

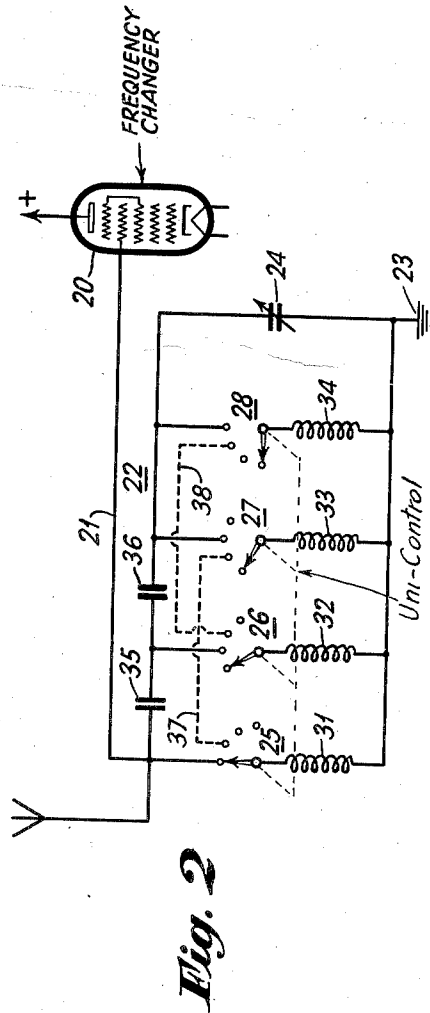
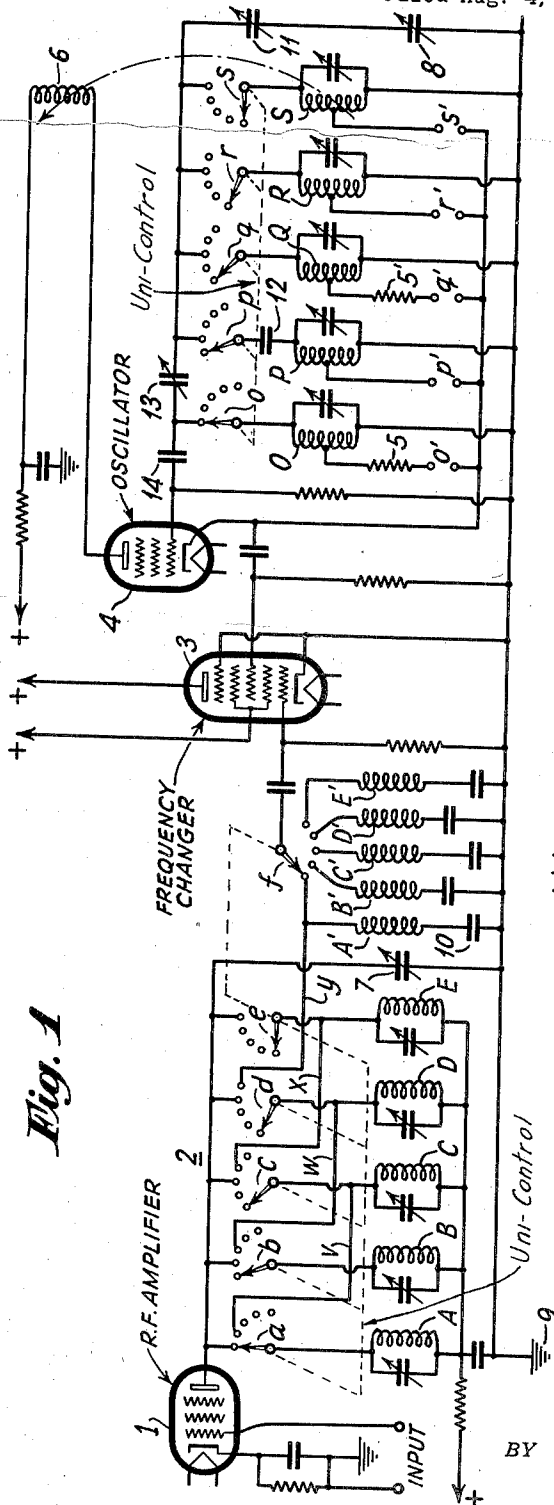
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RADIO RECEIVER

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RADIO RECEIVER

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The present invention relates to circuit arrangements more especially for use in radio receivers and the like.

One object of the present invention is to provide an economic arrangement of components in tuned or tunable stage of a multiwave range radio receiver.

Another object of the present invention is to provide a radio receiver of the superheterodyne type capable of operating over a wide band of frequencies and of being adjusted to operate in various bands of frequencies in which the components are arranged in such a way as to reduce the number of components required and to simplify the switching arrangements required for conditioning the receiver to operate in one or the other of the required frequency bands.

According to one feature of the present invention, a tunable circuit arrangement, more especially for use in a multi-wave band radio receiver is provided, said arrangement comprising a tuning circuit comprising a number of alternative inductive branches, each of which is selectively tunable by actuating a tuning condenser in accordance with the band of frequencies over which the arrangement is required to operate there being a dual purpose condenser so associated with switching means for selectively connecting each inductive branch to the tuning condenser, that in at least one setting of the switching means the dual purpose condenser serves as a padding condenser within the tuning circuit and in at least one other setting of the switching means the said condenser functions as a coupling condenser for coupling the tuning circuit in the circuit arrangement.

In accordance with the above feature of the invention, certain disadvantages which are inherent in superheterodyne receivers of the generally known types are avoided. The grid circuit of the oscillator valve in a superheterodyne receiver usually comprises a tuning arrangement consisting of a capacity branch and an inductive branch in parallel, the capacitive branch usually including the tuning condenser, and each inductive branch including an inductance which may be provided with a trimming condenser. Each inductive branch is connected with the tuning condenser in turn according to the range of signal frequencies to be received. It is usual to arrange the padding condenser corresponding to each wave band to be received, in the inductive branch in series with the inductance therein, and the capacitive branch may include only the tuning condenser. Such an arrangement has the

disadvantage that when the intermediate frequency of the receiver is of normal value, say about 0.5 megacycle per second, padding condensers on the so-called medium wave and long wave bands are of about the same capacity order as the tuning condenser when the latter is set at maximum, and the capacity potentiometer so formed results in the radio frequency oscillator volts across the coil and across the grid of the oscillator valve respectively, being widely dissimilar. In this case oscillation, even with tight couplings, may become difficult to maintain at the low frequency end of the overall range of the receiver, and at the high frequency end of the receiver range, relaxation oscillations will be set up. Further, on the short wave ranges, i. e., on the higher frequency ranges because the

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ratio is normally poor it is difficult to maintain oscillations at the low frequency end as the potentiometer effect in this case, although small, is sufficient to be of importance. If the padding condenser is shorted out on short wavebands, it will be found that the oscillator volts will usually be improved. Thus the performance of the arrangement could be improved by arranging all the padding condensers to be connected in series with the tuning condenser in the capacitive branch, but in this case the number of switches or switch cards required would be doubled, as for each wave range change both an inductance and a capacity would have to be switched separately.

According to a further feature of the invention a further simplification of the switching arrangements in a multi-wave band radio receiver of the type in which tuned coupling is used between the signal frequency receiver and/or amplifying stage and the frequency changing stage, or in any other stage in which the coupling path is completed through an inductance which must be switched in or out according to the wave band received, is effected, in that switching means are provided such that when a particular inductance is switched in to be utilised a physically adjacent inductance, used when the receiver is conditioned to receive signals in a lower frequency range, is short circuited over an inductance utilised when the receiver is conditioned to receive signals in a higher frequency range, whereby interference effects due to the proximity of the unused coils and the used coil are substantially reduced or eliminated.

With this arrangement the inductance used in coupling when the receiver is conditioned to receive a lower band of frequencies than that at which the receiver is operating, is effectively short circuited, and also it is found that it is not necessary to provide special short circuiting arrangements for the inductance used in a higher frequency range other than the simple connection to the coil used in the lower frequency range. Thus it is possible to reduce the number of switch cards required in the type of multi-wave band receiver described.

The nature of the invention and the method of carrying the invention into effect will be clearly understood from the following description with reference by way of example to the accompanying drawing in which Figure 1 is a diagrammatical representation of the output stage of the signal receiving circuit and the input of the frequency changer stage in a superheterodyne receiver embodying the invention, and Figure 2 shows the application of the invention to the tuned radio frequency stage of a radio receiver.

Referring to Figure 1 of the drawing, 1 is a pentode radio frequency amplifier tube of a receiver of which the output indicated generally at 2 is adapted to be coupled over one of the tuned primary coils, A, B, C, D or E providing a tuned anode coupling to the secondary coils A', B', C', D' or E' in the radio frequency input of the frequency changer valve 3 which is shown as being of the hexode type and having an earthed suppressor grid. The beating oscillator which is coupled to the second control grid of the tube 3, comprises a tube 4, the grid circuit of which includes one or other of the oscillator elements, O, P, Q, R, S, which are adapted each to be arranged in an oscillator-circuit of the Hartley type.

In a particular case the coils, A, A', and O may be utilised when the receiver is conditioned to operate on a long wave band, for example from 725 to 2,050 meters, the coils, B, B', and P may be used on the medium wave band, namely, 195 to 575 meters, and the coils C, C' and Q may be used on the first short wave band, namely, from 34 to 110 meters, D, D' and R may be used for the short wave range from 11.3 to 34 meters, and the coils E, E' and S may be used on the short wave range from 5 to 12 meters. It will be appreciated that the last wave range mentioned is the so-called ultra short wave range such as is used for television purposes. It will be readily appreciated that while each of the grouped coils A' to E' and O to S are shown as arranged in a generally similar way, in each group various modifications of the arrangement may be made in respect of the individual coils. For example, the coupling between any of the coils A to E and the respective coils A' to E' might be supplemented by capacitive or further inductive couplings, especially in the short wave ranges where almost certainly some top capacity coupling would normally be used. Some modifications of the arrangements of coils O, Q and S are actually indicated in the drawing, for example, the lead from the mid point of coil O to the cathode includes a resistance 5, and likewise the lead from the coil Q to the cathode of the valve 4 includes a resistance 5', these resistances serving to produce an effective negative bias on the control grid of the oscillator tube 4. In the case of coil S, this is indicated as being inductively linked to the coil 6 arranged in the anode lead of tube 4, this cou-

pling being effective to increase the amplitude of the oscillations set up in coil S. Both the groups of coils A to E and O to S respectively are associated with the tuning condensers 7 and 8, which are effective throughout the ranges of frequencies to which the receiver is responsive, and it will be seen that groups of switches *a, b, c, d, e*, and *o, p, q, r, s* respectively are arranged so that the coils A, B, C, D, E and O, P, Q, R, S can be switched into circuit as required. These switches would normally be ganged for uni-control operation as indicated by the dotted lines or combined in a unitary structure, and each group would preferably be constituted by a single card of a switch, for example, of the "Yaxley" or "Oak" type, and assuming that the switch arms shown in the drawing are rotated together in the same direction, it will be seen that the coils A, B, C, D and E and O, P, Q, R and S respectively will be brought into circuit in pairs, one pair after another in accordance with the wave band in respect of which the receiver is to operate. Switch *f* is provided having five positions, which is gang controlled with the other switches described, to connect the coils A', B', C', D', E' into circuit in accordance with the coils A, B, C, D, or E connected in circuit. For convenience in drawing, switch arm *f* is represented as being rotated in the opposite direction to switch arms *a* to *e* and *o* to *p*.

According to one feature of the invention it will be seen that in the cases of the switches *a, b, c* and *d* when the switch arm has made one movement past the contact which connects the appropriate coil A, B, C or D in circuit, connection is made to leads, *v, w, x*, and *y*. Lead *v* connects coil A to coil C, and thus when the arm of switch *a* closes on the end of said lead, a circuit is completed over coil A and coil C. This circuit constitutes a short circuit for coil A, as far as concerns the frequencies for which coil B is effective, and provides a path of sufficiently low impedance in connection with coil C to eliminate, at least in many practical cases, the need for the provision of a short circuit on this coil. Thus no detrimental inductive effects such as absorption arise in coil B due to the presence of coils A and C while coil B is operating. Similarly when coil C is operating coil B is shortened through coil D, and likewise when coil D is operating coil C is shorted through coil E. In respect of lead *y*, as there is no higher frequency range than that at which coil E operates, lead *y* is connected to the coil A', so that the short circuit for coil D is effected to earth 9 through coil A' and its blocking condenser 10. The coil A', while it may have a relatively large inductance which is effective in the long wave band, may be chosen to have such a high value of self-capacity that in the short-wave band in respect of which coil E is used, coil A' may be regarded as a capacity presenting a low impedance to the short wave signals.

The importance of the above arrangement will be realised when it is remembered that the coils A, B, C, D and E, together with coils A', B', C', D' and E' may be wound in order on the same former, the turns of the coil A' being wound between the turns of the coil A and so on. It will thus be realised that the pairs of coils A and B, B and C, C and D, and D and E will be in close proximity to each other and it thus becomes essential to provide a short circuit of some kind on the pair of coils adjacent to that being used.

A further feature of the invention is to be

found in the arrangement of the tuning circuit connected to the grid of the oscillator valve 4. Referring to this circuit it will be seen that the tuning condenser 8 and its associated padding condenser 11 is used in association with each of the coils, O, P, Q, R and S respectively. If required, any of the coil branches may include additional padding condensers, for example, as indicated at 12, condenser 12 being associated with coil P, and further, in accordance with the invention a padding condenser 13 is inserted as shown between coils P and O which is effective as a padding condenser only when the coil O is operating, but in respect of the remaining coils, P, Q, R and S, the condenser 13 merely serves as a coupling condenser in series with the coupling condenser 14, the condenser 14 being dispensed with, if desired, in certain circumstances, namely, when the value of resistance 5 is such that sufficient bias is provided on the grid of valve 4.

With the arrangement as described above, it will be noticed that the connection to the grid in the case of the tuning circuit for long waves, occurs between the padding condenser 13 and the coil O so that the potentiometer effect above discussed does not arise. As a compromise, padding condensers additional to condenser 11 in series with the tuning condenser 8, may be dispensed with on short wave bands.

In the drawing, a dual purpose condenser 13 has been shown arranged only between oscillator elements O and P, however, similar dual purpose condensers may be arranged between further oscillator elements to act as padding condensers in respect of frequency bands other than the long wave range, each of these padding condensers serving as coupling condensers in respect of ranges of shorter-wave length than that in which it is used for the purpose of padding.

While the use of a dual purpose condenser such as 13 has been described principally with relation to the oscillator circuit of a superheterodyne receiver, such a condenser might be used in any multi-range tunable circuit. For example, in a tuned radio frequency stage of a superheterodyne receiver, wherein the frequency of the local oscillator in the mixing stage is higher than that of the received signals, an arrangement according to the invention might be adopted in the input to the frequency changing stage to avoid loss of radio frequency signal due to the capacity potentiometer effect above referred to.

Such an arrangement is shown in Figure 2 of the drawing which relates to a receiver adapted to be tuned to operate in respect of four frequency bands. In the drawing 20 is the frequency changer valve, 21 the input lead from the aerial or a stage of radio frequency amplification and 22 is a tunable circuit arranged in accordance with the invention by which the input to the tube 20 may be tuned. The circuit 22 is connected to earth or chassis at 23 as shown, and comprises a tuning condenser 24 which may be actuated to tune the receiver in respect of incoming signals, the range of the receiver is determined by the setting of a switch having cards indicated at 25 to 28 inclusive the setting of which switch determines which of inductances 31 to 34 inclusive is in circuit, inductance 31 being used when tuning in respect of long waves and the remaining inductances in successively shorter wave ranges. Condensers 35 and 36 are each a dual-purpose condenser similar to condenser 13 in Fig. 1. Further padding condensers may be provided if required.

Further, if desired, the occurrence of absorption phenomena due to the propinquity of coils 31 to 34 may be reduced by arranging shorting leads as in the case of coils A to E of Fig. 1, as shown, for example in dotted lines at 37 and 38 between coils 31 and 33 and 32 and 34 respectively.

I claim:

1. In a multi-wave band radio receiver, a tunable circuit comprising a tuning condenser, a plurality of inductive branches, switching means for selectively connecting one of said inductive branches across the tuning condenser in accordance with the band of frequencies in respect of which the circuit is required to be rendered operative, and a dual purpose condenser permanently connected in series with the tuning condenser and having a pair of terminal contacts so arranged with respect to the switching means that in at least one setting of the switching means the dual purpose condenser serves as a padding condenser within the tunable circuit, and in at least one other setting of the switching means the said condenser functions as a coupling condenser in series with the tunable circuit.

2. A tunable circuit arrangement according to claim 1 wherein said dual purpose condenser serves as a coupling condenser only when said tunable circuit is conditioned to operate in respect of the lowest band of frequencies to be generated.

3. In a multi-wave band radio receiver of the superheterodyne type, a frequency changing system including a local oscillator having a tunable circuit, said circuit comprising a tuning condenser and a number of inductive branches, means for selectively connecting one of said inductive branches across the tuning condenser in accordance with the band of frequencies in respect of which the circuit is required to be rendered operative, and a dual purpose condenser permanently connected in series with the tuning condenser and having a pair of terminal contacts so arranged with respect to the switching means that in at least one setting of the switching means the dual purpose condenser serves as a padding condenser within the tunable circuit, and in at least one other setting of the switching means the said condenser functions as a coupling condenser in series with the tunable circuit.

4. In a multi-wave band radio receiver, a pair of coupled circuits, each comprising a plurality of inductances, switching means for selectively associating an inductance of one circuit with an inductance of the other in coupled relation, depending on the range of signals to be received, the inductances of at least one of said circuits being arranged in proximity to each other, and connections between the switching means and the inductances of one of the circuits such that when a particular inductance is switched in, a physically adjacent inductance, used when the receiver is conditioned to receive signals in a lower frequency range, is short circuited over an inductance utilised when the receiver is conditioned to receive signals in a higher frequency range, whereby interference effects due to the proximity of the unused inductances and the used inductance are substantially reduced.

5. A multi-stage radio receiver according to claim 4 wherein a connection is provided between the low frequency inductance of one circuit and the switching means associated with an inductance of the other circuit, which inductance is physically adjacent the highest frequency in-

ductance of said other circuit, whereby, when the receiver is conditioned to operate in respect of signals in the highest frequency range, the inductance physically adjacent the inductance used

5 when the receiver is conditioned to operate in said highest frequency range, is short-circuited over the low frequency inductance, said latter inductance having sufficient self-capacity to present a low impedance to signals in said highest frequency range.

10 6. In a multi-wave band radio receiver, a tuning condenser, a plurality of inductive branches having their low potential ends connected to the low potential end of the tuning condenser, a

15 switch arm connected to the high potential end of each inductive branch, a group of contacts cooperatively related with each switch arm, there being as many contacts in each group as there are switch arms, connections from one contact of

20 each group to the high potential end of the tuning condenser, the several switch arms being movable in unison and so constructed and arranged that upon movement of said switch arms between their limits of adjustment the several inductive branches are each progressively connected

25 across the tuning condenser to form therewith a circuit tunable over a predetermined frequency range.

7. In a multi-waveband radio receiver, a tuning condenser, a plurality of inductive branches having their low potential ends connected to the low potential end of the tuning condenser, a switch arm connected to the high potential end of each inductive branch, a group of contacts cooperatively related with each switch arm, there being as many contacts in each group as there are switch arms, connections to the high potential end of the tuning condenser from respectively

30 the first contact of the first group, the second contact of the second group and so on to the last contact of the last group, the several switch arms being progressively disposed at different angles with respect to each other and movable in unison so that upon movement of said switch arms

35 between their limits of adjustment the several inductive branches are each progressively con-

nected across the tuning condenser to form therewith a circuit tunable over a predetermined frequency range.

8. In a multi-wave band receiver according to the invention defined in claim 7, additional connections being provided from between the second, third and fourth contacts of the first, second and third groups, respectively, and the switch arms connected to the third, fourth and fifth inductive branches, whereby in the position of the

10 ganged switch arms to include either the second, third or fourth inductive branches in circuit with the tuning condenser, the inductances physically adjacent to the operative inductance are coincidentally short-circuited.

9. In a multi-wave band radio receiver, an electron discharge tube adapted to have associated therewith a tunable circuit, said circuit comprising a tuning condenser, a plurality of inductive branches having their low potential ends connected to the low potential end of the tuning condenser, a switch arm connected to the high potential end of each inductive branch, a plurality of contacts connected to the high potential end of the tuning condenser, an additional contact

20 and an auxiliary condenser connecting the latter contact with the remaining contacts, there being as many contacts as there are inductive branches and switch arms and each contact being adapted to cooperate with its respective switch arm, the several switch arms being movable in unison and so constructed and arranged that upon movement of the switch arms to connect the additional contact with its switch arm the auxiliary condenser is included in the tunable circuit and

25 functions as a padding condenser, and upon further movement of the switch arms to connect the remaining contacts with other respective switch arms the several inductive branches are each progressively connected across the tuning condenser to form therewith a circuit tunable over a predetermined frequency source and the auxiliary condenser functions as a coupling condenser between the discharge tube and said tunable circuits.

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