Dec. 3, 1946. R. L. HARVEY 2,411,858

TUNING APPARATUS

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FIG. 1.

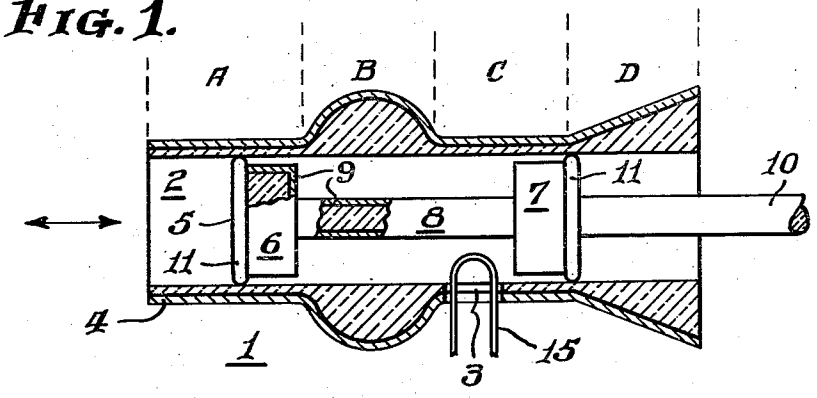
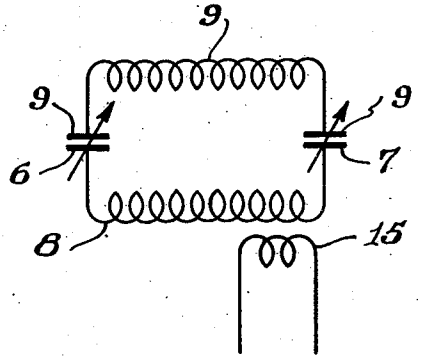


FIG. 2.



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TUNING APPARATUS

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4 Claims. (Cl. 178—44)

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This invention relates to tuning apparatus for use in radio and analogous systems for the communication of intelligence and has for its principal object to provide an improved tuner for use at ultra high frequencies (say, 500–3,000 megacycles) and one capable of tuning over a relatively wide band in that selected portion of the frequency spectrum for which the apparatus is designed.

Another and important object of the present invention is to provide an inexpensive yet reliable tuner of the general type described and one characterized by its ease of assembly and by the simplicity and economy of its parts.

Certain preferred details of construction, together with other objects and advantages will be apparent and the invention itself will be best understood by reference to the following specification and to the accompanying drawing, wherein

Fig. 1 is a longitudinal sectional view of a tuning apparatus constructed in accordance with the principle of the invention and,

Fig. 2 shows, diagrammatically, a circuit which is the electrical equivalent of the tuner of Fig. 1.

The embodiment of the invention which has been selected for purposes of illustration is made up of but three separable parts, comprising: an open ended cylinder indicated generally at 1 and having a bore 2 of a uniform diameter which is small with respect to its length, a piston indicated generally at 5 and which is mounted for slidable movement within the bore of the cylinder 1, and a wire-like conductor 15 which extends into the said cylinder through an aperture 3. The cylinder 1 is constituted of polystyrene or other preferably moldable insulating material and is provided with a metalized outer surface 4 which may consist of a layer of copper plated over an underlying layer of evaporated silver (not shown). It will be observed that this metalized outer surface 4 has an undulate contour, that is to say the cylinder wall is not of uniform thickness, but, as viewed from end to end, comprises a thin-walled portion A, a bulbous portion B, a second thin-walled portion C and a frusto-conical end portion D. If desired the two thick walled sections B and D may be of duplicate contour.

The piston 5 comprises two plug-like parts 6 and 7, respectively, connected by a central rod 8 of a length calculated to bring the said plugs into register, simultaneously, with either the two thin-walled sections A and C or the two thick walled sections B and D. This piston 5 may be

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constituted of solid metal but is preferably made of the same insulating material (e. g., polystyrene) as the cylinder 1 and is provided with a metalized surface 9 which covers both the plugs 6 and 7 and the connecting rod 8. In either event an insulating shaft 10 is provided on one end of the piston for adjusting its position within the cylinder 1. If desired, each of the plugs 6 and 7 may be provided with a circumferential flange 11 which serves to reduce friction and to prevent the metalized surfaces of the plugs from wearing away by contact with the inner uncoated surface of the cylinder. It will be observed that the diameter of the rod 8 is small with respect to the diameter of the plugs 6 and 7, hence there is space between the plugs into which the wire-like conductor or loop extends without interfering with the limited degree of movement required to bring the said plugs into register with the several thin-wall and thick-wall portions of the cylinder.

Since only the outer surface 4 of the cylinder 1 is constituted of metal, the metal (or metalized) plugs 6 and 7 of the piston are at all times presented in useful capacitive relation with the particular surface portions of the cylinder with which they are in register. The value of this capacitance is a function of the quantity or thickness of the insulating material between the surface 4 and the plugs 6 and 7 at any given moment, hence, the capacitance can be varied by moving the piston 5 within the bore of the cylinder 1. Thus, referring now to Fig. 2, one may consider the device of Fig. 1 as comprising two variable capacitors whose adjustable armatures comprise the movable plugs 6 and 7, respectively and whose fixed plates comprise the particular portions of the metal surface 4 of the cylinder 1 with which the plugs are in register at any given moment. Since the plugs 6 and 7 are connected together by the metalized rod 8, and since the several metalized surface sections A, B, C and D, of the cylinder are interconnected by the metal which extends therebetween it is apparent that these two variable capacitors 4—6, 4—7, (Fig. 2) are effectively connected in series. It will also be apparent that since the series connection (i. e., the film 9) inherently possesses distributed inductance, the device of the invention in effect comprises a tuned circuit, which may be inductively coupled, as by means of the wire-like conductor 15 to an external circuit. Thus, if the device of the invention is incorporated in a radio receiver one end of the looped conductor 15 may be connected to the antenna

and the other end to one of the electrodes of a vacuum tube oscillator or amplifier, not shown.

In one successful embodiment of the invention wherein the cylinder 1 and piston 5 were constituted of polystyrene, and were of the dimensions given below, the tuner of the invention operated successfully over a frequency band of 400 to 600 megacycles:

Overall length of the cylinder 6"
Diameter of its bore 1"
Maximum wall thickness ¼"
Minimum wall thickness $\frac{1}{16}$"
Length of piston plugs ½"
Length of the connecting rod 2"

It will be observed that in this typical installation the bore of the cylinder is of a diameter which is small with respect to its length, and that the overall length of the piston 5 was less than one-half of the wavelength corresponding to the maximum frequency. Thus, the device of the invention may be said to operate as a section of a coaxial transmission line (rather than as a waveguide) and, with this fact in mind, it will be apparent that the tuner can be dimensioned to cover substantially any desired frequency band in the "centimeter wave" range.

Various modifications of the invention (such for example, as forming the several portions of the cylinder wall of materials having different dielectric constants) will suggest themselves to those skilled in the art. Accordingly, the foregoing is to be interpreted as illustrative and not in a limiting sense except as required by the prior art and by the spirit of the appended claims.

What is claimed is:

1. A tuning device comprising a hollow cylinder constituted of a dielectric material; said cylinder having a body of non-uniform thickness and a bore of substantially uniform diameter; a film-like metal armature on the outer surface of said cylinder; a core, including a second armature, mounted for slidable movement on and within the bore of said cylinder whereby said armature and said first mentioned armature form a capacitor; said armatures possessing capacitance and distributed inductance of a value calculated to tune said device over a predetermined frequency range, and means presented to the interior of said cylinder for coupling said device to an external circuit.

2. The invention as set forth in claim 1 and wherein said core comprises two spaced-apart plugs of a diameter not exceeding the diameter of the bore of said cylinder and an axially extending connecting rod of smaller diameter, and wherein said coupling means is presented to the space spanned by said connecting rod.

3. The invention as set forth in claim 1 and wherein the body of said cylinder comprises alternate thin and thick wall portions and the relative length of the plug and rod portions of said core are such as to bring said plugs into register, simultaneously with similar alternate wall portions of said cylinder.

4. The invention as set forth in claim 1 and wherein said hollow cylinder comprises a plurality of thin wall portions and an intermediate annular bulbous portion, and said first mentioned armature comprises a continuous metallic deposit covering the outer surface of all of said cylinder portions.

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