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D. E. FOSTER

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VIDEO AMPLIFIER

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Fig. 1

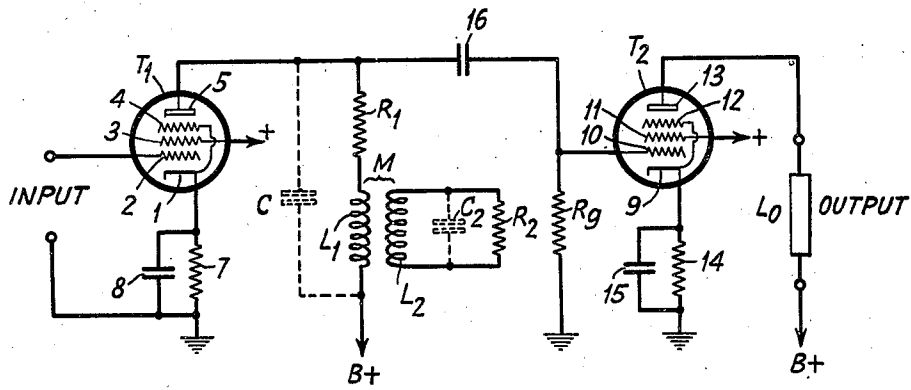
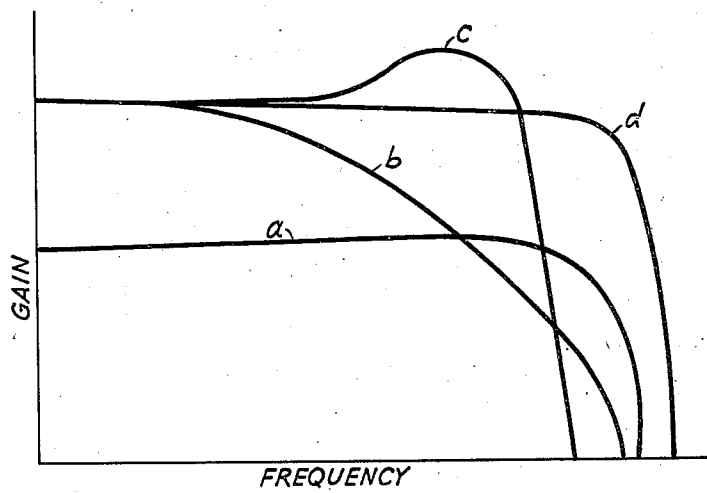


Fig. 2



INVENTOR
Dudley E. Foster
BY *H. S. Brown*
ATTORNEY

UNITED STATES PATENT OFFICE

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VIDEO AMPLIFIER

Dudley E. Foster, South Orange, N. J., assignor to
Radio Corporation of America, a corporation of
Delaware

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5 Claims. (Cl. 179—171)

The present invention relates to wide-band video frequency amplifiers and particularly to amplifiers of the resistance-coupled type adapted to amplify picture signals in television systems.

In video amplifiers in which resistance coupling is employed it is known to minimize the effect of the inherent plate-to-cathode capacity at high frequencies by an inductance called a "peaking" coil, in series with the load resistor. An analysis and the design of such amplifiers are described by Seeley and Kimball in the "RCA Review" for January, 1939, at page 290. By increasing the load resistance increased low frequency gain can be obtained, but this requires a larger peaking coil which in turn results in a high frequency peak. It is therefore the main object of the present invention to associate with the peaking coil a damping circuit which is variable with frequency and thus provide an amplifier which has a substantially flat frequency response over a comparatively wide range of frequencies extending approximately between 60 cycles/second and 5.0 megacycles/second.

Other objects, features and advantages of my invention will appear from the following description taken in connection with the accompanying drawing in which Fig. 1 is a schematic circuit diagram of an amplifier embodying my invention, and Fig. 2 are response curves which will serve to explain the invention.

Referring now to Fig. 1 the amplifier system comprises the amplifier tubes T₁ and T₂, each of which preferably is of the screen grid or pentode type which are substantially constant current tubes. The tube T₁ includes an indirectly heated cathode 1, a control grid 2, a screen grid 3, a suppressor grid 4 and an anode 5. The control grid may be biased negatively a suitable amount by means of the usual network consisting of resistor 7 and shunt condenser 8.

The tube T₂ also includes an indirectly heated cathode 9, a control grid 10, a screen grid 11, a suppressor grid 12 and an anode 13. The control grid 10 may be negatively biased, as in the case of tube T₁, by means of the resistor-condenser network 14—15, the bias voltage being applied through a grid resistor R_g.

In the specific embodiment of the invention illustrated, operating voltage is applied to the anode 5 of the tube T₁ from a suitable source of potential B+ through a coil L₁, commonly known as a peaking coil, and an anode or load resistor R₁. The value of the peaking coil L₁ is so chosen that it resonates with the inherent plate to cathode capacity C (shown dotted in the drawing)

approximately 40% higher than the high frequency end of the range of frequencies to be amplified. Coupled to the coil L₁ by mutual coupling M is the damping circuit consisting of the coil L₂ and the shunt resistance R₂.

The plate 5 of the tube T₁ is coupled to the grid 10 of tube T₂ through the usual coupling condenser 16.

When the values of C, R₁ and L₁ comprising the plate load of a substantially constant current tube are so chosen that

$$R_1 = \frac{1}{\omega_0 C} = 2\omega_0 L_1$$

being equal to $2\pi f_0$ and f_0 being the top frequency of the range to be transmitted, uniform impedance is obtained up to f_0 , and hence uniform gain. This condition of response is represented by the curve a of Fig. 2. If resistor R₁ be increased without change in C or L₁ the low frequency gain is increased but high frequencies drop off as shown by the curve b. Increasing the value of L₁ will again produce uniform response but value of f_0 is decreased and the amplifier will not have flat gain over as wide a frequency range. If L₁ be made larger than

$$\frac{R_1}{2\omega_0}$$

a peak occurs towards high frequencies as shown by curve c, the frequency range still being decreased over that of curve a because the resonant frequency is lowered.

Now by coupling the circuit L₂R₂ to L₁ it acts to vary the inductance of the load circuit in response to frequency. If R₂ is small compared to L₂ it will decrease L₂ by the factor

$$\frac{\omega^2 M^2}{L_2}$$

thus raising the resonant frequency as the applied frequency is increased by virtue of the change in effect of the coupled circuit. Resistor R₂ is likewise reflected to increase the effective resistance load at higher frequencies and also acts to damp out the peak or resonant rise present in curve c, thus giving an overall effect of not only higher but also somewhat more uniform gain as shown by the curve d.

Capacitance C₂, shown dotted, is not essential to the operation of the circuit as described since the change in effective inductance with frequency occurs without C₂. The addition of C₂ if desired will increase the rate of change of effective inductance and for such purpose circuit L₂C₂

should be resonant to a frequency higher than the desired uniform response range.

As has been explained, circuit L_2R_2 acts to change the effective inductance in the plate circuit of T_1 . At low frequencies the effect of L_2R_2 is negligible but since it increases as the square of the frequency the effect becomes substantial at higher frequencies. The magnitude of variation of effective inductance may be changed by adjustment of either M or L_2 . If R_2 is not made small in comparison with the reactance of L_2 at the higher frequencies it is desired to amplify, it too varies the effective inductance.

The action of circuit L_2R_2 , as has been explained, is to change the effective inductance in the load circuit of T_1 as a function of applied frequency and also because of R_2 reflected into the plate circuit, to change to some degree the resistance component of the load circuit. The addition of the adjustable parameters permits a greater degree of freedom in the design of the amplifying stage to accomplish the desired results of wide band and high load impedance.

While I have shown and described a preferred embodiment of the invention, it will be understood that modifications and changes may be made without departing from the spirit and scope of the invention, as will be understood by those skilled in the art.

What I claim is:

1. A circuit arrangement for the uniform amplification of a wide range of frequencies, comprising an amplifier, a load circuit connected to the plate of the amplifier comprising a resistance and an inductance which serves as a peaking coil, a second circuit comprising at least inductance and resistance, the second circuit being inductively coupled to the inductance of the load circuit whereby the effective value of said load circuit is made to vary with variation of applied frequency.

2. An amplifier of high frequency energy comprising a load circuit connected to the plate of the vacuum tube amplifier consisting of a resistance, an inductance in series therewith, a second inductance in mutual inductive relation to

said first inductance, and a second resistor connected across the second inductance whereby the effective load circuit is caused to have a relatively high and uniform impedance over a wide range of frequencies.

3. A circuit arrangement for extending the range of frequencies which are amplified uniformly at substantially high gain, comprising an amplifier, a series connection of a resistance and an inductance in the output circuit of the amplifier, and a damping circuit mutually coupled to the output circuit inductance and variable with frequency for compensating for high frequency attenuation, said damping circuit comprising an inductance and a shunt resistance, said latter inductance having mutual coupling with the output circuit inductance.

4. An amplifying system comprising a source of input frequency varying from extremely low to extremely high frequency, an amplifier, an output load circuit for said amplifier comprising the series connection of a resistor and an inductive impedance, and a parallel combination of an inductance and a shunt resistor in magnetically coupled relation with the inductive impedance for compensating for high frequency attenuation whereby the response characteristic of the amplifier is substantially uniform over a wide range of frequencies.

5. An amplifier system comprising a source of input frequency varying from a frequency of at least as low as 60 cycles per second to a frequency at least as high as 5.0 megacycles per second, a pair of amplifier tubes, a resistor in the output circuit of the first amplifier, a resistor in the input circuit of the second amplifier, a coupling condenser connected between said output and input circuits, an inductance connected in series with said output resistor, and a damping circuit comprising an inductance and a shunt resistor mutually coupled to the output circuit inductance, their impedance values being so related as to compensate for attenuation of the output voltage due to high frequency impressed voltage.

DUDLEY E. FOSTER.