March 6, 1934. F ZIDAR 1,949,733

DUAL VARIO SELECTOR TUNING DEVICE

Filed Oct. 2, 1930 2 Sheets-Sheet 1

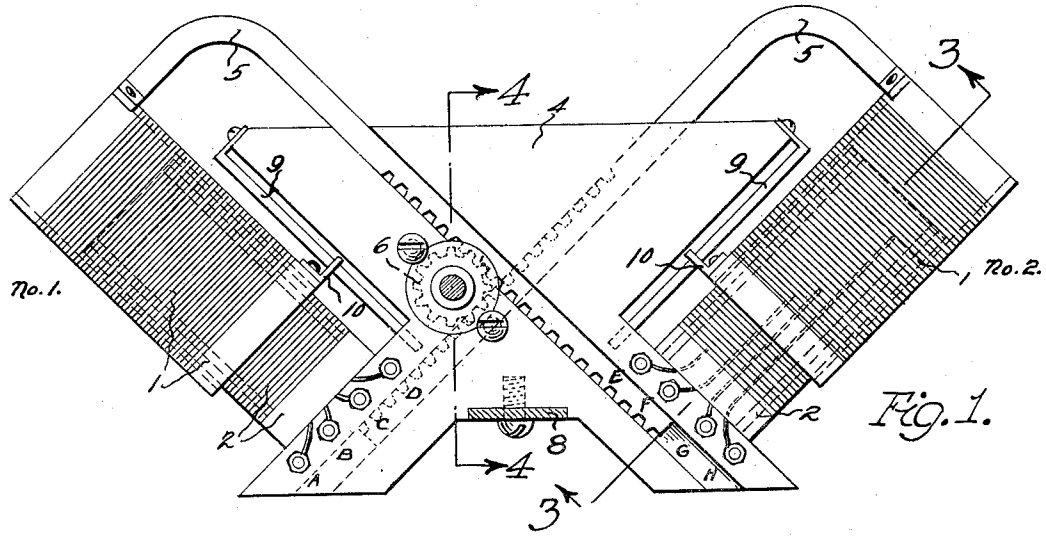


Fig. 1.

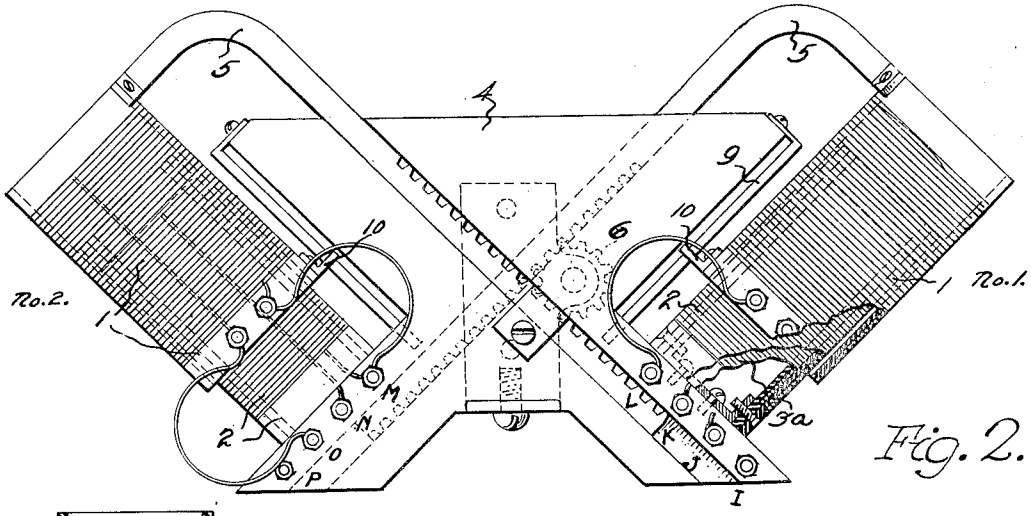


Fig. 2.

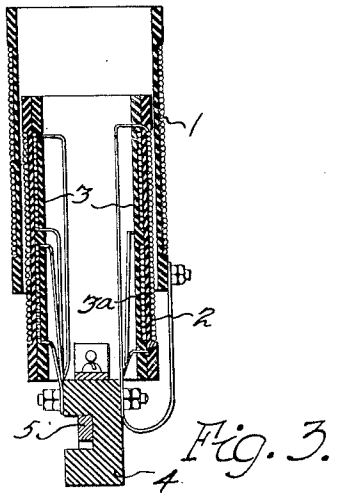


Fig. 3.

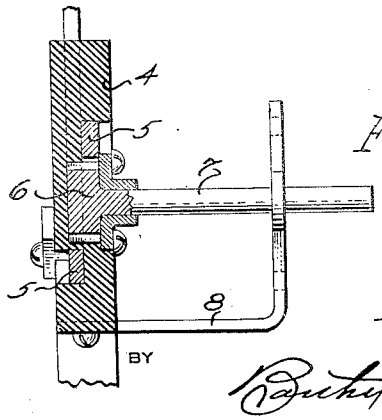


Fig. 4.

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DUAL VARIO SELECTOR TUNING DEVICE

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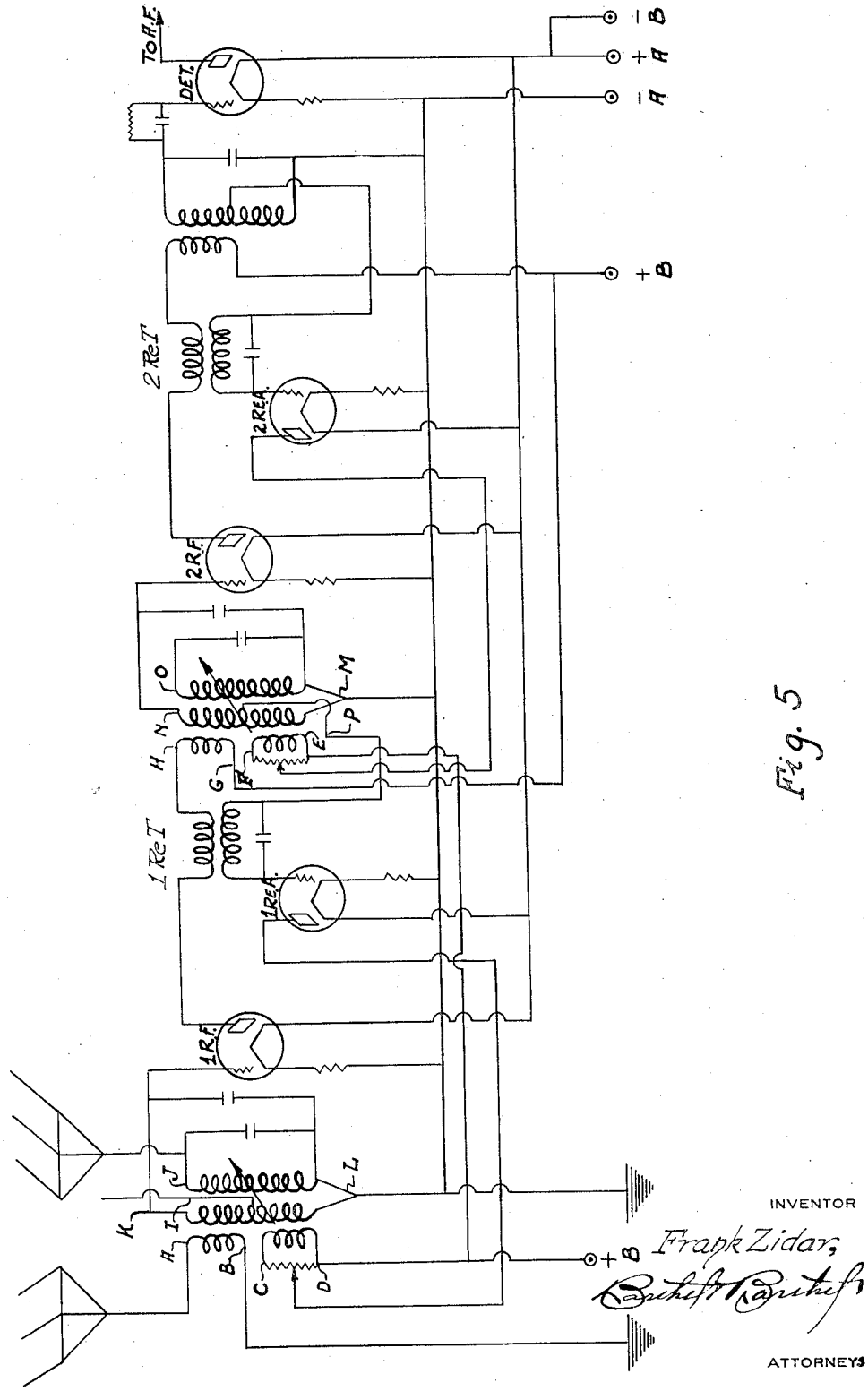


Fig. 5

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UNITED STATES PATENT OFFICE

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DUAL-VARIO SELECTOR TUNING DEVICE

Frank Zidar, Detroit, Mich.

Application October 2, 1930, Serial No. 485,862

6 Claims. (Cl. 250—40)

The present invention relates to means whereby a radio receiving set may be brought into resonance with sending stations operating at various frequencies or different wave lengths.

One object of my invention is the production of a single-control dual-unit structure of simple, compact design yet adapted to meet precision requirements for both selectivity and amplification.

It is an inductive type of tuning unit combining vario-selector and reamplifying elements in a single control device providing uniformly smooth action and particularly adapted for application to reflex or feed back circuits for amplifying signal energy both before and after detection, as incidentally described in my copending radio-circuit application, Serial Number 485,863, filed October 2, 1930.

Another object sought to be realized through use of my vario-selector tuning unit is uniformity of energy transfer throughout range of frequencies to which receiving circuit is tunable through use of my unit.

Another object attained by my invention is a more "natural" quality of tone, as compared with that obtainable through use of variable condensers, less distortion and increased power being due to more effective means of adjusting inductances for correct resonance.

When variable condensers are employed for tuning, the radio frequency transformer coils are fixed in position, but with my vario-selector unit, inductance relationships are variable, the secondaries consisting of both stationary and movable coils, the former being connected to the grids of radio frequency amplifying tubes.

Of the accompanying drawings,

Figure 1 is a front elevation, and

Fig. 2 is a rear elevation of my vario-selector tuning unit.

Fig. 3 is a sectional view of one of the transformer or coil elements taken on line 3—3 of Fig. 1.

Fig. 4 is a sectional view along line 4—4 of Fig. 1.

Fig. 5 is a schematic diagram showing circuit connections to my dual-unit vario-selector tuning device as applied to the radio-frequency end of a receiver having two stages of main-circuit radio-frequency amplification and two stages of auxiliary or feed-back circuit reamplification prior to detection or rectification, the same letters of reference as are used in Figs. 1 and 2 being applied to points of connection.

Similar parts of all drawings are indicated by the same reference figures and letters, as follows:

1—outer or moving part of radio-frequency transformer secondary inductance concentrically held in spaced relationship to the inner or stationary part 2 of secondary inductance.

3—3a—dual primary inductances of radio-frequency transformer concentrically located within stationary part of secondary inductance 2.

4—block or frame on which radio-frequency transformer-selector units are mounted at angle of 90 degrees.

5—racked members for actuating and supporting movable parts of radio-frequency tuning unit transformer secondaries and moving in suitable channels or slots, one behind the other, cut at angle of 90 degrees in opposite sides of block or inductance-supporting frame 4, to permit racked members to pass one another without interference when control knob is turned.

6—gear of sufficient width of face to mesh with combined actuating and coil-supporting racked members 5 by which part of each secondary inductance of both radio-frequency transformer units is moved when control knob is turned.

7—control rod to one end of which is attached a wide face gear 6 meshing with racked parts 5 that move outer parts of transformer secondaries in relation to fixed parts when knob attached to other end of rod 7 is turned.

8—control-rod supporting bracket attached to block or frame 4.

9—guide rod for keeping moving part of secondary inductances in concentrically spaced relationship to stationary parts 2 of radio-frequency transformer secondaries.

10—pierced guiding bracket attached to base of moving part 1 of each radio-frequency transformer secondary inductance and adapted to slide on guide rod 9 which serves to maintain concentricity of outer coil as it is moved in direction of its axis.

On the front or control side of the block or frame 4 there are eight terminals that serve to facilitate the work of making connections. For identification purposes only these terminals, as indicated on Fig. 1, have been lettered to indicate the following relationships:

A—upper end of first or left-hand tuning-unit transformer upper primary inductance to which one antenna is connected.

B—lower end of first or left-hand tuning-unit transformer upper primary inductance connected to separate external ground.

C—connection to plate of first reamplifying tube through a portion of a resistance shunted across ends of first or left-hand lower primary or reamplifying inductance.

D—connection between lower end of lower primary or reamplifying inductance of first or left-hand tuning-unit transformer and B positive.

E—connection between lower end of lower primary or reamplifying inductance of second or right-hand tuning-unit transformer and B positive of same voltage as D.

F—connection to plate or second reamplifying

tube through a portion of a resistance shunted across ends of second or right-hand lower primary or reamplifying inductance.

G—B positive connection to lower end of upper primary inductance of second or right-hand tuning-unit transformer.

H—connection between upper end of upper primary inductance of second or right-hand tuning-unit transformer and lead including (1 Re T) to plate of first radio-frequency amplifying tube.

On the rearward side of the block or frame 4, as indicated by Fig. 2, there are eight other terminals that are connected up as follows:

I—antenna optional connection mid-tapped stationary part of secondary inductance or grid coil of first or left-hand tuning-unit transformer.

J—upper end of movable part of first or left-hand tuning-unit transformer secondary inductance to which another or second antenna at right angles to antenna connected at A is attached.

K—upper end of stationary part of secondary of first or left-hand tuning-unit transformer connected to grid of first radio-frequency amplifying tube.

L—lower ends of stationary and movable elements of secondary inductance of first or left-hand tuning-unit transformer.

M—lower ends of stationary and movable elements of secondary inductance of second or right-hand tuning-unit transformer.

N—upper end of stationary part of secondary of second or right-hand tuning-unit transformer connected to grid of second radio-frequency amplifying tube.

O—upper end of movable part of secondary inductance of right-hand tuning-unit transformer connected by shunt including fixed condenser across ends of said inductance.

P—connection to mid-tap of stationary part of secondary inductance or grid coil of second or right-hand tuning-unit transformer.

The transformer secondaries of my vario selector tuning unit, as indicated by Fig. 3, are made up of two concentrically-disposed coils 1 and 2, the outer one of which is movable in an axial direction, the inner one 2 being fixedly attached to a suitably formed block or frame 4 wherein are formed at right angles to each other two rectangular channels or ways in which slide two racked outer-coil supporting members 5 that mesh with the teeth of a gear 6 by which, through knob attached to control rod 7, members 5 are simultaneously actuated to move back and forth in an axial direction the outer parts of radio-frequency secondary inductances concentrically surrounding and held in spaced relation to the stationary parts of secondary inductances.

Two primary inductances 3 and 3a are axially disposed within the stationary or grid coils of the radio-frequency transformer secondary inductances, as indicated by Fig. 3, the coils lying side by side on the same tubular support, the lower primaries 3a serving as reamplifying inductances for reenergizing the fixedly-mounted portions of the tuning unit transformer secondaries.

As herein disclosed, my vario selector unit is designed for use with two antennas strung at right angles to each other, one antenna being connected to one end of the primary inductance of the first or left-hand radio-frequency transformer, the other end of the primary being separately grounded outside the receiving set, while the other antenna is attached to one end of the movable section of the left-hand tuning-unit transformer secondary inductance, the other end of which is connected to the set ground, to which both the stationary and movable parts of the secondary inductance of the right-hand tuning-unit transformer are connected, the two antennas thus being separately grounded, as in my copending radio-circuit application Serial Number 485,863, filed October 2, 1930.

As shown by Fig. 5, which represents a hook-up similar to those disclosed in my copending application, Serial No. 485,863, the first or left-hand tuning-unit transformer is hooked up ahead of the first radio-frequency amplifying tube (1 R F), the plate of which is connected to the primary of the second or right-hand tuning-unit transformer as well as to the primary of a reamplifying transformer (1Re T) supplying inductively-generated energy to the first reamplifying tube (1 Re A), one end of the reamplifying transformer secondary winding being connected to the grid of that tube, as shown, while the other end is connected to the tapped fixed secondary inductance of the second or right-hand tuning-unit transformer, the tapped fixed secondary of the first or left-hand tuning-unit serving as an optional antenna connection I. The first reamplifying tube (1 Re A) of the auxiliary or feed-back circuit is interposed between the first radio-frequency amplifying tube (1 R F) and the second or right-hand vario-selector tuning-unit transformer interposed between the first (1 R F) and second (2 R F) radio-frequency amplifying tubes, the second reamplifying tube (2 Re A) being interposed between the second radio-frequency tube and the detector (DET) tube, the plate of the second radio-frequency tube (2 R F) being inductively coupled to the detector tube grid and to the second reamplifying tube grid through the secondary winding of the second reamplifying transformer (2 Re T) inserted in the main circuit ahead of the radio-frequency transformer from which inductively-generated amplified energy is supplied to the detector tube grid.

From the plate of the first reamplifying tube (1 Re A) energy is fed back to a reamplifying inductance forming part of the first or left-hand tuning-unit transformer, a variable resistance being shunted across the coil connections C and D, as shown. The reamplifying energy of the first reactivator tube (1 Re A) added to the signal energy passing through the antenna coil, the upper and lower ends of which are attached to tuning-unit transformer connectors A and B, acts inductively on the fixed and moving secondaries of the first or left-hand tuning-unit transformer, the upper or output end K of the fixed secondary being connected to the grid of the first radio-frequency tube (1 R F), the lower ends of both fixed and moving secondaries being attached to a common ground connection L of the first or left-hand tuning unit.

The plate of the second reamplifying tube (2 Re A) is connected to the reamplifying inductance forming part of the second or right-hand tuning-unit transformer, a variable resistance being connected across the ends E and F of the reamplifying inductance, the energy supplied thereto by the second reamplifying tube (2 Re A) acting inductively on the fixed secondary of the second or right-hand tuning-unit transformer, in exactly the same manner as does the energy supplied to the reamplifying inductance of the first or left-hand tuning-unit transformer but with enhanced effect, because the output energy of the second reamplifying tube (2 Re A) is great-

er than that of the first reamplifying tube (1 Re A), to which is delivered the energy inductively-produced in the first reamplifying transformer (1 Re T).

The energy contributed to the main or straight-line circuit by the instrumentalities in the out-of-line or auxiliary feed-back circuit comprising the first reamplifying transformer (1 Re T), first reamplifying tube (1 Re A), and reamplifying inductance of first or left-hand tuning-unit transformer is carried forward through the first radio-frequency amplifying tube (1 R F) to the right-hand tuning-unit transformer primary having connections G and H. The combined initial (or signal) and feed-back energy acts inductively upon the second or right-hand tuning-unit fixed secondary, the upper end of which is attached to connection N, the upper end of moving part of secondary being attached at O, the lower ends of the fixed and movable secondary coils being attached to a ground connection M common to both, the fixed secondary tap connection being at P. The accentuated inductively-generated output of the second or right-hand tuning-unit transformer secondary passes forward to the grid of the second radio-frequency tube (2 R F), the plate of which is connected to the primary of the second reamplifying transformer (2 Re T) and primary of a radio frequency transformer delivering its output to the detector-tube grid, its secondary being tapped for conductive coupling to one end of the second reamplifying transformer (2 Re T) secondary winding, of which the other end is connected to the grid of the second reamplifying tube (2 Re A), the output energy of which is fed back into the reamplifying inductance of the second or right-hand tuning-unit transformer.

Setting of the transformers at an angle of 90 degrees not only serves to remove each from the magnetic field of the other but brings about a mechanical advantage in that angularity of inductance positioning obviates the need for any sort of brake or motion-retarding element to offset the pull of gravity on relatively heavy parts and to prevent accidental disturbance of setting after tuning.

Although angularity of tuning unit transformer setting to avoid interference of magnetic fields is characteristic of the disclosed embodiment of my invention, it should be understood that, without departing from its spirit and scope, freedom from magnetic field interference may be obtained by the shielding of transformers placed in other than angular relationship. Since my tuning unit comprises an inner coil made up of two separate fixedly positioned side-by-side primary inductances of which one serves as a re-energizing or reamplifying element, the two coils being concentrically surrounded by two other coil-supporting tubes on the inner one of which is wound the fixedly positioned grid-coil section of a two-part secondary coil winding, the surrounding outer or tuning section of the secondary coil winding being axially movable in a straight line, it is obvious that with proper shielding there is no necessity for angular positioning of my variable-inductance tuning-unit transformers, which may then, if desired, be disposed in either opposed or parallel relationship, two gears, instead of one being used with latter arrangement to effect proper movement of the telescoping outer coils, the position of the racked coil-supporting members being changed to suit the mounting of tuning unit transformers.

What I claim is:

1. A vario-selector tuning unit of inductive type adapted for use with two antennas preferably set at right angles and having concentrically-disposed primary and secondary inductances arranged in two units at right angles to each other, said primary inductances being surrounded by both fixedly-positioned and axially-movable secondary inductances, said movable or outer secondary inductances surrounding said fixedly positioned or inner secondary inductances and being held in spaced relation thereto by two supporting members adapted to move both of said outer secondary inductances in an axial direction simultaneously through the turning of a single-control knob.

2. An inductive tuning device comprising two transformer units disposed at right angles to each other, each of said units being made up of primary inductances concentrically surrounded by the fixedly-positioned part of a secondary inductance that in turn is surrounded by the movable part of said secondary inductance, said movable secondary inductances being held in spaced relation to said fixedly-positioned secondary inductances by combined supporting and actuating members adapted to move them simultaneously in an axial direction when a control rod to which said combined supporting and actuating members are attached is turned, said tuning device being adapted for use with two antennas set at right angles to each other and with radio transmitting and receiving circuits involving reamplification of signal energy both before and after detection.

3. A radio-circuit tuning unit comprising two angularly-positioned air-core transformers each having two primary inductances concentrically disposed within the inner or stationary part of a two-part secondary inductance, the outer part of which is movable and is supported in spaced relation to the fixed inner or stationary part of the secondary inductance by angularly placed racks or gear-toothed members simultaneously actuated by turning a single control knob so as to move the outer secondary coils in an axial direction and bring transmitting and receiving circuits into resonance.

4. A dual-unit single-control inductive tuning device for bringing transmitting and receiving radio circuits into resonance and comprising in cooperative combination two angularly disposed transformers having a plurality of concentrically arranged primary and secondary inductances, said primary inductances and part of said secondary inductances being fixedly attached to a suitable block or supporting frame having two angularly-disposed ways or slots adapted to receive and retain two slidable coil-supporting members subject through single control knob to simultaneous actuation to impart axial movement to secondary coils surrounding the fixedly-positioned secondary inductances and held in concentrically spaced relation thereto by said slidable coil-supporting members, guide rods, and guide brackets attached to base of tubes on which movable secondary coils are wound, said plurality of primary inductances within each stationary part of said secondary inductances being wound side by side on the same tubular support, one primary coil serving to receive the signal energy delivered by antenna to first or left-hand transformer, the primary inductance alongside and immediately below the first serving as a reamplifying inductance receiving output of the first of

two reamplifying tubes, the upper primary of the second or right-hand transformer receiving the output of the first radio frequency tube, while the lower primary or reamplifying inductance of the second or right-hand transformer receives the output of a second reamplifying tube and reamplifies the fixed secondary or grid coil of the second or right-hand transformer unit which delivers its energy to the grid of the second radio frequency tube.

5. A dual-unit single-control inductive tuning device adapted for application to regenerative, reflex, and feed-back radio circuits having secondary or auxiliary means for reamplifying signal energy both before and after detection, said device comprising two angularly disposed transformer units having concentrically arranged primary and secondary inductances, each of the latter being divided into two parts, one part fixedly held in concentrically spaced relation to the other part that surrounds and is held in movable or variable relation to said fixed part by mechanism subject to actuation by turning a single control knob, two primary inductances concentrically disposed within the fixedly held part of the secondary inductance of each transformer unit being provided to receive both unamplified and reamplified signal energy for reamplifying the output of the fixedly positioned secondary inductance of the tuning unit transformers, one of each pair of said primary inductances also being available for connection to grids of screened-grid tubes.

6. A variable-inductance tuning unit comprising a fixedly-positioned inner coil-supporting element on which two separate primary coils are wound side by side, one of said primary coils serving as a reamplifying inductance, a fixedly-positioned secondary coil concentrically surrounding said primary coils and serving as the grid-coil section of a two-part secondary winding having stationary and movable sections, an outer secondary coil spaced apart from and concentrically surrounding said fixedly-positioned grid coil and serving as the movable or tuning section of said two-part secondary winding, said outer secondary coil being attached to means for supporting it and imparting to it for tuning purposes straight line movement in the direction of its axis.

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