Aug. 27, 1940. P. M. HAFFCKE 2,212,540

METHOD OF AND SYSTEM FOR REDUCING STATIC

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FIG. 1

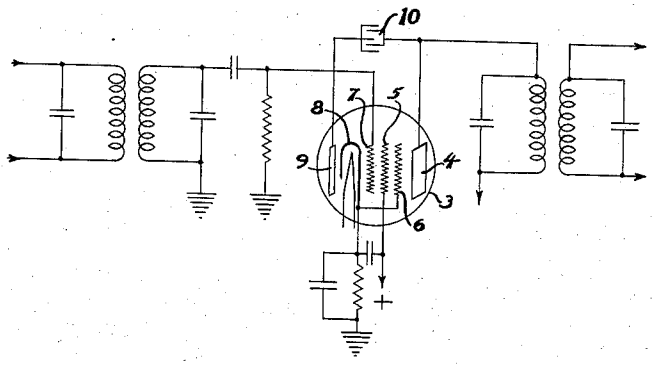
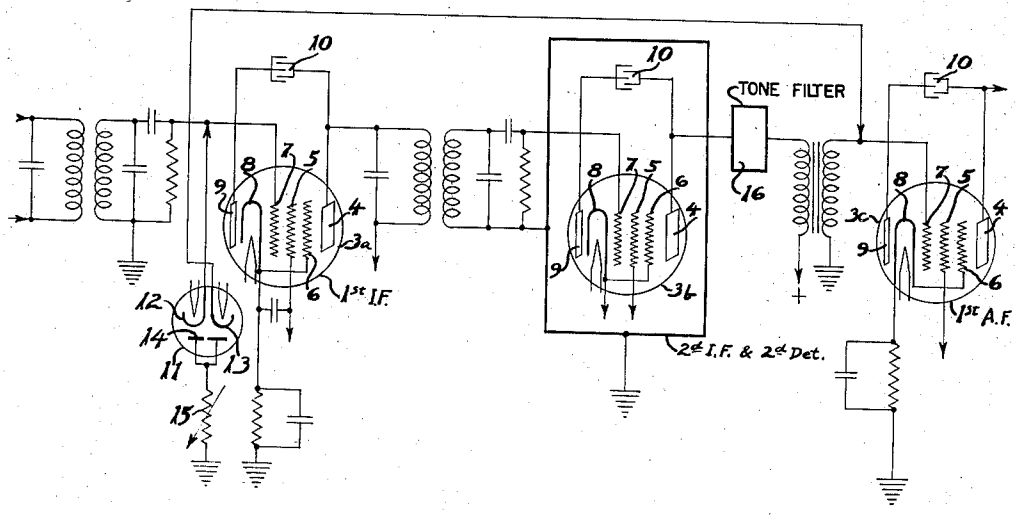


FIG. 2



INVENTOR
Philip M. Haffcke
BY
Ransom K. Sanz
ATTORNEY

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METHOD OF AND SYSTEM FOR REDUCING STATIC

Philip M. Haffcke, Washington, D. C.

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This invention relates to a method of and means for reducing interference with the reception of radio signals, by limiting the peaks of received signal waves when such waves have amplitudes in excess of a predetermined value.

Among the numerous objects of this invention are:

To provide means responsive to excessive voltages on the plate of a vacuum tube to by-pass such voltages to ground;

To utilize a diode section of certain dual purpose tubes to by-pass excessive voltages as aforesaid;

To provide a vacuum tube network whereby excessive surges of negative voltages are by-passed as aforesaid and the output wave is flattened while positive surges are flattened due to rectification by the signal grid;

To provide in a vacuum tube network as next above set forth an additional rectifying path across the input;

To improve reception of radio signals through excessive amplitude interference.

In the drawing:

Fig. 1 depicts a vacuum tube network embodying the principles of my present invention;

Fig. 2 shows diagrammatically a plurality of tubes as in Fig. 1 in cascade, with rectifying means across the inputs of two of the stages.

If the top of a radio wave is levelled off the wave no longer remains of pure sine form and will contain several harmonics as components. This fact is the basis of the present method of static reduction and depends upon the partial limiting of the peaks of the received waves in each of several stages as the signal passes through and is amplified in the receiver.

The above effect is attained in a simple manner, without a large number of units of accessory equipment, by utilizing certain types of dual purpose tubes as combined amplifiers and rectifiers, through the insertion of a simple adaptor between the respective tubes and their sockets, and certain other minor changes that will be apparent from the following description.

Referring now to Fig. 1, the vacuum tube 3 is of the type known to the trade as 2B7 having an amplifier section that includes an anode 4, a screen grid 5, suppressor grid 6 and control grid 7, the cathode 8 being common to the above mentioned amplifier section and the diode section that includes the anode 9. The hook-up is largely conventional except that a capacitor 10 of large capacity is connected between the amplifier anode 4 and the diode anode 9. Thus, when a heavy surge of received energy causes the control grid 7 to swing hard toward the negative and thereby increases the plate resistance, the rapid rise in voltage at anode 4 is by-passed through condenser 10 to cathode 8 and thence to ground. This causes a flattening of the wave in the output circuit of the amplifier on the negative half of the input cycle. On the other half of the wave the signal grid swings strongly positive and acts as a diode rectifier across the input circuit and has a similar flattening effect on the plate current wave.

Fig. 2 shows diagrammatically a plurality of tubes 3*a*, 3*b* and 3*c* similar to the tube 3 in Fig. 1 connected in cascade in a radio receiver. The tube 3*a* may be the first intermediate frequency stage, the tube 3*b* the second intermediate frequency and second detector combined and tube 3*c* may be the first audio frequency stage. The output anodes 4 of the tubes 3*a*, 3*b* and 3*c* are respectively connected to the anode 9 of the diode section in each tube by a large capacity condenser 10, as in Fig. 1. In addition, I have provided a double diode rectifier 11 having one cathode 12 connected to the control grid 7 of tube 3*c* and a cathode 13 connected to the control grid 7 of tube 3*a*, the two anodes 14 of the tube 11 having a common connection through variable resistor 15 to ground. Thus, the tube 11 will become operative to by-pass the portions of waves in excess of a predetermined magnitude and initiate the generation of harmonics in the input to the tube 3*a* and while the results will not be 100 per cent perfect they will be increased in tube 3*b* and still further in tube 3*c*. A tone filter 16 is connected between tube 3*b* and the input to tube 3*c* whereby the undesirable harmonics are rejected and kept out of the audio frequency stage, the connection of cathode 13 of tube 11 to control grid of tube 3*c* serving to damp any tendency to oscillation in the tone filter 16.

Apparently the action of the system shown in Fig. 2 is as follows:

As the signal and the accompanying static surges are transferred to tube 3*a*, the signal grid 7 of that tube and the cathode 12 and anode 14 of tube 11 act as a full wave rectifier across the input transformer and absorb the excessive amplitudes of heavy static impulses, but due to the natural characteristics of the voltage-current curve of such rectifiers, there is a slight rise in the voltage drop across the rectifier elements as the current through the rectifier increases and the effective wave is not actually brought down

to a true flat-topped form, but is left rounded though not nearly so high in proportion to the signal level as originally. The output of this stage thus contains a signal frequency plus many harmonic components, which harmonic components are rejected by the following tuned transformer. However, as all of the excess amplitude is not thrown into harmonics tube 3*b* will also receive considerable surge energy from the static and the diode section of tube 3*b* will, through its connection to the anode 4 by capacitor 10, further reduce or flatten the output current wave form.

The signal delivered to the tone filter therefore contains not only signal but also static which latter is now in large part audio harmonics of the signal tone frequency of such order that a much greater percentage of such excessive surges of static are lost and the background and the inter-signal periods are largely devoid of high amplitude impulses.

The resistor 15, when adjusted to have a low or even a zero value, may cause some lowering of the signal amplitude due to the loading action of the rectifying elements, but even the heaviest static surges are also held down to such an extent that although the signal is somewhat reduced the noise of the heaviest static surges has been lowered to approximately the same level as the signal. The reception now sounds as though the static were only of signal level instead of many times as great. The hissing sound which is caused by the usual automatic volume control, and the persistant ringing of the audio tone filter and of the intermediate frequency stages, all of which necessitate a drastic reduction in the sensitivity, are eliminated.

If a condenser be inserted in the lead of each of cathodes 12 and 13 they will be thrown into parallel with the tuned input circuit of tube 3*a* and will so change the circuit values of the input circuit that it will be automatically detuned with respect to the normal frequency transmission thereof and hence will not transfer signal to the following stages during such time.

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. A method of operating a plurality of dual purpose vacuum tubes in cascade, each of which tubes has an amplifier section including a first anode and a control grid, a diode section including a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode in each tube and thence to said cathode therein and to ground excessive voltages appearing on said first anode in such tube when a received impulse swings said control grid negative beyond a predetermined value, by-passing energy in each tube to ground as grid current when the swing of said grid goes positive beyond a predetermined value, by-passing to ground energy from the input of the first of said tubes in proportion to the input amplitude in excess of a predetermined value, eliminating between the last of said tubes and the next to last thereof undesired harmonics generated by by-passing current to ground as aforesaid, and by-passing to ground energy from the input of said last tube in proportion to input amplitude above a predetermined value to damp oscillations generated by the said elimination of undesired harmonics.

2. A method of operating a plurality of dual purpose vacuum tubes in cascade, each of which tubes has an amplifier section including a first anode and a control grid, a diode section including a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode in each tube and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value, by-passing to ground energy from the input of the first said tube in proportion to the input amplitude in excess of a predetermined value, eliminating between the last of said tubes and the next to the last thereof undesired harmonics generated by by-passing current to ground as aforesaid, and by-passing to ground energy from the input of said last tube in proportion to input amplitude above a predetermined value to damp oscillations generated by the said elimination of undesired harmonics.

3. A method of operating a plurality of dual purpose vacuum tubes in cascade, each of which tubes has an amplifier section including a first anode and a control grid, a diode section including a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode in each tube and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value above normal signal level only, by-passing energy in each tube to ground as grid current when the swing of said grid goes positive beyond a predetermined value, by-passing to ground energy from the input of the first said tube in proportion to the input amplitude in excess of a predetermined value, and by-passing energy from the input of said last tube in proportion to input amplitude in said last tube above a predetermined value.

4. A method of operating a plurality of dual purpose vacuum tubes in cascade, each of which tubes has an amplifier section including a first anode and a control grid, a diode section including a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode in each tube and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value above normal signal level only, by-passing to ground energy from the inputs of the first and last said tubes in proportion to input amplitude in excess of a predetermined value.

5. A method of operating a plurality of dual purpose vacuum tubes in cascade, each of which tubes has an amplifier section including a first anode and a control grid, a diode section including a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode in each tube and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value above normal signal level only, by-passing energy in each tube to ground as grid current when the swing of said grid goes positive beyond a predetermined value, and by-passing to ground energy from the input of at least one of said tubes in proportion to input amplitude in excess of a predetermined value.

6. A method of operating a plurality of dual purpose vacuum tubes in cascade, each of which tubes has an amplifier section including a first anode and a control grid, a diode section including a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode in each tube and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value above normal signal level only, and by-passing energy in each tube to ground as grid current when the swing of said grid goes positive beyond a predetermined value.

7. A method of operating a dual purpose vacuum tube having an amplifier section including a first anode and a control grid, a diode section having a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value above normal signal level only, and by-passing energy to ground as grid current when the swing of said grid goes positive beyond a predetermined value.

8. A method of operating a dual purpose vacuum tube having an amplifier section including a first anode and a control grid, a diode section having a second anode, and a cathode common to both sections, comprising the step of by-passing to said second anode and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value above normal signal level only.

9. In radio receiving apparatus, a plurality of dual purpose vacuum tubes connected in cascade, each of said tubes having a cathode, a first anode adjacent said cathode, a control grid and an output anode; capacitive means connecting each said first anode with the output anode in the same tube, a tone filter in the output of the next to last of said tubes, rectifying means comprising a cathode connected to the control grid of the first of said tubes and an anode, rectifying means comprising a cathode connected to the control grid of the last of said tubes and an anode, and common variable resistive means connecting both the anodes of said rectifying means to ground.

10. In radio receiving apparatus, a plurality of dual purpose vacuum tubes connected in cascade, each of said tubes having a cathode, a first anode adjacent said cathode, a control grid and an output anode; capacitive means connecting each said first anode with the output anode in the same tube, rectifying means comprising a cathode connected to the control grid of the first of said tubes, and an anode rectifying means comprising a cathode connected to the control grid of the last of said tubes and an anode, and common variable resistive means connecting both the anodes of said rectifying means to ground.

11. In radio receiving apparatus, a plurality of dual purpose vacuum tubes connected in cascade, each of said tubes having a cathode, a first anode adjacent said cathode, a control grid and an output anode, an output circuit connected to each said output anode and capacitive means connecting each said first anode with the output anode in the same tube to by-pass excessive energy surges from said output circuit to said first anode when said control grid is swung excessively negative.

12. A vacuum tube network, comprising a dual purpose vacuum tube having an amplifier section including an anode and a control grid, a diode section including an anode, and a cathode common to both sections, means to transfer from the first mentioned anode to the second mentioned anode alternating voltages in excess of a predetermined value and output means independent of said transfer means connected to said amplifier section anode.

13. In radio receiving apparatus, a plurality of dual purpose vacuum tubes each having an amplifying section including an anode and a control grid, a diode section including an anode, and a cathode common to both said sections, means to transfer from the anode in said amplifying section to the anode in the diode section alternating voltages in excess of a predetermined value and output means independent of said transfer means connected to said amplifier section anode.

14. A method of operating a dual purpose vacuum tube having an amplifier section including a first anode and a control grid, a diode section having a second anode, and a cathode common to both sections, comprising the steps of by-passing to said second anode and thence to said cathode and ground excessive voltages appearing on said first anode when a received impulse swings said control grid negative beyond a predetermined value, by-passing energy to ground as grid current when the swing of said grid goes positive beyond a predetermined value and taking off the output energy in a conventional manner.

PHILIP M. HAFFCKE.