

May 7, 1940.

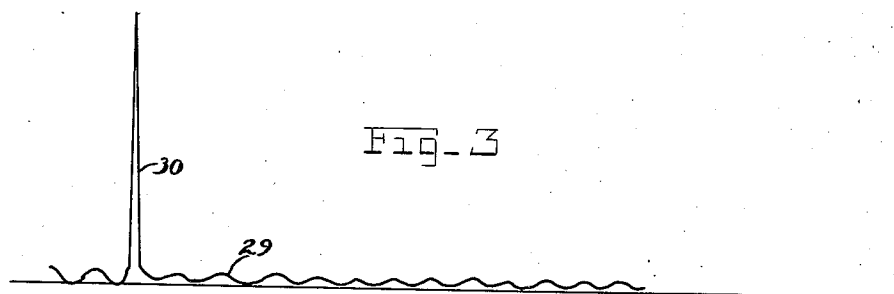
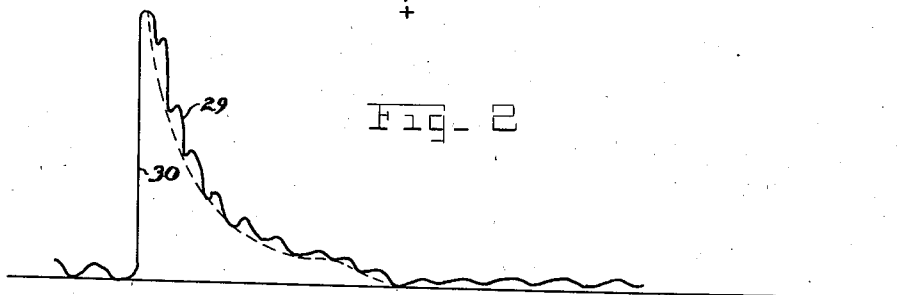
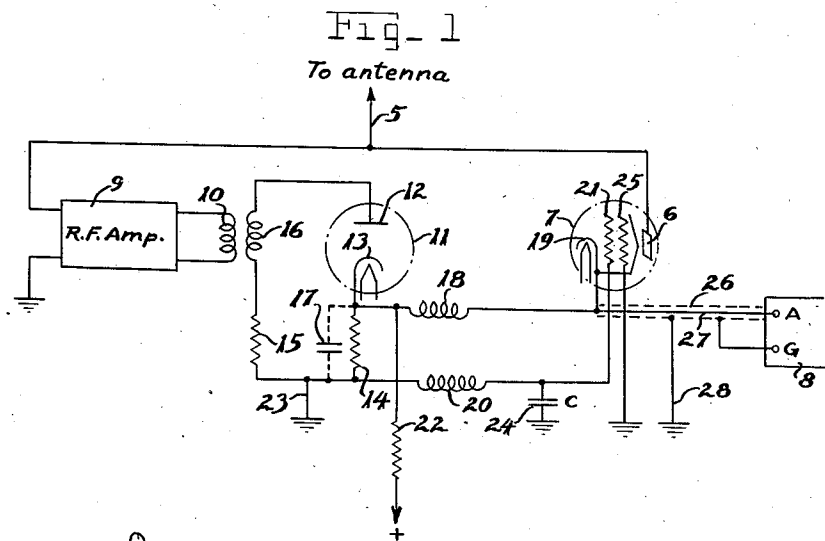
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2,199,401

RADIO DECOUPLING SYSTEM FOR EXCESSIVE AMPLITUDES

Filed Nov. 2, 1937

2 Sheets-Sheet 1



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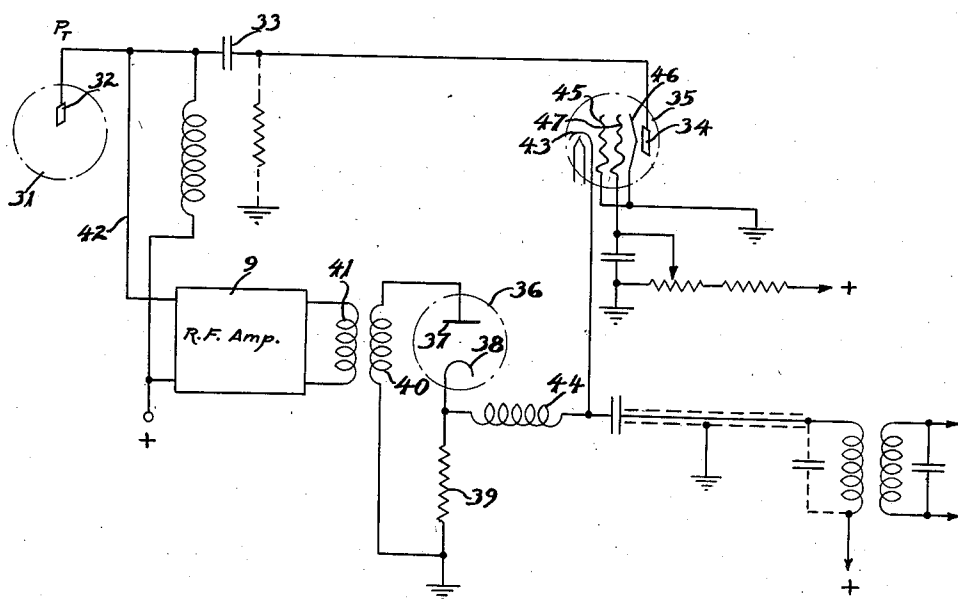
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Fig - 4



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2,199,401

RADIO DECOUPLING SYSTEM FOR
EXCESSIVE AMPLITUDES

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Application November 2, 1937, Serial No. 172,398

8 Claims. (Cl. 250—20)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

This invention relates to means for progressively decoupling a radio antenna from the receiving set associated therewith during periods of excessive amplitudes of incoming energy, to maintain the level of the signal, as contrasted with prior apparatus wherein the reception is wholly interrupted during such periods thereby causing a "hole" in the reception.

Among the objects of this invention are:

To provide means for applying received energy, outside the signal channel, to diminish the conductance through the signal channel in response to excessive amplitudes of received waves;

To provide means whereby the envelope of the excessive amplitudes will be rendered ineffective while the signal envelope is maintained substantially at its normal level;

To make such means as above mentioned to be applicable either between the antenna and the first stage of the receiving set or between two radio frequency stages of the set.

Other and further objects will appear from the ensuing description when read in connection with the drawings wherein:

Fig. 1 illustrates the application of my invention between the antenna and the first stage of the set;

Fig. 2 shows the nature of the oscillograph figure when a spark coil was set into operation adjacent an ordinary receiving set;

Fig. 3 illustrates the oscillograph figure under conditions like those of Fig. 2 when the present invention was used in association with the receiving set;

Fig. 4 discloses the application of the present invention to a circuit for the reception of code signals.

The problem of receiving radio signals intelligibly in spite of the interfering effects of various phenomena frequently called "static," and other like disturbances, has long held the attention of workers in this art and has resulted in numerous proposed solutions that have been more or less effective. One of the heretofore proposed methods of effecting this result is to interrupt completely the transfer of energy through the signal channel of the receiving set and thus to eliminate interfering noises by silencing the receiver. While this solution has certain desirable features it is apparent that a complete stoppage of reception might easily cause omission of a vital part of a signal and I have therefore devised the present means for eliminating the disturbing noises without, except in unusual cases, silencing the receiving set.

In Fig. 1 the antenna 5 is connected to the plate 6 of a vacuum tube 7 connected in series between the antenna 5 and the first stage of the receiving set 8, whereby all energy transferred from the antenna to the set 8 must pass through tube 7. Likewise, connected to antenna 5 is a radio frequency amplifier 9 having preferably two stages of radio frequency amplification and so operating as to amplify disproportionately any received energy having an amplitude above a predetermined limiting value, as set forth in my copending application, Serial No. 87,404, filed June 26, 1936. The output 10 of amplifier 9 is coupled to a rectifier tube 11 whereof the circuit includes anode 12, cathode 13, resistances 14 and 15 and inductance 16. Preferably, a capacitance 17 is connected in parallel with resistance 14 whereby the potential drop across resistance 14 is kept at only bias value while the drop across resistance 15 floats to change the bias on tube 11.

The high potential end of resistance 14 is connected through radio frequency choke 18 to the cathode 19 of tube 7 and the low potential end of the same resistance is connected through radio frequency choke 20 to the control grid of tube 7. The cathode 13 of tube 11 is connected through a relatively high resistance 22 to a positive potential of one or two volts. The sum of resistances 14 and 15 is of about the same order as is the internal impedance of the tube 11 and they are divided with the ground connection 23 between them so resistance 22 will not need to be so large. The by-pass condenser 24 is connected between choke 20 and grid 21. Screen grid 25 of tube 7 is preferably grounded as shown and the shielding 26 for lead 27 from cathode 19 of tube 7 to the input of receiver 8 is grounded at 28.

Owing to the nature of the amplification effected in amplifier 9 incoming energy of ordinary signal amplitude will not result in appreciable output from the amplifier 9 and therefore, due to the bias on cathode 13 of tube 11, the rectifier tube 11 will pass no current. Consequently, when a positive voltage swing is received on plate 6 from antenna 5 the tube 7 will pass current to the receiver 8. However, when the incoming energy has an amplitude much exceeding that of a useful signal the amplifier 9 will cause current to flow through output inductance 10 and thus will so bias the rectifier tube 11 that current will flow therethrough. It is obvious that due to the IR drop through resistance 14 the cathode 19 of tube 7 will have impressed upon it a positive potential while the grid 21 thereof will have impressed upon it a negative potential, thus re-

ducing the conductance of the tube 7 and preventing, in proportion to the potentials impressed on cathode 19 and grid 21, the transfer of energy through tube 7 to receiver 8.

Fig. 2 shows that the envelope of the signal is superimposed upon the envelope of the excessive amplitude disturbance but owing to the much greater strength of the disturbance the signal is not perceptible. Fig. 3 depicts the effect of apparatus as shown in Fig. 1. It will be noted that the first sharp rise of the disturbance is permitted to pass but thereafter the energy transmitted to the receiver 8 is substantially only that of the signal wave 29. It seems probable that the passage of the momentary pulse of disturbance found in Fig. 3 is due to the time constant introduced by capacitance 24.

It is not necessary that the controlling change in conductance be exerted between the antenna and the first stage of the receiver but it may be applied after the radio frequency to control the transfer of energy into the first detector input transformer and when so utilized tuning of the amplifier 9 will be unnecessary.

Fig. 4 illustrates my invention as applied to code reception. The tube 31 is one of the radio frequency tubes in the set whereof the plate 32 is coupled through capacitance 33 to plate 34 of the variable conductance tube 35. The circuit of rectifier 36 includes anode 37, cathode 38, resistance 39 and inductance 40 whereby the rectifier is coupled to output inductance 41 of radio frequency amplifier 9, whereof the input is connected through lead 42 to plate 32 of tube 31. The cathode 43 of tube 35 is connected through radio frequency choke 44 to the high potential end of resistance 39. Control grid 45 and suppressor grid 46 of tube 35 are connected to ground and screen grid 47 of that tube is connected to a source of positive potential.

The tube 35 now constitutes the sole connection in the signal channel between tube 31 and the following stage of the receiving set and consequently any variation in the conductance of this tube is reflected in the transfer of energy through the signal channel. It is apparent that the flow of current through rectifier 36 will result in impressing a positive potential upon cathode 43 of tube 35 and thus the conductance of the tube will be reduced in proportion to the positive potential thus applied. Since the potential drop across resistance 39 depends upon flow of current through rectifier 36 and the flow of current through the rectifier is controlled by the output of amplifier 9, it is apparent that surges of energy having an amplitude above the predetermined signal value will result in diminution of the conductance of tube 35 to prevent transfer of the excessive amplitude energy through the set.

According to the provisions of the patent statutes I have set forth the principle and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically illustrated and described.

The invention herein described and claimed may be used and/or manufactured by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. The combination with an antenna and a radio receiver, of a vacuum tube connected in series between said antenna and the input of said receiver, said tube having an anode, a plurality of grids and a cathode, the said cathode only being connected to the input of said receiver, and one of said grids being grounded, a rectifier tube having an anode and a cathode, an inductance and two resistances connected in series between the anode and the cathode of said rectifier, a ground connection between said resistances, means including an inductance connecting one end of one of said resistances to the cathode of said vacuum tube, means including an inductance connecting the other end of said one resistance to another grid of said vacuum tube, a capacitance connecting said other grid to ground, means to impress a positive potential upon the first mentioned means, and radio frequency amplifying means connected to said antenna and having an output inductance coupled with the inductance between the cathode and the anode of said rectifier.

2. The combination with an antenna and a radio receiver, of a vacuum tube connected in series between said antenna and the input of said receiver, said tube having an anode, a plurality of grids and a cathode, the said cathode only being connected to the input of said receiver and one of said grids being grounded, a rectifier tube having an anode and a cathode, a resistance connected between said rectifier anode and cathode, means connecting to the cathode of said tube that end of said resistance adjacent the rectifier cathode, means connecting the other end of said resistance to another grid of said tube, means to impress a positive bias on the cathode of said rectifier, and amplifying means having its input connected to said antenna and having its output connected to said rectifier.

3. The combination with an antenna and a radio receiver, of a vacuum tube connected in series between said antenna and the input of said receiver, said tube having an anode, a plurality of grids and a cathode, the said cathode only being connected to the input of said receiver and one of said grids being grounded, a rectifier tube having an anode and a cathode, an output circuit connecting said rectifier cathode and anode, means to apply between the cathode and another grid of said tube a voltage drop in said output circuit to diminish the conductance of said tube in proportion to the current in said output circuit, amplifying means connected to said antenna, means operatively associating said amplifying means with said rectifier, and means to bias said rectifier to prevent appreciable output therefrom when the amplitude of the input into said rectifier is less than a predetermined value.

4. In a radio receiver, the combination with a tube connected to carry signals in the signal channel at a frequency higher than audio frequency, of amplifying means deriving energy from the output of said tube, said amplifier being adapted to amplify disproportionately waves of amplitude in excess of a predetermined value, a rectifying tube coupled to the output of said amplifier, a resistance in the circuit of said rectifier connected to the cathode of the rectifier and to ground; a pentode tube having its plate coupled to the output of the first mentioned tube, its control grid and suppressor grid connected to ground and its screen grid connected to a source of positive potential; a radio frequency choke connect-

ing the high potential side of said resistance to the cathode of said pentode, and means coupling the cathode of said pentode to a subsequent stage in the signal channel and constituting the sole path for energy into said subsequent stage.

5 5. In a radio receiver, the combination with a tube connected to carry signal in the signal channel at a frequency higher than audio frequency, of amplifying means deriving energy from the
10 output of said tube, a rectifying tube coupled to the output of said amplifying means, resistance means in the circuit of said rectifier, a second tube having a grid, a plate and a cathode with the said plate coupled to the output of the first
15 mentioned tube, means connecting the cathode of said second tube to the high potential side of said resistance, and means coupling the output of said second tube to a subsequent stage in the signal channel and constituting the sole path
20 for energy into said subsequent stage.

6. The combination with a radio receiving system comprising a plurality of amplification stages, of a tube having a plurality of electrodes including a cathode and so connected that all
25 received energy utilized for signal reception must pass therethrough, said cathode only being connected to a subsequent stage amplifying means connected to receive a portion of the incoming energy and amplify disproportionately the excess
30 of amplitude above a predetermined value, a rectifier coupled to the output of said amplifier, resistance means in the output of said rectifier,

and means to apply the potential at the high potential point of said resistance means to said tube to diminish the conductance of said tube proportionately to the value of the potential at said high potential point.

7. The method of suppressing excessive amplitudes affecting received radio energy, which comprises the steps of collecting signal energy, diverting and disproportionately amplifying a portion of said energy when excessive amplitudes are present, rectifying said disproportionately amplified energy and deriving a potential therefrom, applying the said derived potential to the remainder of said received energy before frequency selective transfer of said remainder to diminish
15 proportionately to said potential the frequency selective transfer of said remainder for amplification, whereby to prevent amplification of excessive amplitudes in said remainder, and amplifying the energy transferred.

8. The method of suppressing excessive amplitudes affecting received radio energy, which comprises the steps of collecting signal energy, deriving a rectified controlling potential from impulses of excessive amplitude accompanying said
25 signal energy, applying said potential to said collected energy before frequency selective transfer of said energy for amplification to reduce the frequency selected transferred energy in accordance with the magnitude of the applied potential, and
30 amplifying the transferred energy as modified by the application of said potential.

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