May 9, 1939. G. L. GRUNDMANN ET AL 2,157,170

TELEVISION RECEIVER

Filed Jan. 29, 1938

FIG. 1.

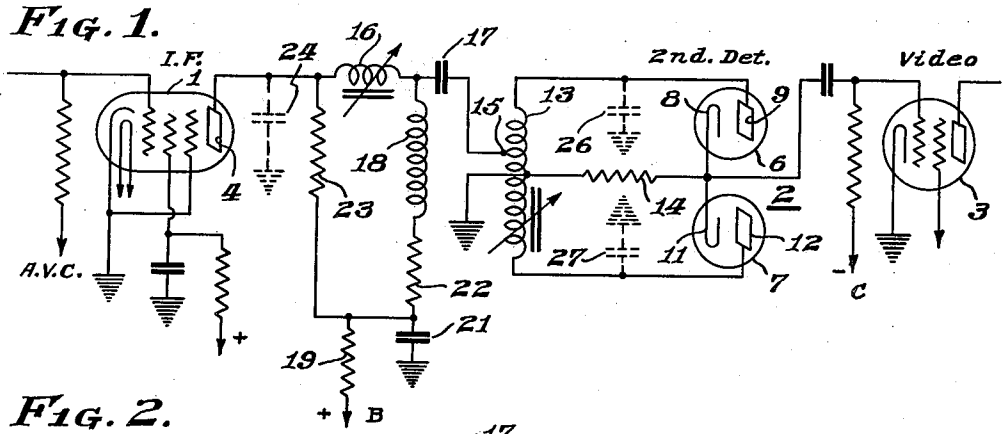


FIG. 2.

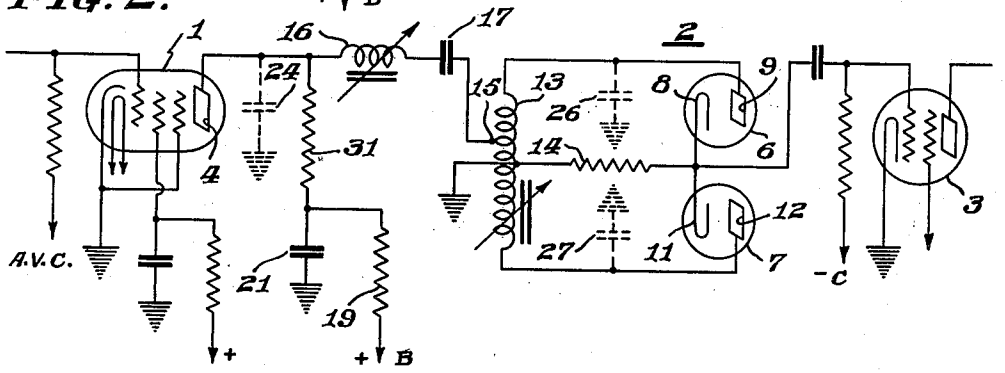
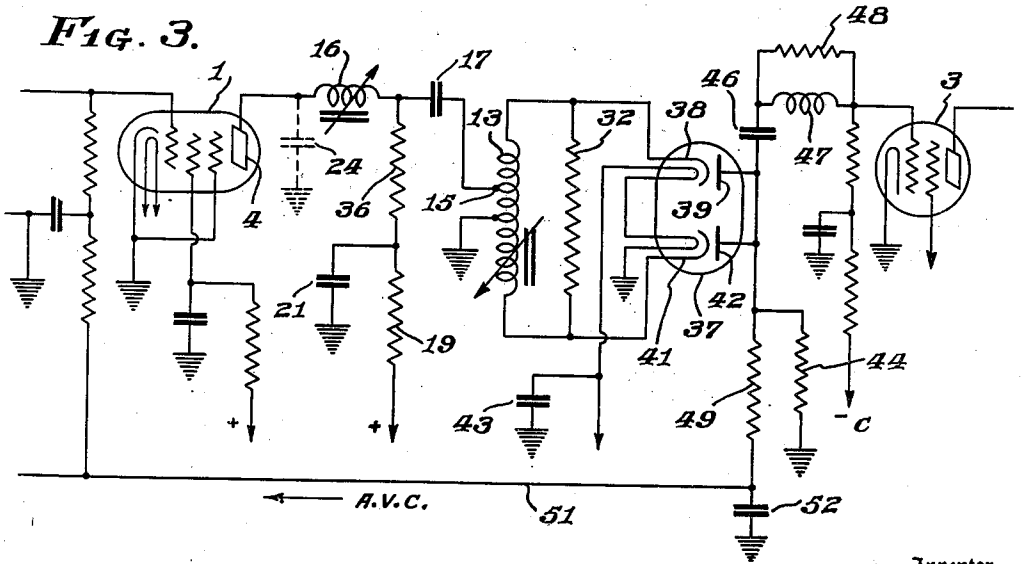


FIG. 3.



Inventor

Gustave L. Grundmann

Horace C. Allen

By

Attorney

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TELEVISION RECEIVER

Gustave L. Grundmann, Westmont, and Horace Clifford Allen, Marlton, N. J., assignors to Radio Corporation of America, a corporation of Delaware

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7 Claims. (Cl. 250—20)

Our invention relates to receivers for the reception of high frequency signals and particularly to television receivers of the superheterodyne type.

In broadcast receivers of the superheterodyne type it is the usual practice to prevent the intermediate frequency carrier wave from appearing in the second detector output by filtering out this signal wave. This can readily be done since the audio frequencies are far removed in frequency from the intermediate frequency carrier wave.

In television receivers, however, the video frequencies are so close to the intermediate frequency that a filter for removing the I. F. carrier wave would remove a large part of the video signals. Accordingly, the second detector is made of the push-pull type whereby the I. F. carrier wave is balanced out.

The coupling circuit between the last I. F. amplifier and the second detector should, of course, have a band pass characteristic similar to that of the preceding I. F. stages. Such a characteristic is obtained by properly coupling two tuned circuits. In the past, these tuned circuits have been coupled capacitively by means of a coupling condenser, the amount of coupling being determined by its capacity, or they have been coupled inductively by placing the coils in the two circuits in inductive relation. When capacity coupling is utilized, because of the small size coupling condenser required and because of the variation in capacity of such condensers due to the tolerances allowed in manufacture, it has been found difficult to obtain in each receiver the desired coupling. Furthermore, capacity coupling causes the selectivity curve to trail on the high frequency side when the modulating frequencies cover a band which is a high percentage of the carrier, as in the case of television.

On the other hand, if it is attempted to obtain the desired coupling by locating coils in inductive relation, considerable difficulty will be encountered in getting sufficiently tight coupling where the modulating frequencies cover a wide band, as in television.

Accordingly, an object of our invention is to provide in a superheterodyne receiver an improved means for coupling an intermediate frequency amplifier to a second detector of the push-pull type.

A further object of our invention is to provide an improved coupling circuit between an amplifier and a push-pull detector, which circuit has a band pass characteristic.

A further object of our invention is to provide in a television receiver an improved coupling circuit between an intermediate frequency amplifier and a second detector.

In a preferred embodiment of our invention, a pair of detector tubes, such as diodes, are connected in push-pull relation by means of an inductance coil in a well known manner. This coil and the tube capacities form one tuned circuit. The plate circuit of the last I. F. amplifier includes a tunable inductance coil and forms the other tuned circuit. The two tuned circuits are coupled by including a portion of the first-mentioned inductance in the tuned plate circuit whereby this portion is common to both tuned circuits.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which

Figure 1 is a circuit diagram of a portion of a television receiver embodying our invention, and

Figures 2 and 3 are circuit diagrams showing modifications of the circuit shown in Fig. 1.

Referring to Fig. 1, there are shown the last I. F. amplifier 1, the second detector 2, and the first video amplifier 3 in a television receiver of the superheterodyne type. The amplifier tube 1 is of any suitable type such as a pentode having the usual cathode and grid electrodes and a plate 4.

The detector 2 is of the push-pull type and preferably comprises two diodes 6 and 7, the diode 6 having a cathode 8 and a plate 9, and the diode 7 having a cathode 11 and a plate 12.

In the specific circuit illustrated, the diodes 6 and 7 have their plates 9 and 12 connected to opposite ends of an inductance coil 13. The center point of the coil 13 is connected to ground. This center point is also connected to the cathodes 8 and 11 through an output resistor 14.

In accordance with our invention, the I. F. amplifier and the second detector are coupled in the following manner:

The plate 4 of the amplifier 1 is connected through a variable inductance coil 16 and a blocking condenser 17 to a point 15 on the coil 13, preferably to a point intermediate the center point and one end of the coil.

Plate voltage for the amplifier tube 1 may be supplied through a choke coil 18 connected to the junction point of coil 16 and condenser 17. The plate voltage supply includes the usual filter resistor 19 and filter condenser 21.

Resistors 22 and 23, which may be omitted, are provided for damping purposes as will be explained later.

The above-described coupling circuit includes

two tuned circuits. One of these circuits, which may be referred to as the primary circuit, may be traced from the plate 4 through coil 16 and condenser 17, through a portion of coil 13 to ground, and from ground through the output or plate capacity of the tube 1 indicated at 24, back to the plate 4. This circuit preferably is tuned to the desired frequency by adjusting coil 16, this coil preferably being provided with a movable magnetic core such as a magnetite core.

The second tuned circuit, which may be referred to as the secondary circuit may be traced from ground through the upper half of coil 13, through the input capacities of diodes 6 and 7, which are indicated at 26 and 27, respectively, and through the lower half of coil 13 back to ground.

The secondary circuit preferably is tuned to the desired frequency by means of a movable core of magnetic material such as magnetite.

The primary and secondary circuits are tuned approximately to the same frequency and coupled the proper amount to provide a substantially flat-topped band pass selectivity curve whereby the I. F. carrier and its video side bands are supplied to the second detector. It will be noted that the only coupling between the primary and secondary circuits is provided by that portion of coil 13 which is common to the two tuned circuits. The correct amount of coupling may be provided very easily merely by connecting the lead from blocking condenser 18 to the proper point on coil 13. The capacity of condenser 17 is immaterial so long as it is great enough to make the condenser have a negligible impedance at the frequencies involved.

The video signals appear across the output resistor 14 and are supplied to the video amplifier 3. It will be understood that the intermediate frequency carrier wave does not appear across resistor 14 as it has been balanced out.

In order to obtain the desired flat top on the selectivity curve for the two tuned circuits, it is usually desirable to include a damping resistor in one of the tuned circuits. In Fig. 1 this damping is provided by resistor 23. As will be understood from the description of the circuit shown in Fig. 3, the damping may be provided by a resistor across coil 13 in place of resistor 23, or resistors may be utilized in both the primary circuit and the secondary circuit.

The resistor 22 is not essential but it is desirable in order to avoid a "hump" on one side of the selectivity curve caused by resonance in the circuit traced from ground, through filter condenser 21, resistor 22, coil 18, blocking condenser 17, and through the coupling portion of coil 13 back to ground.

It will be noted that since the blocking condenser is connected to the coil 13 at a point 15 away from the mid-point of the coil, the circuit tends to be unbalanced a certain amount. The balance of the circuit is restored to a large extent by locating the magnetic core which tunes coil 13 on that half of the coil which is opposite the half to which condenser 17 is connected.

For example, as indicated by conventional symbols in Fig. 1, if the tap 15 is on the upper half of coil 13, the movable magnetic core is positioned in or adjacent to the lower half of coil 13. Preferably, for the best balance, the core extends from the lower end of the coil 13 about half way into the lower half of the coil.

In Fig. 2 the circuit is similar to that in Fig. 1 except that the plate voltage is supplied to the amplifier 1 in a different way. In the two figures, like parts are indicated by the same reference numerals.

In Fig. 2 an operating voltage is supplied to the plate 4 through a plate resistor 31. While this requires a higher plate voltage than does the circuit in Fig. 1 because of the voltage drop in resistor 31, it is preferable, from one viewpoint since there are no undesirable resonant effects to be corrected. The necessary damping for the coupled tuned circuits is provided in the primary circuit by the plate resistor 31.

A preferred embodiment of our invention is shown in Fig. 3, like parts in Figs. 1, 2 and 3 being indicated by the same reference numerals. The two circuits are the same except for the features which will now be discussed.

Fig. 3 shows the preferred way of supplying voltage to the plate of amplifier 1. It is supplied through a resistor 36 which is connected to the junction point of coil 16 and condenser 17. Since this is a point having lower impedance to ground than the plate 4, the resistance of resistor 36 may be less than that of resistor 31 whereby less plate voltage may be supplied from the plate voltage supply. As in Fig. 2, there are no undesirable resonant effects.

It is preferred to provide the necessary damping for the tuned circuits by means of a resistor 32 connected across the coil 13.

In place of the separate diode tubes 6 and 7, a single tube 37 containing two sets of diode elements may be utilized. The tube 37 contains a cathode 38 and cooperating plate 39, and a cathode 41 and cooperating plate 42. The cathodes are indirectly heated, the heating circuit being provided with a suitable filter condenser 43.

In this particular circuit the cathodes 38 and 41, instead of the plates, are connected to opposite ends of the coil 13 whereby the output signal has the desired polarity, thus avoiding the use of a polarity reversing amplifier. The plates 39 and 42 are connected together, an output resistor 44 being connected between the plates and ground.

The video signal appearing across resistor 44 may be supplied to the video amplifier through a coupling condenser 46 and a coil 47 which resonates with the input capacity of the tube 3 at the high frequency end of the amplifier frequency range to extend the frequency range. A damping resistor 48 is shunted across the coil 47.

Automatic volume control may be provided by means of a connection from the diode plates 39 and 42 to the control grids of preceding tubes through a resistor 49 and a conductor 51, a condenser 52 having such capacity as to give the desired time constant.

We claim as our invention:

1. In a superheterodyne receiver, an intermediate frequency amplifier having a plate electrode, a push-pull second detector, said detector having an input circuit which includes an inductance coil, the mid-point of said coil being connected to ground for signal frequencies, a connection from said plate electrode to a point on said coil other than said mid-point, said connection including an inductance coil and a blocking condenser in series, and means for applying an operating voltage to said plate electrode, the circuit including said last mentioned coil, a portion of said first-mentioned coil and the output capacity of said amplifier being tuned to a certain frequency, and the circuit including said first-mentioned coil and the input capacity of

said detector being tuned at least approximately to said certain frequency, the coupling between said tuned circuits which is provided by said coil portion being such as to produce a substantially flat topped selectivity curve.

2. The invention according to claim 1 characterized in that said means for applying an operating voltage to said plate electrode comprises a plate resistor which is connected between a source of plate voltage and the junction point of said second-mentioned coil and said blocking condenser.

3. The invention according to claim 1 characterized in that a damping resistor is connected across said first-mentioned coil.

4. In a superheterodyne receiver, an intermediate frequency amplifier having an output electrode and a certain amount of output capacity, a second detector comprising a pair of rectifying devices connected in push-pull relation by means of an inductance coil having its mid-point connected to ground for signal frequencies, said detector having a certain amount of input capacity, a connection from said output electrode to a point on said coil removed from said mid-point, said connection including an inductance coil and a blocking condenser in series, means for applying an operating potential to said output electrode, the circuit including said last coil, a portion of said first coil and said output capacity forming a tuned primary circuit, said first coil and said input capacity forming a tuned secondary circuit, said tuned circuits being so tuned and coupled as to form a band pass filter.

5. In a superheterodyne receiver, an intermediate frequency amplifier having an output electrode, a pair of detecting devices connected in push-pull relation to form a push-pull second detector, each of said devices having a pair of cooperating electrodes, the input circuit of said push-pull detector including an inductance coil having one end connected to one electrode of one of said pairs of electrodes and having the other end connected to one electrode of the other of said pairs of electrodes, the mid-point of said coil being connected through an output resistor to the other electrodes of said pairs of electrodes, said coil and the input capacity of said detecting devices forming a tuned secondary circuit, means including an inductance coil for connecting said output electrode to a point on said first coil which is on one side of said mid-point whereby said second coil, a portion of said first coil and the output capacity of said amplifier forming a tuned primary circuit, said primary and secondary circuits being so tuned and damped and being so coupled through said coil portion as to form a band pass filter having a pass range in the region of said intermediate frequency.

6. The invention according to claim 5 characterized in that said second inductance coil is tunable for tuning said primary circuit.

7. The invention according to claim 5 characterized in that tuning means is provided for varying the inductance of said first coil whereby said secondary circuit may be tuned, said tuning means comprising a core of magnetic material positioned adjacent to that end of said first coil which is on the opposite side of said mid-point from the point to which said output electrode is connected.

GUSTAVE L. GRUNDMANN.
HORACE CLIFFORD ALLEN.