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TUNING CONTROL AND BAND SWITCHING ARRANGEMENT

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2 Sheets-Sheet 1

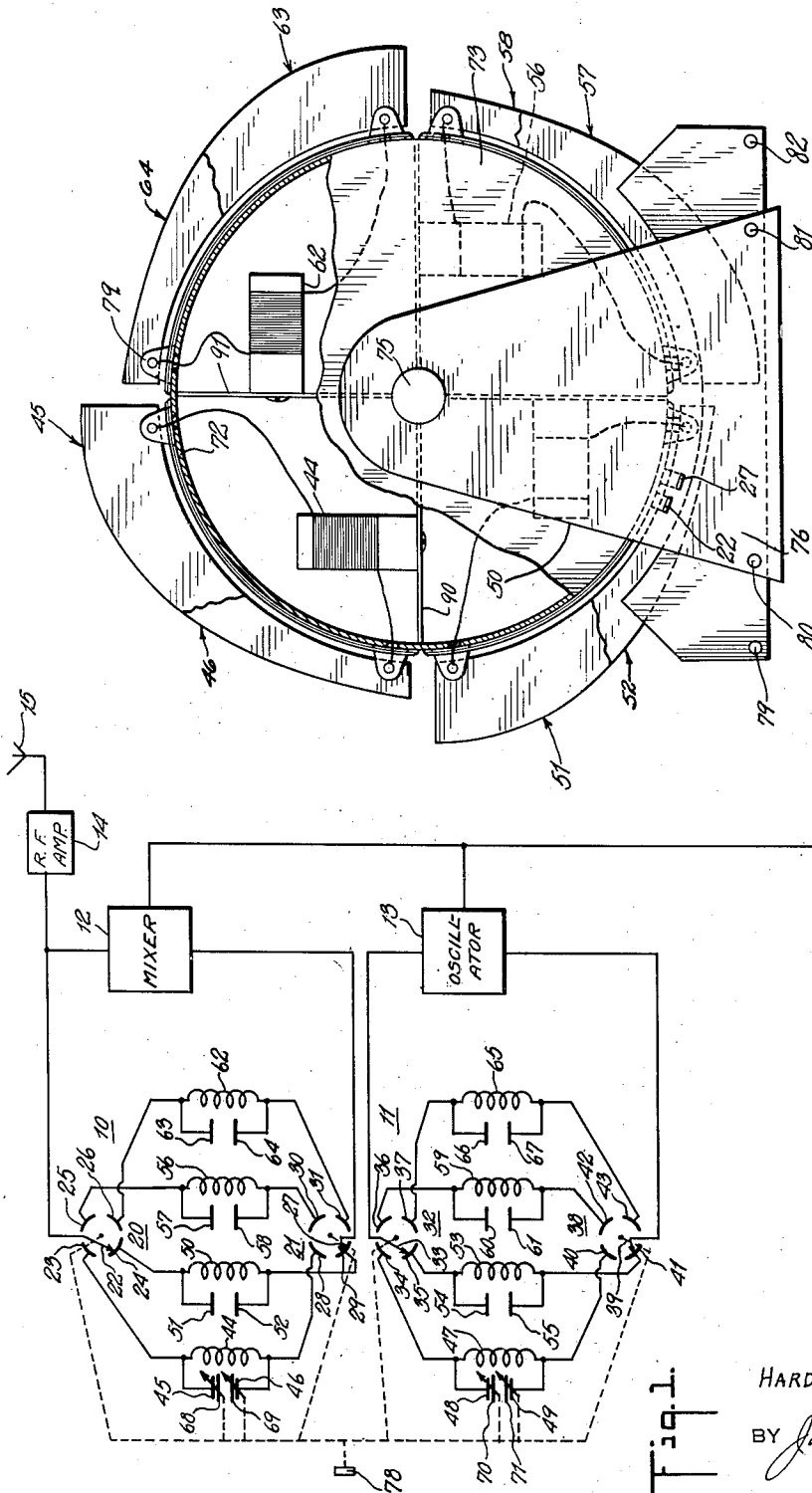


Fig. 2.

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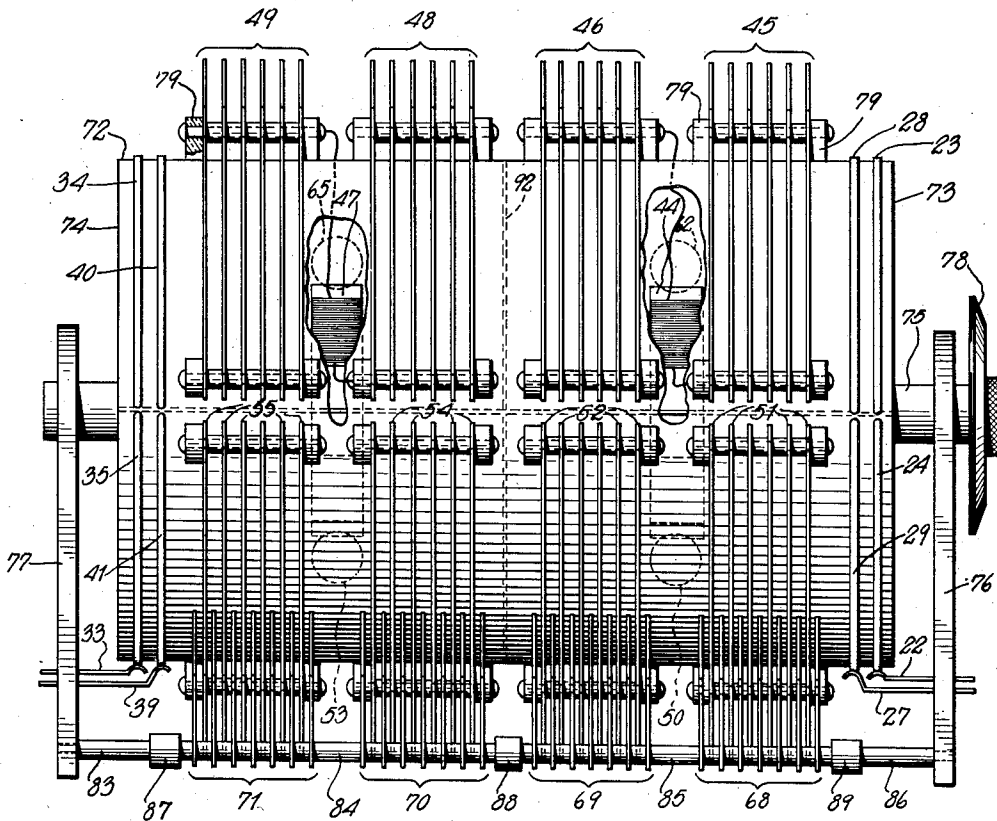
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2 Sheets-Sheet 2



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TUNING CONTROL AND BAND SWITCHING
ARRANGEMENT

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a corporation of Iowa

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2 Claims. (Cl. 250—40)

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This invention relates to multiple tuned circuits such for example as are used in radio sets, and more particularly to a multi-frequency band tuning arrangement capable of continuous coverage of a wide range of frequencies.

Various arrangements have been devised heretofore for enabling wave coupling circuits to be tuned over a wide frequency range. When the required frequency range coverage is too large to be accomplished by single adjustable components whether capacitative or inductive, resort has been had to multi-contact switches for switching from one tuning combination to another tuning combination. Among the disadvantages of such conventional band-changing arrangements are the following. A change in contact resistance may take place at the switch contacts which because of their inclusion in the tuned circuit, causes a change in the desired resonance of the tuning circuit. When the adjustable condenser is designed for tuning over a wide frequency range and has optimum tuning effect within a particular frequency band, it causes a crowding of the frequencies when adjusted to cover a higher frequency band. Furthermore, the adjustable capacitor used for tuning the circuit over a very wide range may be too large for maximum efficiency of operation.

Accordingly, it is a principal object of this invention to provide a tuning control system for use with radio apparatus and the like, which system provides the correct inductance-to-capacity ratio required for the tuning over each frequency band of a series of such bands.

It is also an object of this invention to provide a tuning control system suitable for use over a wide range of frequencies and capable of covering each successive frequency band of a series; and wherein connection is automatically made to the correct frequency-determining combination in a series of such combinations while employing a minimum number of switching contacts.

It is another object of this invention to provide a tuning control system for multi-band operation wherein the band spread on each band can be given any desired magnitude.

It is a further object of this invention to provide a tuning control system employing successive frequency bands covering a wide frequency range wherein the functions of tuning and band switching are accomplished by a single adjusting member such as a tuning dial.

A feature of the invention relates to an improved dual section tuning system each section

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having separate inductance coils for operation over predetermined frequency bands and separate adjustable condenser plates for operation over each of said bands.

Another feature relates to a compact and mechanically symmetrical unit for controlling the tuning of a radio set or the like over a succession of frequency bands.

A further feature relates to a unitary multi-band tuning and band-change unit, comprising a rotatable drum carrying a plurality of separate sets of condenser plates arranged around the periphery thereof, and carrying on its interior in separate shielded compartments a series of inductance coils which cooperate with corresponding condenser plates.

A still further feature relates to a novel compact unit for tuning a device such as a multi-band radio receiver, over a series of frequency bands, the device having sets of condenser stator plates and sets of condenser rotor plates. The rotor plates are peripherally spaced around a hollow drum-like member having a single adjusting shaft. Located on the interior of this drum-like member in separate shielded compartments are the respective tuning inductances for the various frequency bands. A commutator segment arrangement is carried by the drum-like member so that merely by turning said member the proper combination of rotor and stator condenser plates are chosen as well as the proper tuning inductance to cooperate therewith.

A further feature relates to the novel multi-band superheterodyne radio receiver.

A still further feature relates to the novel organization, arrangement and interconnection of parts which cooperate to produce an improved multi-band tuned circuit system for operation over a wide frequency range.

Other features and advantages not particularly enumerated, will be apparent after a consideration of the following detailed descriptions and the appended claims.

In the drawing,

Fig. 1 is a schematic wiring and block diagram showing a superheterodyne radio receiver embodying the inventive concept.

Fig. 2 is a front view of one preferred tuning control according to the invention.

Fig. 3 is a side elevation view of Fig. 2.

Merely for purposes of explanation, the invention will be described and illustrated as applied to the tuning of the frequency conversion oscillator stage and the mixer stage of a conventional superheterodyne radio receiver. It will be under-

stood that the inventive concept is applicable to any other plurality of units which are required to be tuned in tracked relation by adjustable capacitors.

Referring more particularly to Fig. 1, the designations 10, 11, represent respectively the tuning sections which are adapted respectively to tune the mixer 12 and the local heterodyne oscillator 13. The mixer 12 may have its input supplied from any suitable radio frequency amplifier 14 connected to a receiving antenna 15. The output of mixer 12 is applied to the intermediate frequency amplifier 16 which in turn is connected to a suitable detector 17, and a suitable audio frequency amplifier 18, which is connected to a suitable translator or loud speaker 19. Merely for illustrative purposes, the receiver is shown as having four separate tuning bands, although a greater or less number may be used. The tuning and band-change section 10 comprises four parallel coil and condenser combinations, one combination for each band. Likewise, the tuning and band-change section 11 comprises four parallel coil and condenser combinations, one for each of the bands. The section 10 also has a pair of commutators 20, 21. Commutator 20 comprises a stationary brush 22 which contacts successively with the rotatable slip-ring segments 23, 24, 25 and 26. Likewise, commutator 21 comprises a stationary brush 27 which contacts successively with the rotatable slip-ring segments 28, 29, 30 and 31. The commutator 32 of section 11 comprises a stationary brush 33 with its cooperating rotatable commutator slip-ring segments 34, 35, 36, 37. Likewise, the commutator 38 comprises a stationary brush 39 and its cooperating rotatable commutator segments 40, 41, 42 and 43. All the commutator segments are mounted around a common shaft which is adapted to rotate the said segments as a unit. The arrangement of the segments is such that during one quadrant of revolution, contact is made between brush 22 and segment 23; between brush 27 and segment 28; between brush 33 and segment 34; and between brush 39 and segment 40. As the commutator segments are rotated, it will be clear that the remaining segments are likewise connected in circuits in sets of four by their respective brushes. Permanently connected to the segments 23 and 28, is an inductance coil 44 and the terminals of this inductance coil are connected respectively to condenser rotor plates 45, 46. While Fig. 1 shows the plates 45 and 46 as consisting of a single element, it will be understood that this is merely schematic and that each element will consist of a bank of spaced condenser rotor plates as will be described in connection with Figs. 2 and 3.

Likewise, permanently connected to the segments 34 and 40 is the inductance coil 47 which has its terminals connected to condenser rotor plates 48, 49. In a similar manner, segments 24 and 29 are connected to inductance coil 50, the terminals of which are connected to the condenser rotor plates 51, 52. Likewise, commutator segments 35 and 41 are connected permanently to the inductance coil 53 which has its terminals connected to the condenser rotor plates 54, 55. Segments 25 and 30 are permanently connected to inductance coil 56 whose terminals are connected to condenser rotor plates 57, 58. Segments 36 and 42 are permanently connected to inductance coil 59 whose terminals are connected to condenser rotor plates 60, 61. Similarly, the segments 26 and 31 are permanently connected to inductance coil 62 whose terminals are connected to

condenser rotor plates 63, 64. Finally, segments 37 and 43 are permanently connected to inductance coil 65 whose terminals are connected to respective condenser rotor plates 66, 67.

The various sets of rotor plates 45-46, 51-52, 57-58, 63-64, are all provided with a common set of condenser stator plates 68-69. These stator plates are so mounted with respect to the associated rotor plates that as the shaft which carries the various commutator segments and also the rotor plates, is rotated through successive quadrants, each successive set of rotor plates is brought into electrostatic mesh with the common stator plates 68-69. Likewise, the various sets of rotor plates in unit 11 are provided with a common set of stator plates 70, 71, so that as the common shaft for the commutators is rotated through successive quadrants, the rotor plates of unit 11 are successively brought into electrostatic mesh with the stator plates 70 and 71. It will be clear from the foregoing therefore, that since all the rotor plates of both units and all the commutator segments of both units 10 and 11 are controlled by the same shaft, the mere turning of this shaft automatically brings the proper set of condenser rotor plates into mesh with the cooperating stator plates and at the same time automatically connects in circuit the proper one of the tuning inductances in each of the units 10, 11. It will be understood that in accordance with conventional superheterodyne practice, the values of the inductance coils for the oscillator unit 11, and the values of the condenser units are chosen so as to produce a constant frequency difference with respect to the tuning of the mixer unit 10. In other words, regardless of which band is selected for use by rotating the common shaft, which is represented by the dotted line in Fig. 1, there will be produced at all settings the same tuned frequency difference between units 10 and 11.

One preferred structural embodiment of the units 10, 11, is illustrated in Figs. 2 and 3, wherein parts corresponding functionally to those of Fig. 1 bear the same designation numerals.

The drum 72 of metal or other suitable material has its end plates 73, 74, fastened to shaft 75 passing centrally through the drum and mounted for rotation in suitable bearing brackets 76, 77. Shaft 75 passes through member 78 and has at its end a suitable turning knob or dial 79. The group of rotor plates 45, 51, 57, 63, are mounted in a circumferential row on suitable insulated brackets 79 carried by the drum so that all the corresponding plates of each successive group are in circumferential alignment, but with each group spaced apart from the succeeding group so that each group of plates occupies approximately one quadrant of the drum periphery. Likewise, the rotor plates 46, 52, 58 and 64 are mounted in a circumferential row around the periphery of the drum but are axially displaced from the corresponding plates 45, 51, 57 and 63. The rotor plates of unit 11 are mounted in a similar manner around the periphery of drum 72. Extending between the plates 76 and 77 are four tie members 80, 81, 82. Each of these tie members consists of four metal rods 83, 84, 85, 86, which are rigidly joined together by intervening insulating members 87, 88, 89. Supported on the sections 85 of each of the tie members 79, 80, 81, 82, are the stator condenser groups 68, 69. Likewise supported on the sections 84 of these tie members are the stator condenser groups 70, 71. The various sets of stator plates are mounted so as to be interleaved electrostatically with the

various rotor plates as the drum 72 is rotated. The interior of drum 72 is divided into four cylindrical quadrants by means of the intersecting longitudinal partitions 90, 91. Likewise, the interior of the drum may be divided into two halves by a central transverse wall 92. By this arrangement, the interior of the drum is divided into eight separate compartments. In each of these compartments is suitably mounted the corresponding one of the eight inductance coils 44, 50, 56, 62, 47, 53, 59, 65. As indicated schematically in Fig. 1, one terminal of inductance 44 is connected by an insulated wire which passes through a suitable small opening in drum 72 and is electrically connected to the plates 45, the opposite terminal of the coil 44 is likewise connected by a suitable insulated wire to the longitudinally adjacent set of rotor plates 46. Likewise the remaining coils 50, 56 and 62 are connected to respective sets of rotor plates. Thus coil 50 is connected to plates 51, 52; coil 56 is connected to plates 57, 58; and coil 62 is connected to plates 63, 64. Suitably fastened to the right-hand end of the drum 72 so as to be insulated therefrom, are the commutator segments 23 to 26, and 28 to 31. Likewise, insulatingly fastened to the left-hand end of the drum periphery are the commutator segments 34 to 37 and 40 to 43. Insulatingly mounted in the member 76 are the stationary brushes 22 and 27. Likewise, insulatingly mounted in the member 77 are the stationary brushes 33 and 39. Each of the commutator segments occupies approximately one quadrant of the drum periphery and the connections from the various segments to the respective inductance coils and the respective sets of rotor plates are indicated in Fig. 1.

As shown more clearly in Fig. 2, the stator plates have curved peripheries corresponding to the curvature of the drum 72 and are mounted in spaced relation to the drum periphery.

It will be understood that the various condenser plates may be given any planar configuration in accordance with the desired law of capacity variation. Thus, if a linear relation is desired between incremental capacity change with incremental movement, the rotor plates can be designed as follows.

$$\rho = \sqrt{\frac{C_0(f_0 - f_\phi)}{Kc\phi \left[f_0 + \frac{(f_\phi - f_0)\theta}{\phi} \right]^3}} + R$$

where

R=the peripheral radius of drum 72

C₀=the stray capacity

f₀=the lowest frequency to be covered

f_φ=the highest frequency to be covered

θ=the angular displacement of the rotor plate

φ=the arc through which the rotor plate travels from zero to maximum electrostatic mesh

Kc=dielectric constant multiplied by the number of rotor plates used, and

ρ=the distance from the axis of rotation to the outer edge of the rotor plate.

While there has been here described one pre-

ferred embodiment, it is understood that various changes and modifications may be made therein without departing from the scope of the invention.

What is claimed is:

1. A tuning control and band-change arrangement for radio sets and the like, comprising a rotatable drum of conductive material, a first inductance coil carried interiorly of said drum and rotatable as a unit therewith, a first condenser rotor plate insulatingly mounted on the external periphery of said drum and electrically connected to one terminal of said first inductance, a second condenser rotor plate insulatingly mounted on the external periphery of said drum and electrically connected to another terminal of said first inductance, said first and second plates being of similar segmental shape and of co-extensive circumferential length around the periphery of said drum but being displaced from each other longitudinally of said drum, a second inductance coil carried interiorly of said drum and rotatable as a unit therewith, a third condenser rotor plate insulatingly mounted on the external periphery of said drum and electrically connected to one terminal of said second inductance, a fourth condenser rotor plate insulatingly mounted on the external periphery of said drum and electrically connected to another terminal of said second inductance, said third and fourth plates being of similar segmental shape and circumferential extension around the periphery of the drum with the third plate in circumferential alignment with the first plate and the fourth plate in circumferential alignment with the second plate, respective stator condenser plates for said rotor plates fixedly mounted adjacent said drum, commutator means carried by said drum for connecting each of said inductances and their respective electrically connected rotor plates to a common utilization circuit, and a single control shaft for rotating said commutator and said drum to effect continuous band-change and tuning within each band.

2. A tuning control and band change arrangement according to claim 1, in which said drum is divided by a conductive wall into longitudinal compartments and each longitudinal compartment is divided by respective conductive walls into respective radial compartments, and within each radial compartment is mounted one of said inductance coils.

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