Sept. 7, 1948. F. WILBURN 2,448,642

TUNER

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FIG. 1.

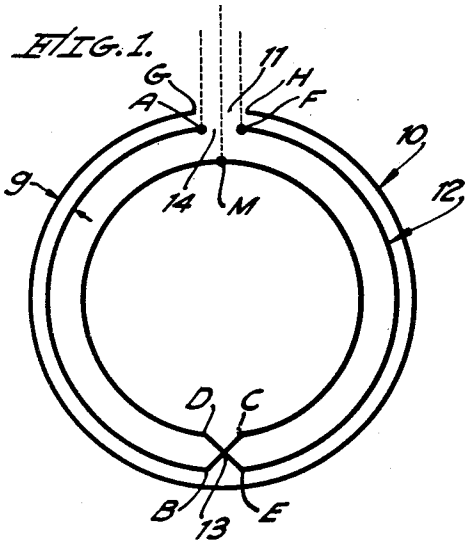
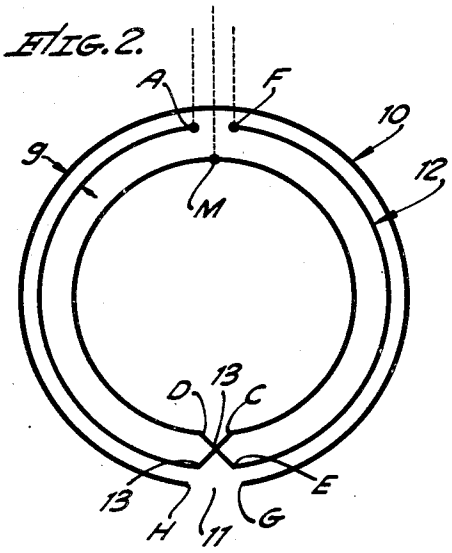


FIG. 2.



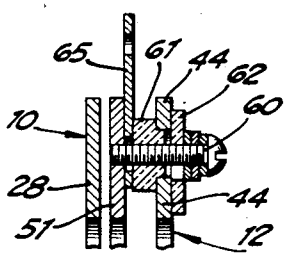


FIG. 7.

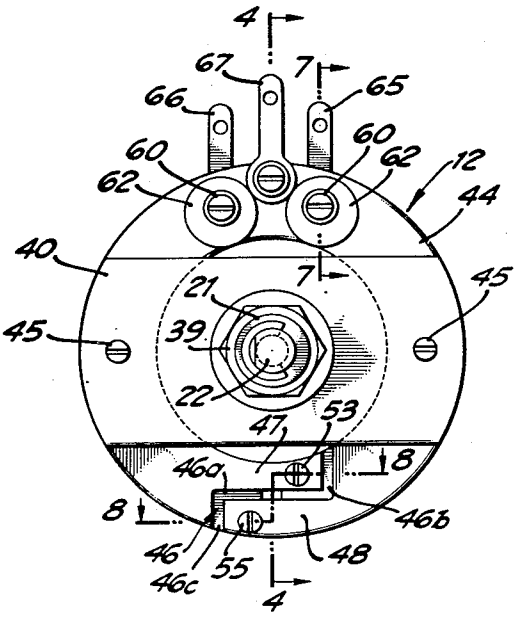


FIG. 3.

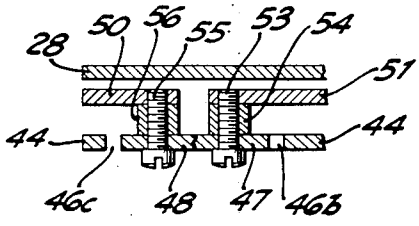


FIG. 8.

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FIG. 4.

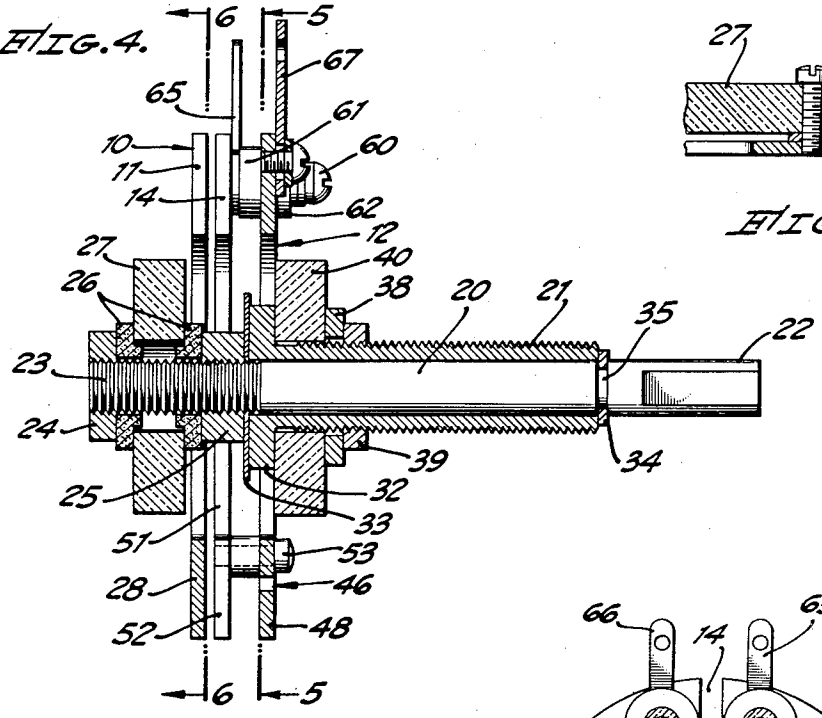


FIG. 9.

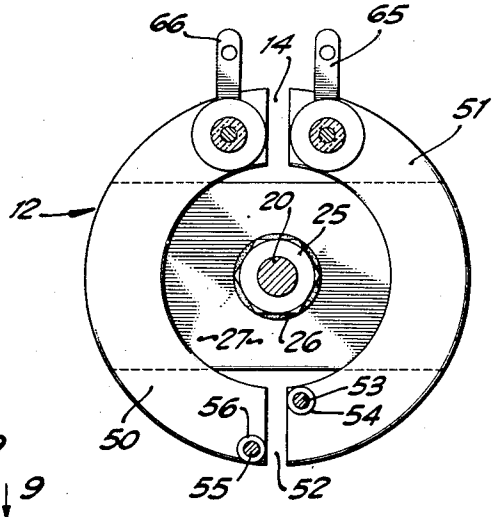


FIG. 5.

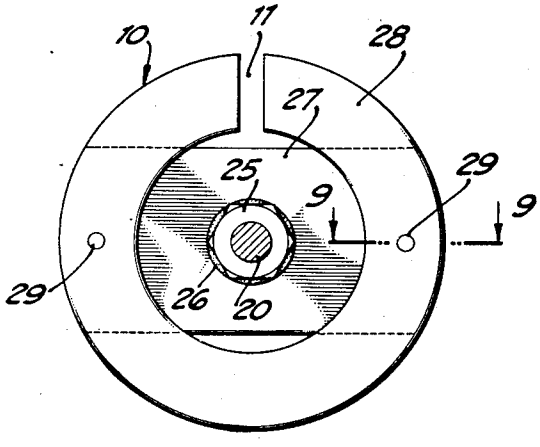


FIG. 6.

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2,448,642

TUNER

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Application March 3, 1947, Serial No. 731,937

2 Claims. (Cl. 171—777)

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This invention relates generally to ultra high-frequency tuners and oscillators, and may be regarded generally as dealing with improvements in the type of device disclosed in my copending application entitled Ultra high frequency tuner, filed March 4, 1946, Serial No. 651,908.

The device of my said prior application provided a pair of relatively rotatable inductor elements forming a pair of coaxial, close-spaced coils of one turn each, which were adapted to be progressively converted from parallel to series connection to increase their inductance, while at the same time the effective distributed capacity between them was being increased. In one embodiment, the provision for accomplishing this result included a brush carried by one end of one of the coils and arranged for sliding contact with the other of the coils. This device was highly efficient, and had the advantage of an unusually high "Q."

Objects of the present invention include the provision of a tuner of the same class, but of greater compactness, and one wherein no sliding contacts are used, with all external connections leading from the stator.

The invention may be discussed to best advantage after referring to the accompanying drawings showing a present illustrative embodiment thereof, and wherein

Figures 1 and 2 are diagrammatic views showing the electrical make-up of the device in its two extreme positions of adjustment, Figure 1 being the high frequency position and Figure 2 being the low frequency position;

Figure 3 is an end elevation of a preferred embodiment of the invention;

Figure 4 is a longitudinal vertical section on line 4—4 of Figure 3;

Figures 5 and 6 are transverse detail sections on lines 5—5 and 6—6, respectively, of Figure 4;

Figure 7 is a detail section on line 7—7 of Figure 3;

Figure 8 is a detail section on broken line 8—8 of Figure 3; and

Figure 9 is a detail section on line 9—9 of Figure 6.

In the drawings, and with particular reference at this time to Figures 1 and 2, numeral 10 designates generally a rotor comprising a one-turn inductor or coil, having a slot or gap at 11, while numeral 12 designates generally a stator comprising a two-turn inductor or coil, having an intermediate cross-over point at 13, and its two ends forming a gap 14. The rotor 10 and stator 12 are coaxially mounted, in relatively close-spaced relation, so as to provide capacitative coupling between the rotor and portions of the stator in a manner presently to be described.

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The stator 12 may be considered as made up of two 180° sections AB and EF, which are both annularly spaced from rotor 10 by a uniform narrow gap g, and a 360° section CD connected between sections AB and EF. A relatively close distributed capacitative coupling is thus provided between the full length GH of rotor 10 and the two 180° end sections AB and EF of the stator. Suitable physical structure by which such spacial relationships may be obtained will be disclosed hereinafter.

Figure 1 shows the high frequency position of the tuner, and Figure 2, where the rotor has been rotated through 180°, the low frequency position thereof. It will be seen that in both positions, the stator provides a coil of two turns, and that the inductance of the device is fixed for all positions. The rotor 10, being arranged throughout its length in close proximity to longitudinal sections of the stator coil, and being therefore capacitatively coupled thereto, greatly augments the distributed capacitance of the combination. Although the actual capacitance between the stator and rotor remains approximately constant for all positions of the rotor, its distribution along the inductance is varied with change in position of the rotor, causing a change in resonant frequency. In the high frequency position of Figure 1, where the gap in the rotor is alined with the gap in the stator, the distributed capacitance provided by the rotor might be considered as being, in effect, across but one turn of the stator; while in the low frequency position of Figure 2, where the gap in the rotor is opposite the cross-over point of the stator, the distributed capacitance provided by the rotor is, in effect, across the full two turns of the stator.

The device can readily be designed to any working range within the field of about 75 m. c. to 1000 m. c., and is capable of approximately a 15 percent or greater working range or swing within that field.

Figures 3 to 9, to which reference is now directed, show one present illustrative physical embodiment of the invention. Numeral 20 designates a rotor shaft, on which is mounted the aforementioned rotor 10, and numeral 21 designates an externally threaded bushing which journals an intermediate portion of rotor shaft 20, and which carries the aforementioned stator 12.

One end portion 22 of rotor shaft 20 projects from bushing 21 and is adapted to receive any

suitable operating knob (not shown), while the other end portion 23 projects from the other end of bushing 21 and is externally screw threaded as indicated. The bushing 21 will be understood to be adapted for mounting in an instrument panel in the conventional manner. Spaced nuts 24 and 25 on the screw threaded portion of rotor shaft 20 position a pair of insulation washers 26 which support between them an insulation mounting plate 27, preferably formed of ceramic, and to which is secured the rotor 10. The rotor 10 is in the form of a radially slotted or split washer or annulus 28, the radial slot being indicated again by the numeral 11. This annulus 28 is secured to insulation plate 27 by means of screws 29 (Fig. 9), and is preferably spaced from plate 27 by means of washers 30.

Bushing 21 has at its end adjacent nut 25 an enlarged head or flange 32, which abuts a washer 33 positioned on shaft 20 against screw 25, while a snap ring 34 snapped into shaft groove 35 adjacent the other end of bushing 21 engages the latter to secure it against axial displacement on the shaft.

Positioned between bushing head 32 and a washer 38 backed up by a nut 39 on the bushing is an insulation plate 40, similar to insulation plate 27, and the elements making up the aforementioned stator are secured to this plate 40 as presently to be described.

The stator includes a washer or annulus 44, of the same inside and outside diameter as the aforementioned rotor washer 28, and which is secured directly to plate 40 by means of screws 45 (Fig. 3). It will later become evident that this stator member 44 corresponds, electrically, to the turn or coil CD of Figs. 1 and 2. This annulus 44 is split at the bottom by a gap 46 (Fig. 3) which is so shaped as to form two horizontally extending, vertically spaced end portions 47 and 48 which overlap one another as indicated. The gap 46 may be described as having a horizontal chordal portion 46*a*, and vertical portions 46*b* and 46*c* extending upwardly and downwardly, respectively, from opposite ends of the portion 46*a*.

The stator includes also, in correspondence to half-turn coil portions AB and EF of Figures 1 and 2, two arcuate, substantially 180° washer segments 50 and 51 (Figure 5), these having the same inside and outside radii as the aforementioned rotor and stator annuli 28 and 44. Members 50 and 51 are spaced at the top to form the gap 14, and they are also spaced at the bottom, as indicated at 52, though no electrical gap is formed thereby. Terminal portion 47 of stator ring 44 will be seen from Figures 3 and 8 to overlap a portion of stator member 51, and connection is made therebetween by means of screw 43 and spacer sleeve 54. Similarly, terminal portion 48 of stator ring 44 overlaps a portion of stator member 50, and connection is made therebetween by means of screw 55 and spacer sleeve 56. The lower ends of members 50 and 51 are thus mounted on the two end portions of ring 44, in a "cross-over" relationship, effecting the electrical cross-over 13 of Figures 1 and 2.

The upper ends of arcuate members 50 and 51 are mounted on but insulated from the upper portion of stator ring 44. As appears in Figure 7, a mounting screw 60 passes through an enlarged hole in ring 44 and its end screws into plate 51, suitable insulation washers 61 and 62 serving to space the parts properly. Terminal lugs 65 and 66 are secured between the stator

plates 50 and 51 and the washers 61, and serve as the end terminals of the coil. A third, middle terminal lug 67 is secured to the top of ring 44, and serves as a center connection to the coil.

The device of Figures 3–9 carries into practical effect the electrical features of the tuner of Figures 1 and 2. It should be clear that the split rotor washer 28 corresponds to the one-turn rotor coil 10 of Figure 1, and that the stator 12 of Figures 3–9 forms a two-turn coil like the coil ABCDEF of Figures 1 and 2. Thus starting with terminal lug 65 (Figure 5) the stator begins with half-turn segment 51, then crosses the space between the plane of stator members 50 and 51 and that of 360° stator annulus 44 to the terminal portion 47 of the latter, continues for a full turn around said annulus, then crosses back to the plane of members 50 and 51 to the corresponding end portion of member 50, and finishes with the half-turn furnished by member 50 to terminal lug 66. Members 50 and 51 are close-coupled to the rotor, like sections AB and EF, while member 44 is relatively remote from the rotor, like section CD. The stator coil thus has two turns, with its first and last half-turn portions close coupled to the rotor. Sufficient has been said of operation in connection with Figs. 1 and 2, and a repetition is not believed necessary.

To give an idea of typical scale (but without intention of limiting the invention), a tuner constructed in accordance with Figures 3–9 designed for the amateur 144–148 m. c. band has an outside rotor and stator diameter of 2''.

The use of a tuner of the present type will be evident to those skilled in the art, and little need be said in that connection. As a wave meter, it requires no external connections, even to its stator. In various other uses, e. g., oscillator, superregenerative receiver, crystal rectifier, etc., the three terminal lugs 65, 66 and 67 furnish end and center tap connections to the stator coil. In Figs. 1 and 2, these points are at A, F and M, respectively. In the use of the tuner in a superregenerative receiver, the two terminals A and F would be connected to the grid and anode circuits of the receiver tube, with the center tap M connected through a high pass condenser to the cathode of the tube, in a conventional circuiting arrangement.

The device of the present invention has the advantage of compactness, elimination of sliding contacts, substantial working range between minimum and maximum resonant frequencies, and high "Q."

I claim:

1. A tuner embodying a pair of coaxial coils, one of substantially one turn and one of substantially two turns, arranged for relative rotation on their common axis; said one-turn coil comprising a substantially 360° ring in a plane at right angles to the coil axis, said ring having a split forming an air gap therein; said two-turn coil comprising a substantially 360° ring in a plane parallel to the first mentioned plane, said ring being slotted to form two end portions, and two substantially 180° ring segments in a third plane parallel to the other two planes and close-spaced to the first mentioned plane, said ring segments being arranged with gaps between opposed ends thereof, and cross-over connections between the end portions of the 360° ring portion of the two-turn coil and the adjacent ends of the 180° ring segments.

2. A tuner embodying a pair of coaxial coils, one of substantially one turn and one of sub-

stantially two turns, arranged for relative rotation on their common axis; said one-turn coil comprising a substantially 360° ring in a plane at right angles to the coil axis, said ring having a split forming an air gap therein; said two-turn coil comprising a substantially 360° ring in a plane parallel to the first mentioned plane, said ring being slotted to form two spaced but overlapping end portions, and two substantially 180° ring segments in a third plane parallel to the other two planes and close-spaced to the first mentioned plane, said ring segments being arranged with gaps between opposed ends thereof, with one of said gaps so disposed relative to said overlapping ring end portions that each of said

ring end portions crosses said one gap and overlaps an end portion of the ring segment therebeyond, and electrical connectors between each of said ring end portions and the said ring segment end portion which it overlaps.

FRANK WILBURN.

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