July 7, 1942. R. C. MOORE 2,289,291

WIDE BAND AMPLIFIER

Filed May 27, 1940

Fig. 1.

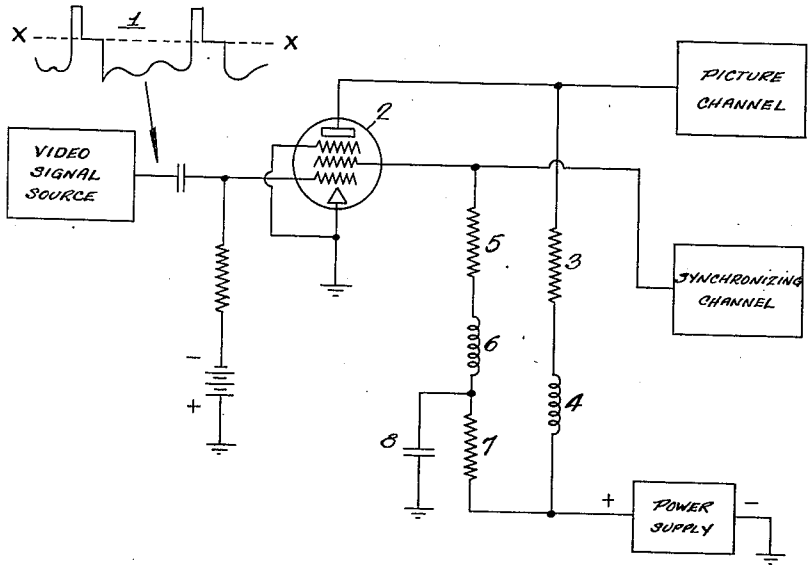
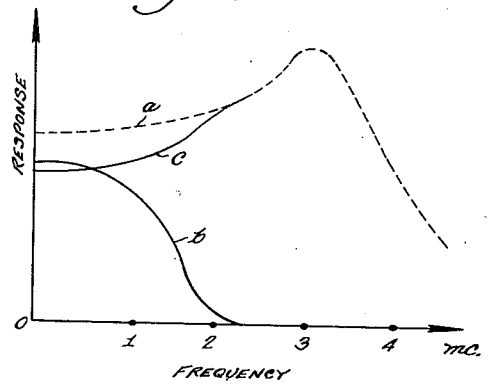


Fig. 2.



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WIDE-BAND AMPLIFIER

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10 Claims. (Cl. 178—7.3)

This invention relates to wide-band amplifiers for electrical wave signals such as are customarily employed in television and the like systems where very high frequency variations are to be amplified. In particular, the invention provides a more efficient method of deriving signal from a point in the video frequency channel of a television receiver for use in the synchronizing channel thereof. As is well known, the signal which carries the intelligence pertaining to picture brightness in television includes signal components of very high as well as components of very low frequency. In order that satisfactory definition may obtain in the reproduced picture, it is necessary that substantially all of these components be transmitted and their relative magnitudes and phase relations preserved. This necessitates the use of specially designed amplifiers and the exercise of great care in avoiding stray capacities to ground throughout the system.

As is known, the television signal also includes a synchronizing component which, when properly separated, is used to control the deflection of an electron beam in a suitable picture reconstituting device. In order to effect this separation, it is customary to derive a signal from a point in the video channel from which may be separated by appropriate means the synchronizing component to actuate the deflecting circuits. This placing of the input to the synchronizing channel across some point in the video amplifier tends to increase the capacity to ground at that point which is repugnant to the desired wide-band response therein.

The present invention provides means by which this capacitive loading of the video amplifier may be substantially avoided. For this purpose, there is provided a high mutual conductance, sharp cut-off pentode space discharge device loaded in its screen-grid as well as in its anode circuit. Across the anode load impedance may be derived the video signal output to the picture channel, and across the screen-grid load impedance may be derived the output to be supplied to the synchronizing signal separating means. In general, it is not necessary that the signal supplied for synchronizing purposes contain the same wide band of frequency components as the signal in the picture channel. This permits the use in the screen circuit of an impedance which is sufficiently small to draw appreciable current only for the relatively low frequency components. Hence, the screen load is effective to reduce only the low frequency response of the plate circuit output, which is not really objectionable as it tends to emphasize the high frequency peaking which is commonly resorted to in video amplifiers to correct for so-called "aperture distortion" which takes place in the television signal generator.

Accordingly, by the present invention there is provided in a wide band signal channel an amplifier stage comprising a pentode or the like space discharge device, a load impedance in the anode circuit of said space discharge device adapted to form an output circuit to the succeeding portion of said channel, having a desired frequency response over a relatively wide frequency band, and an additional load impedance in the screen-grid circuit of said space discharge device adapted to form an output circuit to a separate signal channel, having a desired frequency response over a relatively narrower frequency band required by said separate signal channel, said load impedances being so chosen with regard to their frequency characteristics that the current drawn by one of them is effective to modify the response obtained in the output circuit of the other so as to give the desired response therein.

The invention will be understood by reference to the drawing accompanying this specification, in which

Fig. 1 illustrates an embodiment of the invention; and

Fig. 2 is an explanatory diagram illustrating the results obtained by its use.

Referring first to Fig. 1 it will be seen that the video signal which may be of the form depicted at 1 is supplied to the input of a space discharge device 2 which may be of the pentode type. In accordance with the invention the plate load impedance for this tube may comprise the resistor 3 in series with the inductance or peaking coil 4. The latter should be such as will resonate the inherent capacity associated with the plate of the tube at a frequency near the upper end of the band of frequencies contained in the signal. From this load impedance is derived the wide band output signal which it is necessary to supply to the picture channel. The screen load impedance may comprise the resistor 5 and the inductor 6, the latter being resonant with the inherent capacity associated with the screen grid at a relatively lower frequency than that at which the inductor 4 resonates. From this impedance is derived the narrow band output which is supplied to the synchronizing channel, which, as has already been pointed out, does not require as wide a band of frequencies for satisfactory operation as does the picture channel. It

will be noted that both the plate and the screen circuits derive their power from a common source of supply. The screen circuit may include additional filtering means here shown as comprising the resistor 7 and the condenser 8 for removing low frequency variations engendered in the power supply, which may deleteriously affect the selection of the synchronizing component (i. e., that portion of the signal shown at 1 above the line x—x) by causing the level at which this component occurs to vary. The values of the resistor 7 and the condenser 8 are chosen as large as is practicable in order to avoid such variations. This is feasible inasmuch as the screen operates at a relatively low voltage so that the voltage drop produced by the resistor 7 is not objectionable.

Before considering further the operation of the circuit, it may be well to note the values of circuit elements which may be used in the arrangement shown. They are as follows:

Resistance 3=1,000 ohms
Inductor 4=15 micro-henries
Resistor 5=10,000 ohms
Inductor 6=1,000 micro-henries
Resistor 7=47,000 ohms
Condenser 8=8 micro-farads

It will be understood of course that any and all of these values are subject to considerable variation depending on the type of response desired.

Referring now to Fig. 2 and considering first the response obtained from the plate circuit of the tube 2 with no screen load, this will be represented by a curve similar to the dotted curve *a*. With a pure resistance in the plate circuit, the tendency is for the response to fall off at high frequencies due to the distributed capacity to ground of the tube and other circuit elements. This may, to a certain extent, be overcome and a peaked response may even be obtained by the insertion of the inductance or peaking coil 4 as a part of the plate load impedance. As has already been pointed out, a certain amount of high frequency peaking is desired in the average video amplifier. In general the resistive component of the screen load impedance will be considerably larger than that of the plate load impedance and the inductive component of the former will be such as to cause it to peak at a much lower frequency than that at which the plate load does, as shown by the curve B representing the screen circuit response. The effect of the screen load upon the plate circuit response is shown by the curve *c*. The low frequency response will in general be slightly reduced, which will tend to accentuate the high frequency peaking. This may be tolerable, or even desirable, in a television amplifier but may be avoided, if desired, by redesigning the plate impedance so as to suitably raise the low frequency end of the characteristic.

It will be particularly noted that, by the method of the invention, the capacitance of the synchronizing channel is removed from the plate circuit where high frequency response is desired, and that by design of the two output circuits in accordance with the invention a much more efficient utilization can be made of the available power.

The invention is, of course, capable of various modifications and is not restricted to the specific embodiment illustrated. In particular, it should be recognized that any impedance designed in accordance with the well-known principles of network theory and having the desired frequency characteristic may replace the simple resistance-inductance combinations shown in the embodiments described.

I claim:

1. In an electrical signaling system, a source of an electrical signal comprising a wide band of frequency components, a space discharge device having an electron-emitting element, a control grid and a plurality of electron-receiving elements, said control grid being coupled to said source, a first load impedance means connected to one of said electron-receiving elements for supplying a wide band output, a second load impedance means connected to another of said electron-receiving elements for supplying a narrow band output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a first signal utilization means connected to said first load impedance means, and a second signal utilization means connected to said second load impedance means.

2. In a television receiver, apparatus for separating the video and synchronizing signals, comprising a space discharge device to which the composite signal is applied, said device having an electron-emitting element, a control grid and a plurality of electron-receiving elements, a first load impedance means connected to one of said electron-receiving elements for supplying a wide band video signal output, a second load impedance means connected to another of said electron-receiving elements for supplying a narrow band synchronizing signal output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a video signal channel connected to said first load impedance means, and a synchronizing signal channel connected to said second load impedance means.

3. In a television receiver, apparatus for separating the video and synchronizing signals, comprising a space discharge device to which the composite signal is applied, said device having a cathode, an anode, a control grid and at least one additional grid, a first load impedance means connected to said anode for supplying a wide band video signal output, a second load impedance means connected to said additional grid for supplying a narrow band synchronizing signal output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a video signal channel connected to said first load impedance means, and a synchronizing signal channel connected to said second load impedance means.

4. In a television receiver, apparatus for separating the video and synchronizing signals, comprising a pentode space discharge device to which the composite signal is applied, said device having an anode and a screen grid, a first load impedance means connected to said anode for supplying a wide band video signal output, a second load impedance means connected to said screen grid for supplying a narrow band synchronizing signal output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a video signal channel connected to said first load impedance means, and a synchronizing signal

channel connected to said second load impedance means.

5. In a television receiver, apparatus for separating the video and synchronizing signals, comprising a space discharge device to which the composite signal is applied, said device having an electron-emitting element, a control grid and a plurality of electron-receiving elements, a first load impedance means comprising resistive and inductive components connected to one of said electron-receiving elements for supplying a wide band video signal output, a second load impedance means comprising resistive and inductive components connected to another of said electron-receiving elements for supplying a narrow band synchronizing signal output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a video signal channel connected to said first load impedance means, and a synchronizing signal channel connected to said second load impedance means.

6. A system as claimed in claim 5, in which the inductive component of each load impedance is adapted to resonate with the inherent capacity associated with the element to which it is connected at a frequency within the band.

7. A system as claimed in claim 5, in which the the inductive components of the respective load impedances are adapted to resonate at materially different frequencies with the inherent capacities associated with the elements to which they are respectively connected.

8. A system as claimed in claim 5, in which the resistive component of said first load impedance is several times the resistive component of said second load impedance.

9. In a television receiver, apparatus for separating the video and synchronizing signals, comprising a space discharge device to which the composite signal is applied, said device having an electron-emitting element, a control grid and a plurality of electron-receiving elements, a first load impedance means connected to one of said electron-receiving elements for supplying a wide band video signal output, a second load impedance means connected to another of said electron-receiving elements for supplying a narrow band synchronizing signal output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a video signal channel connected to said first load impedance means, a synchronizing signal channel connected to said second load impedance means, a common power supply means for said electron-receiving elements, and filter means interposed between said power supply means and said second load impedance for eliminating low frequency variations engendered in the power supply means.

10. In a television receiver, apparatus for separating the video and synchronizing signals, comprising a space discharge device to which the composite signal is applied, said device having an electron-emitting element, a control grid and a plurality of electron-receiving elements, a first load impedance means connected to one of said electron-receiving elements for supplying a wide band video signal output, a second load impedance means connected to another of said electron-receiving elements for supplying a narrow band synchronizing signal output coextensive in frequency with at least a part of said wide band, and for modifying said wide band output to attenuate some frequencies and effectively accentuate others, a video signal channel connected to said first load impedance means, a synchronizing signal channel connected to said second load impedance means, a common power supply means for said electron-receiving elements, and filter means interposed between said power supply means and said second load impedance for eliminating low frequency variations engendered in the power supply means, said filter means comprising a large resistance serially connected between said power supply means and said second load impedance, and a large capacitance by-passing said resistor to a point of fixed potential.

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