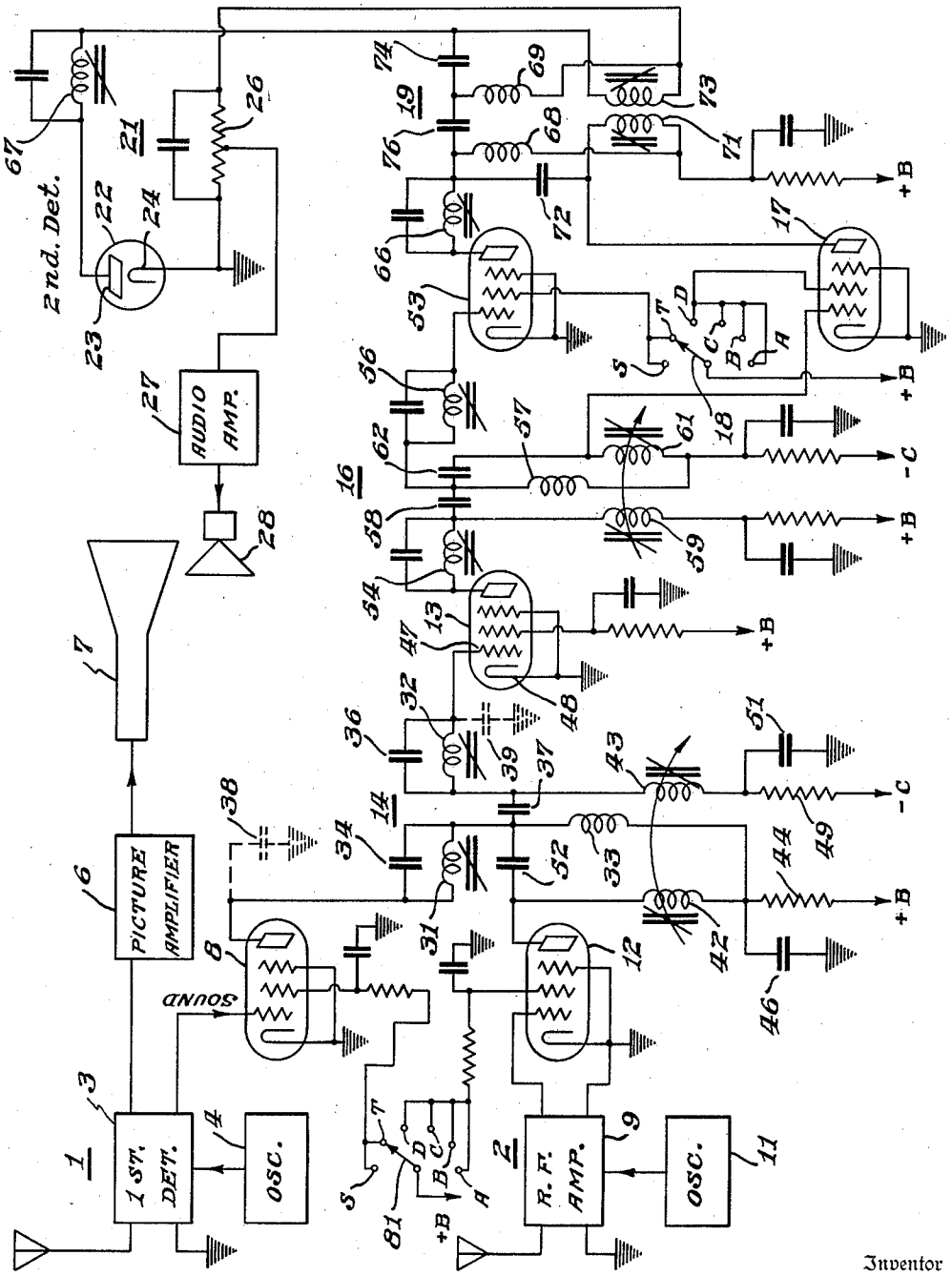
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TELEVISION RECEIVER

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TELEVISION RECEIVER

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6 Claims. (Cl. 250—20)

My invention relates to television receivers or the like wherein it is desired to amplify signals in a plurality of frequency bands. Specifically I have applied my invention to a combination television receiver and broadcast receiver in which the sound signals accompanying the picture are in a high frequency band such as a 9.75 megacycle band and in which the sound signals from broadcast transmitters are in a comparatively low frequency band such as a 460 kilocycle band.

It has previously been the usual practice in designing combination receivers of the above-mentioned type to employ two separate intermediate frequency amplifiers for the television sound signals and the broadcast sound signals. These two amplifiers had a common audio amplifier to which they could be connected selectively by means of suitable switches. For various reasons the feature of switching the two I. F. amplifiers to the audio amplifier was undesirable.

As described and claimed in my Patent 2,183,741, issued December 19, 1939, entitled Television receivers, and assigned to the Radio Corporation of America, the use of two separate I. F. amplifiers and the switching of the audio amplifier from one I. F. amplifier to the other may be avoided by the use of a specially designed I. F. coupling network which includes a high frequency band transformer and a comparatively low frequency band transformer. It has been found that with the circuit design shown in my said patent there may be difficulties caused by harmonics of the broadcast frequency oscillator feeding into the high frequency I. F. channel and producing undesired beat notes in the receiver response.

It is accordingly an object of the present invention to provide an improved combination receiver of the above mentioned type in which it is not necessary that the audio amplifier be switched to the desired amplifier channel and in which difficulties caused by harmonics of the broadcast receiver oscillator are avoided.

It is a further object of my invention to provide a simplified combination receiver of the above mentioned type.

It is a still further object of my invention to provide an improved amplifier in which one amplifier tube selectively amplifies signals in a plurality of frequency bands.

It is a still further object of my invention to provide an improved coupling network for connecting amplifier tubes in cascade relation.

In a preferred embodiment of my invention as applied to a combined television and broadcast receiver, I supply the television sound signals and the broadcast sound signals to an I. F. amplifier having at least one amplifier tube which is common to the two sound channels. This amplifier tube is coupled to preceding tubes and to succeeding tubes through coupling networks each of which comprises two I. F. transformers, one transformer being designed to pass the high frequency television sound signals and having the primary and secondary coupled through a common coupling coil and the other transformer being designed to pass the comparatively low frequency broadcast sound signals.

The receiver is provided with switching means whereby either television sound signals or broadcast sound signals are supplied to the common I. F. amplifier as desired. The two I. F. transformers in each amplifier stage are so coupled and designed that each one is effectively out of the circuit for signals of the frequency that the other transformer is designed to pass. In addition, in accordance with the present invention, the high frequency sound channel includes at least one amplifier tube which contains in either its plate circuit or grid circuit a tuned circuit presenting high impedance only to the high frequencies. Likewise, the low frequency sound channel includes at least one amplifier tube which contains in either its plate circuit or grid circuit a tuned circuit presenting high impedance only to the lower frequencies, that is, the frequencies of the broadcast range. Additional switching is employed whereby only one of the amplifier tubes is rendered active at a given time to further insure that one sound channel will be ineffective for amplifying any signals while the other sound channel is in use.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which the single figure is a circuit diagram of a combined television receiver and broadcast receiver embodying my invention.

Referring to the drawing, the combined receiver includes two superheterodyne receiver sections 1 and 2, receiver section 1 being designed for receiving picture signals and the accompanying sound signals on very high frequency carrier waves (40 to 80 megacycles, for example), and receiver section 2 being designed for receiving sound signals in the ordinary broadcast band (550 to 1500 kc., for example).

Receiver section 1 includes a first detector 3, a tunable oscillator 4, and a picture amplifier 6

through which picture signals are supplied to a cathode ray tube 7. The usual deflecting circuits are not illustrated as they form no part of the present invention.

The television sound signals are supplied to an amplifier tube 8 having its output circuit connected to an I. F. amplifier which is to amplify both television sound signals and broadcast sound signals as will be explained hereinafter.

The receiver section 1 may be similar to the corresponding section of the receiver described in Carlson Patent 1,975,056.

The broadcast receiver section 2 includes a radio frequency amplifier 9, a tunable oscillator 11 and a first detector 12. The I. F. broadcast sound signals are supplied from the output circuit of detector 12 to the first I. F. amplifier tube 13 through a coupling circuit 14 designed in accordance with my invention. These broadcast sound signals pass through another coupling network 16 to an amplifier tube 17 and are amplified thereby when a switch 18 is on one of the broadcast band positions A, B, C, or D to supply voltage to the screen grid of the tube 17.

The broadcast sound signals amplified by the tube 17 pass through a coupling network 19 to a second detector 21 which may be of the common type comprising a diode 22 having a plate 23 and a cathode 24. The audio signals which appear across an output resistor 26 are supplied to an audio amplifier 27 which supplies either television sound signals or broadcast sound signals to a loudspeaker 28, depending upon whether sound signals are supplied from the receiver 1 or from the receiver 2.

Referring now to the design of the coupling networks, and referring first to the network 14, the high frequency tuned transformer or band pass filter includes a primary coil 31, a secondary coil 32 and a coupling coil 33. The coils 31 and 32 are shunted by tuning condensers 34 and 36, respectively, the exact tuning of the primary and secondary circuits being done by means of movable magnetic cores in the coils 31 and 32. This high frequency transformer is of the type described and claimed in application Serial No. 129,804, filed March 9, 1937, as a joint invention of H. C. Allen and G. L. Grundmann, and assigned to the Radio Corporation of America.

A condenser 37 of comparatively large capacity is connected between coils 31 and 32. The condenser 37 has such large capacity that at the high frequency sound band its effect in the circuit is negligible.

It will be seen that the output capacity of detector 8 indicated at 38 is across both the primary coil 31 and the coupling coil 33. Likewise the input capacity of amplifier tube 13 indicated at 39 is across both the secondary coil 32 and the coupling coil 33. Thus the capacities 38 and 39 form part of the tuning capacity of the primary circuit and the secondary circuit, respectively. Since the inductance of the coupling coil 33 is small compared with the inductance of primary coil 31 and secondary coil 32, the fact that condensers 34 and 36 are not across all the inductance in the primary and secondary circuits, respectively, is not of importance. As to the relative values of coils 31, 32 and 33, coils 31 and 32 may have approximately 25 turns each and coil 33 may have 5 turns. It may be noted that in some receiver designs the condensers 34 and 36 may be omitted and the coils 31 and 32 tuned entirely by the tube capacities 38 and 39.

Referring now to the low frequency tuned transformer or band pass filter, it includes a primary coil 42 and a secondary coil 43 which are spaced apart the correct amount to give the desired inductive coupling. Plate voltage is supplied to the detector 12 through a filter resistor 44 and primary coil 42. A filter condenser 46 is connected between the high potential end of filter resistor 44 and ground.

The high potential end of secondary coil 43 is connected to the control grid 47 of amplifier tube 13 through the secondary coil 32. The other end of coil 43 is connected to the cathode 48 of amplifier tube 13 through a filter resistor 49 and a suitable biasing source (not shown). A filter condenser 51 is connected between the low potential end of coil 43 and ground.

The primary coil 42 and the secondary coil 43 are effectively shunted by a condenser 52 and the condenser 37, respectively, at frequencies in the low frequency band whereby the primary and secondary circuits are tuned to provide the desired band pass characteristic. This results from the fact that the coupling coil 33 presents substantially no impedance to signals in the low frequency band. Also the filter condensers 46 and 51 are of such capacity as to present a low impedance to these signals.

From an inspection of the coupling network 14 as shown in the drawing it will be apparent that plate voltage is supplied to the tube 8 through the coupling coil 33 and the primary coil 31, and that there is included in the plate circuit of this tube no tuned circuit which presents a high impedance to the low frequency sound band. Thus, the tube 8 can amplify efficiently only the high frequency sound band.

Also, it will be apparent that the plate circuit of the detector tube 12 contains no tuned circuit which presents a high impedance to the high frequency sound band or to frequencies of this order such as harmonics of the broadcast band oscillator 11 or beat frequencies produced thereby.

The coupling network 16 is similar to the network 14 but it differs in that the plate circuit presents a high impedance to both the high frequency band and the low frequency band while it feeds into separate amplifier tubes for each band, an amplifier tube 53 being in the high frequency channel and the amplifier tube 17 being in the low frequency channel. In this case the grid circuit of the tube 53 presents a high impedance to the high frequency band only while the grid circuit of the tube 17 presents a high impedance to the low frequency band only.

The network 16 comprises a tuned primary 54 and a tuned secondary 56 which are coupled by a coil 57 common to the two tuned circuits to produce a band pass filter for the high frequency sound channel. The tuned primary circuits include a condenser 58 of comparatively large capacity which has very low impedance for signals in the high frequency band.

The band pass filter for the low frequency sound channel comprises a primary coil 59 tuned to the proper frequency by condenser 58 and a secondary coil 61 tuned to the proper frequency by condenser 62. Coupling between primary and secondary coils is obtained by their proper space relation.

It will be seen that the tuned secondary 56 is coupled to the input electrodes of the tube 53 while the tuned secondary 61 is coupled to the input electrodes of the tube 17. In order to further insure that one sound channel will be ineffective to pass signals while the other sound

channel is in use, the screen grid of the tube 53 is supplied with an operating voltage only when the switch arm 18 is on the switch points S or T.

The coupling network 19 for feeding into the second detector 21 comprises a band pass filter for the high frequency channel consisting of a tuned primary 66, a tuned secondary 67 and a coupling impedance common to the two tuned circuits made up of the coils 68 and 69 which are in parallel so far as the high frequency signals are concerned.

The band pass filter for the broadcast frequencies comprises primary coil 71 tuned by a condenser 72 and coupled to a secondary 73 tuned by a condenser 74. The condenser 76 is merely a blocking condenser.

The general design of network 19 where two coupling coils corresponding to coils 68 and 69 are used to permit coupling into a diode detector is described and claimed in my above-mentioned copending application.

The operation of my improved circuit will now be considered somewhat more in detail. If a picture and the accompanying sound are to be received or if sound alone on the high frequency channel is to be received the range switch (not shown) is thrown to either the position T or S. Coupled to this range switch are the switch arms 18 and 81, the switch arm 81 being associated with contact points for the broadcast bands A, B, C and D and with two contact points, one, position T for the combined television and sound, the other position S for the high frequency sound only. With the range switch in the positions T or S the switch arms 18 and 81 are in corresponding positions whereby an operating voltage is applied to the screen grids of the tubes 8 and 53. At the same time the screen grid voltage is removed from the detector tube 12 and the amplifier 17. With this arrangement the broadcast sound channel cannot feed noise into the television sound channel.

The principal advantage of the present invention, however, is that when the broadcast sound channel is being used the harmonic frequencies of the oscillator 11 or beat notes produced by these harmonics cannot feed through the amplifier. As previously explained, this is prevented both by keeping the plate circuit of the tube 12 and the grid circuit of the tube 17 of low impedance above the broadcast band frequencies and by making the tubes 8 and 53 inoperative at this time.

I claim as my invention:

1. In combination, a coupling network for passing signals in a high frequency band and in a low frequency band, said network comprising a high frequency band pass circuit having a tuned primary circuit including a primary coil and a tuned secondary circuit including a secondary coil, at least one inductance coil common to said circuits and coupling them the correct amount to give them a band pass characteristic, and a low frequency band pass transformer having inductively coupled primary and secondary coils, a vacuum tube having a plate circuit which includes said first primary coil only, a second vacuum tube having a plate circuit which includes said second primary coil only, a third vacuum tube having a grid circuit, said secondary coils being connected in series in the grid circuit of said third vacuum tube, and means for so tuning said low frequency transformer as to give it a band pass characteristic without affecting the selectivity characteristic of said high frequency band pass circuit in said high frequency band.

2. In combination, a coupling network for passing signals in a high frequency band and in a low frequency band, said network comprising a high frequency band pass circuit having a tuned primary circuit including a primary coil and a tuned secondary circuit including a secondary coil, at least one inductance coil common to said circuits and coupling them the correct amount to give them a band pass characteristic, and a low frequency band pass transformer having inductively coupled primary and secondary coils, a vacuum tube having a plate circuit which includes said primary coils connected in series, a second vacuum tube having a grid circuit which includes said first secondary coil, a third vacuum tube having a grid circuit which includes said second secondary coil, and means for so tuning said low frequency transformer as to give it a band pass characteristic without affecting the selectivity characteristic of said high frequency band pass circuit in said high frequency band.

3. In a combined high frequency and broadcast frequency receiver, means for converting the high frequency sound signals into intermediate frequency signals having a comparatively high frequency, means for converting the broadcast frequency sound signals into intermediate frequency signals having a comparatively low frequency, an intermediate frequency amplifier, a second detector, said intermediate frequency amplifier including a coupling network comprising a primary circuit and a secondary circuit so tuned and coupled as to pass said high frequency I. F. signals and also comprising a second primary circuit and a second secondary circuit so tuned and coupled as to pass said low frequency I. F. signals, said secondary circuits being connected in series with each other and in the input circuit of said second detector, and means for selectively applying only said high frequency I. F. signals to said first primary circuit and only said low frequency I. F. signals to said second primary circuit.

4. In a combined high frequency and broadcast frequency receiver, means for converting the high frequency sound signals into intermediate frequency signals having a comparatively high frequency, means for converting the broadcast frequency sound signals into intermediate frequency signals having a comparatively low frequency, an intermediate frequency amplifier, a second detector, said intermediate frequency amplifier including a coupling network comprising a primary circuit and a secondary circuit so tuned and coupled as to pass said high frequency I. F. signals and also comprising a second primary circuit and a second secondary circuit so tuned and coupled as to pass said low frequency I. F. signals, said secondary circuits being connected in series with each other and in the input circuit of said second detector, a pair of intermediate frequency amplifier tubes being included in said I. F. amplifier, means for applying only said high frequency I. F. signals to said first primary circuit through one of said I. F. amplifier tubes, means for applying only said low frequency I. F. signals to said secondary primary circuit through the other of said I. F. amplifier tubes, and means for making one of said I. F. amplifier tubes ineffective to pass signals in response to the actuation of means for making the

other of said I. F. amplifier tubes effective to pass signals.

5. In a combined high frequency and broadcast frequency receiver, means for converting the high frequency sound signals into intermediate frequency signals having a comparatively high frequency, means for converting the broadcast frequency sound signals into intermediate frequency signals having a comparatively low frequency, an intermediate frequency amplifier, a second detector, said intermediate frequency amplifier including a coupling network comprising a high frequency band pass circuit having a tuned primary circuit which includes a primary coil and a tuned secondary circuit which includes a secondary coil, there being at least one inductance coil common to said circuits and coupling them the correct amount to give them a band pass characteristic to pass said high frequency I. F. signals, and a low frequency band pass transformer having inductively coupled primary and secondary coils for passing said low frequency I. F. signals, a vacuum tube having a plate circuit which includes said first primary coil, a second vacuum tube having a plate circuit which includes said second primary coil, said secondary coils being connected in series in the input circuit of said second detector, and means for so tuning said low frequency transformer as to give it a band pass characteristic without affecting the selectivity characteristic of said high frequency band pass circuit in said high frequency band.

6. In a combined high frequency and broadcast frequency receiver, an intermediate frequency amplifier comprising a coupling network for passing signals in a high frequency band and in a low frequency band, said network comprising a high frequency band pass circuit having a tuned primary circuit including a primary coil and a tuned secondary circuit including a secondary coil, at least one inductance coil common to said circuits and coupling them the correct amount to give them a band pass characteristic, and a low frequency band pass transformer having inductively coupled primary and secondary coils, a vacuum tube having a plate circuit which includes said primary coils connected in series, a second vacuum tube having a grid circuit which includes said first secondary coil, a third vacuum tube having a grid circuit which includes said second secondary coil, and means for so tuning said low frequency transformer as to give it a band pass characteristic without disturbing the action of said high frequency band pass circuit in said high frequency band, a second coupling network comprising a high frequency band pass circuit having a tuned primary circuit including a primary coil and a tuned secondary circuit including a secondary coil, at least one inductance coil common to said circuits and coupling them the correct amount to give them a band pass characteristic, and a low frequency band pass transformer having inductively coupled primary and secondary coils, said second vacuum tube having a plate circuit which includes said first primary coil of said second network, said third vacuum tube having a plate circuit which includes said second primary coil of said second network, said secondary coils of said second network being connected in series in the input circuit of a second detector, and means for so tuning said low frequency transformer of said second network as to give it a band pass characteristic without affecting the selectivity characteristic of said high frequency band pass circuit in said high frequency band.

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