

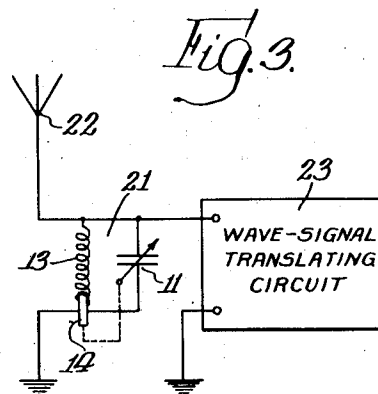
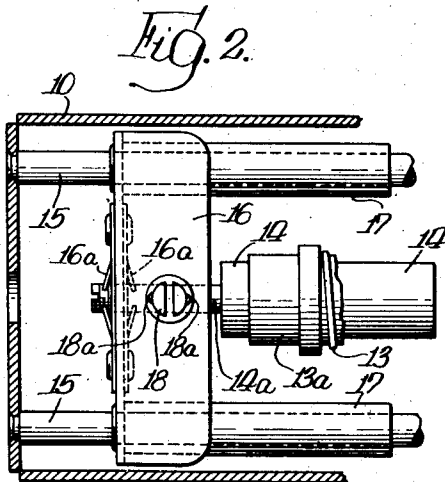
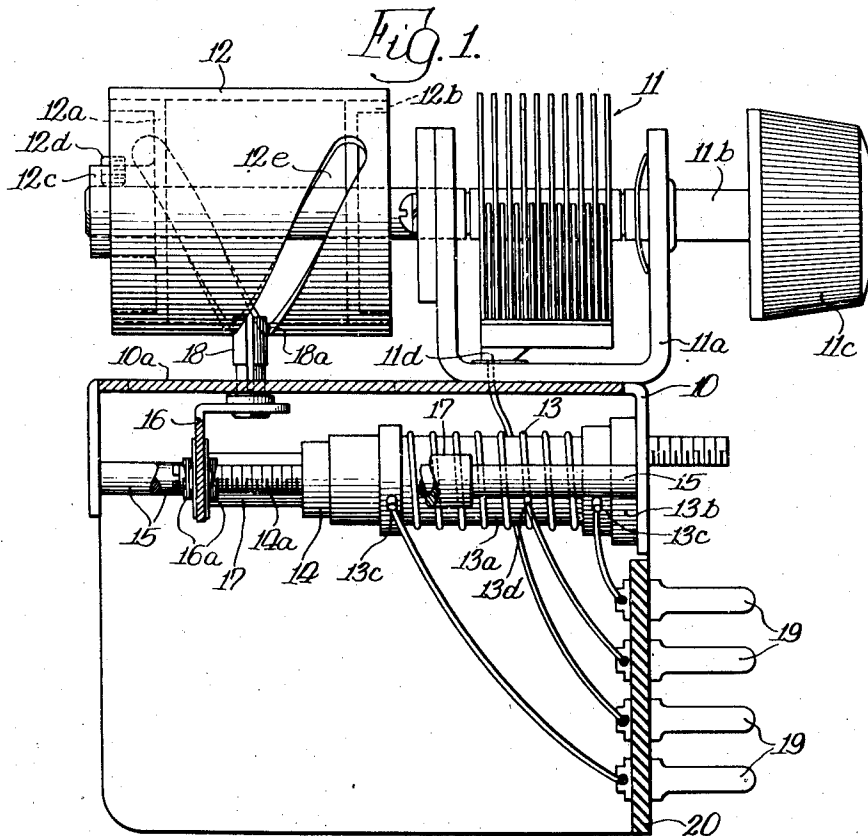
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COMBINED CAPACITIVE AND INDUCTIVE TUNING UNIT

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COMBINED CAPACITIVE AND INDUCTIVE
TUNING UNIT

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This invention relates to combined capacitive and inductive tuning units and, while it is of general application, it is particularly suitable for use in tuning a wave-signal apparatus over a wide range of radio frequencies.

Heretofore tunable radio-frequency circuits have generally comprised inductance and capacitance elements, only one of which has been adjustable to tune the circuit over a desired range of frequencies. The maximum tuning range of such a circuit depends upon the ratio of the maximum value to the minimum value of the adjustable minimum value of the inductance or the capacitance of the element and its associated circuit elements. This corresponds to a frequency range of approximately 3 to 1. When a wider frequency range has been required, resort has been had to switching the values of one or the other of the tuning elements or to adjusting both of the tuning elements simultaneously in the same sense. The first-named expedient is inherently complicated and has the well known disadvantages attendant upon the use of movable contacts and at the same time gives a discontinuous tuning control. On the other hand, the apparatus heretofore proposed for use as the second-named expedient has generally been complicated mechanically as well as bulky and costly.

It is an object of the invention, therefore, to provide a new and improved combined capacitive and inductive tuning unit suitable for tuning a wave-signal apparatus continuously over a wide band of radio frequencies which is simple, inexpensive and compact in construction.

In accordance with the invention, a combined capacitive and inductive tuning unit comprises a supporting frame, a rotatable tuning condenser mounted thereon and having an actuating shaft and a camming element mounted on said shaft and having a helical cam surface. The tuning unit also comprises an inductor including an elongated winding element and an elongated core element, one element being supported from the frame and the other element being axially adjustable relative thereto for adjusting the inductance value thereof. The winding and core elements are parallel to the axis of the shaft and there is provided a driving connection between the camming element and the adjustable element, the driving connection being such that the values

of the condenser and inductor are simultaneously adjustable in the same sense.

Referring now to the drawing, Fig. 1 is a side elevation, partly broken away, of a combined capacitive and inductive tuning unit constructed in accordance with the invention; Fig. 2 is a top detail view of a portion of the apparatus of Fig. 1, while Fig. 3 is a simplified schematic circuit diagram illustrating an application of the combined capacitive and inductive tuning unit of the invention.

Referring now to Figs. 1 and 2 of the drawing, there is illustrated a combined capacitive and inductive tuning unit comprising a supporting box-like frame 10, the front wall of which is broken away for clarity of illustration. Mounted on the frame 10 is a rotatable adjustable tuning condenser 11 which may be of conventional structure including a supporting frame 11a riveted or otherwise secured to the frame 10 and provided with an actuating shaft 11b to which is connected any suitable operating means such as a knob 11c. The tuning unit also comprises a camming element having a driving connection with the condenser shaft 11b and of a configuration for converting the rotary motion of the adjustable condenser into translatory motion and vice versa. For example, the camming element may comprise a cylindrical member 12 mounted on the shaft 11b by means of cup-like end pieces 12a, 12b, the piece 12a being provided with a hub 12c for locking to the shaft 11b by suitable means such as a set screw 12d. The member 12 has a helical camming element either in the form of a helical rib or, as illustrated, a helical cam slot 12e formed in the surface thereof.

The tuning unit also includes an inductor consisting of at least two elements, one element being supported from the frame 10 and the other element being axially adjustable relative thereto for adjusting the inductance value thereof. More specifically, the inductor comprises an elongated winding element 13 wound on a suitable form 13a of insulation material and terminating in an enlarged head or base 13b suitably supported from the frame 10 by rivets, screws or the like, with its axis parallel to the axis of the condenser shaft 11b. The other element of the inductor comprises an elongated magnetic core element 14, preferably in the form of a plug of powdered iron compressed in a binder. The axes of the winding 13 and core 14 are both parallel to the axis of the condenser shaft 11b, as illustrated. In order to adjust the core 14 axially relative to the winding 13, there is provided an elongated guide means

supported from the frame. The guide means may comprise a pair of elongated slots in opposed side plates of frame 10 or, as illustrated, a pair of guide rods 15 disposed parallel to the axis of the winding 13 and secured in the frame by riveting or upsetting the ends thereof in the opposite ends of the frame 10. There is also provided a carriage slidably supported on the guide rods and comprising a crosspiece 16 with an angle-shaped cross section to which are secured a pair of sleeves 17 mounted on the guide rods 15. The core member 14 is provided with a threaded extension 14a molded or otherwise secured into the end thereof and this threaded extension is engaged by a pair of spring clips 16a riveted or otherwise secured to the portion of the frame 16 normal to the guide rods 15. The core 14 may be axially adjusted relative to the cam slot 12e by the threaded extension 14a for alignment purposes. As thus supported on the carriage 16, 17, the magnetic core element 14 is axially adjustable relative to and within the winding 13 for adjusting its inductance value in a manner well understood in the art. It will be apparent, however, that the core member 14 may be stationary and the winding 13 axially movable relative thereto, if desired.

The tuning unit also includes a driving connection between the camming means or member 12 and the adjustable core 14 of the inductor element. Specifically there is provided a pin 18 projecting upwardly from the flange of the carriage 16 and secured thereto by riveting, upsetting, or the like, this pin extending through a slot 19a in the upper wall of the frame 10 and engaging the camming means as by extending into the cam slot 12e. In order substantially to eliminate any backlash, the pin 18 is split and slightly spread and provided with small spherical projections 18a for resiliently engaging the walls of the cam slot 12e, thereby reducing friction and increasing the accuracy of adjustment.

The driving connection between the condenser shaft 11b and the camming element, in this case the mounting of the cam cylinder 12 upon the condenser shaft and the configuration of the camming element, that is, the pitch of the cam slot, are such that the values of the capacitance of the condenser 11 and the inductance of the winding 13 are adjustable in the same sense by adjustment of the knob 11c. The cam slot 12e, while referred to as a helical slot, need not be the ideal mathematical helix but the term is used only to indicate the general type of curve involved.

The configuration of the cam slot 12e and the shape of the plates of condenser 11 may be selected or designed in accordance with the particular variation of inductance and capacitance desired with adjustment of the tuning unit by the knob 11c. For example, the cam slot 12e and the plates of the condenser 11 may be designed to obtain either straight-line frequency variation or straight-line wave length variation with adjustment of the knob 11c. Alternatively, there may be obtained a constant frequency difference between the circuit comprising the tuning unit and another tunable circuit uncontrolled by the same tuning knob 11c as, for example, is desirable in tracking the oscillator circuit of a superheterodyne receiver with the tunable radio-frequency circuits. Furthermore, the cam slot 12e may be so proportioned in relation to the shape of the plates of the condenser 11 as to impart to the

circuit comprising the tuning unit a constant impedance, that is, a constant L/C ratio.

An insulated terminal 11d of condenser 11 and end terminals 13c and an intermediate terminal 13d of the winding 13 may be brought out to a plurality of terminals 19 supported on a terminal plate 20 of insulation material suitably secured to the frame 10. However, it will be understood that, in case other components of the apparatus in which the tuning unit is embodied are to be supported in or from the frame 10, certain of the terminals of the condenser 11 and the winding 13 may be appropriately arranged for connection to their associated elements.

In Fig. 3, there is represented schematically a simplified circuit diagram illustrating an application of the tuning unit of the invention. In this case, the elements of the tuning unit are connected to form a tunable circuit 21 for connection to the antenna 22 of a wave-signal translating circuit 23 which may be either a transmitter or a receiver. Simultaneous adjustment of the inductance of the inductor 13 and the capacitance of condenser 11 is effective to adjust the tuning of the circuit 21 over a wide band of radio frequencies. In a particular apparatus in which the tuning unit of the invention has been embodied, the tuning range was from 14 to 50 megacycles.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit or scope of the invention.

What is claimed as new is:

1. A combined capacitive and inductive tuning unit comprising, a supporting frame, a rotatable tuning condenser mounted thereon and having an actuating shaft, a camming element mounted on said shaft and having a helical cam surface, an inductor including an elongated winding element and an elongated magnetic core element, one element being supported from said frame and the other element being axially adjustable relative thereto for adjusting the inductance value thereof, said winding and core elements being parallel to the axis of said shaft, and a driving connection between said camming element and said adjustable element, said driving connections being such that the values of said condenser and said inductor are simultaneously adjustable in the same sense.

2. A combined capacitive and inductive tuning unit comprising, a supporting frame, a rotatable tuning condenser mounted thereon and having an actuating shaft, a camming element mounted on said shaft and having a helical cam surface, an inductor including an elongated winding element supported from said frame, elongated guide means supported from said frame parallel to the axis of said winding element, an elongated magnetic core element slidably supported by said guide means and axially adjustable relative to said winding for adjusting the inductance value thereof, said winding and core elements being parallel to the axis of said shaft, and a driving connection between said camming element and said adjustable element, said driving connections being such that the values of said condenser and said inductor are simultaneously adjustable in the same sense.

3. A combined capacitive and inductive tuning unit comprising, a supporting frame, a rotatable tuning condenser mounted thereon and having

an actuating shaft, a cylindrical member mounted on said shaft and having a helical cam slot formed therein, an inductor including a winding element supported from said frame with its axis parallel to the axis of said condenser shaft, a pair of elongated guide rods supported from said frame parallel to the axis of said winding element, a carriage slidably supported on said guide rods, a magnetic core element supported on said

carriage and axially adjustable relative to and within said winding for adjusting the inductance value thereof, and a pin extending from said carriage and engaging said cam slot, the configuration of said cam slot being such that the values of said condenser and said inductor are simultaneously adjustable in the same sense.

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