Nov. 19, 1940. P. M. HAFFCKE 2,221,795

STATIC REDUCTION BY SIGNAL CONTROLLED POTENTIALS

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FIG. 1

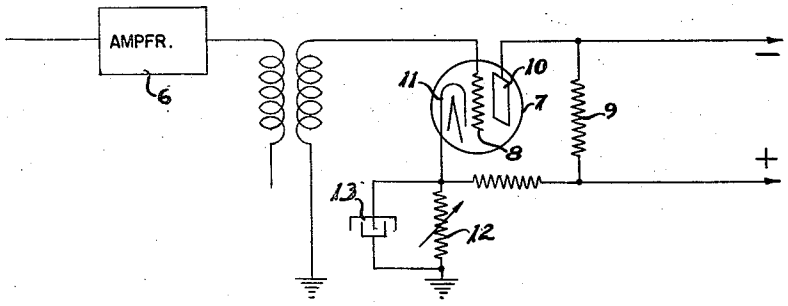


FIG. 2

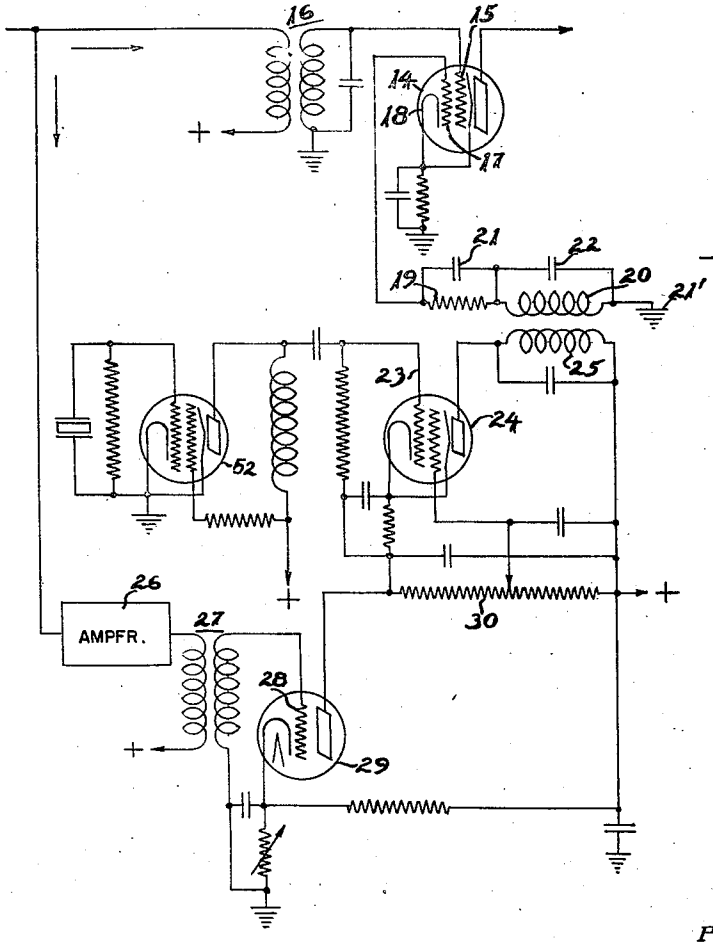
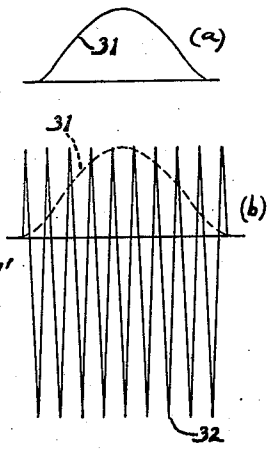


FIG. 3



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FIG. 4

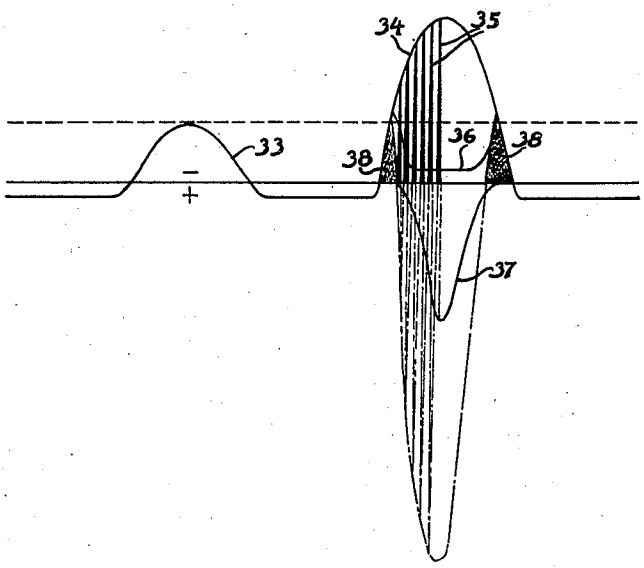
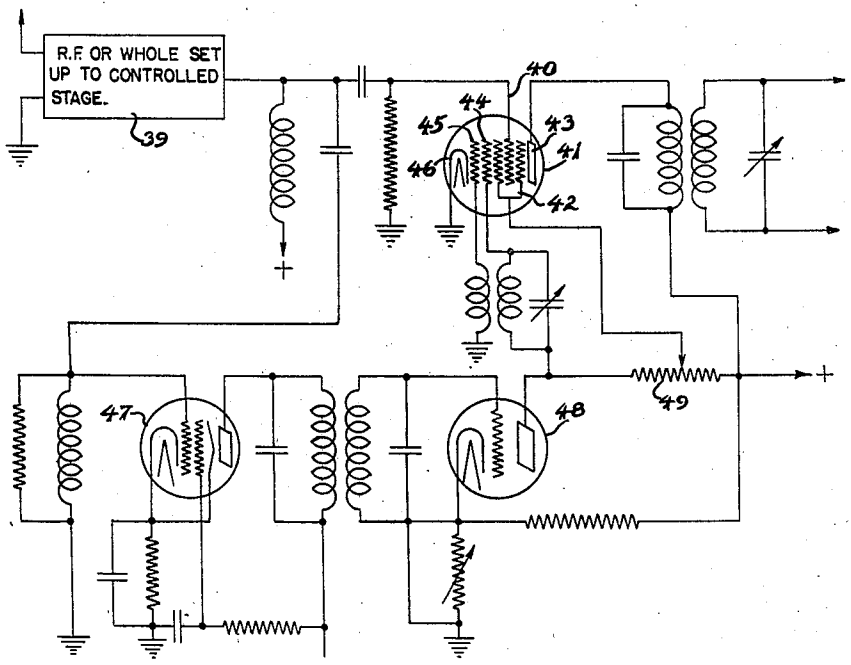


FIG. 5



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STATIC REDUCTION BY SIGNAL CONTROLLED POTENTIALS

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Application April 7, 1938, Serial No. 200,642
16 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 reducing the effect of static surges received with a radio signal by applying a signal controlled potential during the incidence of excessive amplitudes.

Among the numerous objects of this invention are:

To provide means in a radio receiver that will be rendered active by excessive amplitudes of energy to produce a potential to control the output of the receiver;

To provide means to chop a signal wave into waves of much higher frequency;

To leave the wave envelope as in the original received wave but so to reduce the power component thereof that the effect of excessive amplitude in the output does not prevent distinguishing the signal;

To improve generally the operation of radio receivers during times of disturbance by waves having amplitude in excess of a critical value.

In the drawings:

Fig. 1 depicts schematically one means for producing a potential difference in response to excess input energy;

Fig. 2 discloses means for applying such potential to an oscillator to chop an excessive wave into one of much higher frequency;

Fig. 3*a* shows the received wave, and

Fig. 3*b*, the oscillator wave applied in response thereto;

Fig. 4 shows graphically the relation of the wave envelope and the power component thereof and the resultant effective signal level;

Fig. 5 depicts another of the numerous systems that may be devised to utilize this invention.

There are many instances where a source of potential controlled by or at signal frequency is useful, such as reducing the output of a radio frequency amplifier, reducing the output of or silencing heterodyning oscillators, supplying plate current for amplifiers, etc. A particular application of a signal controlled potential is herein disclosed where it is impressed to energize automatically an oscillator whereof the output is used to cut-up a signal wave in such a manner that the effectiveness of the signal wave in the succeeding tuned stages will be but a fraction of the effectiveness of the same wave if left unaltered, although the envelope of the original signal wave is maintained.

In Fig. 1 the output of amplifier 6 is fed into tube 7 whereof the control grid 8 is biased to a point such that plate current cut-off is just effected. Under these conditions the signal waves will cause tube 7 to be conductive on the positive half of the signal wave and a voltage drop will appear across resistor 9 connected between anode 10 and cathode 11 of tube 7. The adjustable bias resistor 12 is by-passed by a fairly large capacity condenser 13 in order to maintain the bias on grid 8 fairly constant at the value for which the resistor 12 is set. The voltage drop appearing across resistor 9 may be used to feed the anode circuit of a tube which it is desired to control.

In Fig. 2 I show an application of the principle described in connection with Fig. 1. Here the tube 14 may be a tube in the signal channel of a radio receiver or it may be a buffer stage between the heterodyning oscillator and a frequency changing tube. The control grid 15 is connected to a conventional input circuit 16 and a grid 17 is disposed between control grid 15 and cathode 18, there being in series with the grid 17 a resistor 19 and an inductance 20 which is grounded at 21' with capacitors 21 and 22 respectively in parallel with resistor 19 and inductance 20. The oscillator tube 52 has its output connected to control grid 23 of amplifier tube 24 whereof the plate circuit includes an inductance 25 coupled to inductance 20. The amplifier 26 is fed from the same signal channel as is input transformer 16 and has its output coupled, through transformer 27, to the input grid 28 of tube 29 that is so biased as to prevent the flow of plate current until the amplitude of input energy exceeds a predetermined value. The tube 24 is so biased that there is normally no flow of current in the output circuit thereof. However, when a sufficiently heavy surge is received grid 28 of tube 29 will be swung positive and current will flow in the anode-cathode circuit of tube 29, thus giving rise to a potential drop across resistor 30 which will unblock amplifier tube 24 and permit output therefrom at the frequency of the oscillations set up in tube 52.

The amplified oscillations will be transmitted from inductance 25 to inductance 20 and thereby to grid 17 which will cause oscillations in the electron stream in tube 14. However, the electron stream thus oscillating will be controlled by the signal voltages on grid 15 and while the signal wave envelope may have the form shown at 31 in Fig. 3*a* the oscillations due to tube 52 will have the form indicated at 32 in Fig. 3*b*, but due to the fact that the signal grid 15 exercises subsequent control the envelope will be maintained as indicated in dotted lines and des-

ignated by 31 in Fig. 3b. The voltage swing applied to grid 17 will be high enough to cause rectification and a drop across resistor 19 so that condenser 21 will assume a biasing potential acting upon grid 17 to such an extent that only, say, the upper one-third or even less of the positive half of the wave will be effective to cause tube 14 to pass current and the effect will be as indicated in Fig. 4.

The curve 33 in Fig. 4 indicates normal signal amplitude but when a wave of excessive amplitude is received the oscillations from tube 52 are transmitted to grid 17 of tube 14 with the result that while the signal wave envelope impressed by grid 15 is represented by 34 yet the actual power component of the wave is represented by the shaded portions 35, giving as the effective signal level the curve 36. The bias on grid 17 due to the rectification above mentioned is shown by curve 37. The stippled portions 38 represent the plate current during those parts of the received wave that lie below the predetermined maximum signal amplitude, during which time the oscillator 52 is not effective to exert any control upon the electron stream in tube 14.

Fig. 5 shows another application of the signal controlled potential. Here the radio frequency stages or the whole of the receiver up to the controlled stage is represented at 39, the output thereof being applied to grid 40 of the tube 41 which is a dual purpose tube having an amplifier or detector section including the grids 42 and anode 43 in addition to grid 40, and an oscillator section whereof the grid 44 functions as the anode and grid 45 as the control grid, the cathode 46 being common to the two sections. Received energy from the output of 39 is applied to the input of tube 47 that is biased for almost Class C operation. The arrival of excessive amplitudes throws the tube 47 into operation and the output thereof is amplified by tube 48 having the resistor 49 in its output circuit. The passage of current through resistor 49 results in a potential drop that is applied to anode 44 of the oscillator section of tube 41 and so reduces the anode voltage of the oscillator section that it ceases to operate and there is consequently no intermediate frequency output from tube 41 and hence no output from the receiver.

The system shown in Fig. 5 may also be adapted to a buffer stage between a separate heterodyning oscillator so that the channel between oscillator and the frequency changing tube may be momentarily interrupted during periods of excessive amplitude. In such case, the voltage drop across resistor 49 will be the source of plate potential for the buffer stage, the voltage at any time being determined by the concomitant plate resistance of tube 48. Because the buffer stage is not an oscillating tube, no difficulty will be experienced in rapid restoration of the frequency passed by this stage as might be experienced with some oscillators after they have been damped out of oscillation.

Due to the fact that the tube 48 will never become a dead short circuit of zero resistance, the voltage across resistor 49 will always be of some value above zero up to as high as it may go when tube 48 is blocked, which will allow some of the oscillator frequency always to be present in the output of the buffer stage even though this stage be completely neutralized, should it be found necessary to neutralize the buffer in special cases.

In all cases, however, the position in which the tubes 41 and 14 are located in the receiver will determine whether an amplifier ahead of the potential control tube is required, but in any case the input to the tube 47 or 29 must overbear the bias on the signal grid of the tubes 29 and 48 in order to lower the plate resistance and cause sufficient voltage drop to appear across the resistors 30 or 49, as the case may be.

At such periods that the voltage drop across resistor 49 is not sufficient to quench entirely the oscillator section of tube 41, the screen grids 42 will receive lowered voltage and will therefore impart less acceleration to the electron stream and so will cause a drop in the output in addition to that caused by the weakened output of the oscillator section. Thus, it is apparent that for surges insufficient to cause an actual interruption in the signal a well defined progressive weakening of the output amplitude of the stage is assured.

While my invention has been described as utilizing a supersonic "chopping" frequency, it is within the purview thereof to use a "chopping" frequency within the audio range and removing it by suitable filters.

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 payment of any royalties thereon or therefor.

I claim:

1. A method of operating a vacuum tube network, comprising the steps of generating oscillations having a frequency much higher than the frequency of the signal to be fed into said network, receiving signal-bearing energy and feeding the same into said network, utilizing a portion of said received energy when the amplitude thereof is above a predetermined magnitude to effect amplification of the said oscillations, feeding said amplified oscillations into said network to throw the electron stream in said network into oscillations having the frequency of said generated oscillations and applying received signal bearing energy to the electron stream thus oscillation to control said stream additionally in accordance with the envelope of the original signal wave, the said oscillations impressed on said electron stream greatly reducing the power component of the wave.

2. A method of operating a vacuum tube network, comprising the steps of generating oscillations having a frequency much higher than the frequency of the signal to be fed into said network, receiving signal-bearing energy and feeding the same into said network, utilizing a portion of said received energy when the amplitude thereof is above a predetermined magnitude to effect feeding of said oscillations into said network, impressing said oscillations upon the electron stream to throw the electron stream in said network into oscillations having the frequency of said generated oscillations and applying received energy to the electron stream thus oscillating to control said stream additionally in accordance with the envelope of the original signal wave, the said oscillations impressed on said electron stream greatly reducing the power component of the wave during incidence of excessive amplitude waves.

3. A method of operating a vacuum tube network, comprising the steps of generating oscillations having a frequency higher than the frequency of the signal to be fed into said network,

receiving signal-bearing energy and feeding the same into said network, utilizing a portion of said received energy when the amplitude thereof is above a predetermined magnitude to effect feeding of said oscillations into said network, impressing said oscillations upon said electron stream to throw the electron stream in said network into oscillations having the frequency of said generated oscillations, and applying received energy to the electron stream thus oscillating to control said stream additionally in accordance with the envelope of the original signal wave, the said oscillations impressed on the electron stream greatly reducing the power component of the wave during the incidence of excessive amplitude waves.

4. A method of operating a vacuum tube network, comprising the steps of receiving signal bearing energy and feeding the same into said network, chopping the wave and reducing the power component thereof by throwing the electron stream in said network into oscillations having a frequency much higher than the frequency of the signal to be received when the amplitude of said received energy is excessive, and applying to the electron stream thus oscillating said received signal bearing energy to control said electron stream additionally in accordance with said received energy and thereby maintain the original envelope of said received signal bearing energy.

5. A method of reducing the effect, in the output of a vacuum tube network, of excessive amplitudes of received energy, comprising the step of chopping up the received wave in the network during periods of excess amplitudes only into oscillations of frequency higher than that of the received wave and of amplitude at least equal to said excessive amplitude while maintaining the envelope of the original signal wave, whereby the power component of said wave is greatly diminished.

6. A method of operating a vacuum tube network, comprising the steps of generating oscillations having a frequency higher than that of the signal to be fed into said network the envelope of said oscillations being of amplitude at least equal to the maximum amplitude of received energy, applying a signal controlled potential to effect input of said oscillations into said network during periods of excessive amplitudes of received energy, and maintaining on said oscillations the envelope of the original signal wave.

7. A vacuum tube control system, comprising a signal-channel tube having a cathode, a control grid, and another grid between said cathode and said control grid; input means connected to said control grid, a resistor and an inductance in series with said other grid, and a capacitor respectively in parallel with each of said resistor and said inductance, one terminal of said inductance being grounded; a source of high frequency oscillations, means to amplify said oscillations, and means to impress said amplified oscillations upon said inductance; a second vacuum tube, input and output circuits associated therewith, means to impress signal energy upon said input circuit, said second tube being biased to blocking for inputs below a predetermined magnitude, means in said output circuit wherein a potential difference is developed when said second tube passes current, and means to apply said potential difference to said oscillation amplifying means to cause said amplifying means to operate during the time said potential difference is present but not otherwise.

8. A vacuum tube control system, comprising a signal-channel tube having a cathode, a control grid, and another grid between said cathode and said control grid; input means connected to said control grid, a resistor and an inductance in series with said other grid and a capacitor respectively in parallel with each of said resistor and said inductance, one terminal of said inductance being grounded; a source of high frequency oscillations, means to amplify said oscillations, and means to impress said amplified oscillations upon said inductance; signal-controlled means to develop a potential difference in response to signal amplitudes in excess of a predetermined value, and means to apply said potential difference to said oscillation amplifying means to cause said amplifying means to operate during the time said potential difference is present but not otherwise.

9. A vacuum tube control system, comprising a signal-channel tube having a cathode, a control grid, another grid between said control grid and said cathode and input means connected to said control grid; a source of high frequency oscillations, means to amplify said oscillations, means to impress said amplified oscillations upon said other grid; a second tube, input and output circuits associated therewith, means to impress signal energy upon said input circuit, said second tube being biased to blocking for inputs below a predetermined magnitude, means in said output circuit wherein a potential difference is developed when said second tube passes current, and means to apply said potential difference to said oscillation amplifying means to cause said amplifying means to operate during the time said potential difference is present but not otherwise.

10. A vacuum tube control system, comprising a signal-channel tube having a cathode, a control grid, another grid between said control grid and said cathode and input means connected to said control grid; a source of high frequency oscillations, means to amplify said oscillations, means to impress said amplified oscillations upon said other grid; a second tube, input and output circuits associated therewith, means to impress signal energy upon said input circuit, said second tube being biased to blocking for inputs below a predetermined magnitude, means in said output circuit wherein a potential difference is developed when said second tube passes current, and means to apply said potential difference to said oscillation amplifying means to cause said amplifying means to operate during the time said potential difference is present but not otherwise.

11. A vacuum tube control system, comprising a signal-channel tube having a cathode, a control grid, another grid between said control grid and said cathode and input means connected to said control grid; a source of high frequency oscillations, means to amplify said oscillations, means to impress said amplified oscillations upon said other grid; signal-controlled means to develop a potential difference in response to signal amplitudes in excess of a predetermined value, and means to apply said potential difference to said oscillation amplifying means to cause said amplifying means to operate during the time said potential difference is present but not otherwise.

12. In a radio receiver, a vacuum tube in the signal channel having elements constituting an oscillator section and a detector section, said oscillator section including an anode electrode and a control electrode, a vacuum tube network con-

nected to receive energy from said signal channel and having such parameters that there is not output until said energy exceeds normal signal amplitudes, a second vacuum tube network coupled to receive output energy from the first-mentioned network and having an output circuit that includes a resistor, and means to apply to said oscillator anode the potential drop of output from said second network across said resistor whereby to prevent functioning of said oscillator section for the duration of said potential drop.

13. In a radio receiver, a vacuum tube in the signal channel having elements constituting an oscillator section and another section, said oscillator section including an anode electrode and a control electrode, a vacuum tube network connected to receive energy from said signal channel and having such parameters that there is no output until said energy exceeds normal signal amplitudes, a second vacuum tube network coupled to receive output energy from the first-mentioned network and having an output circuit that includes a resistor, and means to apply to said oscillator anode the potential drop of output from said second network across said resistor whereby to prevent functioning of said oscillator section for the duration of said potential drop.

14. In a radio receiver, a vacuum tube in the signal channel having elements constituting an oscillator section and a detector section, said oscillator section including an anode electrode and a control oscillator section including an anode electrode and a control electrode, means responsive to received energy of amplitude in excess of a predetermined value, means associated with and controlled by said responsive means to produce a potential drop, and means to apply said potential drop to said oscillator anode to oppose operation of said oscillator section.

15. A vacuum tube system, comprising a source of oscillations of frequency higher than that of a signal to be received, a vacuum tube in a signal channel in said system, means to impress said oscillations upon the electron stream in said tube, means responsive to received energy of amplitude in excess of a predetermined value to restrict the impressing of said oscillations upon said electron stream to such periods as energy of said excess amplitude is being received, and means to control the thus oscillating electron stream in accordance with a signal wave to derive the envelope of said signal wave, with reduced power when the amplitude of said envelope is excessive, from the said stream.

16. A vacuum tube system, comprising a signal-transfer vacuum tube whereof the operation depends upon an electron stream therein, means to impress upon said stream oscillations of a frequency higher than that of a signal bearing wave to be received, means to limit the impressing of oscillations to periods of incidence of received waves having excessive amplitudes and means to control said electron stream additionally in accordance with the signal carried by said received wave, whereby the amplitude of said higher frequency oscillations are made to conform to the envelope of said signal.

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