

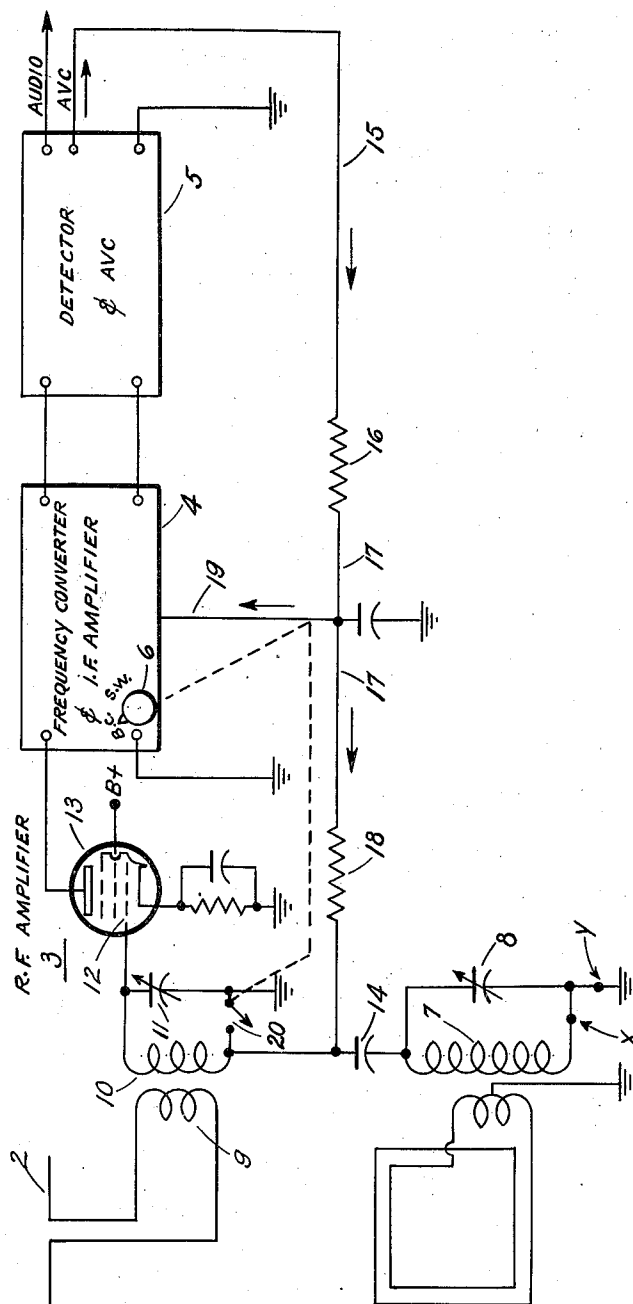
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MULTIBAND RADIO RECEIVER

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MULTIBAND RADIO RECEIVER

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1

This invention relates to improvements in multi-band radio receivers. More particularly, the invention has to do with a novel circuit arrangement by means of which the switching of an automatic volume control circuit may be effected simultaneously with the band switching operation, without the use of additional switches or switch contacts.

In multi-band radio receivers it is frequently desirable to apply automatic volume control voltage to a certain number of stages in one band, and to a different number of stages in another. Thus, for example, in the broadcast band it may be desirable to apply an automatic volume control voltage to all carrier frequency stages (i. e., radio frequency, converter, and intermediate frequency), whereas in a high frequency band it may be desirable to apply the automatic frequency control voltage to only a few of the carrier frequency stages. It is known, for example, that in certain high frequency bands improved reception is obtained if the first carrier frequency stage is operated at substantially full gain throughout, irrespective of signal strength. So far as I am aware, practical circuits for effecting such changes in automatic volume control distribution have heretofore required the use of additional switches or switch contacts.

It is the principal object of the present invention to provide means for effecting such changes in automatic volume control distribution without the use of additional switches or switch contacts.

It is another object of the invention to provide a simple and inexpensive switching arrangement for controlling both band selection and automatic volume control distribution, without deleteriously affecting reception in either band.

These and other objects of the invention, and the manner in which they are attained, will appear from the following detailed description and the accompanying drawing in which the single figure is a partly diagrammatic, partly schematic, illustration of a multi-band radio receiver constructed in accordance with the principles of the invention.

In the drawing there is illustrated, by way of example, a two-band radio receiver adapted to receive signals in the standard broadcast band and in a short wave (high frequency) band. The high frequency band may be adapted for the reception of either amplitude modulated or frequency modulated signals, depending upon the particular requirements. The receiver, aside from the subject-matter of the present invention, is conventional, and comprises a broadcast band

2

loop antenna 1, a high frequency dipole antenna 2, a radio frequency amplifier stage 3, frequency converter and intermediate frequency amplifier stages 4, and a detector and automatic volume control stage 5. Band switching, in the frequency converter stage, may be accomplished in conventional manner by means of the band switch 6.

The loop antenna 1 is tuned in conventional manner by means of a coupled resonant circuit comprising the inductance coil 7 and the variable tuning condenser 8. The high frequency antenna circuit, which includes the dipole 2 and the coupling coil 9, is tuned by means of a resonant circuit comprising the inductance coil 10 and the variable tuning condenser 11. In practice the tuning condensers 8 and 11 are ganged together on a shaft (not shown) common to the tuning means employed in the frequency converter stage. Usually the condenser 11 is small compared to the broadcast band tuning condenser 8. On the other hand it is also known, when the two bands are not widely separated in frequency, to eliminate the condenser 8 entirely and to use the condenser 11 in the tuning of both bands.

The two inductance coils 7 and 10 are connected in series between control grid 12 of pentode 13 and the chassis (ground), or other suitable point of fixed potential. Connection between the coils 7 and 10 is by means of the D. C. blocking condenser 14. The impedance of this condenser at signal frequencies should be small. From the standpoint of best design, the condenser 14 is preferably inserted at the point shown. It will be evident to those skilled in the art, however, that alternatively this condenser may be inserted at either of the points designated *x* and *y*.

An automatic volume control voltage for the R. F. amplifier pentode 13 is supplied from the source 5, by way of the conductor 15, resistor 16 (optional), conductor 17, and resistor 18, to the junction between the high frequency coil 10 and the blocking condenser 14. While the automatic volume control voltage is preferably introduced at the low potential end of the short wave coil 10 as shown, it will be apparent to those skilled in the art that, alternatively, this voltage may be introduced at the high potential end (i. e., grid end) of the coil 10, or at any intermediate point thereon. Moreover, if the condenser 14 be transferred to the point *y* the automatic volume control voltage may, if desired, be introduced at the low potential end of the coil 7, i. e., at the point *x*. Automatic volume control voltage from the source 5 may also be supplied to the frequency

converter and intermediate frequency amplifier stages 4 by way of the conductor 19.

Band switching in the input circuits to the radio frequency amplifier stage 3 is accomplished by means of a switch 20 which may be ganged with (or be a part of) the band switch 6. In the open position (shown) the receiver is adapted for operation in the broadcast band, tuning being accomplished through the agency of the variable condenser 8. In this position the high frequency coil 10 is effectively in series between the high potential end of the resonant circuit 7-8 and grid 12 of pentode 13. However, at broadcast band frequencies the inductance of coil 10 is negligible and its effect on the circuit is likewise negligible. The small high frequency tuning condenser 11 is now effectively in shunt with the tuning condenser 8 and aids in tuning the coil 7.

When the switch 20 is in its closed position, the loop antenna circuit is effectively shorted, while at the same time the high frequency resonant circuit comprising the inductance coil 10 and tuning condenser 11 is completed, permitting the reception of signals in the high frequency band as supplied by the dipole 2. It is an important feature of the invention that in the high frequency, or closed, position of the switch 20, the said switch is at the low potential end of the resonant circuit 10-11, rather than at the high potential end thereof. In this position the distributed capacity of the switch to ground does not appear in shunt with the tuning condenser 11 and hence does not diminish or "dilute" the tuning range of the condenser.

By virtue of the connections recited hereinbefore, an arrangement has been provided wherein the single switch 20 serves simultaneously as a band switching means, and as a means for providing an automatic volume control voltage for the amplifier 3 during broadcast reception and for removing said voltage during reception in the high frequency band. Thus it will be observed that during broadcast reception, with the switch 20 open, automatic volume control voltage is applied to the control grid 12 of pentode 13 by way of the path 15, 16, 17, 18, and the coil 10. On the other hand, during high frequency reception, when the switch 20 is closed, the left-hand end of the series resistor 18 is grounded through the switch 20, thus removing the automatic volume control voltage from the pentode 13. At the same time, the blocking condenser 14 and the series resistor 18 are completely removed from association with the resonant circuit 10-11 thus reducing circuit losses in the frequency band where small losses are particularly to be avoided.

In general the resistance of the series resistor 18 should be high, e. g., of the order of a half megohm or more, so that the closing of the switch 20 will not substantially reduce the magnitude of the automatic volume control voltage supplied to the remaining carrier frequency stages 4 by way of the conductor 19. On the other hand, there may be instances when it is desired to reduce the magnitude of the automatic volume control voltage applied to the stages 4 during high frequency reception. This may be conveniently accomplished by inserting the resistor 16 in the automatic volume control path as shown. Closing of the switch 20 will then reduce the voltage supplied to the conductor 19 by a factor depending upon the ratio of resistors 16 and 18, as will be evident to those skilled in the art.

In the interests of simplicity the invention has been illustrated and described as applied to a

single stage in a conventional radio receiver. It will be evident, of course, that the invention is similarly applicable to other stages, or to more than one stage. The invention is capable of still other modification within the scope of the appended claims.

I claim:

1. In a multi-band radio receiver, a band-selecting switch, a source of automatic volume control voltage, a vacuum tube having at least a control grid, an anode and a cathode, a first coil adapted for operation over a predetermined wave band, a second coil adapted for operation over a different wave band, means for tuning said coils over their respective wave bands, a direct-current connection between the high potential end of said second coil and the control grid of said vacuum tube, a connection between the low potential end of said second coil and the high potential end of said first coil, a connection between the low potential end of said first coil and said cathode, one of said two last-named connections including a capacitor, a direct-current connection between said source of automatic volume control voltage and the low potential end of said second coil, and switch contact elements operative in one position of said band-selecting switch to effect a direct-current connection between the low potential end of said second coil and said cathode, and operative in another position of said band switch to break said last-named connection.

2. In a multi-band radio receiver, a source of automatic volume control voltage, a vacuum tube operating at a carrier frequency, a first coil adapted for operation over a predetermined wave band, a second coil adapted for operation over a higher frequency wave band, means for tuning said coils over their respective wave bands, a direct-current connection between the high potential end of said second coil and the control grid of said vacuum tube, a connection between the low potential end of said second coil and the high potential end of said first coil, a connection between the low potential end of said first coil and a point of substantially fixed potential, one of said two last-named connections including a capacitor, a high-resistance direct-current connection between said source of automatic volume control voltage and the low potential end of said second coil, and a switch connected between the low potential end of said second coil and a point of substantially fixed potential, said switch being adjustable to open-circuit and closed-circuit positions selectively.

3. In a multi-band radio receiver, a first carrier frequency stage including a vacuum tube having a control grid, a subsequent carrier frequency stage, a source of automatic volume control voltage, a band-selecting switch for conditioning said receiver for the reception of signals in either one of a plurality of wave bands, a first coil adapted for operation over a predetermined wave band, a second coil adapted for operation over a different wave band, means for tuning said coils over their respective wave bands, a direct-current connection between the high potential end of said second coil and the control grid of said vacuum tube, a capacitor connected between the low potential end of the said second coil and the high potential end of said first coil, a connection between the low potential end of said first coil and a point of fixed potential, a direct-current connection between said source of automatic volume control voltage and the gain control element of said subsequent stage, a high resistance series re-

5

sistor connected in a direct-current path between said source and the low potential end of said second coil, and switch contact elements operative in one position of said band-selecting switch to connect the low potential end of said second coil to a point of fixed potential, and operative in another position of said band switch to break said last-named connection.

4. In a multi-band radio receiver, a first carrier frequency stage including a vacuum tube having a control grid, a subsequent carrier frequency stage, a source of automatic volume control voltage, a band-selecting switch for conditioning said receiver for the reception of signals in either one of a plurality of wave bands, a first coil adapted for operation over a predetermined wave band, a second coil adapted for operation over a different wave band, means for tuning said coils over their respective wave bands, a direct-current connection between the high potential end of said second coil and the control grid of said vacuum tube, a capacitor connected between the low potential end of the said second coil and the high potential end of said first coil, a connection between the low potential end of said first coil and a point of fixed potential, a pair of series connected high resistance elements connected in a direct-current path between said source and the low potential end of said second coil, a direct-current connection between the junction of said resistance elements and the gain control element of said subsequent stage, and switch contact elements operative in one position of said band-selecting switch to connect the low potential end of

6

said second coil to a point of fixed potential, and operative in another position of said band switch to break said last-named connection.

5. In a multi-band radio receiver, a source of automatic volume control voltage, a vacuum tube having at least a grid, a cathode, and an anode, a first coil adapted for operation over a predetermined wave band, a second coil adapted for operation over a different wave band, means for tuning said coils over their respective wave bands, a capacitor, means connecting said coils and said capacitor in series between said grid and said cathode, a direct-current connection between said source and said grid, and a single-pole-single-throw switch connected between said cathode and a point intermediate said coils, said switch, in its closed position, providing a direct-current short-circuit across said source while simultaneously providing an alternating-current short-circuit across one of said coils.

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