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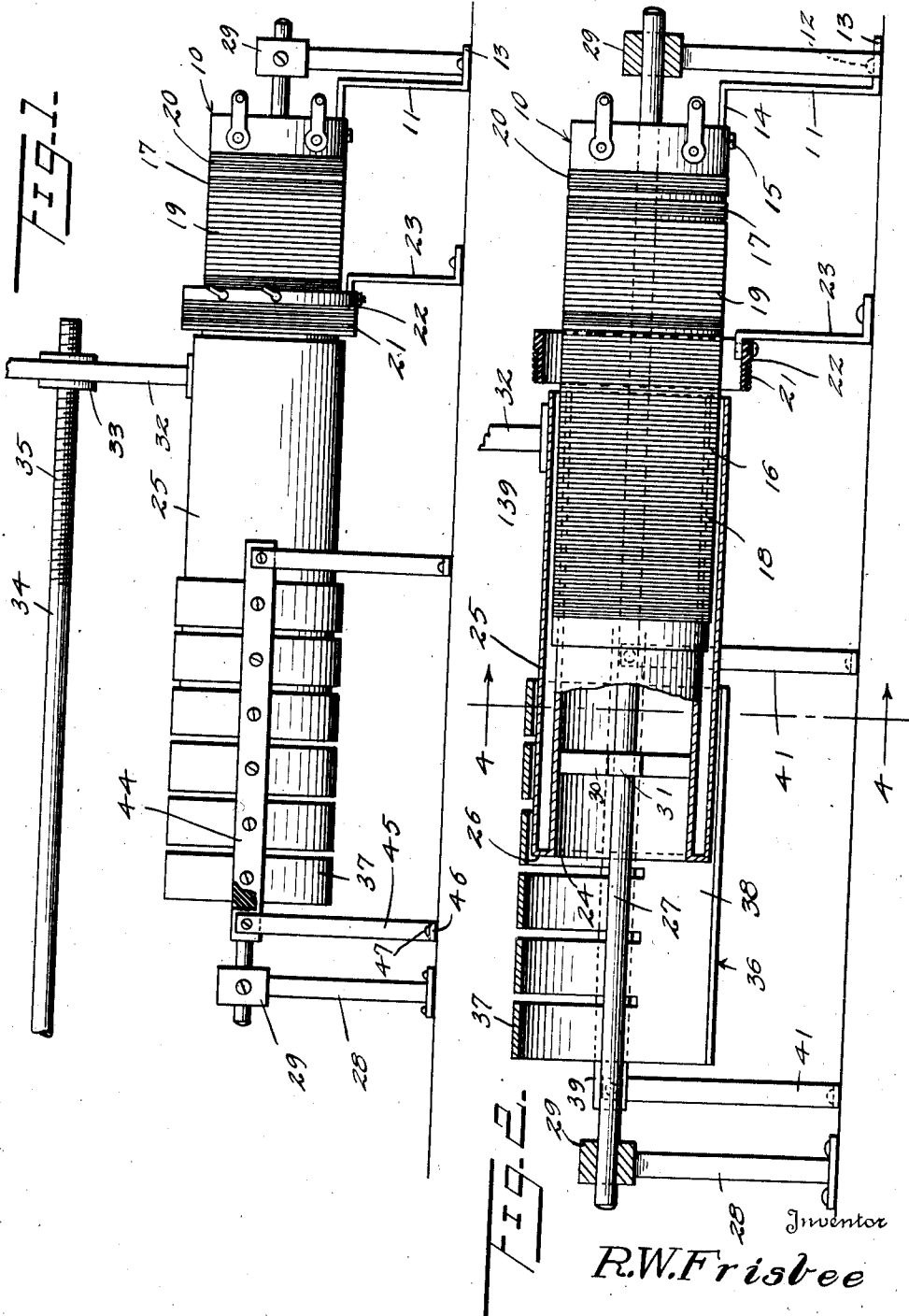
R. W. FRISBEE

2,250,366

RADIO FREQUENCY TUNER UNIT

Filed Jan. 19, 1940

3 Sheets-Sheet 1



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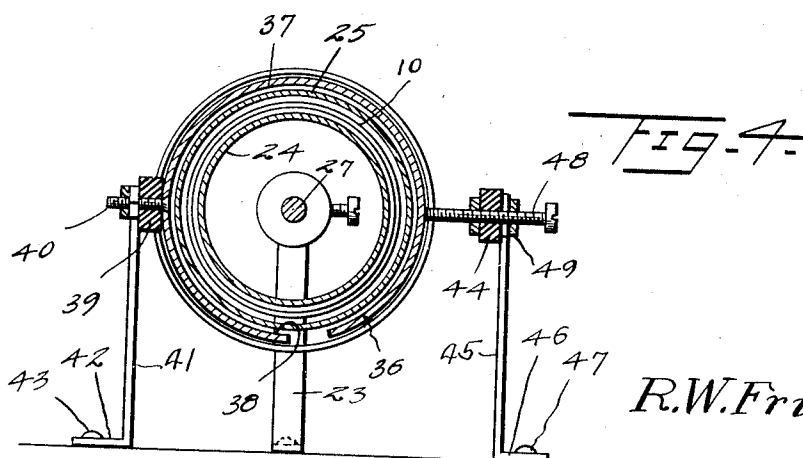
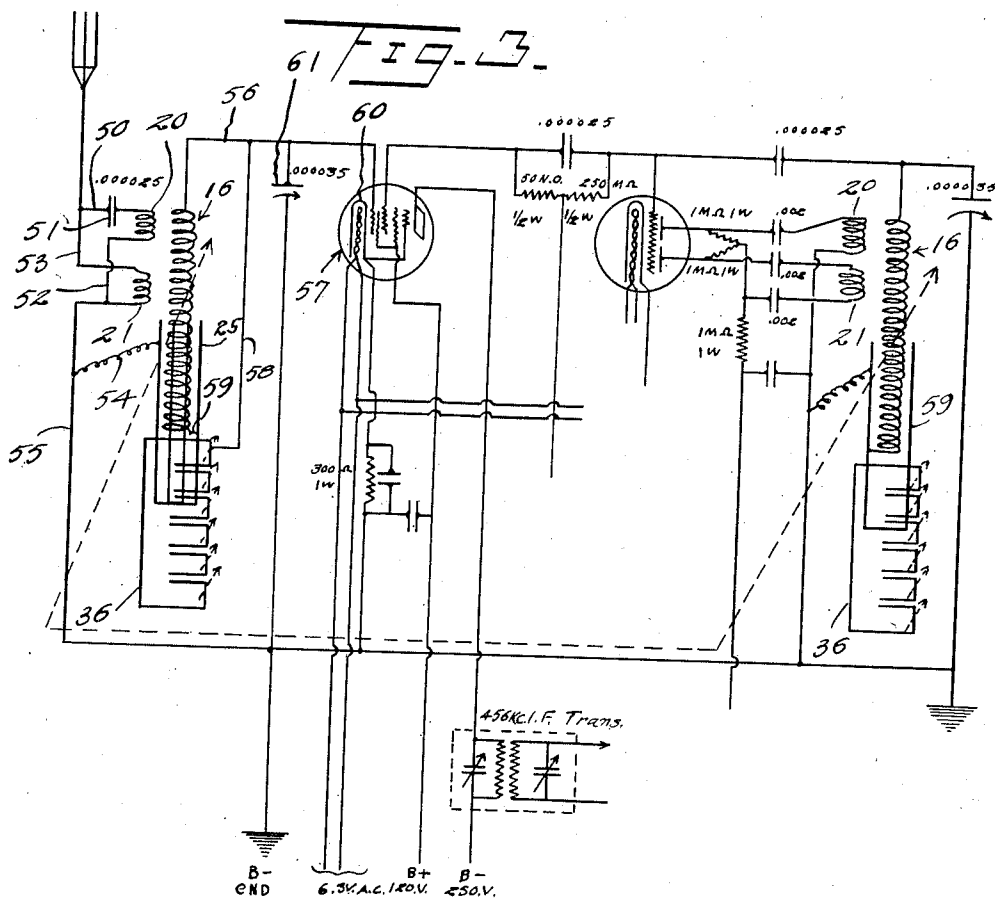
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3 Sheets-Sheet 2.



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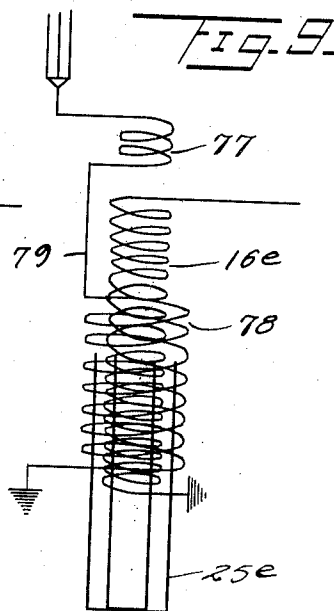
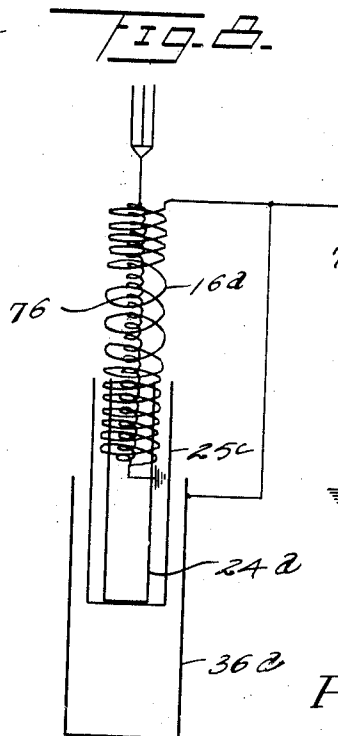
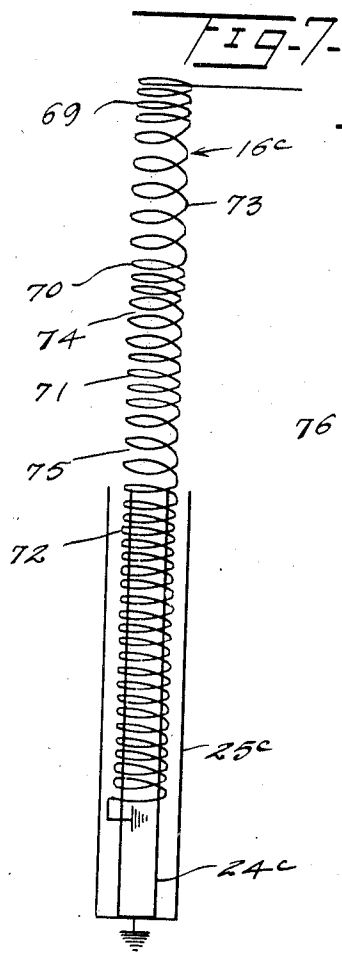
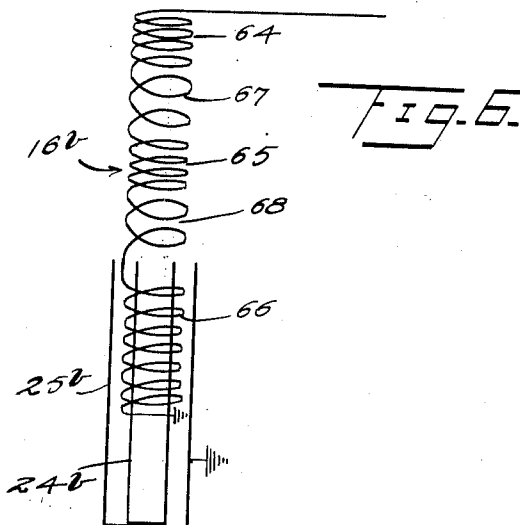
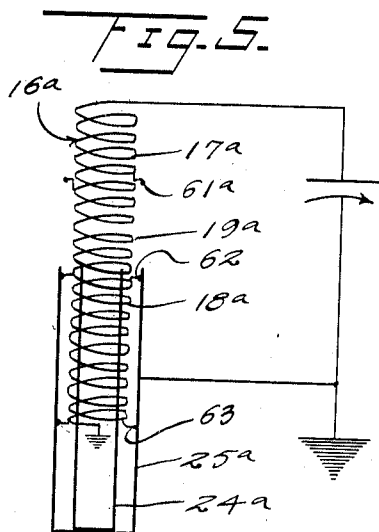
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,250,366

RADIO FREQUENCY TUNER UNIT

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Application January 19, 1940, Serial No. 314,722

7 Claims. (Cl. 250-40)

This invention relates to radio apparatus and more particularly to a radio frequency tuner unit.

At the present time in the construction of radio receivers of the type known as "all wave" receivers, it is the practice to provide inductance coils with inductive fields capable of being tuned by means of a variable condenser within a fixed range of kilocycles or meters or what are commonly referred to as wave bands. In order to provide a receiver which will be capable of tuning the desired "ranges" of "bands" it is the practice to use individual coils or radio frequency transformers for selected "ranges" or "bands" and connect a switch structure thereto so that selected coils or transformers may be placed in circuit with the balance of the apparatus. It is, therefore, an object of this invention to provide a single radio frequency unit or transformer which is capable of accomplishing the results which are accomplished by a plurality of transformers or coils, wave band switches, and conventional type of variable condenser gang.

Another object of this invention is to provide a radio frequency unit for use with "all wave" receivers, which may be easily and accurately adjusted to oscillate within any selected frequency range.

A further object of this invention is to provide a radio frequency unit for use with "all wave" reception wherein the unused turns of the inductance coil, when turned to high frequencies are grounded and bypassed, or shielded from the active coil turns to thereby prevent "deadend losses" caused by magnetic or inductive coupling.

A still further object of this invention is to provide a unit of this type which may be adjusted from minimum to maximum frequency range, inductively, and which includes a capacitor in the form of a variable condenser correlated with the remaining structure in such a manner as to provide the necessary capacity in proportion to the amount of inductance in the resonant circuit, for correct L/C ratio.

A further object of this invention is to provide a unit of this type which may be used in a single stage radio frequency or oscillator circuit or in a multiple stage circuit.

A further object of this invention is to provide a stationary coil structure with a shiftable grounded non-magnetic, metallic shield or shunt and a stationary condenser plate which is so positioned relative to the shield that as the shield

is moved relative to the coil structure to increase or decrease the inductance thereof, the shield will also move relative to the condenser stator plate so that the variance in the capacity of the condenser will be in proportion to the variance of the inductance of the coil structure.

A further object of this invention is to provide a means of increasing the inductive coupling between the primary and secondary windings as the inductance in the secondary is increased, this being necessary for maximum efficiency since at lower frequencies or longer wave lengths greater coupling is required and the higher the frequency, the smaller the inductance in the secondary so that only a small amount of coupling is necessary to the primary.

A further object of this invention is to provide a means of "electrical band spread" for tuning in at "short wave," wave lengths.

To the above objects and to others which may hereinafter appear, the invention consists of the novel construction, combination and arrangement of parts as will be more specifically referred to and illustrated in the accompanying drawings wherein is shown an embodiment of this invention, but it is to be understood that changes, variations and modifications may be resorted to which fall within the scope of the invention as claimed.

In the drawings:

Figure 1 is a detail side elevation of a radio frequency tuner constructed according to an embodiment of this invention,

Figure 2 is a view similar to Figure 1, but showing a portion of the device in longitudinal section,

Figure 3 is a schematic diagram of an oscillatory circuit embodying this invention,

Figure 4 is a sectional view taken on the line 4-4 of Figure 2,

Figure 5 is a schematic view of the secondary of a modified form of tuning unit,

Figure 6 is a schematic view of the secondary of another form of tuning unit,

Figure 7 is a schematic view of a further form of secondary coil used with this invention,

Figure 8 is a schematic view of a further modification of this tuning unit,

Figure 9 is a schematic view of a still further form of tuning unit.

Referring to the drawings, the numeral 10 designates a coil form which in the present instance is cylindrical in configuration. This form 10 is supported by means of a supporting bracket 11, which includes a right angular foot 13, which

is adapted to be secured by a fastening device 12 to a suitable support, an upper right angular leg 14 extends from the vertical leg 11 and is secured, as by fastening device 15, to the form 10. A secondary coil, generally designated as 16 is wound on the form 10 and comprises a wire of suitable diameter, which is wound helically about the form 10. The secondary 16 comprises a pair of closely wound or grouped wire portions 17 and 18, which are spaced apart on the form 10 and a loosely wound intermediate portion 19 connects the two closely wound groups 17 and 18 together. The closely wound portion 18 is relatively longer than the closely wound portion 17; the closely wound portion 18 comprising substantially 139 turns of wire on the form 10 whereas the closely wound portion 17 comprises substantially 4 turns of wire. The intermediate part 19, which is formed of wire turns which are spaced apart approximately $\frac{1}{8}$ of an inch is formed of substantially 16 turns of wire, which are integral with the closely wound groups or portions 17 and 18.

A primary coil 20 is wound on the form 10 at a point spaced outwardly from the small groups 17 of the secondary 16 and a second primary 21 is formed of substantially 12 turns of wire on an insulated cylindrical form 22. One end of the second primary 21 is connected to one end of the first primary 20. The form 22 is supported in concentric relation about the secondary 16 by means of a supporting bracket 23, which is similar to the bracket 11. The form 22 is of a larger diameter than the external diameter of the secondary 16 and preferably the second primary 20 is positioned closely adjacent the junction between the large closely wound group 18 and the loosely wound group 16.

An inner grounding shield 24 is disposed loosely within the form 10 and an outer grounding shield 25 is connected at one end, as at 26 to one end of the inner shield 24. The outer shield 25 is of such a diameter as to be disposed in spaced relation to the wire, which is wound on the form 10 and preferably the two shields 24 and 25 are of substantially equal length and are capacitively associated with the secondary 16 so as to by-pass selected portions of the large group 18 of the secondary 16. The shield structure comprising the two shields 24 and 25 are slidable on a supporting rod 27, which is supported by means of a pair of standards 28 having bushings 29 at their upper ends. The inner shield 24 is provided with one or more spiders 30 including a guide bushing 31, which slidably engages the supporting bar 27 so that the two shields 24 and 25 may be moved relative to the secondary coil 16. The outer shield 25 may have a rod 32 fixed thereto and a nut 33 may be secured to the rod 32 so that a shield operating member 34 provided with threads 35 may engage the nut 33 in order to move the two shields 24 and 25 lengthwise of the secondary 16. A substantially cylindrical condenser stator plate generally designated as 36 is disposed coaxial with the shield 25 and this condenser plate 36 comprises a split cylindrical body or shell, which is provided with a plurality of spaced apart segments 37, which are secured at one end to the plate or body 38. The segments 37 have one end thereof free, as shown in Figure 4 and this free portion of each segment 37 is adapted to be adjusted relative to the outer shield 25 as will be hereinafter described. A horizontally disposed supporting bar 39 is secured as by fastening de-

vices 40 to the condenser 36 and the supporting bar 39 is mounted on the upper ends of a pair of brackets or supporting members 41. The supporting members 41 are provided at their lower ends with outwardly extending feet 42, which may be secured as by fastening members 43 to a suitable support.

An insulated bar 44 is disposed diametrically opposite the supporting bar 39 and is secured to the upper ends of a pair of vertical posts or supporting members 45, which are provided at their lower ends with feet 46. The feet 46 may be secured by fastening members 47 to a suitable support. A threaded adjusting member 48 is threaded through the supporting bar 44 and the inner end of the adjusting member 48 is adapted to engage an arcuate condenser plate 37 so as to adjust the plate 37 relative to the shield 25. The lock nut 49 may be threaded onto the screw or bolt 48 so as to hold the screw or bolt 48 in adjusted position. Preferably the condenser structure 36 is formed with the condenser plates or segments 37 of resilient construction, which are initially distorted slightly so that when the screw or bolt 48 is moved outwardly the plate or segment 37 will follow the screw and thus move outwardly with respect to the shield 25, which forms the rotor or ground plate of a variable condenser.

Referring now to the schematic diagram in Figure 3, the primary coil 20 is connected by a wire 50 to the antenna and a fixed condenser 51 is interposed in the wire 50. The opposite end of the primary coil 20 is connected by wire 52 to one end of the second primary coil 21 and the opposite end of the primary coil 21 is connected by a wire 53 to the antenna wire 50 outwardly of the condenser 51. A wire 54 is connected at one end to the outer shield member 25 and the opposite end of the wire 54 is connected to a ground wire 55, which is connected to the coil 21. One end of the secondary coil 16 is connected by a wire 56 to the grid of the first radio frequency tube, generally designated as 57, and a wire 58 is connected at one end to the condenser 36 and at the other end to the wire 56. The opposite end of the secondary coil 16 is connected by a wire 59 to the shield structure including the inner and outer shields 24 and 25. The wire 55 is connected to the cathode 60 of the tube 57.

In the use and operation of this tuner, where it is desired to balance the secondary coil 16 in resonance with another circuit, a conventional trimmer variable condenser 61, which is connected between the wires 55 and 56 for tracking at high frequencies, for receiving radio impulses of substantially 550 kilocycles, the two shields 24 and 25 may be positioned substantially entirely within the condenser structure 36 so that the inductance of the secondary coil 16 will not be affected by the shields 24 and 25. When the shields 24 and 25 are non-capacitively associated with the secondary coil 16 the incoming impulses will flow through the two primary coils 20 and 21 and will be transferred inductively to the secondary coil 16. However, where it is desired to vary the inductance of the secondary 16 so as to increase the kilocycle range of the coil 16 the shield structure is moved in telescoping relation to the large group 18 of the coil 16. In this position the overlapping or telescoping portions of the shields 24 and 25 will reduce the inductance of the coil 16. As the shields 24 and 25 are moved forwardly relative to the secondary 16, this shield is also moved inversely with respect

to the condenser plate 36, so as to vary the capacity of the condenser 36 in proportion to the inductance of the coil 16. Where it is desired to receive radio impulses up to substantially 18,000 kilocycles, the shields 24 and 25 are moved forwardly to a point closely adjacent the second primary 21, and/or between 21 and 16, so that these shields will not only reduce the inductance of the major portion of the closely wound group 18, but will also reduce the inductance of the second primary 21 from secondary 16. The radio impulses will at this time pass through the first primary coil 20 and be picked up through the small closely wound group 17 and the loosely wound group 16.

In Figure 5, there is disclosed another modification of this invention wherein the secondary coil 16a is provided with closely wound groups of wire turns 17a and 18a which are connected together by a loosely wound group 19a. At the inner end of the group 17a a pair of outwardly projecting contacts 61 are connected to the group or coil 17a and these contacts may be of resilient construction adapted to wipe the inner surface of the shield 25a. A second pair of contacts 62 are connected to the inner end of the group or coil 18a and are also adapted to contact with the shield 25a. A third pair of contacts 63 are connected to the outer end of the group or coil 18a and are in constant contact with the shield 25a. With a construction of this kind, the secondary coil 16a is electrically shorted according to the position of the shields 24a and 25a. The unshielded or unshorted (active) turns of inductance coil 16a will be tuned to the desired frequency by use of a variable condenser of conventional design as shown in schematic Figure 5.

Figure 6 shows a further modification of the secondary coil wherein the secondary coil 16b is formed of electrically connected coils or closely wound groups or turns of wire 64, 65 and 66. A loosely wound group or coil 67 connects the coils or groups 64 and 65 together, and a second loosely wound group or coil 68 connects the coils or groups 65 and 66 together. Shields 24b and 25b are constructed and operated the same as shields 24 and 25 and the remaining structure associated with Figures 1 to 4 will be associated with the structure shown in Figure 6.

Figure 7 also shows a further modification of the secondary coil wherein the secondary coil 16c is formed of closely wound turns of wire or coil 69, 70, 71 and 72. Groups or coils 69 and 70 are electrically connected together by a loosely wound coil or group 73; groups of coils 70 and 71 are connected together by a loosely wound coil or group 74, and groups or coils 71 and 72 are connected together by a loosely wound coil or group 75. The loosely wound coils 73, 74 and 75 are formed of flat or substantially wide wire and provide a means whereby a relatively wide band spread may be obtained without loss of efficiency. Shields 24c and 25c are associated with the secondary 16c in the same manner and with the remaining structure shown in Figures 1 to 4, inclusive.

In Figure 8 there is shown a further modification of this invention wherein the secondary 16d may be constructed in the form shown in any one of the Figures 1 to 7, inclusive. The primary 76 is in the form of a loosely wound coil having a length substantially equal to the length of the secondary 16d and connected with the adjacent end of the secondary 16d to the ground.

In Figure 9 there is shown a secondary coil 16e

similar to any one of the hereinbefore described secondary coils. A primary coil 77 is disposed at one end of the secondary 16e, one end of the coil 77 being adapted to be connected to the antenna. A second primary coil 78 formed of spaced turns of wire is disposed in telescoping relation about a portion of the secondary 16e and also about the outer shield 25e. One end of the second primary coil 78 is electrically connected to an end of coil 77 by a wire 79 and the other end of coil 78 is connected to the ground.

The secondaries shown in Figures 8 and 9 are to be used with the remaining structure shown in Figures 1 to 4, inclusive.

It will be apparent from the foregoing that the operator 34 may be adjusted to any desired degree, so as to position the shields 24 and 25 at selected telescopic positions along the length of the secondary coil 16. It will, therefore, be apparent that this shield structure may be adjusted to any position with respect to the secondary 16 depending on the particular frequency which it is desired to tune to. With a radio frequency tuning unit as constructed according to this invention, it will not be necessary to provide special radio frequency transformers for selected kilocycle groups and connect such selected transformers to a selector switch in order to permit the radio receiver to be tuned to any particular kilocycle range or group.

The schematic diagram of an oscillatory circuit shown in Figure 3 is only one form of circuit with which the hereinbefore described radio frequency tuning unit may be combined.

The movement of the shields 24 and 25 may be effected by any suitable mechanical means, such as a screw operating means, a gear train, toothed rack or the like, which may be synchronized with the operation of the dial pointer or dial, or may be operated independently thereof.

What I claim is:

1. A radio frequency transformer comprising a cylindrical insulated form, a secondary coil on said form, a primary coil on said form adjacent an end of said secondary coil, a second primary coil connected to said first primary coil and disposed in spaced relation to said first primary coil and telescoping a portion of said secondary coil, a pair of connected inner and outer shields shiftable relative to said secondary coil and to said second primary coil for varying the inductance thereof, and an annular condenser stator plate disposed coaxial with said form and said shields and extending from an end of said form whereby decrease of the telescoping engagement of said shields with respect to said secondary coil will simultaneously increase the telescoping engagement of said shields with respect to said condenser.

2. A radio frequency transformer comprising a cylindrical form, a secondary coil about said form, said coil including a plurality of closely positioned turns of wire and a plurality of spaced turns of wire to provide inductive electrical band spread, a primary coil on said form and spaced from one end of said secondary coil, a second primary coil connected to said first primary coil and positioned between the ends or the entire length of said secondary coil, said second primary coil being of greater diameter than said secondary coil and disposed concentric thereto, a cylindrical metallic shielding element of a diameter intermediate that of the secondary coil and said second primary coil and axially movable with respect thereto for varying the inductance thereof,

and a stationary condenser plate in electrostatic relation to said element.

3. A radio frequency transformer comprising wire turns forming a primary coil, a secondary coil formed partly of closely positioned wire turns and partly of spaced wire turns between said closely positioned turns, a second primary coil connected to said first primary coil and disposed concentric of and in spaced relation to said closely positioned turns, a shield disposed in capacitive relation between said secondary coil and second primary coil, means supporting said shield for coaxial adjustment relative to said secondary and primary coils, and a stationary condenser plate spaced from said secondary and primary coils and disposed in capacitive relation to said shield, movement of said shield relative to said secondary and primary coils inversely affecting the capacity of said condenser and the coupling between said primary and secondary coils.

4. A radio frequency transformer comprising a secondary coil, a primary coil at one end of said secondary coil, a second stationary primary coil connected at one end to an end of said first primary coil, said second primary coil being loosely positioned about the exterior of said secondary coil and intermediate the ends of and in telescoping inductive relation to said secondary coil, a cylindrical shield, and means for moving said shield in telescoping relation with respect to said secondary coil to thereby vary the inductance of the latter and simultaneously vary the inductance of said second primary coil.

5. A radio frequency transformer comprising a primary coil and a secondary coil, said secondary coil including a plurality of closely positioned turns of wire round in traverse section and a plurality of spaced turns of wire electrically connected to said closely positioned turns, said

spaced turns of wire being formed of relatively flat strips, and a cylindrical shield movable in telescoping relation to said secondary coil.

6. A radio frequency transformer comprising a secondary coil formed of a plurality of closely positioned wire turns and a plurality of loosely positioned wire turns connected to said closely positioned wire turns, a cylindrical shield movable in telescoping relation to said secondary, a primary coil at one end of said secondary coil, a second primary coil electrically connected to an end of said first primary coil and spaced endwise from the latter, said second primary being disposed loosely about a portion of said secondary coil in a position whereby variation of the inductive capacity of said secondary by endwise movement of said shield will also vary the inductive capacity of said second primary.

7. A radio frequency transformer comprising a secondary coil formed of helically wound wire having a small group of closely positioned convolutions of wire at one end thereof, a second group of closely positioned convolutions at the other end thereof and an intermediate group of spaced convolutions of wire connected to said first and second groups, a pair of primary coils each formed of closely positioned convolutions of wire, one of said primary coils being disposed in spaced relation to an end of said first group, and the other primary coil being connected at one end to said first primary coil and disposed in telescoping relation about said secondary coil and spaced endwise from said first primary coil and a metallic shielding element disposed in coupled coaxial relation between said secondary coil and said other primary coil and movable relative thereto to vary the inductance of said secondary coil and said other primary coil.

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