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N. H. CLOUGH

TUNING SYSTEM

Filed April 15, 1926

*Fig. 1*

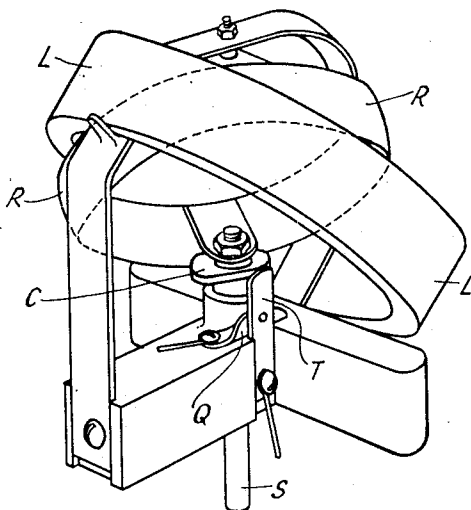


*Fig. 2*

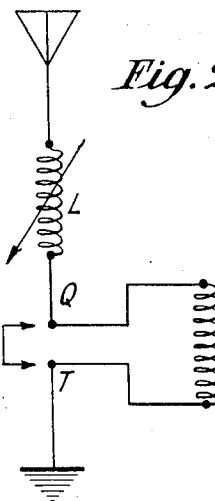


*Fig. 3*

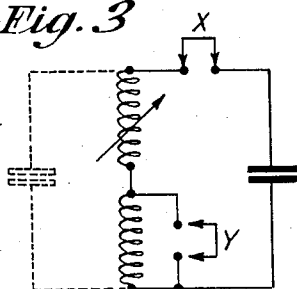


*Fig. 4*

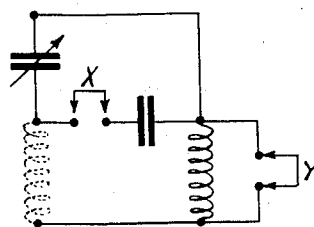


*Fig. 5*

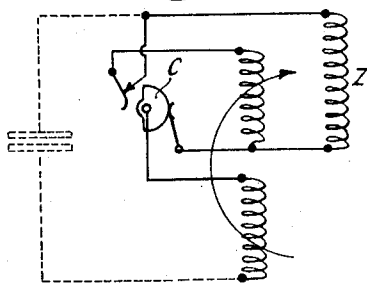
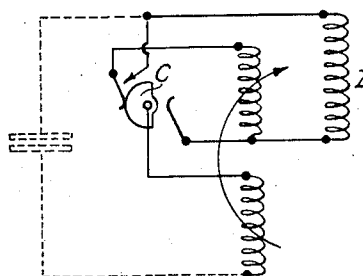


*Fig. 6*



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## UNITED STATES PATENT OFFICE.

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## TUNING SYSTEM.

Application filed April 15, 1926, Serial No. 102,136, and in Great Britain April 24, 1925.

My invention relates to radio frequency resonant circuits and particularly to tuning devices therefor.

An object of my invention is to provide a tuning device adapted to operate over two separate bands of wave lengths.

Another object of my invention is to provide a tuning system for radio circuits comprising a single device having a single indicator, adapted to tune wave lengths in one range over a portion of its graduations and wave lengths in another range over the remaining portion of its graduations.

In the prior art it has been customary to provide variable tuning means such as variable inductances which by rotation through a range of  $180^\circ$  cover a given band of frequencies and their corresponding wave lengths. It has been customary also in certain instances to provide separate switching means for inserting or removing additional impedances in the resonant circuit, whereby other frequency bands may be received. This, however, has been found awkward because of the necessity for the additional manipulation of controls and the added complexity.

It is often desirable to provide for the reception on a single tuning device of two bands of wave-lengths, separated by an interval (e. g. 300-500 metres, and waves in the vicinity of 1600 metres). This disadvantages of using, for this purpose, a tuning device with a high ratio of maximum to minimum wave-length, continuously variable between these limits (e. g. a series-parallel variometer), are (a) desired wave-lengths are crowded together on two portions of the scale, the rest of which is occupied by wave-lengths not desired, and (b) the difficulty of providing approximately equal sensitivity at maximum and minimum. When applying my invention, however, these disadvantages are no longer present and the whole  $360^\circ$  of tuning scale may be usefully employed.

According to my invention I provide the rotatable element of a tuning device with a switch or switches, adapted automatically to include or exclude a loading device or devices from the circuit of the said tuning device in series or in parallel therewith.

The tuning device may take the form of a variable inductance, such as a variometer or a variable condenser, and the loading de-

vice may be a fixed inductance or a fixed condenser.

In one form of construction, the variable tuning and loading device comprises a tuning device of the kind in which full variation is effected on rotation of the rotatable element through  $180^\circ$ , and a switch which, after the said rotatable element has been rotated through  $180^\circ$ , automatically includes in series with the tuning device a loading device, so that on continued rotation of the rotatable element through a further  $180^\circ$ , full variation of the tuning device will again be effected, but over a different range. After the rotatable element has been rotated through  $360^\circ$ , the loading device is again automatically cut out.

By this means convenient reception of signals lying within two separate frequency bands is possible.

Other objects and structural details of my invention will be apparent from the following description when read in connection with the accompanying drawing, wherein:

Fig. 1 is a view in elevation of the apparatus of my invention.

Figs. 2, 3, 4, 5, and 6 are diagrammatic representations of circuits adapted to employment with the device of my invention.

Referring to Figure 1, L is a coil whose inductance can be varied by rotating a copper ring R, which is mounted within the coil upon a spindle S. Also mounted upon the spindle S is an insulated cam C, so shaped that, through  $180^\circ$  of rotation of the ring R, it presses the switch tongue T away from a contact upon the plate Q; while during the other  $180^\circ$  of rotation, it permits the tongue T to make contact. The switch T-Q serves in its closed position to short-circuit an additional external inductance connected in series with the coil L.

The electrical arrangement is shown diagrammatically in Figure 2, in which the switch Q-T is represented by a double-headed arrow.

The invention may be employed to include or cut out any kind of loading device or loading devices, and, if desired, more than one switch may be provided. For example, in the arrangement shown diagrammatically in Figure 3, in which an extra inductance and an extra capacity are employed for loading a variometer, two switches X and Y are provided, and are so arranged that X opens

when Y closes, and vice versa. In this figure, the variometer is represented by a variable inductance, and the additional inductance by a fixed inductance. The full-line capacity represents the additional capacity, while the dotted-line capacity represents the capacity of the rest of the circuit (e. g. an aerial-earth capacity).

Figure 4 shows diagrammatically a method of loading a variable condenser with inductance and capacity. The arrangement is analogous to that shown in Figure 3, the switch X opening when the switch Y is closed and vice versa. The dotted inductance represents the inductance of the coil originally in the circuit.

Figures 5 and 6 show diagrammatically an arrangement for loading an ordinary two-coil variometer with an additional coil. The coils of the variometer are represented by the arrow-linked inductances.

In the arrangement shown in Figures 5 and 6, the dotted capacity represents the capacity of the rest of the circuit. The cam C, which operates the switches, is, of course, electrically conductive, and the switch is so designed with respect to the said cam that the inductance of the circuit is increased for rotation of the spindle in the same direction in both positions of the said switch.

Z is a loading inductance of large value compared with that of a half winding of the variometer, so that when the apparatus is in the position shown in Figure 5, the shunting effect of the inductance Z upon the upper variometer coil is negligible.

In the position shown in Figure 6, the inductance is connected in series with the variometer.

By the system of my invention I am enabled to provide a convenient tuning system adapted to use over two or more separate frequency bands under the actuation of a single control and indicating device.

While I have shown but one embodiment of my invention in the foregoing drawings and description it is capable of various modifications therefrom without departing from the spirit thereof, and it is desired therefore that only such limitations shall be im-

posed thereon as are required by the prior art or indicated by the appended claims.

I claim as my invention:

1. In a resonant circuit a variometer, a fixed inductance, and a switch cooperating with said variometer and actuated thereby, adapted to include or exclude said fixed inductance from said resonant circuit.

2. A variable impedance comprising a two coil variometer, an impedance element, and a switch for connecting said impedance element in series with said variometer and in parallel with one of the coils of said variometer.

3. A variable impedance comprising a two coil variometer, an impedance element, and a switch for connecting said impedance element in series with said variometer during one half of the rotation of said variometer, and in parallel with one of the coils of said variometer during the other half of the rotation of said variometer.

4. A variable impedance comprising a two coil variometer, an impedance element, and means cooperating with said variometer and actuated thereby for connecting said impedance element in series with said variometer during half of the rotation of said variometer and in parallel with one of the coils of said variometer during the remainder of the rotation of said variometer.

5. A variable impedance comprising a two coil variometer, an inductance member, and a switch cooperating with said variometer and actuated thereby for connecting said inductance element in parallel with one of the coils of said variometer during part of the rotation of said variometer and in series with said variometer during the remainder of the rotation of said variometer.

6. A variable impedance comprising a two coil variometer, an inductance member, and a switch for connecting said inductance member in series with said variometer during one half of the rotation of said variometer and in parallel with one of the coils of said variometer during the other half of the rotation of said variometer.

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