

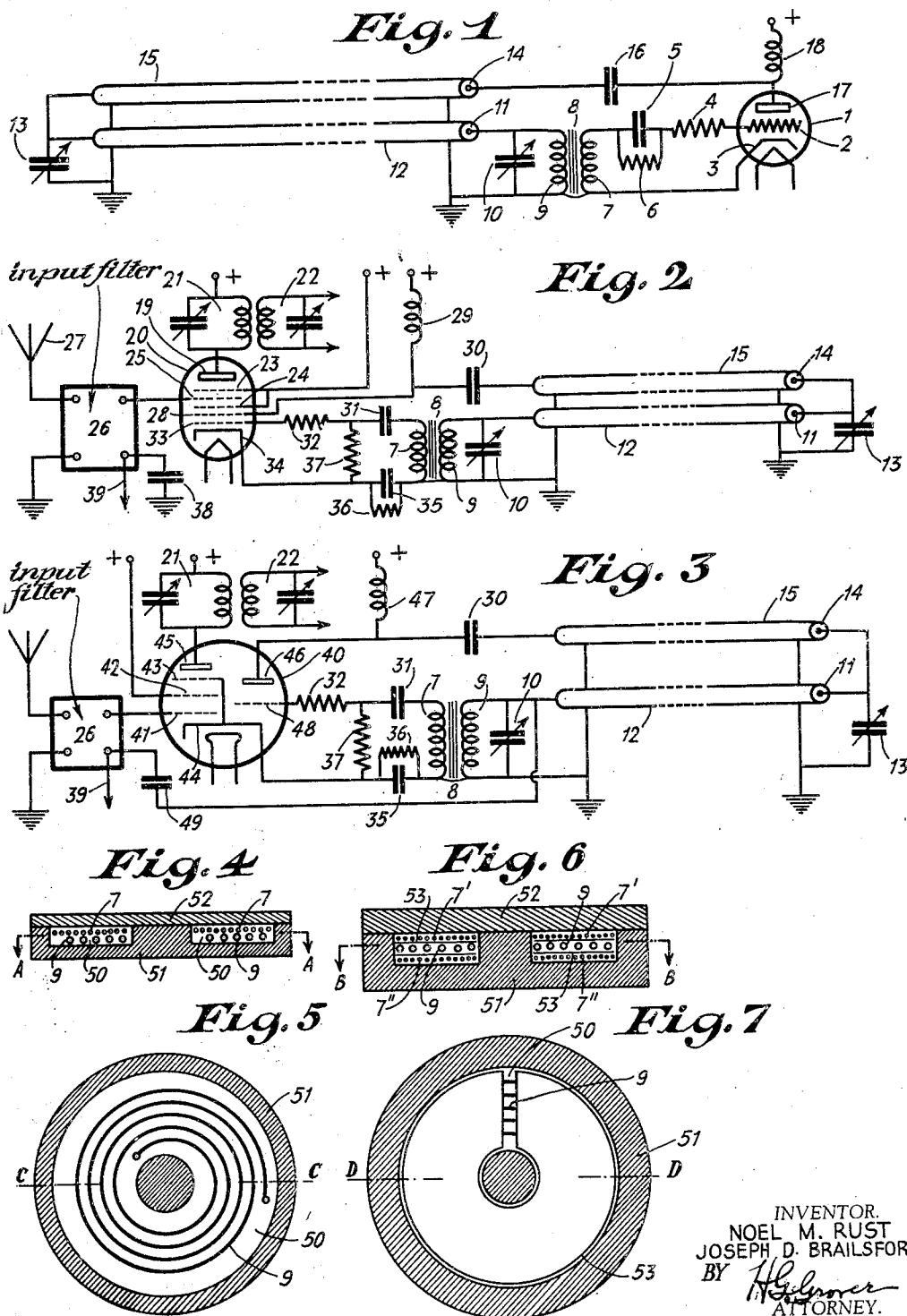
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REMOTELY CONTROLLABLE RADIO AND SIMILAR HIGH FREQUENCY RECEIVERS

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REMOTELY CONTROLLABLE RADIO AND
SIMILAR HIGH FREQUENCY RECEIVERS

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This invention relates to remotely controllable radio and similar high frequency receivers and has for its object to provide an improved tunable receiver of the kind wherein tuning may be accomplished by means of a reactance which is situated at a relatively remote point with respect to the remainder of the receiver.

A known type of radio receiver, that sometimes termed the "single span tuning" type, is a special form of superheterodyne receiver and comprises a band pass or low pass filter circuit adapted to pass any received frequency within a predetermined range or below a certain upper limit and a local oscillator adapted to change a received signal frequency to a beat frequency which is higher than the upper limit of the filter, the beat frequency being then passed to a beat frequency amplifier demodulator and audio frequency amplifier and reproducer, as in the usual way. With such a receiver, by suitably designing the input filter tuning control may be effected merely by controlling the frequency of the heterodyne oscillator thus avoiding any necessity of using "ganged" tuning control. From the point of view of remote control, therefore, this type of receiver offers obvious advantages, but when the tuning condenser of the local oscillator is removed any substantial distance from the rest of the receiver and connected to the circuit which it tunes by conductors of any substantial length, practical difficulties are met with owing to the capacity and inductance (principally the former) of the conductors connecting the condenser to the rest of the circuit. In fact, if lengths of more than a few feet of conductor are employed for radio frequency working, the tuning range becomes unduly restricted primarily because of the fact that the self-capacities of the connecting conductors are effectively in parallel with the tuning condenser.

The object of the present invention is to provide an improved remotely controllable radio or other high frequency receiver wherein a tuning reactance or reactances may be located at a substantial distance from the rest of the receiver, and yet a reasonable tuning range obtained.

According to this invention in its broadest aspect, one or more tuning reactances required to tune one or more tunable circuits of a radio or other high frequency receiver and required to be remotely situated with respect to the remainder of the receiver is or are connected to the remainder of the receiver through a screened cable or cables which do not directly connect said tuning reactance or reactances to the remainder of

the circuit or circuits to be tuned thereby, but are arranged to associate said tuning reactance or reactances with the remainder or remainders of said tuned circuit or circuits through a ferro-magnetically cored very tightly coupled transformer or transformers situated adjacent the receiver proper and having a low impedance winding or windings facing towards the tuning reactance or reactances and a high impedance winding or windings facing towards the receiver proper.

In the preferred embodiment of the invention, a receiver of the single span tuning type comprises a local oscillator having a tunable circuit consisting of a condenser and an associated inductance and said condenser is situated at a distance from said inductance and is associated therewith through a screened cable system and a ferro-magnetically cored very tightly coupled transformer having a low impedance winding connected to the conductors of the cable system and a high impedance winding connected to the inductance, said transformer being situated at the other end of the cable system from said condenser. In practice the secondary of the transformer may itself constitute the inductance of the tuned circuit so that a coil additional to said secondary is not required.

The invention is illustrated in the accompanying drawing wherein, Figure 1 is a diagrammatic representation of one arrangement for carrying out the invention; Figure 2 illustrates in diagrammatic form still another arrangement using a heptode frequency changer; Figure 3 illustrates another embodiment of the invention wherein the frequency changer consists of the triode portion of a pentode triode tube; Figures 4 and 5 illustrate a form of the transformer used in connection with the present invention; and, Figures 6 and 7 illustrate another form of a suitable transformer.

Referring to Figure 1 which shows diagrammatically one way of carrying out this invention the local oscillator valve 1 of a radio receiver of the single span tuning type, has its grid 2 connected to its earthed cathode 3 through a circuit extending from the grid via a so-called "anti-squigger" resistance 4 (i. e. a damping resistance), a condenser 5 shunted by the grid leak 6 and the high impedance secondary 7 of a very tightly coupled ferro-magnetically cored transformer 8. The transformer has a low impedance primary 9 which is shunted by a trimmer condenser 10 and is earthed at one end, the other end of the primary being connected through

the central conductor 11 of a screened cable 11, 12, to one side of a remotely situated tuning condenser 13. The same side of this condenser is also connected through the central conductor 14 of a second screened cable, 14, 15, and then through a feed back or coupling condenser 16 to the anode 17 of the oscillator valve 1 which is connected to the usual anode potential source (not shown) through a choke 18. The metal screens 12 and 15 of the two cables are connected together and earthed at the transformer end and are also connected at the other end to the other side of the remotely situated condenser. With this arrangement the transformer impedance may be suited to match the valve and cable impedances and it may be shown that owing to the coupling through one cable to the anode of the valve, difficulties due to the inductance of the screened cables, are avoided. It will be found that the whole arrangement will oscillate satisfactorily and give a wide tuning range even when the condenser is situated a substantial distance from the rest of the apparatus. The remainder of the receiver is not shown but may be as well known per se.

Another arrangement in accordance with this invention is illustrated in Figure 2. Here a single span tuning type of circuit embodying a so-called heptode frequency changer is employed. Referring to Figure 2 the anode 19 of the heptode 20 is connected to a source (not shown) of anode potential through a fixed tuned circuit 21 responsive to the predetermined beat frequency, the inductance in this tuned circuit being coupled as in the usual way to the first tuned circuit 22 of a succeeding beat frequency amplifier (not shown). The fifth and third grids (counting from the cathode outwards) 23 and 24 of the heptode are connected together and to a suitable source of positive potential (not shown). The fourth grid 25 receives input signals via the input filter 26 from the aerial 27 and the second grid 28 is connected to a suitable source of positive potential (not shown) through a choke 29 the grid side of this choke being connected through a coupling condenser 30 and the central conductor 14 of a screened cable 14, 15, to one side of a remotely situated tuning condenser 13. The same side of the condenser is connected through the central conductor 11 of another screen cable 11, 12, to one end of the low impedance primary 9 of a ferro-magnetically cored very tightly coupled transformer 8 this primary being shunted by a trimmer condenser 10 and having its other side earthed. The remaining side of the remotely situated condenser 13 and the screens 12, 15 of the two cables are also earthed. The transformer 8 has a high impedance secondary 7 which is connected to earth on one side and at the other side is connected through a condenser 31 and an "anti-squigger" resistance 32 to the first grid 33 of the heptode. The cathode 34 of the heptode 20 is earthed through a capacity shunted grid bias resistance combination 35, 36, and is also connected through a further resistance 37 to that side of the "anti-squigger" resistance 32 remote from the first grid. The remaining output terminal of the input filter 26 is connected to earth through a suitable condenser 38 and automatic volume control potentials derived in any manner known per se may be applied through a lead 39 connected to the last mentioned output terminal of the input filter 26.

Figure 3 illustrates another embodiment of the invention wherein a receiver of the single span tuning type having a frequency changer consisting of the triode portion of a pentode-triode valve 40 is employed. Here one output terminal of the input filter 26 is connected to the first grid 41 of the pentode portion of the valve 40, the second grid 42 of the pentode portion of the valve is connected to a suitable source of positive potential (not shown) the third or suppressor grid 43 of the pentode portion of the valve is connected to the cathode 44 (which is common to the two portions of the said valve) and the anode 45 of the pentode portion is connected through a fixed tuned circuit 21 responsive to the predetermined beat frequency to a source of anode potential (not shown). This tuned circuit is coupled as before to the first circuit 22 of a succeeding beat frequency amplifier. The anode 46 of the triode portion of the valve receives anode potential through a choke 47 and is connected through a coupling condenser 30 and the central conductor 14 of a screened cable 14, 15 to one side of a remotely situated tuning condenser 13 the same side of this condenser being connected through the central conductor 11 of another screened cable 11, 12, to one side of the low impedance primary 9 of a very tightly coupled ferro-magnetically cored transformer 8. This primary is shunted by a trimmer condenser 10 and its other side is earthed as also is the remaining side of the remotely situated tuning condenser 13 and the screens 12, 15, of the two cables. The transformer 8 has a high impedance secondary 7 one side of which is connected through a coupling condenser 31 and an "anti-squigger" resistance 32 to the grid 48 of the triode portion of the valve 40. The other side of the secondary 7 is earthed and also connected through a capacity shunted bias resistance combination 35, 36, to a further resistance 37 and the above mentioned "anti-squigger" resistance 32 to the grid 48. The junction point between the elements 35 and 37 is connected to the cathode 44 and the remaining output terminal of the input filter 26 is connected through a condenser 49 to the end of the low impedance primary 7 adjacent the conductor 11. The said remaining output terminal of the input filter 26 may be connected through a lead 39 to receive automatic volume control potentials derived in any manner known per se.

One preferred form of transformer for use in carrying out this invention and suitable for use in any of the above described embodiments as the transformer 8 is illustrated in sectional elevation in Figure 4 and in sectional plan in Figure 5 the view of Figure 4 being taken on the line C—C of Figure 5 and the view of Figure 5 being taken on the line A—A of Figure 4. This transformer has a low impedance primary winding 9 and a high impedance secondary winding 7 both in the form of annular coils arranged side by side and so close to one another that the coupling between them (ignoring for the moment the iron of the transformer and assuming the coils to be in air) is as high as possible. The two coils thus arranged are positioned in an annular groove 50 formed in a disc 51 of ferro-magnetic material suitable for high frequency work—preferably the material known under the registered trade name "Ferrocort" is used—and the ferro-magnetic circuit of the transformer is completed by a second disc 52 of similar material placed

across the annularly grooved disc so as to enclose the coils. If desired a split conductive electrostatic screening annulus (not shown) may be provided between the primary and secondary windings so as to reduce electrostatic coupling therebetween.

A modified form of transformer is illustrated in Figures 6 and 7, Figure 6 being a sectional elevation on the line D—D of Figure 7, and Figure 7 being a sectional plan on the line B—B of Figure 6. Here instead of using a single high impedance secondary coil the secondary is constituted by two similar annular coils 7' 7'' between which the low impedance primary 9 is sandwiched. In this form of construction electrostatic screening may be dispensed with though screens 53 can be provided, if required. The two portions of the high impedance secondary are connected in series and should be of such winding sense and connection as to be magnetically aiding.

In both the above forms of transformer, the closing disc 52 which completes the ferro-magnetic circuit may be cemented in position or may be held on by a suitable clamp, e. g. a clamping bolt passing through the centre of the two disc-like ferro-magnetic members and axial with respect thereto. Where a central clamping bolt is used as described the said bolt may also be employed to hold together the two portions of a copper or other metal screening box (not shown) which portions in turn hold the two portions of the ferro-magnetic core together. For example in one construction (not illustrated) the screening box consists of a cylindrical box portion and a lid portion of such size as to accommodate the transformer between them and the lid portion is clamped in position upon the disc portion by a central bolt passing right through the apparatus. Of course other forms of clamping may be used to hold the portions of the screening box and/or the portions of the ferro-magnetic core of the transformer together but the central bolt arrangement is probably the most convenient and simplest.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. In radio receiving apparatus or the like, a tuning reactance adapted to tune a tunable circuit of said receiver and to be remotely situated with respect to the remainder of said receiver, said reactance being connected to the remainder of the receiver through a screened cable means arranged to associate the tuning reactance with the remainder of the circuit it is to tune through

means comprising a ferro-magnetically cored very tightly coupled transformer connected to the end of the cable means remote from the tuning reactance and having a low impedance winding facing towards the tuning reactance and a high impedance winding facing in the other direction, said screened cable means comprising a first concentric tubular cable having a grounded outer conductor and an inner conductor, said inner conductor being connected at one end to one terminal of the tuning reactance and at the other end to one end of the low impedance transformer winding, the other terminal of the tuning reactance and the other end of the low impedance transformer winding being grounded, and a second concentric tubular cable having its outer conductor connected to the outer conductor of the first cable and its inner conductor connected at one end to the live terminal of the tuning reactance, said inner conductor being coupled at its other end to an output electrode of a thermionic tube the input circuit of which is tuned by the remotely situated reactance.

2. In a superheterodyne receiver, a local oscillation generator circuit including an electronic tube having a cathode and at least two cold electrodes, one of said cold electrodes acting as a control electrode, the other thereof as an anode, a tuning circuit for controlling the frequency of the oscillations including an inductance coil and a variable tuning condenser, said condenser being remotely situated with respect to the inductance coil, means for connecting the condenser across the coil comprising a shielded cable, said cable being arranged to connect one end of the coil to one side of the condenser, means for grounding the other end of the coil, the cable shield and the other side of the condenser, means comprising a shielded cable for connecting the ungrounded side of the tuning condenser to the cold electrode of said tube which acts as an anode, the shield of said last named shielded cable being also grounded, said inductance coil comprising the primary winding of a ferro-magnetically cored, very tightly coupled transformer, means for connecting the secondary winding of said transformer between the cold electrode of said tube acting as a control electrode and the cathode of said tube, and means connecting said cathode to ground.

3. An arrangement as described in the next preceding claim, characterized by that the primary of the transformer is a low impedance winding and the secondary of the transformer a high impedance winding.

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