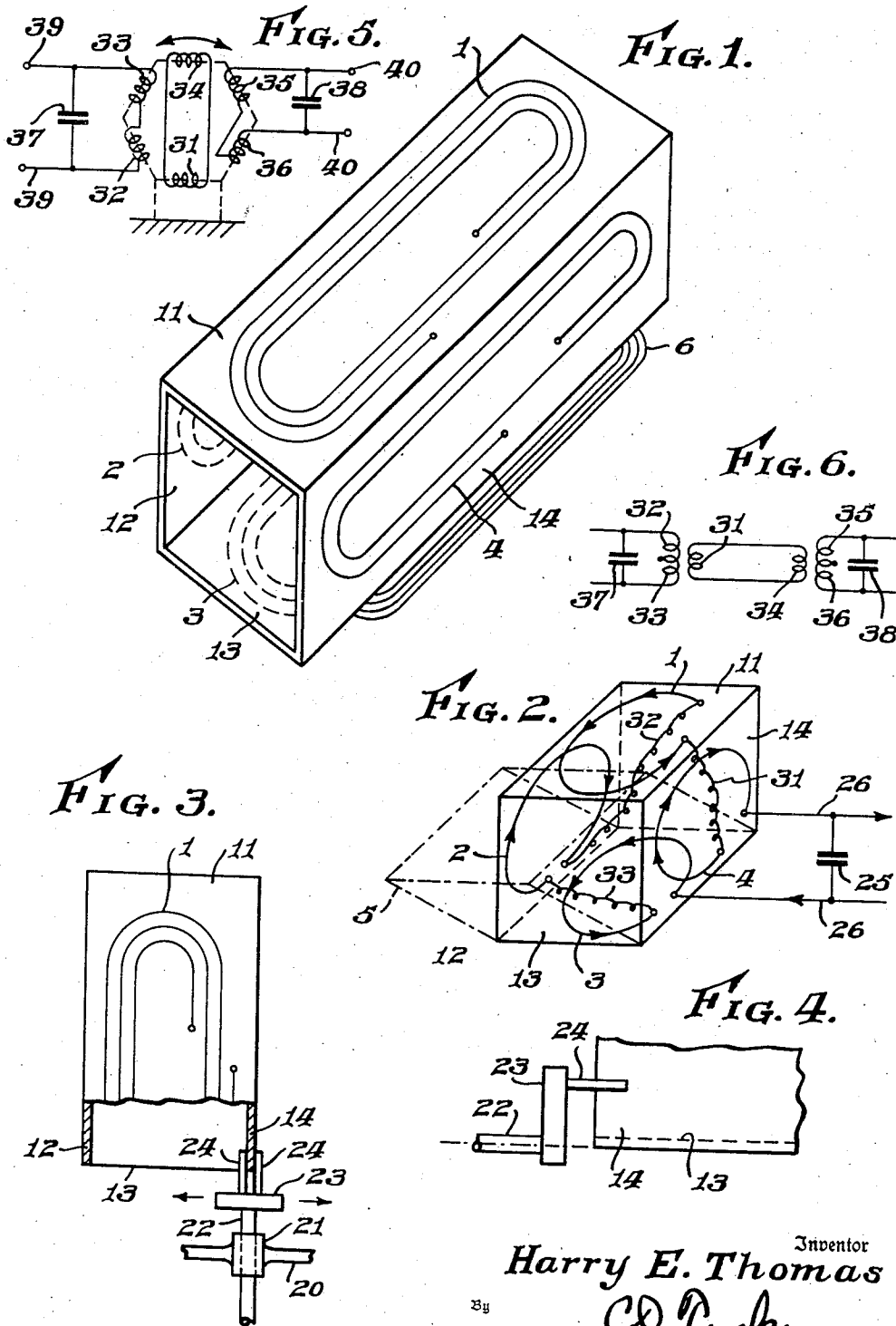
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MECHANICALLY TUNED LOOP ANTENNA

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MECHANICALLY TUNED LOOP ANTENNA

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1 Claim. (Cl. 250—33)

This invention relates generally to variable inductive devices and particularly to mechanically tuned inductors or loop antennas comprising a plurality of loops and means for varying the mutual inductance between three or more of the loops.

From the standpoint of economical receiver construction, it is quite desirable to tune the antenna circuit and the input circuit to the first radio frequency tube by means of a variable inductance in conjunction with a fixed capacitor. Heretofore, considerable difficulty has been experienced in designing a suitable variable inductance having an inductance ratio of the order of nine to one which is necessary for tuning coverage of the usual broadcast frequency band. Most variable inductors provide inductance variations of only three or four to one, while those utilizing metallic cores are subject to critical design and adjustment. Older methods, utilizing shorting turns or metallic sheaths, cause considerable loss in efficiency, seriously reducing the sensitivity of the receiver.

This invention contemplates the use of a tuned inductor or loop antenna having satisfactory efficiency throughout the desired frequency band, and providing for a ratio of minimum to maximum inductances of the order of ten to one. The invention is adapted to simple and inexpensive mechanical design, and may provide tuning of both the antenna circuit and the input circuit to the first radio frequency input tube. The tuned loop of the invention includes, by way of example, four loops serially connected, mounted upon a collapsible, hinged frame in such a manner that maximum inductance is provided when the frame is in one position and a gradual reduction of inductance is provided as the shape of the frame is changed.

Among the objects of the invention are to provide an improved method of and means for combining a plurality of inductors, adjustable with respect to each other, for varying the total inductance of the circuit. Another object of the invention is to provide an improved method of and means for combining a plurality of inductors mounted upon a suitable collapsible hinged frame. Still another object is to provide an improved method of and means for adjusting the relative positions of a plurality of serially connected inductors hinged with respect to each other. A further object is to provide an improved variable inductance comprising a plurality of interconnected coils, hinged with respect to each other, and means for varying the relative posi-

tion of the coils to change the mutual inductance thereof. Another object is to provide a variable filter circuit comprising a plurality of tuned circuits having substantially constant inductive coupling, the tuning of said tuned circuits being a function of the mutual inductance between the inductive circuit components.

The invention will be described by reference to the drawing of which Figure 1 is a perspective view of one embodiment of the invention; Figure 2 is a schematic diagram of the same embodiment of the invention; Figure 3 is a plan view of a modification of the invention; Figure 4 is an elevational view of the operating device comprising a component of Fig. 3; Figure 5 is a schematic diagram of a second embodiment of the invention; and Figure 6 is an equivalent circuit diagram of the embodiment of Fig. 5. Similar reference numerals are applied to similar elements throughout the drawing.

Referring to Fig. 1, four loops, 1, 2, 3, and 4, wound in the same direction, are mounted upon four supports 11, 12, 13, and 14, respectively, which are hinged to each other to form a hollow body having substantially square cross section. It is apparent that if the loops are constructed to be self-supporting, for example, collodion supported windings, the supports 11, 12, 13 and 14 may be omitted and the windings directly hinged to each other by suitable cloth or other type hinges. Any suitable means of securing the support 13 to a suitable base, and varying the angular relation of the supports 11, 12, and 14 thereto, may be provided.

Fig. 2 is a schematic diagram showing the direction of the currents at any instant through the four serially connected coils 1, 2, 3 and 4. The connections between the coil terminals are indicated by the pigtail connections 31, 32, and 33. When the coils 2 and 4 are substantially normal to the coils 1 and 3, the mutual inductance between the coils 2 and 4 is additive, and the mutual inductance between the coils 1 and 3 is also additive, while the mutual coupling between the coils normal to each other is at a low value. As the coils 2 and 4 are rotated counterclockwise with respect to the coil 3, for example, to the position 5, the mutual inductance between the coils 1 and 3 and the mutual inductance between the coils 2 and 4 is decreased. The currents in the coils 2 and 3 and the currents in the coils 1 and 4 are in phase opposition, to a degree depending upon the angle of rotation. If the coils 2 and 4 are rotated clockwise with respect to the coil 3, the mutual inductance be-

tween the coils 1 and 3 and the mutual inductance between the coils 2 and 4 is gradually reduced, but the mutual inductance between the coils 1 and 4 and the mutual inductance between the coils 2 and 3 is increased to a relatively high value as the angle of rotation is increased, due to the extremely close coupling between these coils at the extreme clockwise adjustment. A fixed tuning condenser 25 is connected across the output terminals 26 to tune the loop circuit to the desired minimum frequency at the maximum inductive adjustment.

Fig. 3 is similar to the device described by reference to Fig. 1 with the addition of a typical actuating device for adjusting the relative angular relation of the four loops. The actuating device includes a bearing 21 mounted on a suitable support 20. A shaft 22, journaled in the bearing 21, carries a crank arm 23 which includes two pins 24 which contact opposite faces of one of the vertical coil supports 14. If the axis of the shaft 22 coincides with the hinge between the supports 13 and 14, a reasonably close fit may be provided between the support 14 and the pins 24 thereby eliminating substantially all back-lash. Any suitable well known means for providing non-linear angular adjustment may be substituted to facilitate tuning. Fig. 4 is a side view of the tuning device and shows the shaft 22, crank 23, pin 24, and coil support 14.

It will be apparent that the constructional details may be varied considerably without deviating from the principles of the invention and that various modifications of the invention may be made insofar as they are necessary to the particular requirements of radio circuits other than antenna circuits. For example, the device may be made with relatively small compact coils suitable for use as a tuning inductance. Also suitable means may be provided for coupling circuits to the variable inductance provided by the invention, such as the coil 6 in fixed inductive relation to the coil 3. (See Fig. 1.) When the invention is adapted to use as a tuned loop antenna, the pickup throughout the useful frequency range has been found to be relatively uniform and the variation of inductance to resistance has been found to follow well-known practice. Flat wound coils are preferable when used as a loop antenna, since they provide higher mutual inductance and better signal pickup, while also being highly adaptable to simple and economical construction.

Fig. 5 schematically illustrates one method of

combining six windings, arranged hexagonally to provide a bandpass tuning device, comprising a tuned primary circuit including a first coil 32 connected in series with a second coil 33, both in parallel with a fixed tuning capacitor 37. A link circuit, including a serially connected stationary coil 31 and a movable coil 34, provides substantially constant coupling between the primary circuit and a secondary tuned circuit comprising the serially connected coils 35 and 36, both in parallel with a second tuning capacitor 38. Input currents are applied to the terminals 39 and output currents are derived from the terminals 40. The windings 32 and 33 are connected to provide aiding fields whereby an increase in mutual inductance results as the winding 32 is rotated counterclockwise with respect to the stationary coil 31. The windings 35 and 36 are connected to provide opposing fields whereby a similar increase in mutual inductance results from the counterclockwise rotation due to an increase in the angular relation of the coils 35 and 36 as compared to the decrease in angular relation of the coils 32 and 33.

The coupling remains substantially constant due to a substantially constant rate of coupling and decoupling of the tuned circuits with the two windings forming the link circuit, providing the mutual inductance of oppositely arranged coils may be kept at a low value. It should be understood that any other number and arrangement, including polarity, of coils may be used to provide a desired filter circuit without departing from the scope of the invention defined by the appended claim.

I claim as my invention:

A variable inductive device including at least three interconnected windings, means including separate insulating substantially flat members supporting each of said windings, hinge means for varying simultaneously the relative position and angular relation of said supporting members and hence said windings to vary the mutual inductance between at least two of said windings and for varying simultaneously in the opposite sense the mutual inductance between said two windings and the balance of said windings and eccentric means rotatable on the axis of one of said hinge means having an eccentric portion thereof in engagement with one of said insulating members for varying the angular relation and relative positions of said windings.

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