June 30, 1942. A. L. GREEN 2,288,236

TUNING ARRANGEMENT FOR RADIO SIGNALING APPARATUS

Filed April 11, 1941 3 Sheets-Sheet 1

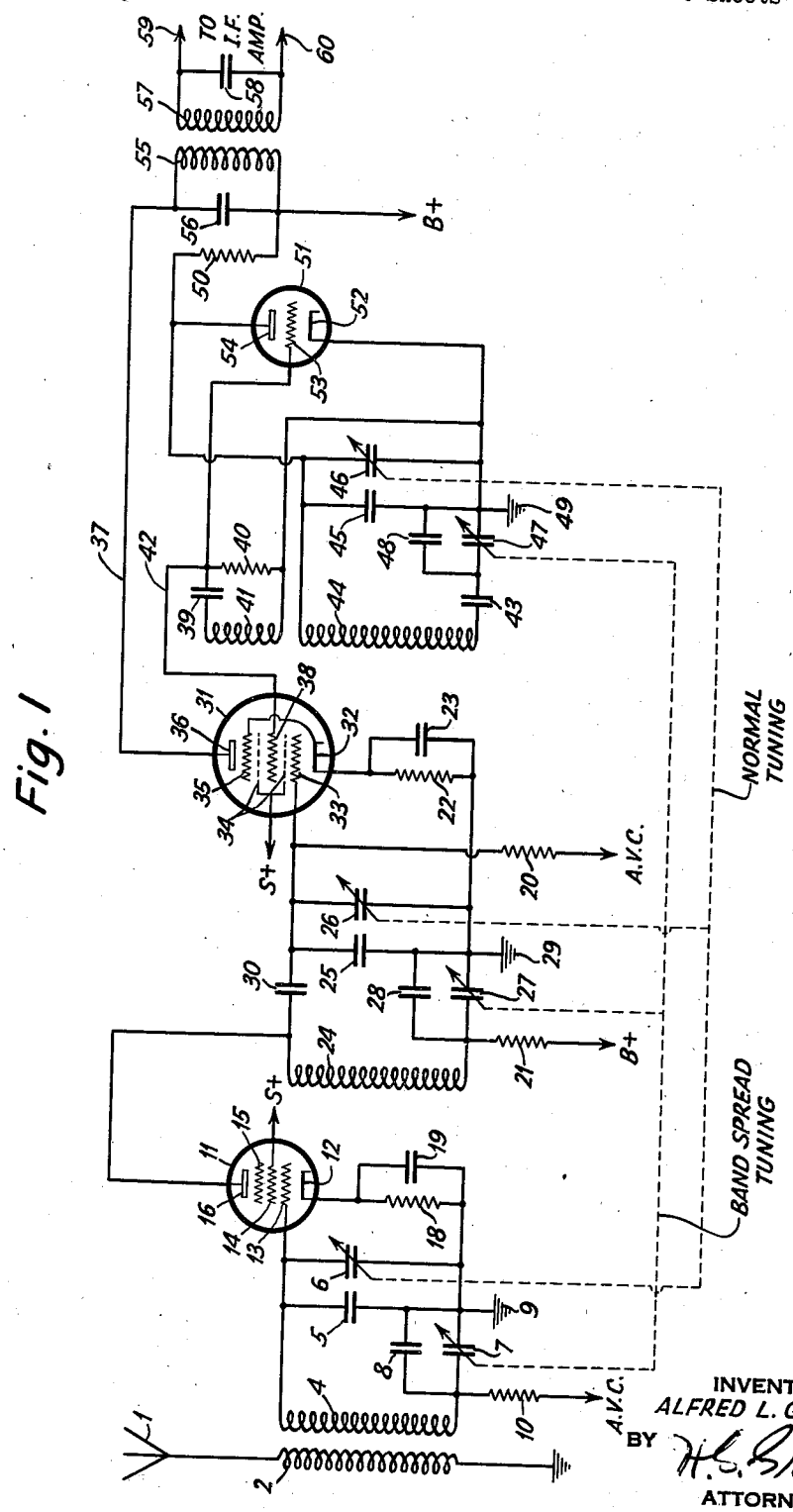


Fig. 1

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Filed April 11, 1941 3 Sheets-Sheet 2

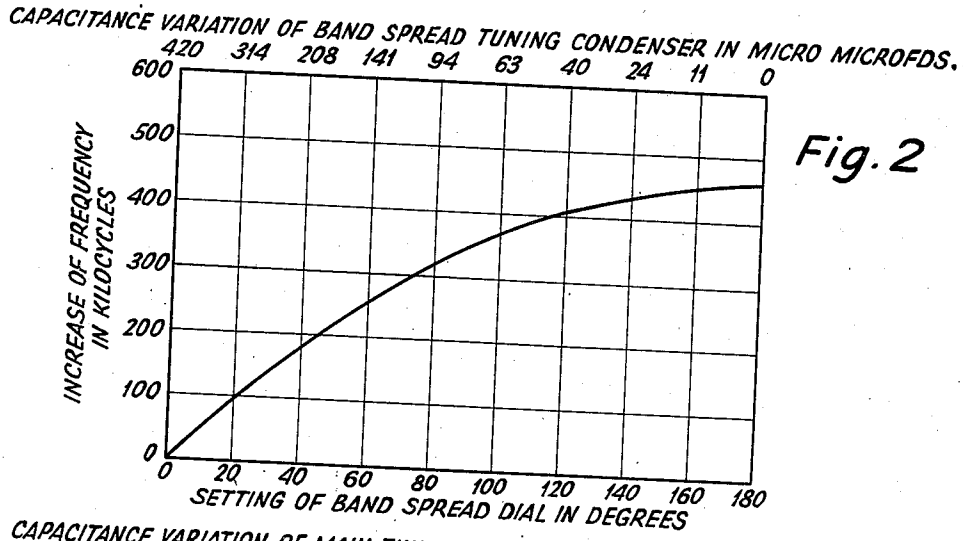


Fig. 2

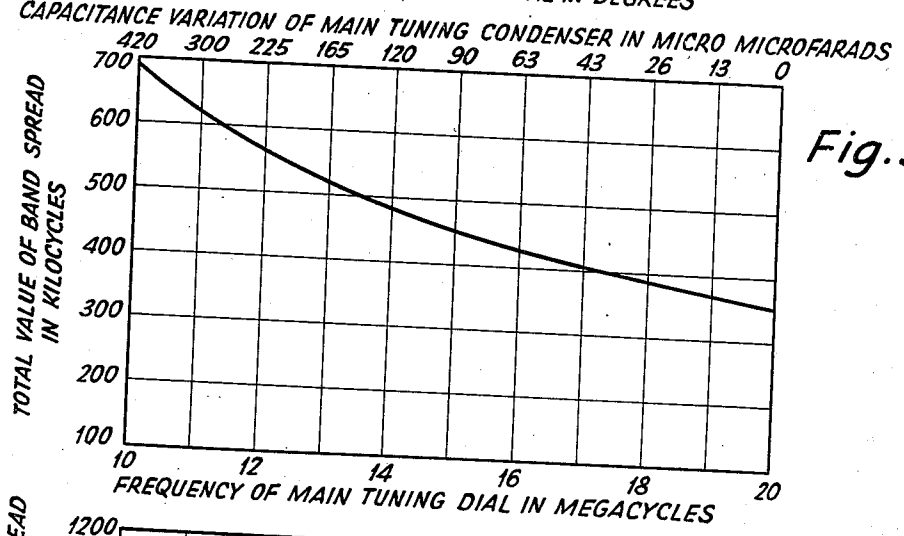


Fig. 3

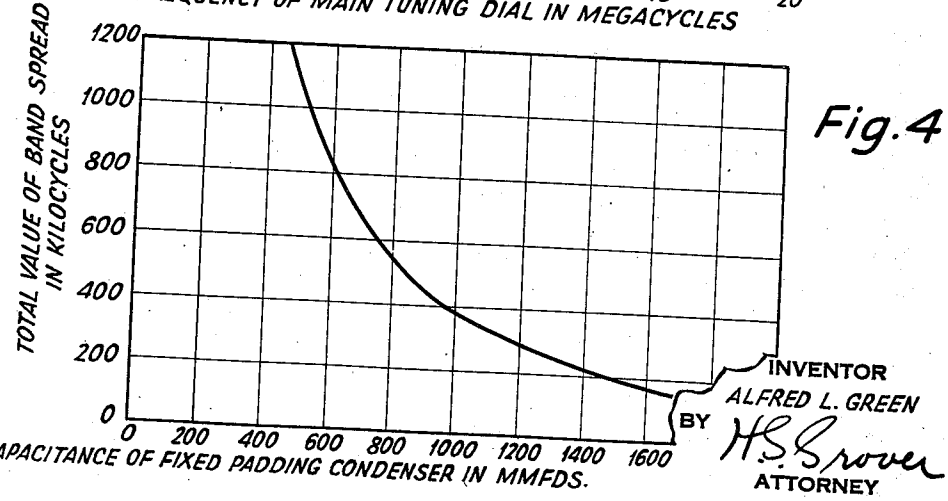


Fig. 4

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TUNING ARRANGEMENT FOR RADIO SIGNALING APPARATUS

Filed April 11, 1941 3 Sheets-Sheet 3

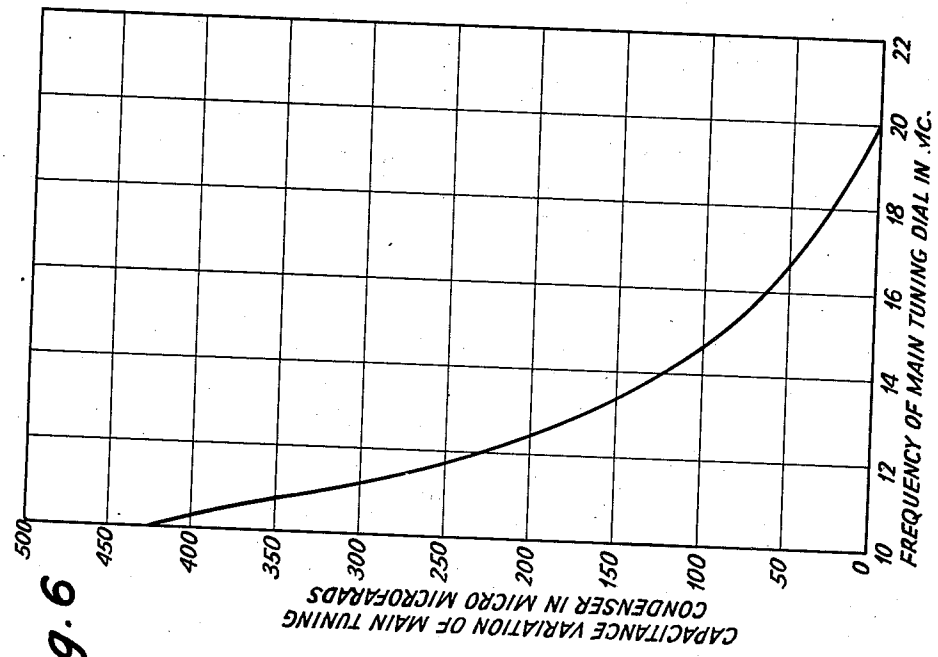


Fig. 6

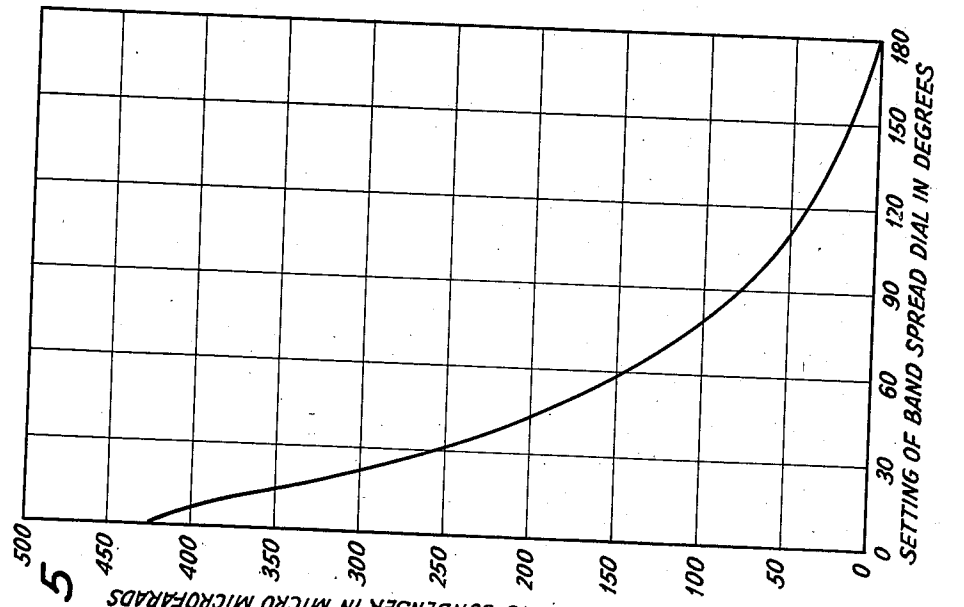


Fig. 5

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UNITED STATES PATENT OFFICE

2,288,236

TUNING ARRANGEMENT FOR RADIO SIGNALING APPARATUS

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Application April 11, 1941, Serial No. 388,040
In Australia April 12, 1940

13 Claims. (Cl. 250—20)

This invention relates to fine tuning systems for radio receivers or amplifiers and more particularly to bandspread tuning systems for superheterodyne receivers.

In multi-band receivers it is customary to provide a main tuning condenser having a ratio of maximum capacitance to minimum capacitance sufficiently great that when considered in relation to stray capacities, a frequency-ratio of approximately 3:1 is provided. By way of example, the ratio of maximum frequency to minimum frequency in the medium-frequency broadcast band, 540 kilocycles to 1600 kilocycles, is approximately 2.96:1. Since, moreover, multi-band switching is customarily achieved by switching different coils across the same main tuning condenser, it follows that substantially the same frequency-ratio is obtained in each frequency band and that the difficulties of manual tuning become progressively greater as the mean frequency of the band is increased.

In order to overcome this tuning difficulty it is known to insert, in series with the main tuning condenser, a fixed padding condenser which acts to reduce the capacitance-ratio of the main tuning condenser and hence to restrict the frequency-ratio. Again, it is known to provide a second, bandspread, manually operated tuning control to give fine tuning. In a simple bandspread arrangement, a variable condenser of small capacitance-ratio is shunted across the main tuning condenser, and, by suitable choice of the relative capacitances of the main and of the bandspread tuning condensers, it is feasible to arrange that a portion of the frequency-band covered by the main tuning condenser, for example that corresponding to a change in setting of the control of 1 degree of rotation, is spread to say 10 degrees of rotation of the separate bandspread control.

Nevertheless, it is known that the simple bandspread system does not give satisfactory results because the effectiveness of the control varies widely with respect to the capacitance, i. e., the setting, of the main tuning condenser. It has therefore been found necessary to devise more elaborate band-spread tuning arrangements, particularly for communication receivers wherein a high quality of performance is required, which, however, increases the complexity and the cost of the tuning system. In particular, a tuning system of the prior art may comprise three variable condensers associated with each tuning coil in the receiver, namely a main tuning condenser, a bandspread tuning condenser and thirdly a variable padding condenser functioning to equalise the effectiveness of the bandspread tuning condenser over the frequency band covered by the main tuning condenser. Again it is found that, on attempting to assemble a plurality of combinations of the three condensers into ganged mechanically uni-controlled condenser assemblies, the condition then arises that it is not electrically feasible to provide a common earthed rotor spindle for the band-spread tuning assembly and/or for the main tuning assembly, whereas the common earthed rotor spindle is a desirable feature and is, in fact, substantially universal in modern ganged condenser assemblies used for main tuning.

In order to overcome the above stated difficulties, the present invention provides improvements in tuning arrangements for radio signalling apparatus comprising a plurality of tuning coils, each of said coils being shunted by a series-connected combination of a main tuning condenser and a band-spread tuning condenser, uni-control means for said main tuning condensers, additional and independent uni-control means for said band-spread tuning condensers and means for connecting the junction points of said series connected condensers to a point of substantially zero radio frequency potential.

The invention further provides improvements in tuning arrangements for radio signalling apparatus comprising a plurality of tuning coils, each of said coils being shunted by a series-connected combination of a main tuning condenser and a fixed padding condenser, mechanical uni-control means for said main tuning condensers, bandspread tuning condensers connected across said fixed padding condensers, additional and independent mechanical uni-control means for said bandspread tuning condensers and means for equalising the radio frequency potentials of the junction points of said main tuning condensers and said fixed padding condensers.

In carrying the present invention into effect the tuning arrangements preferably comprise a main tuning dial which operates, by mechanical uni-control, an assembly of main tuning condensers and a bandspread tuning dial which operates by additional mechanical uni-control an assembly of band-spread tuning condensers. The two condenser assemblies, namely, the main tuning and bandspread, are identical and each assembly comprises a common earthed rotor spindle to which all of the rotor plates are attached in combination with a plurality of insulated sections of stator plates, there being one section of stator

plates per condenser assembly corresponding with each tuning coil in the receiver.

An additional feature of the invention is that a combination of a bandspread tuning condenser and its associated fixed padding condenser fulfills the additional function of automatic volume control (A. V. C.) filter condenser. Again the said combination, in another application, fulfills the function of anode decoupling condenser.

It is important to notice that, whereas the tuning arrangements of the prior art required the previously mentioned combination of three variable condensers in order to provide effective bandspread control independently of the setting of the main tuning control, the present invention utilises only two variable condensers in combination with a fixed padding condenser. Nevertheless it is found that the effectiveness of the bandspread control varies only slowly with respect to capacitance variation of the main tuning condenser, and, moreover, the sense of variation of the effectiveness of the bandspread control has the desirable feature that the bandspread control is slightly more effective to vary the tuning at the low-frequency limit of a main tuning band than at the high-frequency limit. This feature acts to reduce loss of sensitivity which would otherwise result at the high frequency limit of the band due to errors in alignment of the cascaded tuned circuits, if the effectiveness of the band spread were the same over the whole band or greater at the high frequency limit than at the low frequency limit.

In order, however, that the invention may be more readily understood, reference will now be made to the drawings accompanying the provisional specification and in which—

Figure 1 illustrates a typical circuit of portion of a radio receiver embodying one way of carrying out the invention;

Figure 2 illustrates the action of the bandspread tuning condenser;

Figure 3 illustrates the dependence, on the setting of the main tuning dial, of the bandspread action, and

Figure 4 illustrates the dependence, on the value of the fixed portion of the bandspread condenser, of the bandspread action.

Figure 5 is a curve illustrating capacitance variation of bandspread tuning condenser in relation to the angular setting of the band spread tuning dial while Figure 6 illustrates capacitance variation of the main tuning condenser in relation to the frequency setting of the main tuning dial.

Referring now to Figure 1, there is illustrated a portion of a superheterodyne receiver which comprises aerial 1, primary coil 2, and earth 3. Radio-frequency signals are passed from primary coil 2 to secondary coil 4, one terminal of the latter being connected to control grid 13 in radio-frequency amplifying valve 11 and the other terminal through filter resistance 10 to the customary automatic volume control (A. V. C.) system (not shown). Coil 4 is tuned to the frequency of the incoming signals by the combination of condensers 5, 6, 7 and 8 of which the main tuning condenser 6 is connected between the earth point 9 or receiver chassis and the junction point of coil 4 and grid 13.

Trimming condenser 5 is shunted directly across the main tuning condenser 6 while the bandspread tuning condenser 7 is connected between earth point 9 and the junction point of coil 4 and A. V. C. filter resistance 10. Fixed padding condenser 8 is shunted directly across bandspread condenser 7.

In radio-frequency amplifying valve 11, cathode 12 is connected to earth through cathode bias resistor 18 shunted by by-pass condenser 19. Screen grid 14 is connected to a source of positive screen supply voltage, grid 15 is a suppressor grid and anode 16 is connected through lead 17 to one terminal of tuned-anode coil 24, whose other terminal is connected through decoupling resistor 21 to a source of positive anode supply voltage.

Coil 24 is tuned to the frequency of the incoming signals by the combination of condensers 25, 26, 27, 28 and 30 of which grid blocking condenser 30 is connected between lead 17 and control grid 33 in mixer valve 31. The capacity of condenser 30 is large compared with that of condensers 25, 26, 27 or 28 whereby condenser 30 has negligible effect on the tuning of coil 24. The main tuning condenser 26, which is mechanically uni-controlled with condenser 6, is connected between earth point 29 and the junction point of condenser 30 and control grid 33. Trimming condenser 25 is shunted directly across condenser 26, which the bandspread condenser 27, which is mechanically uni-controlled with condenser 7, is connected between the earth point 29 and the junction point of coil 24 and decoupling resistance 21. Fixed padding condenser 28 is shunted directly across bandspread condenser 27.

In mixer valve 31, cathode 32 is connected to earth through cathode bias resistor 22 shunted by by-pass condenser 23. Control grid 33 is connected through grid leak 20 to the customary A. V. C. system (not shown). Screen grids 34 are connected to a source of positive screen potential, suppressor grid 35 is connected to cathode 32 and anode 36 is connected through lead 37 to the output intermediate-frequency transformer comprising primary winding 55 tuned by condenser 56 and coupled to secondary winding 57 tuned by condenser 58. One terminal of primary winding 55 is connected to the source of positive anode voltage while output terminals 59 and 60 of secondary winding 57 are connected to an intermediate-frequency amplifier, followed by the customary detector, associated A. V. C. system, audio-frequency amplifier, output valve and reproducer (not shown).

Injector grid 38 in valve 31 is connected by lead 42 to control grid 53 in oscillator valve 51 having its cathode 52 earthed and its anode 54 is connected through shunt-feeding resistor 50 to the source of positive anode potential. Anode 54 is also connected to one terminal of tuned anode-oscillator coil 44 the other terminal of the latter being connected through oscillator-padding condenser 43 to the high potential (radio-frequency) terminal of bandspread condenser 47.

Oscillator coil 44 is tuned by the combination of condensers 43, 45, 46, 47 and 48 of which the main tuning condenser 46 is mechanically uni-controlled with condensers 6 and 26, while the bandspread tuning condenser 47 is mechanically uni-controlled with condensers 7 and 27. Tuning condenser 46 is connected between earth point 49 and the junction point of coil 44 and anode 54, while bandspread condenser 47 is connected between earth point 49 and oscillator-padding condenser 43, as previously mentioned. Trimming condenser 45 is shunted directly across tuning condenser 46 while fixed padding con-

denser 48 is shunted directly across bandspread condenser 47.

Coil 44 is magnetically coupled to grid coil 41, one terminal of which is earthed. The other terminal of grid coil 41 is connected through blocking condenser 39 to control grid 53 which is connected to earth through grid leak 40.

In a preferred embodiment of the invention, main tuning condensers 6, 26 and 46 comprise three sections of a ganged mechanically uni-controlled multiple condenser of the type, comprising a common earthed rotor spindle, well-known to those skilled in the art, while bandspread condensers 7, 27 and 47 comprise three sections of a similarly ganged mechanically uni-controlled multiple condenser of construction identical with that of the combination of main tuning condensers 6, 26 and 46.

Turning now to the method of operation of the apparatus illustrated in Figure 1, suppose, by way of example, that R. F. signals at a frequency of 15 megacycles are picked up in aerial 1 and are selected in tuned secondary coil 4, amplified in radio-frequency amplifying valve 11 and passed to tuned-anode coil 24. The selected radio-frequency voltage appearing across tuning condenser 26 is applied to mixer valve 31, and, on account of the injection of oscillator voltage from valve 51 through lead 42 at grid 33 at a frequency of 15,455 kilocycles, the output signals at anode 35 are at the required intermediate-frequency of 455 kilocycles to which intermediate frequency coils 55 and 57 are tuned. Up to this point the operation of the apparatus follows customary superheterodyne practice in which the frequency of the oscillations generated by oscillator valve is designed to be greater than that of the incoming signal by the difference-frequency of 455 kilocycles, independently of the setting of the uni-controlled tuning condensers 6, 26, and 46. This result is customarily achieved by proper design of the ratio of the inductance of coils 24 and 44, of the ratio of trimming condensers 25 and 45, and of the value of the oscillator-padding condenser 43.

According to the invention, however, the apparatus illustrated in Figure 1 also includes the ganged uni-controlled bandspread tuning condensers 7, 27 and 47, shunted respectively by the fixed-padding condensers 8, 28 and 48. The method of operation of the bandspread tuning system is further illustrated in Figures 2, 3 and 4.

In Figure 2, the abscissae represent the setting of the bandspread dial attached to the uni-controlled condensers 7, 27 and 47 while the ordinates represent the increase of frequency, measured in kilocycles, with respect to the frequency of 15 megacycles to which the receiver has been tuned by suitable adjustment of the main tuning dial associated with the uni-controlled main tuning condensers 6, 26 and 46. When the setting of the bandspread dial is at zero degrees and the main dial is set to the mark 15 megacycles, the receiver is tuned to a frequency of 15 megacycles. On adjusting the setting of the bandspread dial, however, to 60 degrees, the receiver tuning is changed by an amount of approximately 280 kilocycles according to the results plotted in Figure 2, and the receiver is then tuned to a frequency of 15,280 kilocycles. Correspondingly, with the main tuning dial set to the mark at 15 megacycles and the bandspread dial turned completely through 180 degrees, the tuned frequency is increased by approximately 480 kilocycles to 15,480 kilocycles. It is therefore apparent that the action of the bandspread dial is to give uni-controlled adjustments to the tuning of the three coils 4, 24, and 44, and thus to provide fine tuning of the receiver, without the loss of sensitivity which would otherwise occur with only one of the three coils tuned by the bandspread system.

Again in Figure 2 it is to be noted that alternative abscissae have been illustrated, the effect being that the curve shown in this diagram is actually the combination of two co-incident curves. One of the two said curves has been described, as illustrating the dependence, on the angular setting of the bandspread tuning dial, of the increase in the frequency of the main tuning dial.

The other of the two co-incident curves illustrates the dependence on the capacitance variation of the bandspread tuning condenser, of the same frequency increase in the main tuning dial. It will immediately be apparent that the comparison of the alternative sets of abscissae provides, in effect, a measure of the law of capacitance variation of the bandspread tuning condenser with respect to the angular setting of the bandspread dial and that such law of variation is similar to that of a straight-line frequency condenser, such as is customarily used as a main tuning condenser. This comparison is illustrated directly by the curve in Figure 5 which shows the law of capacitance variation of the bandspread tuning condenser with respect to the angular setting of the bandspread dial. Again it is to be pointed out that the experimental conditions corresponding to Figure 2 include a value of capacitance of fixed-padding condenser 8 of 880 micro-microfarads, with similar values for condensers 28 and 48. The value of trimming capacity 5, including stray capacities, the minimum capacity of the condenser 6 and the input capacity of valve 11, is 100 micro-microfarads, with a similar value for condenser 25. The value of condenser 45 is, as is customary in superheterodyne oscillator circuits, slightly greater than that of condenser 5. The setting of the main tuning dial is at 15 megacycles, the band covered by the main tuning dial is from 10 megacycles to 20 megacycles, and the law of capacitance variation of the main tuning condenser with respect to the angular setting of the main tuning dial is identical with that, which may readily be deduced from the comparison of the alternative sets of abscissae illustrated in Figure 2, of the bandspread tuning condenser with respect to the angular setting of its tuning dial.

The foregoing numerical data indicate that one function of the combination of condensers 7 and 8 is to restrict the frequency band of the main tuning dial to 10–20 megacycles, i. e., a frequency ratio of 2:1, whereas the capacitance variation of main tuning condenser 6 is customarily such as to give a frequency ratio of approximately 3:1. Such a restriction of the frequency ratio is desirable in the high-frequency ranges of a communication receiver, in order to maintain the sensitivity approximately constant throughout each range, but it is to be noted that the frequency ratio may readily be increased, or decreased, from the amount chosen in this example simply by making appropriate adjustments to the capacitances of condensers 5 and 8, and to the corresponding condensers associated with coils 24 and 44.

Turning now to Figure 3, the abscissae repre-

sent in megacycles the frequency scale of the main tuning dial, associated with uni-controlled tuning condensers 6, 26 and 46 while the ordinates represent in kilocycles the total value of the band-spread, that is to say, the total change in tuning frequency corresponding with the action of changing the setting of the band-spread tuning dial, associated with uni-controlled bandspread tuning condensers 7, 27 and 47, from zero degrees to 180 degrees. The corresponding capacitance variation of the band-spread tuning condensers has previously been considered in relation to Figure 2 from which it is apparent that the effectiveness of the band-spread system varies only slowly with respect to the angular setting of the main tuning dial. This effect is further illustrated in Figure 3 by the provision of an alternative set of abscissae by which the curve also expresses the relation between the total value of the bandspread in kilocycles and the capacitance variation of the main tuning condenser measured in micro-microfarads. A comparison of the alternative sets of abscissae in this diagram provides, in effect, a measure of the law of capacitance variation of the main tuning condenser with respect to the frequency calibration of the main tuning dial, whereby it is apparent that the electrical characteristics of the main tuning condenser are such as are customarily found in the straight-line-frequency type of variable condenser used for main tuning in superheterodyne receivers. This comparison is illustrated directly by the curve in Figure 6 which shows the law of capacitance variation of the main tuning condenser with respect to the frequency scale of the main tuning dial.

By way of example, at a main tuning frequency of 20 megacycles, when the capacitance of the main tuning condenser 6 has its minimum value, the total value of the bandspread is approximately 340 kilocycles. On the other hand, at the low-frequency limit of the band, 10 megacycles, when the capacitance of condenser 6 has been increased by 420 micro-microfarads, the total value of the bandspread is approximately 680 kilocycles. This slow variation in effectiveness of the bandspread system, with respect to variations in the setting of the main tuning dial, is a desirable feature in communication receivers because it is then possible to obtain fine tuning independently of the frequency of the signals to be received.

It is also important to notice that the slope of the curve plotted in Figure 3 is such that the total value of the bandspread decreases as the main tuning frequency is increased. This effect is found to have the practical advantage that, at the high-frequency limit of the band, i. e., 80 megacycles, errors in alignment of the tuned circuits associated with coils 4, 24 and 44 are of less importance with respect to loss of receiver sensitivity than if the amount of bandspread at this frequency were relatively large. At this point it is convenient to consider the relative values of condensers 8, 28 and 48, shunted across bandspread condensers 7, 27 and 47 respectively. It is possible that exact alignment of the tuned circuits, including coils 4, 24 and 44 cannot readily be achieved in practice independently of the settings of both the main and the band-spread tuning dials, and in particular it is probable that exact equality between the capacitances of fixed-padding condensers 8, 28 and 48 is not desirable if perfect alignment is to be achieved. Nevertheless it is convenient in practice to specify identical units for bandspread condensers 7, 27 and 47 and equal capacitances for fixed-padders 8, 28 and 48, in order to simplify the design construction and testing of the apparatus. It then follows that alignment errors, with the associated losses in sensitivity and signal-image ratio, are considerably reduced in accordance with the invention, on account of the sense of variation of band-spread action with respect to variation in main tuning frequency, as illustrated in Figure 3.

It is to be noted that the results plotted in Figure 3 correspond with the experimental conditions of Figure 2, i. e. the value of trimming condenser 5, including various stray capacities is 100 micro-microfarads, the value of fixed-padder 8 is 880 micro-microfarads, and the laws of the capacitance variation of the main tuning and band spread tuning condensers with respect to their respective angular tuning dial settings are identical. Corresponding values apply to condensers 25, 45, 28, 48, 26, 46, 27, 47, with the exception that trimming condenser 45 has slightly greater capacitance than condenser 25, as previously noted.

Turning now to Figure 4, the ordinates represent the total value in kilocycles of the band-spread, that is to say the total increase in main tuning frequency produced by a rotation of the bandspread dial from zero degrees to 180 degrees, while the abscissae correspond with the capacitance in micro-microfarads of fixed-padding condensers 8, 28 or 48. The capacitance of trimming condenser 5, 25 or 45 is, as previously, 100 micro-microfarads when the value of condenser 8 is 880 micro-microfarads, in order to restrict the frequency ratio to 2:1. For other values of fixed-padding condenser 8, as plotted in Figure 4, the capacitance of trimmer 5 has been adjusted to a value such that, independently of the capacitance of fixed-padder 8, the frequency ratio of the main tuning dial is always 2:1. It follows that the results plotted in Figure 4 indicate, independently of other factors, the law of variation of the effectiveness of the bandspread system with respect to changes in the value of the fixed-padder 8 shunted across bandspread tuning condenser 7. It is therefore apparent that the selection of an appropriate value of shunt capacity 8 makes it possible to vary the amount of bandspread as desired, large values of capacity 8 having the effect of restricting the amount of bandspread action and small values of fixed-padder capacity giving large variations of tuning with respect to the setting of the bandspread dial.

The results plotted in Figure 4 correspond with those of Figures 2 and 3, i. e., the laws of capacitance variation of the main tuning and the bandspread tuning condensers with respect to their respective angular tuning dial settings, are identical with those previously discussed in relation to Figures 2 and 3 and the curve in Figure 4 corresponds with a setting of the main tuning dial of approximately 15 megacycles.

Reverting now to Figure 1, it has been pointed out that, although the principal function of the combination of bandspread tuning condenser 7 and fixed-padder 8 is to give fine tuning, i. e., bandspread action, the combination also has the desirable effect of restricting the frequency ratio of the main tuning dial.

It is also to be pointed out that the same combination fulfills still further functions and,

correspondingly, reduces the number of components customarily required in the apparatus. By way of example, the combination of condensers 7 and 8 in Figure 1 replaces the A. V. C. filter condenser which is customarily connected between earth point 9 and the junction point of coil 4 and A. V. C. filter resistance 10. Alternatively in Figure 1 it is feasible to remove the connection between components 10 and 4 as shown and to feed the A. V. C. bias voltage through a resistance (not shown) directly to control grid 13. In this latter case the combination of condensers 7 and 8 fulfills the function of the isolating condenser which would then be required in order to prevent the control grid 13 being short-circuited directly to earth, with respect to direct currents, through coil 4. Again in Figure 1 it is to be noted that the combination of condensers 27 and 28 also fulfills the function of the anode decoupling condenser which is customarily connected between earth point 29 and the junction point of coil 24 and anode decoupling resistor 21. Turning to the oscillator circuit in Figure 1, it is sometimes feasible to dispense with oscillator-padding condenser 43, for example in a frequency band in which the ratio of the incoming signal frequency to the intermediate-frequency is a large quantity. In such cases the combination of condensers 47 and 48 then fulfills the function of an isolating condenser to prevent the positive terminal of the source of anode voltage from being short-circuited directly to earth, with respect to direct currents, through coil 44. Superheterodyne tracking is then maintained by suitable adjustment to the ratio of inductances of coils 24 and 44.

Although the invention has been described chiefly in relation to that portion of a superheterodyne receiver illustrated in Figure 1, it is clear that the idea of the invention is equally applicable to tuned-radio-frequency receivers, and, in fact, coils 4 and 24 are respectively the input and output coils for tuned-radio frequency amplifying valve 11. Correspondingly condensers 7 and 27 give bandspread action, according to the invention, in the input and output tuned radio-frequency circuits respectively of amplifying valve 11.

For the purpose of the foregoing description of an exemplary embodiment of the invention, the earth points 9, 29 and 49 are to be regarded as points of "equivalent" and "substantially zero" radio frequency potential to which the junction points between condensers 6/7, 26/27, 46/47 and/or 6/8, 26/28, 46/48 are connected.

What I claim is:

1. In a radio receiver, a tuning arrangement comprising a plurality of tuning coils, each of said coils being shunted in its entirety by a series connected combination of a main tuning condenser and a band spread tuning condenser, uni-control means for said main tuning condensers, additional and independent uni-control means for said bandspread tuning condensers, and means for connecting the junction points of said series connected condensers to a point of substantially zero radio frequency potential.

2. In a radio receiver or amplifier having a plurality of coils tuned by mechanically uni-controlled main tuning condensers, a tuning arrangement comprising an additional variable condenser connected to the low potential end of each coil and in series with each of said tuning condensers, additional and independent mechanical uni-control means for varying the capacities of said additional condensers, and means for connecting the junction points of the series connected condensers to a point of constant radio frequency potential.

3. In a radio receiver, a tuning arrangement comprising a plurality of tuning coils, each of said coils being shunted in its entirety by a series connected combination of a main tuning condenser and a fixed padding condenser, mechanical uni-control means for said main tuning condensers, bandspread tuning condensers connected across said fixed padding condensers, additional and independent mechanical uni-control means for said bandspread tuning condensers, and means for equalising the radio frequency potentials of the junction points of said main tuning condensers and said fixed padding condensers.

4. In a radio receiver, a tuning arrangement comprising a plurality of tuning coils, each shunted in its entirety by a series connected combination of a main tuning condenser and a bandspread tuning condenser, mechanical uni-control means for said main tuning condensers, additional and independent mechanical uni-control means for said bandspread tuning condensers, means for restricting the ratio of maximum capacitance to minimum capacitance of each of said bandspread tuning condensers, and means for maintaining the junction points of said series connected condensers at a substantially constant radio frequency potential.

5. In a radio receiver, a tuning arrangement comprising a plurality of tuning coils, each shunted in its entirety by a series connected combination of a main tuning condenser and a bandspread tuning condenser, mechanical uni-control means for said main tuning condensers, additional and independent mechanical uni-control means for said bandspread tuning condensers means for restricting the ratio of maximum capacitance to minimum capacitance of each of said main tuning condensers, and means for maintaining the junction points of said series connected condensers at a substantially constant radio frequency potential.

6. A tuning arrangement as claimed in claim 1, characterised in that at least one of said tuning coils, shunted by the series connected combination of a main tuning condenser and a bandspread tuning condenser, constitutes the input circuit of a thermionic valve and that biassing potential is applied to the control grid of said valve through said coil and that the bandspread tuning condenser constitutes the filtering means for said biassing potential.

7. A tuning arrangement as claimed in claim 1, characterised in that at least one of said tuning coils, shunted by the series connected combination of a main tuning condenser and a bandspread tuning condenser is located in the output circuit of a thermionic valve and that operating potentials are applied to the anode of said valve through said coil and that the bandspread tuning condenser functions additionally as a decoupling condenser.

8. A tuning arrangement for superheterodyne receivers comprising in combination, a radio frequency input circuit including an inductance shunted in its entirety by a series connected combination of a main tuning condenser and a bandspread tuning condenser, an oscillator circuit including an inductance shunted in its entirety by a series connected combination of a main tuning condenser and a bandspread tuning

condenser, mechanical uni-control means for said main tuning condensers, additional and independent uni-control means for said bandspread tuning condensers, and a common connection between the junction points of the series connected condenser combinations and a point of substantially constant radio frequency potential.

9. A tuning arrangement for superheterodyne receivers as claimed in claim 8, characterised in that a padding condenser is shunted across each of the bandspread tuning condensers.

10. A tuning arrangement for superheterodyne receivers as claimed in claim 8, characterised in that a trimming condenser is shunted across each of the main tuning condensers.

11. A tuning arrangement for superheterodyne receivers as claimed in claim 8, characterized in that a trimming condenser is shunted across each of the main tuning condensers and in that a padding condenser is shunted across each of the bandspread tuning condensers.

12. A tuning arrangement as claimed in claim 1, characterised in that the uni-controlled main tuning condensers and the uni-controlled bandspread tuning condensers are of the same mechanical construction.

13. A tuning arrangement as claimed in claim 1, characterised in that the main tuning condensers comprise a condenser assembly in which the rotor plates are electrically and mechanically connected to a common uni-control shaft maintained at substantially zero radio frequency potential and that the bandspread tuning condensers comprise an assembly substantially identical with that of the first mentioned assembly.

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