Jan. 12, 1954 L. G. KETCHAM 2,666,187

VARIABLE INDUCTANCE

Filed June 28, 1949

Fig. 1.

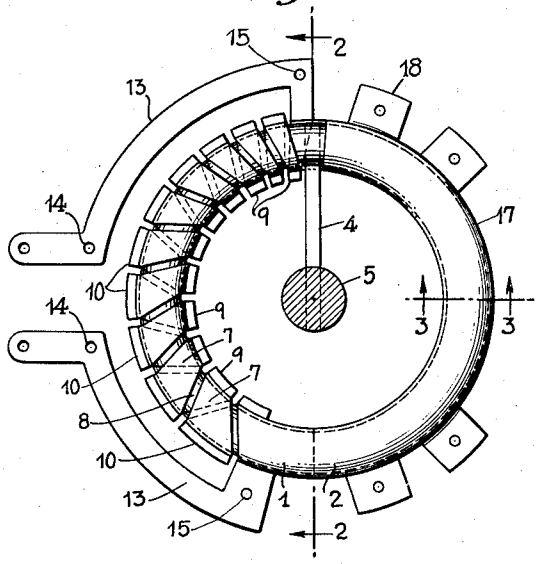


Fig. 2.

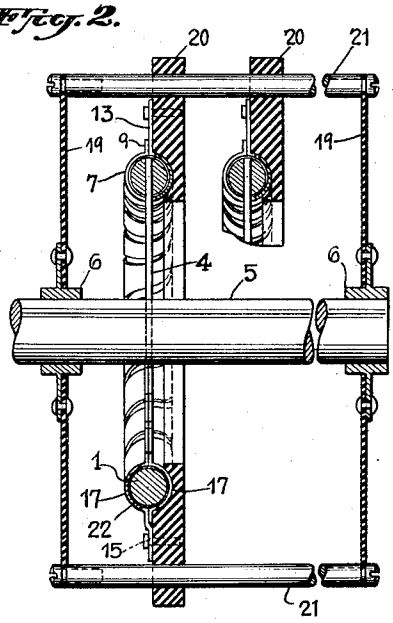


Fig. 4.

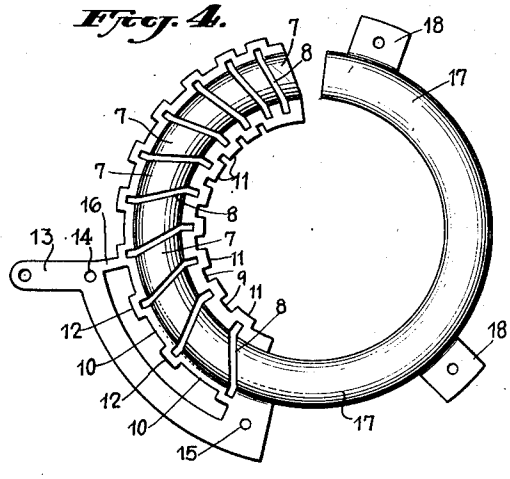


Fig. 3.

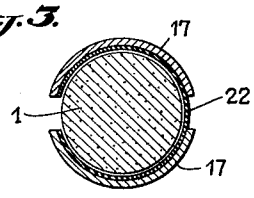


Fig. 6.

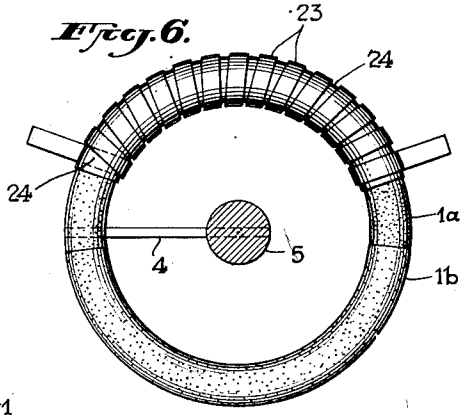
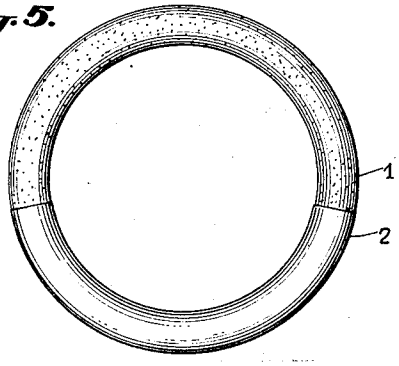


Fig. 5.



INVENTOR.
LYMAN G. KETCHAM.
BY Brand Cronby & Brad
ATTORNEYS.

Patented Jan. 12, 1954

2,666,187

UNITED STATES PATENT OFFICE

2,666,187

VARIABLE INDUCTANCE

Lyman G. Ketcham, Summit, N. J., assignor to Automatic Manufacturing Corporation, Newark, N. J., a corporation of New Jersey

Application June 28, 1949, Serial No. 101,713

11 Claims. (Cl. 336—136)

1

The present invention relates to automatic tuning devices of the permeability type, such as are used to adjust the constants of radio, television and like electrical circuits. The primary aim of the invention is to provide an efficient tuning device which will afford adjustment over a greater range in frequency in a smaller space, and in which the adjusting operation will be exceedingly simple. The invention has particular reference to an adjustable unit of the above character wherein a ferrous core is used which is in the form of a complete ring or torus, either or both of the core and its cooperating coil preferably having certain special features of construction as hereinafter disclosed in greater detail. The disclosure however should be considered as merely illustrative of the invention in its broader aspects.

In the drawings—

Fig. 1 is a side view of an automatic tuner constructed to operate in accordance with the invention, the main functional parts being shown independently of their mounting.

Fig. 2 is a section on line 2—2 of Fig. 1, looking in the direction of the arrows, and also shows a type of supporting structure appropriate for accommodating a gang of units of the character shown in Fig. 1.

Fig. 3 is a section on line 3—3 of Fig. 1, looking in the direction of the arrows.

Fig. 4 is a plan view of a type of metal stamping which may be used in constructing a coil of the character shown in Figs. 1 and 2.

Fig. 5 is a plan view showing detached, the type of core used in the device shown in Figs. 1 to 3.

Fig. 6 is a view similar to Fig. 1 but showing modified forms of coil and core structure.

The invention is shown in Figs. 1 and 2 as applied to a tuning unit having a core 1 in the form of a ring or torus, and which may be understood as constructed of powdered iron in known manner such that its permeability is substantially uniform throughout. However one arcuate portion of the core, which will usually be slightly less than 180° in extent, has a coating 2 of a metal such as silver, copper or aluminum which is of substantially higher electrical conductivity than the body of the core. The core member 1 is rotatable with respect to the coil structure which encloses a portion thereof, and therefore, depending upon the extent to which the coated area 2 of the core member projects into the coil structure, this coated area acts as a shorted turn which neutralizes or decouples

2

the permeability of the core, and further decreases the inductance of the coil below its nominal air core value, the inductance being at a minimum when the coated section of the core coincides with the coil and at a maximum when the coated section is remote from the coil. As shown in Figs. 1 and 2, the core member 1 may be mounted by means of a radial arm 4 upon a rotary spindle 5 supported by appropriate bearings 6.

The coil structure associated with the core may be made in juxtaposed arcuately shaped sections each partially enclosing the core, so that these sections may be joined together to constitute a helical coil or winding surrounding part of the core, without requiring that the winding be wound around the body of the core or about a coil form.

Fig. 4 shows a form of metal stamping appropriate for constructing a coil of the above character, a metal plate being stamped out to provide a series of partial helical turns 7 separated by slots 8 and each provided with inner and outer flanges 9 and 10 respectively, the adjacent half helical turns 7 being initially held in proper position to each other by bridging strips 11 on the inner rim of the stamping, and similar bridging strips 12 on the outer rim of the stamping. A terminal strip 13 extending from the partial helical turn at the left of Fig. 4, may also be stamped out at the same time, this strip being shown as provided with rivet holes 14 and 15 for attachment to an appropriate insulating support as hereinafter described. The terminal strip 13 is also shown as provided with a temporary connecting strip 16 (Fig. 4) to assist in holding it in position during the assembly operations hereinafter described. Optionally the stamping above described may also be provided with a continuous, somewhat less than semi-circular, arcuate portion 17, for purposes later described, this arcuate portion being shown as provided with supporting lugs 18 for attachment to an appropriate insulating support by eyelets or the like.

In assembling a coil structure of the above character, two complementary, mating metal stampings of the character shown in Fig. 4 will be employed, one being right hand and the other left hand, so to speak, so that when juxtaposed as shown in Fig. 1, the partial helical turns 7 of the two sections will match up to form complete helical turns surrounding the core, adjacent flanges 9 and 10 of such turns being then suitably bonded together as by soldering and

each complete turn thereby being structurally discontinuous at the bonded flanges or ends but being electrically continuous.

Then the coil structure surrounding the core may be placed in an appropriate shear, to cut off the bridge strips 11, 12 and 16, thus forming a continuous helical coil out of the assembled sections.

In Fig. 2 I have shown a mounting structure appropriate for a gang of units of the above character, wherein the spindle 5 is journaled in end plates 19 which will be understood as located at the opposite ends of the assembly, and each tuning unit is supported by an insulating ring 20 held in position by rods 21 extending through the assembly. Each coil structure may be secured to its supporting ring 20 by eyelets or similar fastening devices passing through the terminal strips 13, and the tabs 18 if the latter be used.

Thus the tuning operation is exceedingly simple, requiring merely angular adjustment of spindle 5 and the core or cores carried thereby, with respect to the corresponding coil structure or structures. The core being of torus form, will afford maximum permeability, and the unit will afford adjustment over a large range in frequency, and will be relatively small in displacement. As indicated in Figs. 1 and 4, the pitch of the helical conducting turns making up the coil structure if desired may be made different at different points along the coil to obtain straight-line frequency tuning, i. e. avoid crowding at the high frequency end of the band over which the unit is used.

Also if desired, the arcuate sections 17 of the coil structure above described, may be used to provide variable capacity in the resulting unit. As indicated in Figs. 1, 3 and 4, these arcuate sections 17, being insulated from each other and having a dielectric strip 22 interposed between them and core 1, will produce a variable capacity effect in the circuit in which the unit is used, depending upon the angular relation of the silvered section 2 of the core with respect to the arcuate sections 17 which act as condenser plates or armatures.

Also when the unit is to be used in the lower frequency range, the core member as indicated in Fig. 6, may be constructed to afford different permeability in different arcuate portions of the body thereof. Fig. 6 shows arcuate portions 1a and 1b, one of which is relatively high and the other relatively low in permeability. In previous permeability tuning units, a limiting factor has been that the so-called "q" value has been quite low when the core was remote from the winding, but with a core of the above described character the "q" value will be relatively high in all positions of the core. In circuits of relatively low frequency, the coil structure as indicated in Fig. 6 may be in the form of a helical conductor 10, wound about an arcuate coil form 11, the core sections 1a and 1b being separately constructed of powdered iron of different permeability and cemented together by an iron containing cement, or being of different cross-sectional areas.

While the invention has been disclosed as carried out by tuning devices of the specific constructions above described, it should be understood that changes may be made therein without departing from the invention in its broader aspects, within the scope of the appended claims.

I claim:

1. A tuner of the character described, having a core member in ring form, and a cooperating coil member of general arcuate shape enclosing a portion of said core member and disposed substantially concentrically with respect thereto, means mounting said coil and core members to afford relative angular movement of one with respect to the other, one arcuate portion of said core member having a coating of conductivity which is relatively high as compared to the body of the core.

2. A tuner of the character described, having a core member in ring form and a cooperating coil member of general arcuate shape extending along a portion of said core member and disposed substantially concentrically with respect thereto, means mounting said coil and core members to afford relative angular movement of one with respect to the other, said core member being of substantially uniform permeability in different arcuate portions thereof but one such arcuate portion having a coating of higher conductivity than the body of the core.

3. A tuner of the character described, having a core member in ring form, and a cooperating coil member of general arcuate shape enclosing a portion of said core member and disposed substantially concentrically with respect thereto, means mounting said coil and core members to afford relative angular movement of one with respect to the other, one arcuate portion of said core member having a coating of conductivity which is relatively high as compared to the body of the core, different turns of said coil member being of different pitch.

4. A tuner of the character described, having a core member of magnetic material in ring form, and a cooperating coil member of general arcuate shape enclosing a portion of said core member and disposed substantially concentrically with respect thereto, means mounting said coil and core members to afford relative angular movement of one with respect to the other, different arcuate portions of said core member being constructed to provide different permeability characteristics thereof in different angular positions of said core member with respect to said coil member.

5. A device of the character described having a coil member of general arcuate shape, a core member in ring form having a portion thereof enclosed by said coil member, said coil member comprising juxtaposed metal stampings each comprising a partial helical turn extending part way around the core, respectively adjacent ends of said partial turns of said stampings being joined together to make up a series of complete helical turns encircling the adjacent portion of the core member and one arcuate portion of said core member having a coating of conductivity which is relatively high as compared to the body of the core.

6. A tuner of the character described, having a core member in ring form, and a cooperating coil member of general arcuate shape enclosing a portion of said core member and disposed substantially concentrically with respect thereto, means mounting said coil and core members to afford relative angular movement of one with respect to the other, different arcuate portions of said core member being constructed to provide different permeability and conductivity characteristics thereof in different angular positions of said core member with respect to said coil member, said coil member also having associated

therewith, arcuate juxtaposed condenser plates overlying a portion of said core member.

7. A tuner of the character described having a core member in ring form, a cooperating coil member of general arcuate shape enclosing a portion of said coil member, juxtaposed condenser armatures overlying a portion of said core member and spaced from said coil member in a circumferential direction along said core member, means mounting said core member, said coil member and said condenser armatures to afford relative angular movement between said core member and said coil member and armatures, different arcuate portions of said core member being constructed to provide different permeability and conductivity characteristics thereof in different angular positions of said core member with respect to said armatures.

8. A coil for encircling a ring shaped core, said coil comprising juxtaposed metal stampings each having the shape of an arc whose radius is substantially equal to the radius of said core and each comprising a partial helical turn, respectively adjacent ends of said partial turns of said stampings being joined together to make up a series of complete helical turns and the dimensions of each complete turn being at least equal to the corresponding cross-sectional dimensions of said core.

9. A coil comprising a plurality of juxtaposed metal stampings each comprising a partial helical turn, the partial turn of one of said stampings being mounted in complementary relationship to the partial turn of another of said one stamping respectively adjacent the end of the partial helical turn of said other stamping being bonded to said end of said partial turn of said other stamping to make up a complete helical turn and the complete helical turn thereby being structurally discontinuous at the bonded ends but being electrically continuous.

10. A coil comprising a plurality of juxtaposed

metal stampings each comprising a plurality of adjacent partial helical turns, the partial turns of one of said stampings being mounted in complementary relationship to the partial turns of another of said stampings and respectively adjacent ends of said partial turns of said one stamping being bonded to respectively adjacent ends of the partial turns of the other of said stampings to make up a series of complete helical turns and each complete turn thereby being structurally discontinuous at the bonded ends but being electrically continuous.

11. A coil comprising a plurality of juxtaposed metal stampings each comprising a plurality of helical half turns having flanges at the ends thereof, the half turns of one of said stampings being mounted in complementary relationship to the half turns of another of said stampings and respectively adjacent flanges at the ends of said half turns of said one stamping being bonded to respectively adjacent flanges at the ends of the turns of said other stamping to make up a series of complete helical turns each having flanges thereon, each complete turn thereby being structurally discontinuous at the bonded flanges but being electrically continuous.

LYMAN G. KETCHAM.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
868,752	Barker	Oct. 22, 1907
1,712,121	Scheller	May 7, 1929
1,775,981	Warner	Sept. 16, 1930
2,126,473	Keller	Aug. 9, 1938
2,245,373	Weis et al.	June 10, 1941
2,354,331	Polydoroff	July 25, 1944
2,568,169	Raczynski	Sept. 18, 1951

FOREIGN PATENTS

Number	Country	Date
410,217	Great Britain	May 17, 1934