

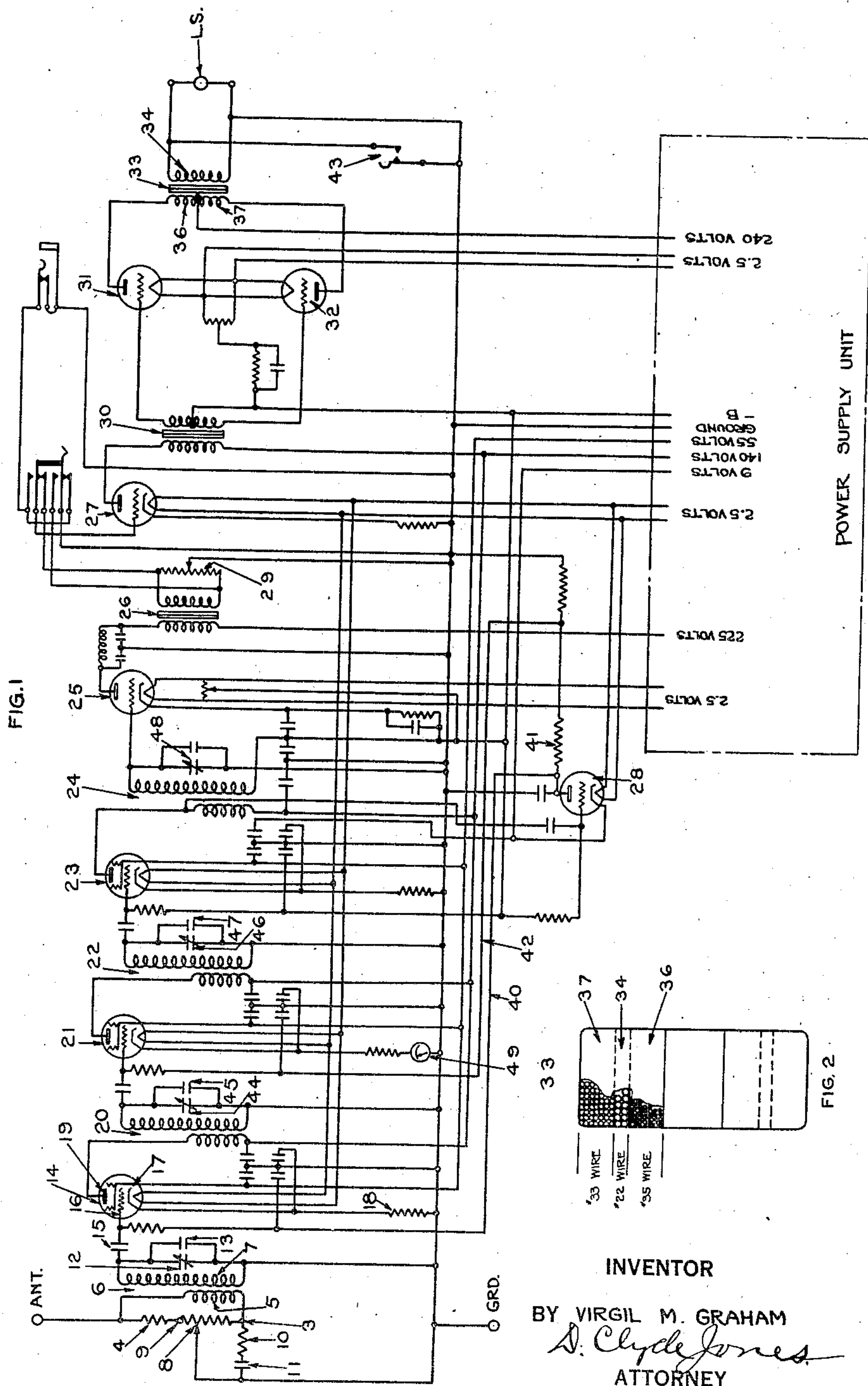
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RADIO RECEIVING SYSTEM

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RADIO RECEIVING SYSTEM

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This invention relates to signalling systems and more particularly to radio signal receiving systems.

It has been discovered under certain conditions of operation that the radio signal introduced into the first radio frequency stage of a radio receiver is of such magnitude that it overloads the vacuum tube in this stage causing distortion. Such a condition usually exists where the radio receiver is being operated in a location close to a strong local broadcasting station.

In accordance with the present invention a sensitivity control is introduced into the receiver whereby the sensitivity of the first stage may be adjusted to prevent the mentioned distortion while keeping the relative frequency characteristic of the input stage substantially constant, that is without changing the frequency characteristics seriously. This and other features of the invention will appear from the detailed description and appended claims.

For a clearer understanding of the invention reference is made to the drawings in which Fig. 1 is a circuit diagram of a radio receiver of the present invention together with a source of power indicated within the broken line rectangle; Fig. 2 is a view partially in cross section of a transformer suitable for use in the output circuit of the push-pull audio amplifier stage forming a part of the radio receiver.

Referring to Fig. 1 there is indicated an antenna *Ant.* connected to ground *Grd.* in series with the primary winding 5 of a transformer generally designated 6. This winding, made on a small cylindrical form and positioned to provide loose coupling with respect to its secondary winding 7, is of the high impedance type, that is its characteristics are such that its natural period is somewhat above the broadcast spectrum. The secondary winding 7 of this antenna transformer 6 and a well-known tuning capacitor 12 in multiple are connected respectively to the control grid 16 and through resistance 18 to the cathode 17 of a screen grid vacuum tube 14. It will be noted that a compensating capacitor 13 is connected in

multiple with the capacitor 12 and provides a means during the manufacture of the receiver to adjust the capacitor 12 to have equal capacitance variations with other tuning condensers to be mentioned which are all actuated from a common control.

With the antenna system and the input circuit of the vacuum tube 14 of the first radio frequency stage connected in the manner just described it so happens that when the receiver is being operated closely adjacent to a powerful broadcast station that the signal voltage applied to the grid 16 is of such magnitude that it causes over-loading of the vacuum tube 14 with the resulting distortion. In order to overcome this difficulty a compensating network interrelated with the antenna network and adjusted from a manual control is coupled to the output of the first radio frequency stage. This network includes a fixed resistor 4 and the resistor element of a potentiometer 8 connected in series across the terminals of the primary winding 5 while the movable element of the rheostat is connected to the ground terminal. The common terminal 3 of the primary winding, and the series resistor 4 are connected through a third resistor 10 and a fixed capacitor 11 to the movable element of the potentiometer. On a comparatively weak signal the movable element of the potentiometer is moved toward the common terminal 3 so that the series resistors 4 and 8 are shunted by the primary winding 5 and the entire field strength of the signal applied across the primary winding 5, develops the full signal voltage which is applied to the control grid 16 of the vacuum tube 14. However, on a strong signal the movable element of the potentiometer is moved toward the terminal 9 so that the voltage input to the primary winding 5 is greatly reduced. On signals of intermediate strength the movable element of the potentiometer is adjusted to a point between the terminals 3 and 4 depending on the volume which the listener desires to obtain.

The compensating network is so interrelated to the antenna network that if the potentiometer 8 is adjusted to prevent more or

less signal energy reaching the input of the first amplifier stage the effect on the relative frequency response characteristic of this first stage is not seriously changed, that is the frequency response curve is substantially flat in all positions of adjustment of the potentiometer 8. The fixed resistor 4, which may have a value of 10 ohms, is introduced to prevent the primary 5 from being completely short-circuited when the movable part of the potentiometer 8 whose value may be 20000 ohms is moved to the terminal 9. The value of the capacitor 11, which preferably should match the antenna capacity, is arbitrarily selected to have a value .00025 while the value of the resistor 10, which has been found satisfactory in use, may be 500 ohms. From the foregoing it will be seen that the antenna capacity and the compensating capacity network including the capacity 11 are so interrelated to the primary winding 6 that as the effect of one of these networks on the primary is reduced the effect on the other is increased.

It will be understood that except under extraordinary conditions the potentiometer 8 or sensitivity control is not operated but is adjusted only in cases of unusual signal strength. The fixed resistor 10 is introduced into the network to serve as a damping means otherwise since under certain conditions of adjustment the network would become resonant to certain broadcast frequencies and in the absence of the damping means undesirable oscillations would develop.

The output of the first radio frequency stage including the vacuum tube 14 is coupled by means of an air-core transformer 20 to a second radio frequency stage including the screen grid vacuum tube 21 tuned by a capacitor 44 on the same shaft as capacitor 12 and adjusted by capacitor 45. This second stage in turn is linked by an air-core transformer to a third radio frequency stage including the screen gride vacuum tube 23 similarly tuned by capacitor 46 on the common shaft and likewise adjusted by capacitor 47. This last stage is also coupled by an air-core transformer 24 to a linear power detector 25 also tuned by capacitor 48 from the common shaft in the same manner as the radio frequency stages. This linear power detector has been described in a paper before the I. R. E. May 15, 1929, on Detection at high signal voltages, by Stuart Ballantine and need not be further described here except to state that it is provided with an automatic bias arrangement which gives a substantially linear variation in audio output with respect to the radio frequency input, with the result that the second harmonic distortion which is quite high with the square law detector is practically eliminated.

The detector just described is linked by an audio frequency transformer 26 to a first

audio frequency amplifying stage including the vacuum tube 27 while this stage is connected by an audio transformer 30 to a push-pull audio amplifying stage including the vacuum tubes 31 and 32. The output of these last two vacuum tubes is connected by means of a transformer having a divided primary winding to a loud speaker indicated at LS. It should be pointed out that the transformer 33, shown in detail in Fig. 2, has a secondary winding 34 formed of #22 wire wound between the windings of the divided primary 35, one of which portions 36 is formed of #35 wire and the other portion 37 formed of #33 wire.

It has been the practice in the past, first to wind one section of the primary such as 36 of a certain size wire, then to wind the secondary 34 and finally to wind the other primary section 37 of the same size wire as the section 36. Since the sections 36 and 37 must have an equal number of turns and since the length of the turns in the section 37 is greater than that in 36 the resistance of the two sections is not equal and therefore the two sections are out of balance, a condition which prevents the most effective operation of the push-pull amplifier including the vacuum tubes 31 and 32.

It will be noted that the resistor element of a rheostat 29 is connected across the terminals of the secondary winding of the audio transformer 26 and serves as a manual volume control. The circuits of the radio receiver also include an automatic volume control in the form of a rectifier vacuum tube 28 with associated circuits. It will be seen that the grid of this rectifier is connected in multiple with the control grid of the vacuum tube 23 so that with a signal greater than a predetermined magnitude a controlling voltage is developed at the anode of the rectifier 28. This voltage is applied over conductor 40 to the control grid 16 of the vacuum tube in the first radio frequency stage while it is connected through a resistor 41 and conductor 42 to the control grid of the second radio frequency stage 21. Thus as the incoming signal varies in magnitude, an increased or diminished control voltage is applied over conductor 40 and 42 to the control grids of the first two radio frequency stages so that the volume of all signals above a given signal strength are rendered of uniform volume. In this way, when the manual volume control 29 has once been adjusted to give the desired volume, the automatic volume control device including the vacuum tube 28, functions to keep all signals at the predetermined magnitude.

In the tuning of this radio receiver, the operator adjusts the capacitors 12, 44, 46, and 48 by the common control, to the desired station setting and by noting the maximum deflection of the meter 49 can adjust the settings of these capacitors so that the radio re-

ceiver is exactly tuned to the desired program.

What I claim is:

1. In a radio frequency amplifier, a stage of radio frequency amplification having an input circuit, an antenna network and a compensating network linked to said circuit, and means for rendering the antenna network less effective as the compensating network is rendered more effective while maintaining substantially unchanged the frequency characteristic over the tuning range of said input circuit.

2. In a radio frequency amplifier, a stage of radio frequency amplification having an input circuit, an antenna capacity and a compensating capacity associated with the input circuit, and means for rendering one of said capacities more effective while the other capacity is rendered less effective.

3. In a radio frequency amplifier, a stage of radio frequency amplification having an input circuit, an antenna capacity and a compensating capacity associated with said input circuit, means for rendering one of said capacities more effective as the other is rendered less effective so that the resultant capacity effect on said input circuit is substantially constant, and damping means electrically associated with one of said capacities to prevent oscillations.

4. In a radio frequency amplifier, a stage of amplification having an input circuit, a signal intercepting capacity associated with said circuit, means for attenuating the effect of the intercepted signal, a compensating capacity network coupled to said input circuit and proportionally varied by said means, and damping means associated with said compensating capacity.

5. In a radio frequency amplifier having a primary stage provided with an input circuit, a transformer having its primary winding coupled to said input circuit, an antenna capacity effective between one terminal of said winding and ground, an attenuation network connected between the other terminals of said network to ground, and a voltage divider connected across the terminals of said winding, the movable element of said voltage divider also being connected to ground.

6. In a radio frequency amplifier having a primary stage provided with an input circuit, a transformer having its primary winding connected in said input circuit, an antenna capacity effective between one terminal of said winding and ground, an attenuation network connected between the other terminals of said network and ground, a voltage divider connected across the terminals of said winding, the movable element of said voltage divider also being connected to ground, and damping means connected in said attenuation network.

7. In a radio frequency amplifier having

a primary stage provided with a transformer in its input circuit, a potentiometer having its terminals connected in shunt of the primary of said transformer, an antenna connected to one common terminal of said potentiometer and said primary winding, the other common terminal of said potentiometer and primary winding being connected to ground through a capacitor and resistance in series, and a conductor connecting ground with the movable element of said potentiometer.

8. In a radio frequency amplifier, a primary stage provided with an input circuit, an antenna system coupled by a transformer to the input circuit, a voltage divider associated with the primary winding of said transformer to control the signal energy developed in said primary winding, and means controlled by said voltage divider in its various adjustments to maintain the frequency response characteristics of the input circuit substantially constant.

In witness whereof, I hereunto subscribe my name this 24th day of June, A. D. 1929.

VIRGIL M. GRAHAM.

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