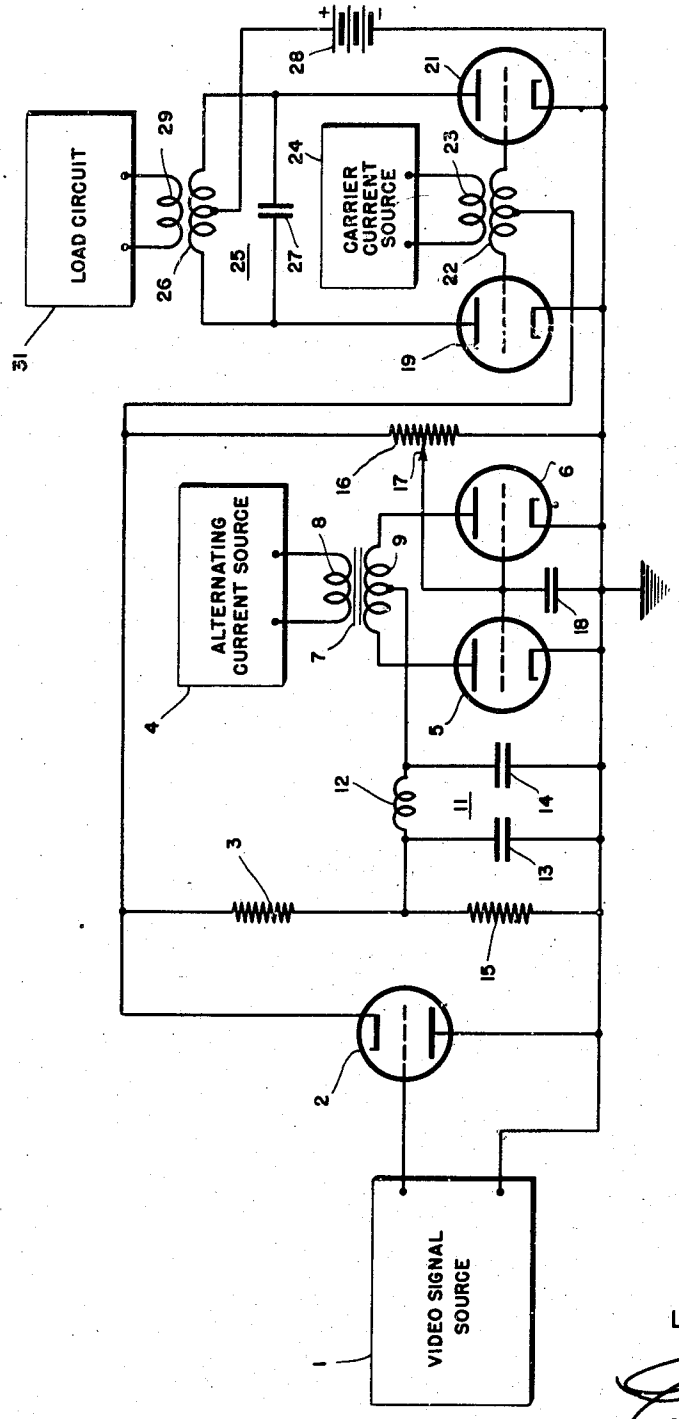
May 10, 1949. L. F. MAYLE 2,469,606

VIDEO SIGNAL LEVEL CONTROL

Filed Oct. 25, 1945



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Patented May 10, 1949

2,469,606

UNITED STATES PATENT OFFICE

2,469,606

VIDEO SIGNAL LEVEL CONTROL

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Application October 25, 1945, Serial No. 624,340

5 Claims. (Cl. 332—38)

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This invention relates to signal control systems and particularly to systems for effecting automatically the control of video signal level in a television system.

In television systems, video signals are generated to represent the light and shade values of a subject. These video signals consist chiefly of two components. One of these components is of a relatively high frequency and represents the instantaneous variations of the light from the successive elemental areas of the subject. The other component, usually termed the direct current component, is of a relatively low frequency and represents the average light value of the television subject. Both components are necessary for the faithful reproduction of a subject. In one type of video signal generating device in common use, only the alternating current component of the video signals is produced. The so-called direct current component is developed separately and combined with the alternating current component for modulating a carrier current wave. In another type of video signal generating device, there are produced both the alternating and the direct current components. When using the latter type of device, it is desirable to employ amplifiers for the video signals which are capable of providing the required amplification of both signal components.

In any case, it is customary to modulate a power amplifier which is separately excited by carrier current wave energy with a video signal consisting of both components. In such cases, grid modulation of the power amplifier is most generally used by impressing the video signals upon the grid circuit of the amplifier. Such amplifiers, for reasons of effecting efficient operation, customarily are arranged for class C operation. This type of amplifier is provided with a negative grid bias for this purpose. Frequently the video signals which are used to modulate a class C power amplifier have a direct current component which varies over a considerable range. It has been found that, when this direct current component has a relatively high negative value, the power amplifier, by reason of its negative grid bias, may be cut off in response to such signals with the result that the modulation of the carrier current wave will not correspond accurately to the light and shade values of the television subject.

It, therefore, is an object of this invention to provide a signal level control system of such a character to permit the use of intelligence signals having a direct current component which varies over a considerable range for modulating a power

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amplifier without biasing the amplifier to cut-off at one extreme value of the direct current component range of variation.

Another object of the invention is to provide a video signal level control system wherein the magnitude of the space current for a video signal vacuum tube amplifier is varied under the control of the direct current component of the video signal derived from the output circuit of the vacuum tube amplifier.

In accordance with the invention, broadly, the signal level control system is provided with a vacuum tube amplifier having input and output circuits. The input circuit is coupled to a source of intelligence signals which may include both the alternating current and the direct current components. Unidirectional space current is supplied to the output circuit of the signal amplifier by a grid controlled vacuum tube rectifier, the input circuit of which is coupled to a source of alternating current. The output circuit of the signal amplifier is coupled to the control grid circuit of the rectifier so that the unidirectional current developed in the output circuit of the rectifier is varied in accordance with the direct current component of the amplified intelligence signals. By this means the level of these signals may be controlled so as not to exceed predetermined limits. A utilization circuit for the controlled signals is coupled to the output circuit of the signal amplifier.

More specifically, in accordance with a preferred embodiment of the invention for use in a television system, amplified video signals developed in the output circuit of the vacuum tube amplifier are derived from a cathode follower circuit connected to this tube. The rectifier for supplying space current to the vacuum tube amplifier comprises a pair of grid controlled vacuum tubes connected in a manner to effect a full wave rectification of the alternating current. Also, the utilization circuit coupled to the cathode follower video signal amplifier tube includes a class C power amplifier arranged for grid modulation by the amplified video signals.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

The single figure of the accompanying drawing is a schematic circuit representation of a video signal level control system embodying this invention.

Referring now to the drawing, there is shown diagrammatically a video signal source 1 which may be any desired type of video signal generator wherein there are produced in the output circuit video signals including the alternating current and the direct current components. For example, if an image analyzing tube of the charge storage type such as an iconoscope is employed, the direct current component of the video signals may be separately generated and combined with the alternating current component for the development of a complete video signal in the output circuit of the source 1. In the case where an image analyzing tube of the dissector type is employed, both components of the video signals are present in the output circuit thereof which may, if desired, constitute the output circuit of the source 1. A video signal signal amplifier capable of amplifying both components of the video signals is conductively coupled to the output circuit of the source 1. The amplifier may comprise a vacuum tube 2 having its control grid coupled directly to one of the output circuit terminals of the video signal source. The tube 2 is arranged in a cathode follower circuit wherein a load impedance device such as a resistor 3 is connected between the cathode and the negative terminal of a source of unidirectional space current. The anode of the amplifier tube 2 is connected directly to the grounded terminal of the unidirectional current source.

The source of unidirectional current for the video signal amplifier tube comprises a source of alternating current 4 and a rectifier for converting the alternating current into unidirectional current. In the illustrative embodiment of the invention this rectifier includes a pair of grid controlled vacuum tubes 5 and 6. The alternating current source is coupled to the anodes of the rectifier tubes by a transformer 7 comprising a primary winding 8 and a secondary winding 9. The cathodes of the rectifier tubes are connected to ground. A filter 11 comprising a series inductance element such as a coil 12 and a pair of shunt capacitance elements such as the condensers 13 and 14 is connected between the midpoint of the transformer secondary winding 9 and ground. The output terminals of the rectifier are connected to the terminals of a load resistor 15. It is seen, therefore, that the positive terminal of the unidirectional current source is the grounded end of the resistor 15 and the negative terminal is the end of the resistor 15 which is connected to the cathode follower resistor 3.

A bleeder resistor 16 is connected in parallel with the space discharge path of the video signal amplifier tube 2. The bleeder resistor is provided with a tap 17 which is conductively coupled to the control grids of the rectifier tubes 5 and 6. A bypass condenser 18 is connected between the control grids of the rectifier tubes and ground.

The signal voltages developed in the output circuit of the video signal amplifier tube 2 are employed to effect grid modulation of a power amplifier. The power amplifier comprises a pair of vacuum tubes 19 and 21, each including at least a cathode, an anode and a control grid. The cathodes of these tubes are connected to ground. The control grids of the power amplifier tubes are connected respectively to the terminals of an inductance coil 22. Another coil 23 is arranged for inductive coupling to the grid coil 22 and is connected at its terminals to a source of a carrier current wave 24. The cathode of the video amplifier tube 2 is conductively coupled to the

midpoint of the power amplifier grid coil 22. A parallel resonant circuit 25 comprising an inductance coil 26 and a condenser 27 is tuned to the frequency of the carrier current wave and is connected between the anodes of the respective power amplifier tubes 19 and 21. Space current for these tubes is supplied from a source of unidirectional current such as a battery 28, the positive terminal of which is connected to the midpoint of the inductance coil 26 and the negative terminal of which is connected to ground. An output inductance coil 29 is inductively coupled to the coil 26 and its terminals are connected to a load circuit 31.

Before describing in detail the operation of the video signal level control system in accordance with this invention, a brief consideration will be given to the operation of conventional apparatus wherein video signals are employed to grid modulate a power amplifier arranged for class C operation with no provision being made for controlling the level of the video signals. Assume that the video signals derived from the source 1 are impressed upon the control grid circuit of the amplifier tube 2 in such polarity that the signal representative of picture white is negative with respect to the signal representative of picture black. Since the tube 2 is arranged with a cathode follower circuit, the amplified video signals derived from the cathode thereof are in phase or have a similar polarity to the video signals impressed upon the control grid. Also, assume that the amplified video signal voltage representative of an elemental area of the television subject of normal brightness is of such magnitude that the negative signal voltage derived from the cathode of the tube 2 relative to ground effects a minimum of space current conduction in the power amplifier tubes 19 and 21. A video signal voltage derived from the cathode of the tube 2 representative of darker elemental areas of the subject will be of less negative magnitude and, therefore, will effect greater conduction of space current in the power amplifier tubes.

However, an amplified video signal voltage derived from the cathode of the tube 2 which is representative of an elemental area of the subject which is of a greater-than-normal brightness will be of greater negative magnitude relative to ground. Consequently, because of the fixed negative biasing of the power amplifier control grids relative to their associated cathodes in order to obtain class C operation, such a signal voltage will produce no response by the power amplifier tubes. The combination of bias and signal voltages impressed upon the grid circuits of these tubes produces cut-off of space current therein. As a result, it may not be possible to modulate a carrier current wave with video signals representative of the brightest elemental area of the subject. It, therefore, would be impossible under these circumstances to faithfully reproduce the television subject on the screen of a receiving tube.

The video signal level control system in accordance with the invention prevents the amplified video signal voltages derived from the amplifier tube 2 from exceeding the limiting voltages by which the power amplifier tubes 19 and 21 may be modulated. Assume that there is an increase in the average brightness of a television subject. The direct current component of the amplified video signals derived from the cathode of the tube 2 will have a greater negative magnitude relative to ground. A higher negative voltage will

be developed in the bleeder resistor 16 and as a result, an increased negative voltage will be impressed upon the control grids of the rectifier tubes 5 and 6. The alternating current component of the video signals developed in the resistor 16 will have no effect upon the control grids of the rectifier tubes for the reason that this component is bypassed to ground by means of the condenser 18.

In response to an increased negative voltage on the control grids of the rectifier tubes, space current in these tubes is decreased. Consequently, the voltage drop produced in the rectifier load resistor 15 by the unidirectional current derived from the rectifier is decreased and a lower space current producing voltage is impressed upon the amplifier tube 2. This lower voltage effects a reduction in the space current of the tube 2, thereby effecting a reduction in the voltage developed in the cathode follower resistor 3.

It is seen, thus, that there is effected by means of the rectifier control a compensation for any tendency for the negative magnitude of the amplified video signal voltages to exceed that which will effect a complete cutoff of space current in the power amplifier tubes 19 and 21. Accordingly, video signal voltages representative of all of the elemental areas of a television subject are effective to suitably modulate a carrier current wave, irrespective of changes in the average brilliance of the subject. Hence, the carrier wave which is radiated or otherwise transmitted to the receiver will be modulated by video signals from which an accurate reproduction of the subject may be reproduced.

While there has been described what, at present, is considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A video signal level control system comprising, a video signal vacuum tube amplifier having input and output circuits, a source of video signals coupled to the input circuit of said video signal amplifier, a source of alternating current, a grid controlled vacuum tube alternating current rectifier having an input circuit coupled to said alternating current source and an output circuit coupled to the output circuit of said video signal amplifier for supplying unidirectional space current thereto, a coupling between the output circuit of said video signal amplifier and the control grid circuit of said rectifier to control the magnitude of the unidirectional current supplied to said video signal amplifier in accordance with variations of the level of said video signals, and a utilization circuit coupled to the output circuit of said video signal amplifier.

2. A video signal level control system comprising, a video signal amplifier including a vacuum tube having input and output circuits, a source of video signals coupled to the input circuit of said video signal amplifier tube, a load impedance device coupled to the output circuit of said video signal amplifier tube, a source of space current for the output circuit of said video signal amplifier tube including a grid controlled alternating current rectifier tube having input and output circuits, a source of alternating current coupled to the input circuit of said rectifier tube, a resistor connected in both the output circuits of said video signal amplifier and said rectifier tubes, a utilization circuit coupled to the load impedance device of said video signal amplifier tube, and a coupling between the output circuit of said video signal amplifier tube and the control grid of said rectifier tube.

3. A video signal level control system comprising, a video signal amplifier including a vacuum tube having a cathode, an anode and a control grid, a source of video signals coupled to the control grid of said video signal amplifier tube, a load impedance device coupled between the cathode and the anode of said video signal amplifier tube, a source of space current for said video signal amplifier tube including a grid controlled rectifier tube having a cathode, an anode and a control grid, a source of alternating current coupled between the anode and the cathode of said rectifier tube, a load resistor coupled to the anode of said rectifier tube and also to the space discharge path of said video signal amplifier tube, a power amplifier including a vacuum tube having an input and an output circuit, a source of carrier current coupled to the input circuit of said power amplifier tube, a load circuit coupled to the output circuit of said power amplifier tube, a coupling between the load impedance device of said video signal amplifier tube and the input circuit of said power amplifier tube, and a coupling between the cathode of said video signal amplifier tube and the control grid of said rectifier tube.

4. A video signal level control system comprising, a video signal amplifier including a vacuum tube having a cathode, an anode and a control grid, a source of video signals coupled between the control grid and anode of said video signal amplifier tube, a load impedance device connected to the cathode of said video signal amplifier tube, a source of space current for said video signal amplifier tube including a pair of grid controlled rectifier tubes, each having a cathode, an anode and a control grid, a source of alternating current coupled to the anodes of said rectifier tubes, a load resistor coupled between the anodes and the cathodes of said rectifier tubes and also in series with the space discharge path of said video signal amplifier tube and said load impedance device, a power amplifier including a pair of vacuum tubes connected in push-pull relationship and having an input and an output circuit, a source of carrier current coupled to the input circuit of said power amplifier, a resonant circuit coupled in the output circuit of said power amplifier, a load circuit coupled to said resonant circuit, a coupling between the cathode of said video signal amplifier tube and the input circuit of said power amplifier, a bleeder resistor connected to the cathode of said video signal amplifier tube, and a coupling between the control grids of said rectifier tubes and a point on said bleeder resistor.

5. A video signal level control system comprising, a video signal amplifier including a vacuum tube having a cathode, an anode and a control grid, a source of video signals including both the alternating current and the direct current components coupled to the control grid of said video signal amplifier tube, a first load resistor connected to the cathode of said video signal amplifier tube, a source of space current for said video signal amplifier tube including a

pair of grid controlled rectifier tubes, each having a cathode, an anode and a control grid, a source of alternating current coupled to the anodes of said rectifier tubes, a filter coupled between the anodes and the cathodes of said rectifier tubes, a second load resistor connected across the terminals of said filter and also in series with the space discharge path of said video signal amplifier tube and said first load resistor, a power amplifier including a pair of vacuum tubes, each having a cathode, an anode and a control grid, a source of carrier current coupled to the control grids of said power amplifier tubes, a resonant circuit coupled between the anodes of said power amplifier tubes, a load circuit inductively coupled to said resonant circuit, a conductive coupling between the cathode of said video signal amplifier tube and the control grids of said power amplifier tubes, a bleeder resistor connected between the cathode and the anode of said video signal amplifier tube, a conductive coupling between the control grids of said rectifier tubes and a point on said bleeder resistor, and an alternating current bypass condenser coupled between the control grids and the cathodes of said rectifier tubes.

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