Aug. 12, 1941. F. J. BINGLEY 2,252,613

SIGNAL TRANSMISSION SYSTEM

Original Filed Nov. 23, 1935

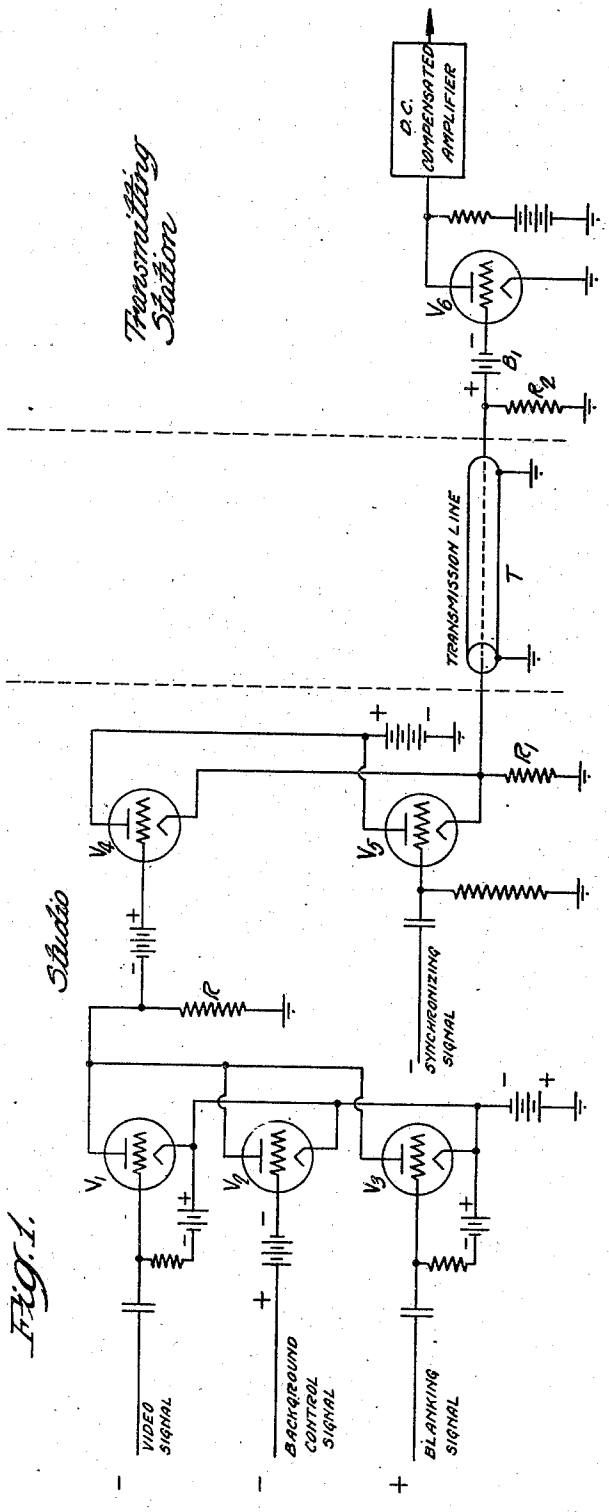


Fig. 1.

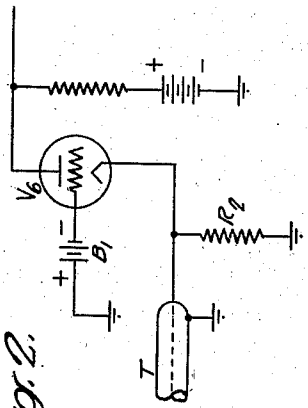


Fig. 2.

Inventor:-
Frank J. Bingley
by his Attorneys
Howson & Howson

Patented Aug. 12, 1941 2,252,613

UNITED STATES PATENT OFFICE

2,252,613

SIGNAL TRANSMISSION SYSTEM

Frank J. Bingley, Philadelphia, Pa., assignor, by mesne assignments, to Philco Radio and Television Corporation, Philadelphia, Pa., a corporation of Delaware

Original application November 23, 1935, Serial No. 51,324, now Patent No. 2,171,536, dated September 5, 1939. Divided and this application July 5, 1939, Serial No. 282,935

4 Claims. (Cl. 178—44)

This invention relates to signal transmission systems and, more particularly, to a transmission system for use in television apparatus. The present application is a division of copending application, Serial No. 51,324, filed November 23, 1935, now Patent No. 2,171,536, granted September 5, 1939.

In the said parent application, there is disclosed a complete television system wherein provision is made for transmitting a background control signal to control automatically the background and brightness of the transmitted picture. To this end, there is provided a signal-combining amplifier wherein the several signals involved, including the background control signal, are combined and there is also provided a low impedance transmission line for transmitting the composite signal from the combining amplifier at the television studio to the transmitting station, at which there is provided a D. C. compensated amplifier capable of transmitting the background control signal. The present application is directed to the apparatus above mentioned and, more particularly, to that part of the system comprising the said transmission line and the apparatus at each end thereof.

One object of the present invention is to provide a novel signal transmission circuit employing a low impedance transmission line for transmitting a wide band of frequencies such as that encountered in a modern high definition television system.

A more specific object of the invention is to provide a novel signal transmission circuit for transmitting a composite signal of a television system, including a background control signal comprising a substantially zero frequency component of the composite signal.

Other objects and features of the invention will appear hereinafter.

In the accompanying drawing:

Fig. 1 is a diagrammatic illustration of one form of the invention as applied to a television system; and

Fig. 2 is a fragmentary illustration showing a modified arrangement at the output end of the transmission line.

Referring to Fig. 1, there is shown at the left side thereof a signal-combining amplifier which may be located at the television studio as indicated on the drawing. This amplifier comprises a tube V_1 energized by a negative video or picture signal, a tube V_2 energized by a negative background control signal, and tube V_3 energized by a positive blanking signal which will include both the horizontal and vertical blanking signals and which may be obtained from the usual synchronizing signal generator. Since the present invention is not concerned with the specific methods and means of obtaining the several signals involved, it is unnecessary to illustrate or describe them herein. Reference may be had, however, to the above-mentioned parent application for a complete disclosure of such methods and apparatus.

The outputs of the three tubes V_1, V_2 and V_3 are added in the common output circuit including the resistance R, and the composite signal is used to energize tube V_4 by means of the conductive coupling thereto. By virtue of the common load circuit, the negative background control signal and the negative video signal are added together producing a signal including the zero frequency component necessary for automatic background control. The blanking signal may be such as to maintain the space current of tube V_3 at some small value except for the interval during which the scanning beam is returned to a new starting point. During that interval, the blanking signal becomes sufficiently positive to increase the current drain of tube V_3 through resistance R enough to bias tube V_4 beyond plate current cut-off.

During the presence of the video signal, tube V_5, which is adapted to be energized by the synchronizing signals, including both horizontal and vertical signals and whose load circuit is common with that of tube V_4, is drawing some constant current which establishes a predetermined constant voltage drop in the resistance R_1. In the absence of a blanking signal, the video signal with the background component is transferred through tube V_4 and will appear across the resistance R_1. During the blanking interval, tube V_4 is biased beyond cut-off and consequently draws no current and, in addition, the synchronizing signal is negative and, therefore, reduces the current drain of tube V_5, reducing the voltage across resistance R_1, thus establishing the synchronizing signals in the composite signal during the blanking interval with opposite polarity with respect to the video signal.

A low impedance transmission line T is preferably employed to transfer the composite signal from the studio to the apparatus at the transmission station, as illustrated. The resistance R_1 constitutes a common load impedance for the tubes V_4 and V_5 and it will be noted that this impedance is connected in the cathode circuit of the said tubes. The transmission line, which prefer-

ably comprises a coaxial cable, has its input end connected to the resistance R_1. The surge impedance of the transmission line may be of some small value, say 34 ohms. To avoid reflection, the cable must be terminated at each end by an impedance substantially the same as the surge impedance of the line. Thus, the impedance looking into the terminated line from tubes V_4 and V_5 will be of the order of 17 ohms. This impedance is sufficiently low so as not to cause any serious degenerative effects in the composite signal amplifier. It will be noted that the tubes V_4 and V_5 have their anode-to-cathode impedance in shunt with the external terminating impedance and this must be considered in choosing the proper terminating impedance. Preferably the tubes V_4 and V_5 should have a high mutual conductance and under these conditions the impedance of the tubes may comprise a substantial part of the terminating impedance.

It will be understood that the impedance of the transmission line may vary considerably from the specific value above-mentioned. For example, in one experimental system, the impedance of the line was about 80 ohms and gave substantially the same results.

The output end of the transmission line is terminated in a resistance R_2 which may be coupled to tube V_6 by means of a blocking battery B_1. The tube V_6 serves to couple the transmission line to a D. C. compensated amplifier, which may take any of the forms disclosed in the above-mentioned parent application. The D. C. compensated amplifier forms the subject of another divisional application, Serial No. 282,934, filed July 5, 1939.

Although a wide band of frequencies is transmitted through the system, the conductive coupling illustrated in Fig. 1 may be used by virtue of the fact that the capacitive impedance of the blocking battery to ground, even at the highest frequencies, is large compared to the low impedance of the transmission line and, consequently, there will be no attenuation of the high frequencies by reason of this by-pass impedance.

An alternative form of the coupling at the output end of the transmission line is shown in Fig. 2. In this instance, the resistance R_2 takes the form of a cathode load resistor in the output circuit of tube V_6 so that there is provided a cathode drive circuit. The choice of the coupling methods illustrated in the two figures will depend upon the desired signal polarity. In the arrangement of Fig. 2, degeneration is practically non-existent due to the low value of the terminating impedance. Further, the voltage drop in this impedance, due to the static space current of the tube V_6, is of negligible importance.

As mentioned above, while the transmission circuit provided by the invention is particularly useful in a television system, it is not limited to such usage but may be employed in any instance where it may find useful application. It will be understood too that the invention is not limited to the specific forms illustrated and described herein for the purpose of disclosure. Further embodiments and modifications of the system will be apparent to those skilled in the art and are to be considered within the scope of the invention.

I claim:

1. In a signal transmission circuit, a space discharge device having at least a control element, a cathode and an anode, said device having a high mutual conductance, a signal input circuit connected between said control element and a point of fixed potential, a source of electrical energy connected between said anode and said point of fixed potential, a transmission line having its input terminals connected between said cathode and said point of fixed potential, means for terminating the output end of said line in its characteristic impedance, said transmission line having a characteristic impedance which is very small compared to the anode-to-cathode impedance of said space discharge device, whereby a small proportion of the voltage of said source is applied to said line, the line conductors are maintained at or near said fixed potential, and the degenerative effects occasioned by the presence of said line in both the grid-cathode and anode-cathode circuits of said space discharge device are rendered negligible, a vacuum tube amplifier having its grid-cathode circuit connected to the output terminals of said transmission line, said transmission line providing a conductive coupling means between said space discharge device and said vacuum tube amplifier whereby direct current components of signals may be transmitted therebetween, and a bias battery connected serially in the connection between the grid of said vacuum tube amplifier and said transmission line.

2. In a wide band television system, a television studio, a signal-combining amplifier at said studio, said amplifier comprising at least one space discharge output device having at least a control grid, a cathode and an anode, an input circuit for said device connected between said grid and a point of fixed potential, a source of anode supply voltage connected between said anode and said point of fixed potential, a transmitting station remote from said studio, a transmission line extending between said studio and said transmitting station, said line having its input terminals connected between said cathode and said point of fixed potential, means for terminating the output end of said line in its characteristic impedance, said transmission line having a characteristic impedance which is very small compared to the anode-to-cathode impedance of said space discharge device, whereby a small proportion of the voltage of said source is applied to said line, the line conductors are maintained at or near said fixed potential, and the degenerative effects occasioned by the presence of said line in both the grid-cathode and anode-cathode circuits of said space discharge device are rendered negligible, a vacuum tube amplifier at said transmitting station having its grid-cathode circuit connected to the output terminals of said transmission line, said transmission line providing a conductive coupling means between said space discharge device and said vacuum tube amplifier whereby direct current components of signals may be transmitted between said studio and said transmitter, and a bias battery connected serially in the connection between the grid of said vacuum tube amplifier and said transmission line.

3. In a single transmission circuit, a space discharge device having at least a control element, a cathode and an anode, a signal input circuit connected between said control element and a point of substantially fixed potential, a source of anode voltage connected between said anode and said point of fixed potential, a transmission line having its input terminals connected between

said cathode and said point of fixed potential, means for terminating the output end of said line in its characteristic impedance, said transmission line having a characteristic impedance which is very small compared to the anode-to-cathode impedance of said space discharge device, whereby a small proportion of the voltage of said source is applied to said line, the line conductors are maintained at or near said fixed potential, and the degenerative effects occasioned by the presence of said line in both the grid-cathode and anode cathode circuits of said space discharge device are rendered negligible, a vacuum tube amplifier having its grid-cathode circuit connected to the output terminals of said transmission line, said transmission line providing a conductive coupling means between said space discharge device and said vacuum tube amplifier whereby direct current components of signals may be transmitted therebetween, and biasing means for overcoming the small positive voltage applied to the input circuit of said vacuum tube amplifier from said source of anode voltage by way of said transmission line.

4. In a signal transmission circuit, a space discharge device having at least a control element, a cathode and an anode, a signal input circuit connected between said control element and a point of substantially fixed potential, a source of anode voltage connected between said anode and said point of fixed potential, a transmission line having its input terminals conductively connected between said cathode and said point of fixed potential, thereby effecting a direct current connection between the conductors of said line, said cathode and said point, means for terminating said line in substantially its characteristic impedance, said transmission line having a characteristic impedance which is small compared to the anode-to-cathode impedance of said space discharge device, whereby a small proportion of the voltage of said source is applied to said line, the line conductors are maintained at or near said fixed potential, and the degenerative effects occasioned by the presence of said line in both the grid-cathode and anode-cathode circuits of said space discharge device are rendered negligible, and a vacuum tube amplifier having its input circuit coupled to the output terminals of said transmission line for deriving signals therefrom.

FRANK J. BINGLEY.