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MULTIBAND INDUCTANCE UNIT

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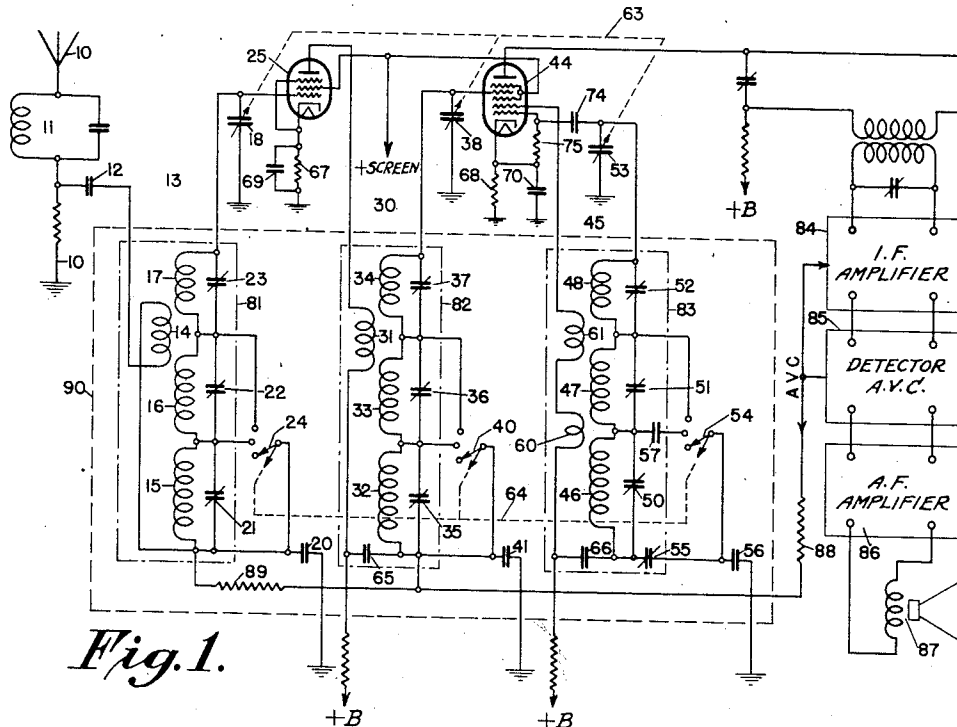


Fig. 1.

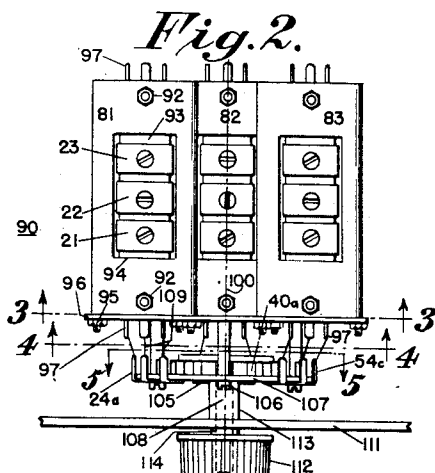


Fig. 2.

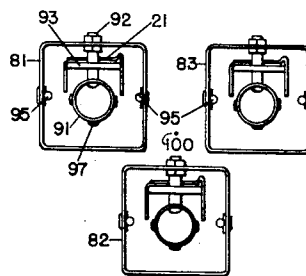


Fig. 3.

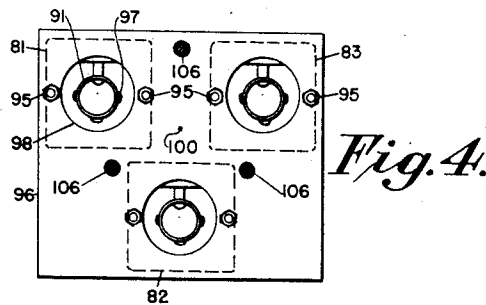


Fig. 4.

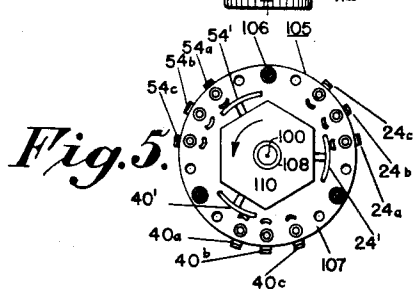


Fig. 5.

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MULTIBAND INDUCTANCE UNIT

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6 Claims. (Cl. 250—40)

This invention relates to multi-band radio receivers and particularly to an interchangeable assembly unit of the various inductance elements and associated apparatus that are utilized to provide for the multi-band operation of such receivers.

Many multi-band receivers differ from each other only by a comparatively small portion of the total apparatus of which they are comprised, such differences being due to the fact that they are designed to operate over different sets of frequency bands. This condition exists in particular between receivers manufactured at a common source but destined for different distributors in the same market, and between receivers manufactured at a common source but destined for different markets. It has been a common practice, notwithstanding the identity of a considerable portion of the apparatus of such receivers, to manufacture and stock complete receivers for each different set of frequency bands. Further, the manufacture of multi-band receivers to a given production standard has been difficult due to the limited tolerances ordinarily permitted in the assembly and wiring of such receivers. This is particularly true in the higher frequency bands, where small deviations in the length and/or placement of the leads to the tuned circuit elements cause substantial deviations in the responses of such tuned circuits.

It is an object of this invention to eliminate the duplication entailed by the manufacturing practice mentioned above, to enable multi-band receivers to be manufactured readily and closely to a given production standard, to reduce the number of complete receivers that the manufacturer must carry in stock, to reduce the losses resulting from unsold receivers and to simplify the manufacture of different receivers having considerable identical equipment.

It is a further object of this invention to provide a compact, readily accessible, readily adjustable and interchangeable multi-band inductance unit including the various inductance elements and associated apparatus, such as band-selecting switches and trimmer condensers, in which elements the differences between two or more otherwise identical multi-band receivers normally obtain. As a consequence, the manufacturer may make up and stock a single receiver chassis, minus the multi-band inductance unit, for all such receivers, may make up and stock such units for each of the different sets of frequency bands for which it is desired to design a receiver, and thus, may quickly and easily fill orders for receivers operative over any particular set of bands by equipping the chassis with multi-band inductance units corresponding to such particular set of bands. In addition, due to the use of the multi-band inductance unit, the

completed receivers adhere closely to the production standard, particularly as to alignment and band coverage.

Other objects of the invention will become apparent when considering the following specification, taken in conjunction with the accompanying drawing and the appended claims.

A preferred embodiment of the invention contemplates a multi-band inductance unit consisting of the inductances for all the tunable stages of the receiver, the inductances for each of the several stages being formed into an assembly, as by winding them on a common form. The term "tunable stage" is used herein to denote any tunable system of a receiver such as a tunable radio-frequency selector or a tunable frequency-determining circuit of an oscillator or oscillator-modulator. The inductance assemblies are mounted upon a supporting structure which also supports a rotary switch. This switch has groups of contacts individual to the several tunable stages of the receiver, the groups of contacts being disposed about the operating shaft of the switch. The several inductance assemblies are so disposed on the supporting structure that terminals provided on such assemblies are proximate to their respective switch contacts. The interconnecting leads between the inductance assembly terminals and the switch contacts may thus be short and linear. The entire unit is arranged to be detachably mounted upon a suitable supporting panel. The inductance assemblies are usually enclosed within shield cans which are also mounted upon the supporting structure. When the inductance assemblies are provided with trimmer condensers, these are preferably mounted within the respective shield cans with access to their adjusting screws provided through suitable apertures in the shield cans. In order that such access may be had after the unit is installed in a receiver, the shield cans are mounted in a staggered relationship upon the supporting structure with all the adjusting screw apertures facing in the same direction.

In the drawing, Fig. 1 is a circuit diagram, partly schematic, of a multi-band superheterodyne receiver to which the invention is particularly applicable; Fig. 2 is a view in elevation of a multi-band inductance unit embodying the invention; Fig. 3 is a view of the unit taken along the section line 3—3 of Fig. 2; Fig. 4 is a view of the unit taken along the section line 4—4 of Fig. 2; and Fig. 5 is a view of the unit taken along the section line 5—5 of Fig. 2.

Referring to Fig. 1, the multi-band superheterodyne receiver there shown comprises an antenna circuit 10, with an intermediate-frequency trap circuit 11 therein, connected through coupling condenser 12 to the multi-band selector circuit 13 of the first tunable stage of the receiver. Circuit

13 includes a primary inductance element 14, three series connected secondary inductance elements 15, 16, and 17 inductively related to the primary element 14, and a variable tuning condenser 18 connected across the exterior terminals of the series connected inductances, the low potential side of condenser 18 being connected to the low potential terminal of inductance element 15 through a coupling condenser 20. Three adjustably fixed trimmer condensers 21, 22 and 23 are connected in parallel with inductance elements 15, 16 and 17, respectively. Inductance elements 15 and 16 may be selectively short-circuited by a band-selecting switch 24 so as selectively to connect the inductance elements 15, 16 and 17 effectively in circuit with variable condenser 18 for causing the first tunable stage of the receiver to operate over the several frequency bands.

A vacuum tube 25 serving as a radio-frequency amplifier is connected to the selector circuit 13, the anode of such tube being connected to the primary inductance element 31 of the selector circuit 30 of the second tunable stage of the receiver. This circuit 30 has series-connected secondary inductance elements 32, 33 and 34, parallel trimmer condensers 35, 36 and 37, a variable tuning condenser 38, a band-selecting switch 40 and a coupling and series-aligning condenser 41 arranged and connected in the same manner as the corresponding elements in the first tunable stage of the receiver. The selector circuit 30 is connected to the modulator grid of a vacuum tube 44 serving as an oscillator-modulator.

The third tunable stage of the receiver includes the oscillation circuit 45 for tube 44, circuit 45 comprising three series-connected secondary inductance elements 46, 47 and 48, parallel trimmer condensers 50, 51 and 52, a variable tuning condenser 53 and a band-selecting switch 54 arranged and connected in the same manner as the corresponding elements in the first and second tunable stages. The low potential terminal of inductance element 46 is connected to the low potential side of variable condenser 53 through coupling and series-aligning condensers 55 and 56 in series, the condenser 56 acting alone in aligning in the high-frequency range and the two condensers 55 and 56 acting together in the low-frequency range. In the middle-frequency range condenser 56 acts alone as a coupling condenser, and as an aligning condenser in conjunction with a condenser 57 which is then effectively connected in series therewith by the band-selecting switch 54.

The oscillation-producing coupling, or feedback, for oscillation circuit 45 is provided by two series-connected primary inductance elements 60 and 61 connected in the oscillator anode circuit of tube 44 and coupled to the secondary inductance elements 46, 47 and 48 and by one or both of the condensers 55 and 56.

Variable tuning condensers 18, 38 and 53 are preferably ganged for unicontrol, as indicated by the dotted line 63. Band-selecting switches 24, 40 and 54 are also preferably ganged for unicontrol, as indicated by the dotted line 64. Suitable blocking condensers 65 and 66 are provided in the anode circuits of tubes 25 and 44; cathode biasing resistors 67 and 68 and by-pass condensers 69 and 70 are provided in the cathode circuits of tubes 25 and 44; and a grid condenser 74 and a grid leak 75 are provided for the oscillator control grid of tube 44. The inductance elements of the circuits 13, 30 and 45, together with their respective trimmer condensers, are mounted within shield cans

81, 82 and 83 for the several circuits, as schematically illustrated in Fig. 1.

In cascade with oscillator-modulator 44 are an intermediate-frequency amplifier 84, a detector and automatic amplification control source 85, an audio-frequency amplifier 86 and a sound reproducer 87. The automatic amplification control bias potential (A. V. C.) may be applied to any one or more of the radio-frequency amplifier tube 25, the oscillator-modulator tube 44 and the intermediate-frequency amplifier 84 as desired. The automatic amplification control connection to the oscillator-modulator tube 44 includes a filter comprising high resistance element 88 and condenser 41, while that to the amplifier tube 25 includes a filter comprising high resistor 89 and condenser 20.

In operation, the desired received signal is selected in selector circuit 13, is amplified in tube 25, is further selected by the selector circuit 30 and transferred to the oscillator-modulator tube 44 where the signal is converted into a modulated intermediate frequency. The signal, as thus converted, is amplified in the intermediate-frequency amplifier 84 and rectified by detector 85, producing the audio frequencies of modulation, which are amplified in the audio-frequency amplifier 86 and reproduced by the sound reproducer 87.

The amplification of the received signal is subject to automatic control by the A. V. C. bias potentials, according to the manner well understood in the art, to maintain the signal output of the receiver within a relatively narrow range for a wide range of amplitudes of received signals.

The interchangeable multi-band inductance unit 90 for the receiver is a unit formed of the following apparatus shown in Fig. 1: the inductance elements of the tunable circuits 13, 30 and 45 and their respective trimmer condensers, shield cans, and band-selecting switches. In addition, the unit may include various condensers and resistances which are electrically proximate and related to the preceding apparatus, for example, condensers 65, 41, 66, 55, 56 and 57 and resistors 88 and 89.

Referring now to Figs. 2-5, which illustrate a preferred construction of the multi-band inductance unit 90, the inductance elements 14, 15, 16 and 17 of the first tunable stage of the receiver are wound on a common form 91 and axially displaced thereon, the resulting inductance assembly being mounted within the shield can 81 and secured thereto by bolts 92 at either end of the form. Bolts 92 also support a strip 93 parallel to the axis of the form and positioned between the form and the shield can. Mounted along strip 93 are the trimmer condensers 21, 22 and 23, with the adjusting screw of each facing upwardly, as viewed in Fig. 2, the shield can 81 being suitably apertured or cut away as at 94, above the adjusting screws, so that access may be had thereto. Shield can 81 has two lugs 95 suitably attached thereto at one end which extend through a supporting and shielding plate 96 and serve to mount thereon the shield can 81, its inductance elements and their trimmer condensers, with the axis of form 91, and longitudinal axis of the shield can 81, perpendicular thereto. The form 91 has suitable inductance element terminals 97 mounted thereon at each end. The terminals preferably extend beyond the open ends of the shield can 81, shield plate 96 having an aperture 98 therein for the set of terminals 97 at the supported end of the shield can.

The corresponding apparatus for the other two tunable stages of the receiver are assembled and mounted in a manner similar to that described for the first tunable stage. A detailed description of the mounting and arrangement of such apparatus for the other two tunable stages is thus unnecessary.

The shield cans 81, 82 and 83 are mounted on shield plate 96 so that the adjusting screws for all of the trimmer condensers and the apertures of their respective shield cans face in the same direction.

The three shield cans are also mounted on shield plate 96 in staggered relationship so that the adjusting screws for all trimmer condensers may be reached by access to a single side of the unit. In the unit illustrated, the three shield cans are at the vertices of a substantially equilateral triangle, with the adjusting screws for all the trimmer condensers facing a plane which is parallel to the longitudinal axes of the shield cans and to one side of the triangle. In addition, the shield cans are so proportioned that there is substantial clearance between cans 81 and 83 through which access may be had to the adjusting screws for the trimmer condensers within shield can 82.

The band-selecting switches 24, 40 and 54 of Fig. 1 are incorporated in a rotary switch 105 secured, as by the bolts 106, to the shield plate 96 on the opposite side from the shield cans. Rotary switch 105 is preferably a single deck switch in order to reduce the over-all length of the unit, with the plane of its switch body 107 parallel to the plane of the shield plate 96, and is provided with a switch actuating shaft 108 the axis 100 of which extends perpendicularly to the plane of switch body 107. The switch is preferably so positioned relative to the axes of forms 91 that the axis 100 is substantially equidistant from such axes. The contacts of the switch are preferably so arranged, as in the unit illustrated, that the terminals of the switch contacts 24a, 24b and 24c of the band-selecting switch 24, of the switch contacts 40a, 40b and 40c of the band-selecting switch 40 and of the switch contacts 54a, 54b and 54c of the band-selecting switch 54, are proximate to the terminals of the inductance assemblies with which they are respectively associated and which extend through the shield plate 96. The connecting leads 109 between the inductance assembly terminals 97 and their respective switch contact terminals are thus short and substantially linear.

The contact structure of rotary switch 105 is subject to wide variation. In the unit illustrated, the actuating shaft 108 rotates a disk 110 of insulation material on the periphery of which are mounted contact bridges 24', 40' and 54' for selectively engaging the switch contacts respectively associated therewith.

The switch actuating shaft 108 is adapted to extend through a panel 111, which may be the front panel of a receiver, and is provided with an actuating knob 112. To provide a simple and effective support for the entire unit, a sleeve 113, surrounding shaft 108 and secured at one end to the switch body 107, extends through and engages the panel 111, between a shoulder on the sleeve and a nut 114 thereon.

The various condensers and resistances which may also be mounted upon the unit have, for simplicity, not been illustrated in Figs. 2-5. In general these are sufficiently small to be mounted within the shield cans and are preferably so

mounted, being supported by the connecting leads therefor.

From the above description it is clear that this invention provides a multi-band inductance unit that is small, compact, electrically efficient and subject to close production control, that may readily be made up for different sets of bands by suitably proportioning the electrical characteristics of the apparatus of which it is constituted; that may be connected and tested as an independent unit; that may easily be mounted and removed from a receiver chassis, the electrical connections to be made between it and the receiver chassis being few in number and relatively simple; and one that may easily have its adjustable elements adjusted, if necessary, after installation of the unit in the receiver chassis.

While I have described what I at present consider the preferred embodiment of my invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from my invention, and I, therefore, aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

What is claimed is:

1. In a multi-band radio receiver having a plurality of tunable stages; a compact, multi-band inductance unit comprising; rotary switching mechanism including an actuating shaft and a plurality of contacts disposed about said shaft, said contacts comprising a plurality of groups, at least one for each of the stages of the receiver; a group of inductance elements for each of the stages of the receiver the inductance elements of each of said groups being non-inductively related to the inductance elements of the other of said groups, each group including a plurality of inductance elements having different inductance values for operation over the several bands of the receiver, said groups of inductance elements being mounted with their axes parallel to the axis of said shaft and being angularly disposed about the axis of said shaft at substantially equal radial distances, said inductance elements of each of said groups being similarly disposed with respect to said axis, and axially spaced along said axis, said groups of inductance elements having terminals in proximity to their respective groups of contacts; and short and substantially linear connections between the terminals of each group of inductance elements and its respective group of contacts.

2. In a multi-band radio receiver having a plurality of tunable stages; a compact, interchangeable, multi-band inductance unit comprising; rotary switching mechanism including an actuating shaft and a plurality of contacts disposed about said shaft, said contacts comprising a plurality of groups, at least one for each of the stages of the receiver; a group of inductance elements for each of the stages of the receiver the inductance elements of each of said groups being non-inductively related to the inductance elements of the other of said groups, each group including a plurality of inductance elements having different inductance values for operation over the several bands of the receiver, said groups of inductance elements being supported from said switching mechanism with their axes parallel to the axis of said shaft and being angularly disposed about the axis of said shaft at substantially equal radial distances, said inductance elements of each of said groups being similarly disposed with respect to said axis and axially spaced along said axis,

said groups of inductance elements having terminals in proximity to their respective groups of contacts; and short and substantially linear connections between the terminals of each group of inductance elements and its respective group of contacts, said unit including provisions suitable for detachably engaging a supporting panel.

3. In a multi-band radio receiver having a plurality of tunable stages; a compact, multi-band inductance unit comprising; rotary switching mechanism including an actuating shaft and a plurality of contacts disposed about said shaft, said contacts comprising a plurality of groups, at least one for each of the stages of the receiver; a group of inductance elements for each of the stages of the receiver, each group including a plurality of inductance elements having different inductance values for operation over the several bands of the receiver, said inductance elements being mounted with their axes parallel to the axis of said shaft, a plurality of said inductance elements being angularly disposed about the axis of said shaft at substantially equal radial distances, others of said inductance elements being similarly disposed with respect to said axis, but axially displaced from said last-mentioned inductance elements, said groups of inductance elements having terminals in proximity to their respective groups of contacts; short and substantially linear connections between the terminals of each group of inductance elements and its respective group of contacts, a shield can individual to the group of inductance elements of each of the stages, and adjustable trimmer condensers for the several inductance elements of each group mounted within the respective shield can, said shield cans being apertured to provide access for adjustment of said trimmer condensers, all such apertures being accessible from a given side of said unit.

4. In a multi-band radio receiver having a plurality of tunable stages: a compact, interchangeable, multi-band inductance unit comprising; a supporting shield plate; a rotary switch supported therefrom at one side and including an actuating shaft and a plurality of groups of contacts disposed about said shaft, one group for each of the stages of the receiver; an assembly of inductance elements for each of the stages of the receiver, each assembly including a plurality of inductance elements having different inductance values for operation over the several bands of the receiver, each of said inductance assemblies being supported from said shield plate at the side thereof opposite said switch with terminals for such assembly extending through an aperture in said shield plate and in proximity to one of said groups of contacts; and short and substantially linear connections between the terminals of each assembly and its proximate group of contacts, said unit including provisions suitable for detachably engaging a supporting panel.

5. In a multi-band radio receiver having a plurality of tunable stages: a compact, interchangeable, multi-band inductance unit comprising; a supporting structure; a rotary switch supported therefrom and including an actuating shaft and a plurality of groups of contacts disposed about said shaft, one group for each of the stages of the receiver; an assembly of inductance elements for each of the stages of the receiver, each as-

sembly including a plurality of coaxial inductance elements having different inductance values for operation over the several bands of the receiver, said inductance assemblies being supported from said structure with terminals individually in proximity to said groups of contacts and with their axes parallel to each other; short and substantially linear connections between the terminals of each assembly and its proximate group of contacts; a separate shield can for each inductance assembly supported from said structure; and adjustable trimmer condensers for the several inductance elements of each inductance assembly mounted within the shield can thereof along a line parallel to the axis thereof, the several shield cans being apertured along lines parallel to the axes of said assemblies to provide access for adjustment of said trimmer condensers with all such apertures facing in one direction, certain of said assemblies being positioned rearwardly relative to the direction in which said apertures face, and staggered relative to those forward in the direction in which said apertures face, the latter being spaced to provide access to the apertures of those behind, said unit including provisions suitable for detachably engaging a supporting panel.

6. In a multi-band radio receiver having a plurality of tunable stages: a compact, interchangeable, multi-band inductance unit comprising; a supporting shield plate; a single deck rotary switch supported therefrom at one side and including a switch body, an actuating shaft perpendicular to said body and a plurality of groups of contacts, one group for each of the stages of the receiver, said switch body being parallel to the plane of said shield plate and said groups of contacts being symmetrically disposed on said switch body about said shaft; an assembly of inductance elements for each of the stages of the receiver, each assembly including a plurality of coaxial inductance elements having different inductance values for operation over the several bands of the receiver; a plurality of shield cans, one for each of said inductance assemblies, secured to said shield plate on the side thereof opposite said switch and so that their longitudinal axes are perpendicular to the plane of said shield plate, each of said inductance assemblies being supported in and by its associated shield can with terminals in proximity to one of said groups of contacts, said shield plate having apertures through which said terminals extend; short and substantially linear connections between the terminals of each assembly and its proximate group of contacts; trimmer condensers for the several inductance elements of each inductance assembly mounted within the shield can of the associated assembly along a line parallel to the axis thereof, the several shield cans being apertured along lines parallel to the axes of said assemblies to provide access to the adjustable elements of said trimmer condensers, all such apertures being faced in one direction and all said assemblies being so staggered that access may be had to the adjustable elements of all the trimmer condensers from one side of said unit; and means secured to said switch for detachably mounting said unit upon a supporting panel.