

Dec. 24, 1940.

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2,225,741

TELEVISION AND OTHER SIGNAL TRANSMISSION SYSTEMS

Filed March 25, 1937

3 Sheets-Sheet 1

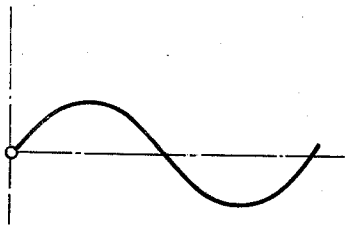


Fig. 1-a

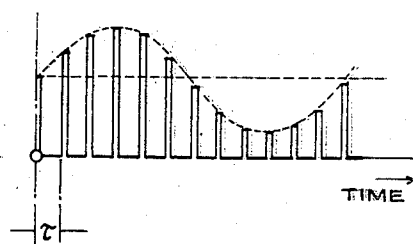


Fig. 1-b

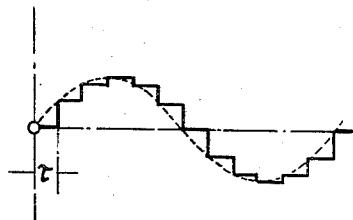


Fig. 1-c

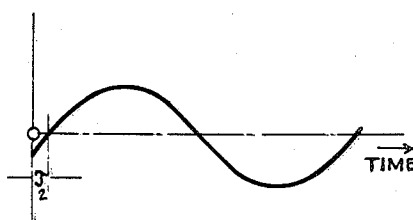


Fig. 1-d

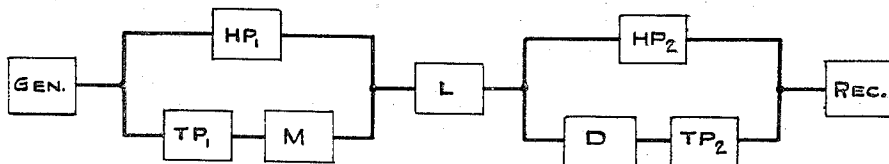


Fig. 2

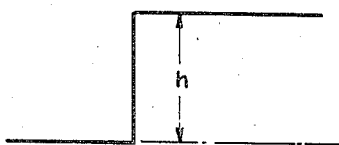


Fig. 3-a

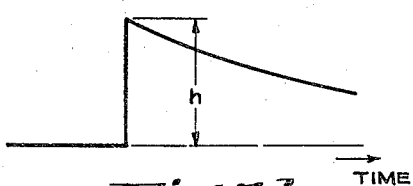


Fig. 3-b

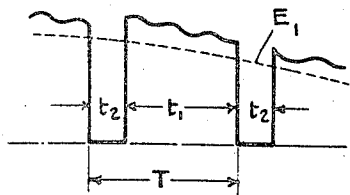


Fig. 4-a

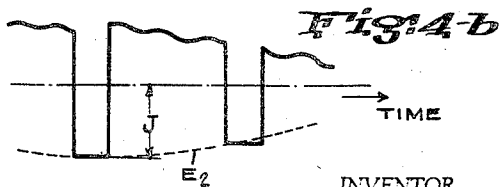


Fig. 4-b

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3 Sheets-Sheet 2

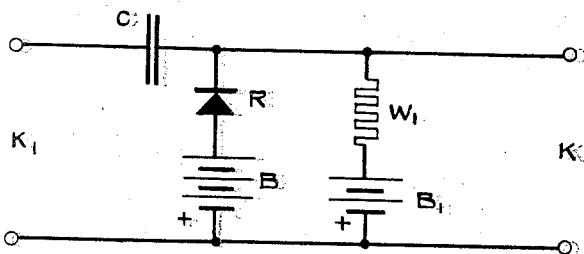


Fig. 5

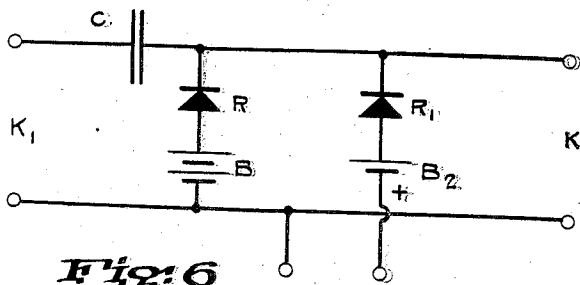


Fig. 6

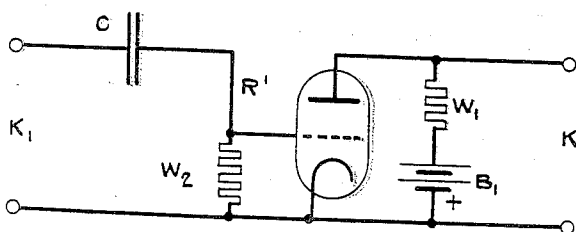


Fig. 7

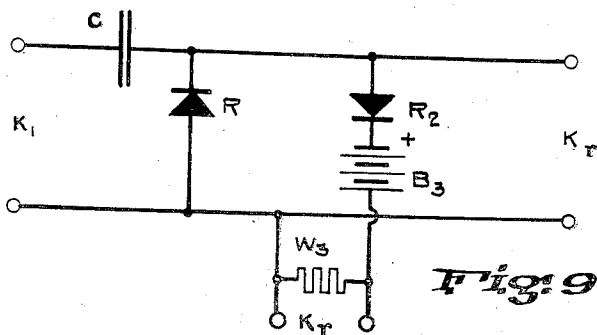


Fig. 9

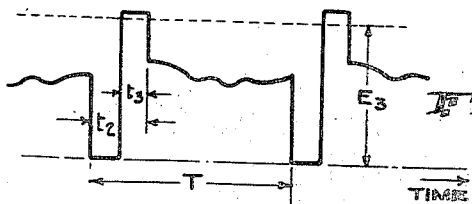


Fig. 8

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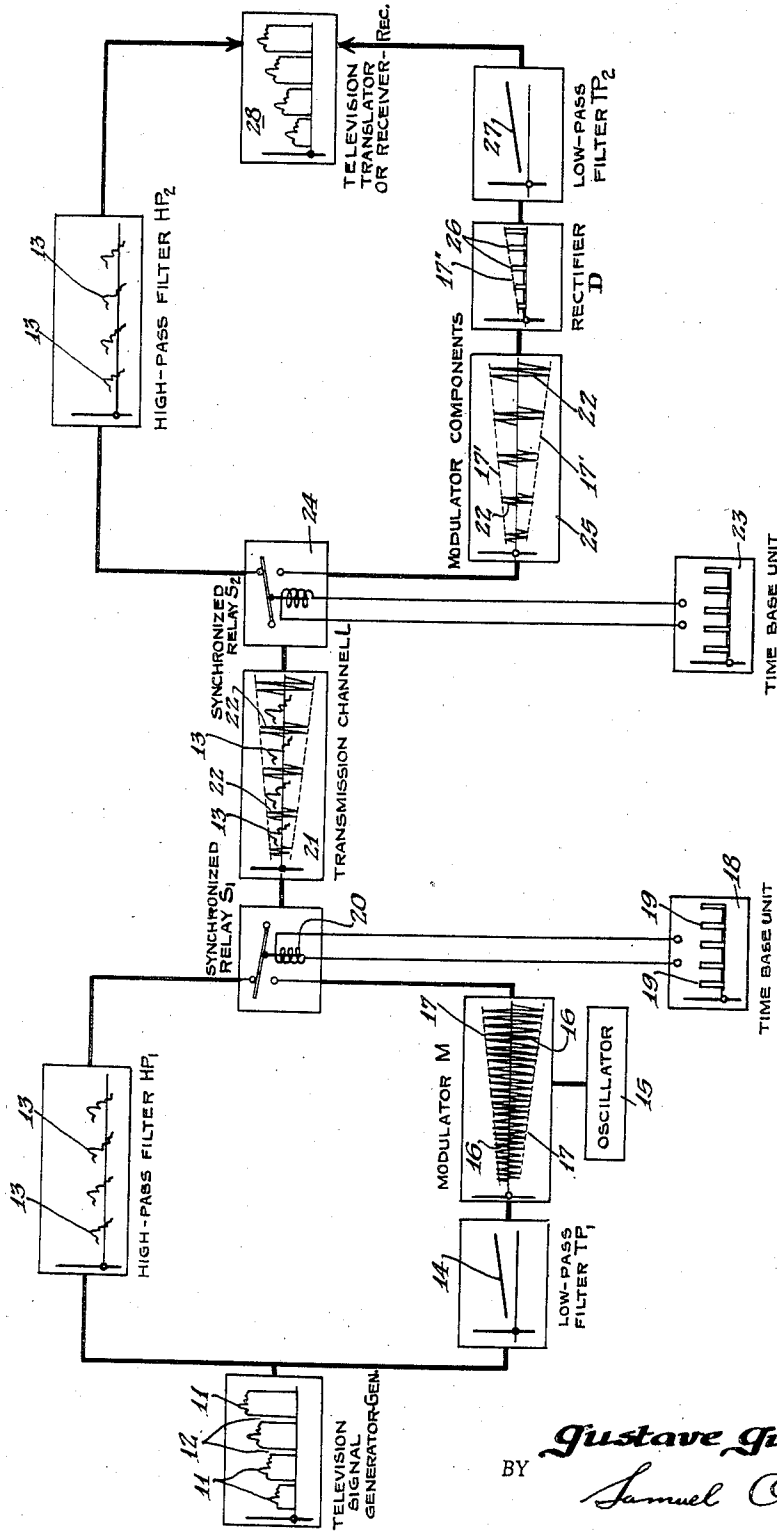
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TELEVISION AND OTHER SIGNAL TRANSMISSION SYSTEMS

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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

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TELEVISION AND OTHER SIGNAL TRANSMISSION SYSTEMS

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In Germany March 26, 1936

17 Claims. (Cl. 178—6)

This invention relates to signalling systems, and more particularly relates to novel methods of and means for television signal transmission.

Television or other signals may be transmitted directly over a transmission channel, i. e. without being subject to frequency changing or modulation before transmission. However, in practice the frequency range of a channel is often limited, and in order to make better use of a channel e. g. in order to enable conveyance of several signal components over the same line to be effected, it is common to send the signals through carrier frequency modulators, as in telegraphy and telephony systems. In cases where one transmission channel does not suffice to convey a whole signal band, several channels can instead be used. This has been proposed for instance for the transmission of television signals which normally occupy a wide frequency range. The present invention will be described in connection with television signal transmission.

A television signal is a voltage curve corresponding to the light and shade distribution in a picture or scene to be transmitted and may comprise frequency components from zero frequency (the direct current or background brightness component) up to one million cycles per second or higher. For such a signal one channel might be provided for the higher signal frequencies and another channel for the lower frequencies including the direct current component. For the faithful transmission of the latter frequencies, however, very expensive apparatus is necessary when using known systems.

In order to make more economical and advantageous use of a transmission channel of finite band width it has accordingly been common to feed at least the low frequency components of the television signals to a modulator, at the transmitting end, transmit them on a carrier and again demodulate them at the receiving end. In most known transmission systems a fixed carrier frequency is superposed whereby the whole signal frequency band is displaced up the frequency spectrum.

The use of a separate second channel for the higher frequencies of the television signal offers the advantage that the frequencies, the distortionless transmission of which is often a matter of considerable difficulty, need not be transmitted on a carrier.

Even in such known systems however, there is no full utilization of the channel. Consider the case of a television signal having picture line periods and successive synchronizing periods.

During the synchronizing pauses which are necessary for the synchronizing of the receiver, no fine details of the signal need be transmitted. The present invention takes advantage of this circumstance to transmit, without the use of a carrier or modulator such as has hitherto been usual, the whole of a television signal over a single channel with limited transmissibility for the low frequencies. One transmission channel is therefore saved and set free for other purposes. The economic and technical drawbacks incident upon frequency-band displacement and in particular if distortion is involved in the modulators are thus avoided.

In carrying out the present invention all the signal components are transmitted over the same channel, the higher frequencies being transmitted direct whilst the lower signal frequencies and the direct current component are handled in a manner to be later described herein and which may perhaps be not unfittingly referred to as "partial modulation." In this way of carrying out the invention the transmission of the higher signal frequencies and that of the lower frequencies are separated, short pauses in the transmission being used for the transmission of signals which are characteristic of the momentary values of the lower frequencies.

Accordingly, an object of the present invention is to provide novel methods for transmitting low frequency and direct current signals.

Another object of the present invention is to provide a novel method for transmitting current components of a wide frequency signal band.

Still another object of the present invention is to provide novel methods of and apparatus for transmitting the low frequency and direct current components of a television signal band.

A further object of the present invention is to provide novel method of and apparatus for transmitting low frequency and direct current components of a wide signal frequency band across a channel having a frequency response characteristic normally excluding such low frequency currents.

Still a further object of the present invention is to provide novel methods for transmitting low frequency and direct current components during the synchronizing intervals between successive lines of television transmission.

These and further objects of the present invention will become apparent by the following description taken in connection with the drawings, in which:

Figures 1a, b, c and d are curves illustrating

the transmission of a relatively low frequency sine wave by pulses at a higher frequency, used in describing the principle of the present invention.

5 Figure 2 is a schematic circuit diagram of the arrangement for carrying out the present invention.

Figures 3 and 4 are curves illustrating the transmission of synchronizing signals and television signals.

10 Figures 5, 6 and 7 are schematic diagrams of modifications for rectifier arrangements corresponding to D in the system of Figure 2.

Figure 8 is a curve illustrating a modified signal used in television signal transmission in accordance with the present invention for providing automatic volume control.

Figure 9 is a schematic circuit diagram of a modified rectifier arrangement for providing the automatic volume control biasing voltage in connection with the signals of Figure 8.

Figure 10 is a schematic representation of a television system corresponding to the diagram of Figure 2, containing illustrations of the signals at the different stages of transmission and reception.

In practicing the invention, low frequency and direct current components are transmitted with sufficient precision by determining and transmitting their momentary values at intervals of time which are small in relation to the shortest periodicity in the signal and which may and preferably do correspond to the transmission pauses (synchronizing intervals). Thus for example, let us suppose that a sine wave as shown in Fig. 1a is to be transmitted. Such a wave could be transmitted with sufficient precision by sending the momentary pulses p shown in Fig. 1b. By filtering out the additional harmonics involved in the zigzag or stepped curve of the Fig. 1b, the original sine wave could again be reconstructed. In order to decrease the proportion of harmonics, a sequence of impulses as shown in Fig. 1b could with advantage be converted after transmission into a wave train as shown in Fig. 1c. The distortions present in this wave (as compared with the original sine wave of Fig. 1a) consist in a slight phase displacement of the fundamental wave and the addition of sum and difference frequencies. These latter frequencies can, of course, be filtered out again at the receiver after transmission. There would still remain, however, the phase displacement as indicated by the small time $\frac{1}{2}t$ in Fig. 1d.

It is further found that when several low frequencies are simultaneously transmitted in this way over the same channel then (neglecting channel distortion) no inter-modulation occurs, i. e., no combination frequencies of the different low fundamental frequencies occur.

The momentary signals may be transmitted by short wave trains of corresponding amplitude, phase or frequency, or by short impulses of corresponding amplitude or length. As such short signals always contain components of higher frequency, the transmission channel used must, of course, be designed to accommodate them.

A transmission channel able to handle the higher signal frequencies in a high fidelity television transmission system is sufficient for this and during the transmission pauses in the signal, is free for use for the transmission of such signals. Short signal pauses, as for instance (and preferably) the synchronizing intervals, can

therefore be used for the transmission of the lower frequencies and the direct current component. In this way the provision of a separate transmission channel for the low signal frequencies and the direct current component is avoided, and the whole signal can be transmitted over a channel suitable for the transmission of the higher frequencies but of comparatively small band width accommodation without the necessity for using a modulator or carrier as ordinarily employed.

Figure 2 shows in simplified block diagram form one arrangement in accordance with the invention for the transmission and reception of television signals. In Fig. 2, HP₁ is a high-pass filter by means of which higher frequencies are filtered out at the television signal generator Gen and introduced direct to the transmission system L, in general a transmission line or channel. TP₁ is a low-pass filter which separates out the lower frequencies and direct current component, and feeds them to a modulator device M which gives a modulated output corresponding to the signals during the transmission pauses and in particular during synchronizing pauses.

The low frequency signals transmitted as modulations of a higher frequency wave are filtered out and evaluated at the receiving end by a demodulator D which may be arranged to be switched in for example only at particular times—during the synchronizing intervals. The low frequencies thus recovered, together with the direct current component, are superposed through the low-pass filter TP₂ on the remaining higher signal frequencies fed through the high-pass filter HP₂ so that the original wide band television signals are again obtained substantially as generated. The filter HP₁ at the transmitter end may in some cases be omitted, for owing to the restricted frequency transmission range generally presented by the transmitting means, the lower frequency signals are as a rule kept back in any case. The low pass filter TP₁ can also be dispensed with. If this be done the momentary value of the television signal transmitted at any time in the pauses, and corresponding to the lower frequencies will also contain components of the higher frequencies, and this fact should be taken into consideration in evaluating the signals at the receiving end.

The synchronizing signals or impulses which are generally rectangular in wave shape and which occur at predetermined time-intervals T (see Figs. 4a and 8) may be, with great advantage, employed for the transmission of the momentary values of the low frequency and direct current components of the signal. As is well known, such voltage changes or synchronizing signals are correctly transmitted (see Fig. 3a) as regards their immediate commencements even though the channel employed for television transmission has very limited transmission qualities as regard lower frequencies. In particular the "height" h of the signal (see Fig. 3a) is correctly retained (as transmitted) at the beginning of the signal. It is only later on in the synchronizing interval (see Fig. 3b) that the absence of lower frequencies (due to losses in transmission) makes itself apparent and the curve—which should be horizontal—drops as shown in Fig. 3b.

In accordance with this invention, the "height" h of the synchronizing signal at the margin or commencement, and which remains even after transmission, is utilized as a measure of the mo-

mentary value of the whole signal directly before and after the synchronizing signal. The television signal to be transmitted, which as shown in Fig. 4a generally contains as the synchronizing signal a synchronizing interval t_2 at the end of each picture line (t_1), is, however, distorted. The actual signal during the transmission of a line t_1 is, owing to the many picture points, of a high frequency nature and therefore is not of further interest at the moment. It is necessary, however, to consider the slowly fluctuating mean value or signal envelope E_1 (see Fig. 4a) which obviously becomes reduced below its true value if the transmission channel introduces distortion of the nature illustrated in Fig. 3b. At the receiving station the alternating signal components of the television signals will be re-obtained as shown in Fig. 4b.

The low frequency components which are not properly transmitted can, however, be reintroduced at the receiving end by providing apparatus which applies to the receiver such additional voltage that during the synchronizing pauses a particular predetermined and constant voltage value is maintained. A low frequency supplementary voltage E_2 controlled by the voltage peaks J in the synchronizing signals (E_2 is shown in the broken lines in Fig. 4b) can be supplied and in this manner the low frequencies lost in the transmission means impermeable to low frequency may be made good and distortion of the nature illustrated by Fig. 3b compensated for. This supplementary voltage when superposed on the transmitted television signal restores for all practical purposes the original signal of Fig. 4a. The present invention provides such means.

The apparatus at D in Fig. 2 may include an automatic regulator which in response to small deviations of the synchronizing signal voltage from the predetermined normal value, e. g. zero voltage, effects the necessary corrections. The supplementary voltage as given by the envelopes line E_2 of Fig. 4b is then applied to the signal through the filter TP_2 . Rec represents a television receiver upon which the combined low and high frequencies are impressed for image translation.

Figure 5 shows, in simplified diagram form, a rectifier arrangement which can be used at D in Fig. 2. From the transmission line L (Fig. 2—not shown in Fig. 5) signals with reduced low frequencies as shown in Fig. 4b are applied via the terminals K_1 to a network including a condenser C and a rectifier R connected, for example, in such sense that it eliminates all the negative half waves of input voltage, so that the output terminals K can never become negative. The current passing through the rectifier raises the signals by the amount J in Fig. 4b, so that at the terminals K the original signal according to Fig. 4a is again obtained. W_1 is a resistance which prevents too high a rise of the signal voltage or too long a continuance at too high a value.

The regulating circuit of Fig. 5 thus maintains the voltage during synchronizing intervals of the television signal always at a predetermined value (in this case zero) and thus produces at the terminals K a very close approximation to the original signals of Fig. 4a. B and B_1 are bias batteries for suitably biasing the rectifier R and the current flow through the resistance W_1 . By adjusting these batteries, background or brightness control can be effected at the receiving end. A bias opposed to the pass direction of the rectifier will result in the negative half-waves of the in-

coming alternating voltage being only partly eliminated i. e. cut off after they have attained a certain negative value corresponding to the steady bias voltage. The condenser C is a blocking condenser.

There is no difficulty in separating out the synchronizing impulses for use for scanning deflection purposes. For example, in the simple circuit shown in Figure 6, the references K_1 , C, R and B and K represent the same parts as in Fig. 5, and the synchronizing signals are taken off from the terminals K if the voltage of the battery B_2 , which is in series with the second rectifier R_1 , is suitably adjusted. Alternatively, in an arrangement as shown in Fig. 5 a resistance may be connected in series with the rectifier G and synchronizing voltages taken off from the terminals across such resistance.

By suitable choice of the sense or polarity of the rectifier and of the bias voltage, synchronizing signals of almost any form, such as impulses having a predetermined maximum amplitude, can be used for the characterization of the lower signal frequencies. Again it is not necessary to use dry rectifiers, for other rectifiers, for instance diode valves or audion or other valve rectifiers can be used. Figure 7 shows a circuit like that of Figure 5 except that the rectifier is an audion valve rectifier R' with a high ohmic resistance W_2 in its grid circuit.

By suitably choosing the form of the synchronizing impulses, for example as shown in Figure 8, the rectifier arrangement may also be used to derive a regulating voltage for automatic amplification regulation i. e. for anti-fading volume control. A rectifier circuit suitable for this is shown in Fig. 9. Here it is assumed that the synchronizing voltage is of the form of Fig. 8 and if the portion which is present during the brief time t_3 exceeds a predetermined value E_3 (see Fig. 8) a current will flow through the rectifier R_2 , the battery B_3 and the resistance W_3 and will produce at the terminals K_2 a regulation voltage which can be used as known, per se, to reduce the amplification of the receiver. The battery B_3 provides a back voltage of value E_3 (Fig. 8) and therefore prevents current from flowing through the rectifier R_2 and producing across W_3 a voltage which will decrease the amplification, so long as the impulse portion of time duration t_3 does not exceed this normal value E_3 .

The invention is particularly applicable in the television and picture transmitting arts. The picture signal amplifier at the transmitter end may be an alternating current amplifier with a sufficiently low cut-off frequency, there being no need to provide a sub-carrier for the picture signals as a whole, and the television signals can be transmitted directly over one channel without displacing the signal frequency band in the frequency spectrum. This direct and simple transmission system offers various advantages in transmission; for instance, a high degree of constancy of mean transmitting power. In the receiver, faithful reproduction even of the lowest picture frequencies and a correct adjustment of the steady or background brightness can be attained very simply. Of course the known expedients of using carriers and sub-carriers can be employed if desired.

The invention is applicable not only to television but also to other communication systems. Thus for example, periodic, very brief and therefore not disturbing interruptions in transmission can be used for the characterization of the lower frequencies of a signal to be transmitted, where-

by simplified and cheapened transmission channels with relatively greatly limited transmission qualities for low frequencies can be used without resorting to the use of a carrier as in the ordinary way.

Another application of the invention is to direct current amplifiers, in which as is known the direct current component is always more or less subject to slow fluctuations as a result of fortuitous small alterations in the bias and other electrical parameters in the first stages.

By employing an arrangement in accordance with this invention, if necessary with a separate automatic regulating apparatus which reacts after the manner of a back-coupling on the bias at the input, the correct direct-current component of the amplified signals can always be again adjusted at the input and by short interruptions which should generally succeed each other only at considerable intervals of time. In such a case of course the upper cut-off frequency of the amplifier must be sufficiently high to allow of correct transmission of the characteristic impulses.

Figure 10 is a schematic representation of a television system corresponding to the diagram of Fig. 2 of the general application of the present invention. The television signal generator Gen contains conventional means for scanning the image to be transmitted and generating the signals represented by curve 11 comprising successive lines of scanning spaced by intervals 12 during which the synchronizing impulses or conditions take place. The line-by-line picture currents in the illustrated curve 11 have successively increasing average current values.

The output of the generator Gen is introduced to the high pass filter HP₁ which prevents the direct current and low frequency components of the television currents 11 from passing. The currents passed by the filter HP₁ corresponds to the curve 13 wherein the direct current has been removed as will be understood by those skilled in the art. Simultaneously, the output of the generator is introduced to the lowpass filter TP₁ wherein the high frequency currents corresponding to curve 13 are blocked and the low frequency and direct current components are passed. Curve 14 at the filter TP₁ represents the increasing direct current value of the signals 11 at the generator. The low frequency current curve 11 is substantially continuous, averaging out the synchronizing pauses corresponding to 12 at the generator.

In accordance with the present invention, the low frequency currents 14 are caused to modulate a high frequency carrier wave in order that transmission thereof may be feasible on the high frequency transmission channel useful for the high frequency components corresponding to curve 13 at the filter HP₁. Accordingly oscillator 15 is provided for introducing the continuous carrier frequency current to the modulator M wherein the low frequency current 14 produces the modulated current corresponding with curve 16. The dotted envelope 17-17' of the modulator curve 16 corresponds to the wave form of the direct current component 14, as is evident. Successive pulses may be substituted for the carrier wave.

The modulated curve 16 is transmitted between the television line currents and during the synchronizing intervals a synchronized relay S₁ provides the necessary selective switching to the transmission channel L. A time base unit 18

generates pulses 19 corresponding to the frequency of the synchronizing intervals and simultaneous therewith. The time base unit 18 operates the synchronized relay S₁ through the schematically indicated switch 20. It is to be understood that other well known switching means synchronized with the intervals 12 of the generated television signals may be used for the synchronized relay S₁. The design of the synchronous switching is predominantly electronic in character in order to properly actuate the signalling channel L at relatively high speeds of operation such as is requisite for television systems.

The composite signals introduced to the transmission channel L are represented by the curve 21 which comprises the curves 13 transmitted through the high pass filter HP₁ interspread by portions 22 of the low frequency modulated carrier current 16. It is to be understood that necessary amplifiers and circuit components are omitted for simplifying the representation of the present invention. The transmission line L is connected to the synchronized relay S₂ at the receiver which is operated by the time base unit 23 in a manner similar to the corresponding arrangement at the transmitter end. The frequency of the time base unit 23 corresponds to that of unit 18 and is arranged to maintain synchronous operation in a manner well known in the art. The switch 24 of the relay S₂ connects the current from channel L alternately to the high pass filter HP₂ and the rectifier D. The currents 13 pass through the high pass filter HP₂ and correspond to the similar currents 13 at the transmitter filter HP₁.

The modulated components 22 are introduced to the rectifier D and rectified in a manner illustrated by the pulses 26. The envelope 17' of the pulses 26 substantially defines the outline corresponding to the low frequency currents 14 at the transmitter. The circuits of Figs. 5, 6, 7 and 9 may be used as the rectifier D for producing the positive pulses 26.

The output of the rectifier D is passed through the low pass filter TP₂ to produce the current 27 of low frequency and block the high frequency components of the pulses 26. The wave shape of the filtered current 27 is practically the same as that of the transmitter current 14 as will now be evident. The high frequency currents 13 of the high pass filter HP₂ are introduced to the television translator or receiver Rec. simultaneously with the low frequency current 27 from the lowpass filter TP₂. The combined effect of the high and low frequency currents simultaneously acting at the receiver results in the current distribution illustrated by curves 28 and corresponding substantially identically with the curves 11 at the television generator.

The television translator Rec. is preferably a cathode-ray tube scanner or an equivalent receiver scanning device which is responsive to the combined high frequency and low frequency currents to build up the image in proper brilliancy and detail. Circuitual and operational details for the translation are of conventional form and arrangement.

I claim:

1. A method of transmitting a television signal band interrupted by successive synchronizing intervals, said band containing high frequency, low frequency and direct current components, which comprises the steps of segregating the low frequency and direct current components from the

signals, generating successive momentary signal impulses having amplitudes modulated in accordance with the low frequency and direct current components, and transmitting said impulses during said synchronizing intervals through a channel having a transmission band width corresponding substantially to the band embraced by the high frequency signal components, receiving the high frequency components and modulated impulses, synchronously segregating and rectifying the modulated signal impulses, producing a resultant low frequency and direct current from the rectified impulses, combining said resultant current with the received high frequency signal components to reconstruct the original wide band television signals, and deriving a direct potential from the rectified impulses for controlling the gain of the television receiver.

2. In a method of transmitting a signal wave comprising a direct current component and ranges of low and high frequency components lying above and below, respectively, of a predetermined frequency, the steps of splitting said wave into a first partial wave containing the range of low frequency components and said direct current component and a second partial wave containing the high frequency components only, generating successive short signal impulses having magnitudes representative of the momentary amplitude of said first partial wave and following each other at a frequency which is high compared with the highest component frequency of said first partial wave, transmitting said second partial wave through a transmitting channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, interrupting the transmission of said second partial wave during short periods substantially equal to the duration of and in synchronism with said signal impulses, and transmitting said signal impulses during the interrupting periods of said second partial wave through the same transmission channel.

3. In a method of transmitting a television signal wave comprising a direct current component and ranges of low frequency and high frequency components lying above and below, respectively, a predetermined frequency, said signal wave being interrupted by successive synchronizing intervals, the steps of splitting said signal wave into a first partial wave containing the range of low frequency components and said direct current component and a second partial wave containing the range of high frequency components only, generating successive short signal impulses having magnitudes representative of the momentary amplitude of said first partial wave and following each other at a frequency equal to and in synchronism with said synchronizing intervals, transmitting said second partial wave through a transmission channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, and transmitting said signal impulses through the same transmission channel during the interrupting intervals of said first partial wave.

4. A method of transmitting a signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, the steps of splitting said signal wave into a first partial wave comprising the range of low frequency components

and said direct current component and a second partial wave comprising the high frequency components only, generating a carrier wave, modulating said carrier wave in accordance with said first partial wave and producing from the modulated carrier a series of short carrier wave trains, said carrier wave trains following each other at a frequency which is high compared with the highest component frequency of said first partial wave, transmitting said second partial wave through a channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, sequentially interrupting the transmission of said second partial wave during short periods having a duration substantially equal to and in synchronism with said carrier wave trains, and transmitting said carrier wave trains through the same transmission channel during the interrupting periods of said second partial wave.

5. In a method of transmitting a television signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, said signal wave being interrupted by synchronizing intervals, the steps of splitting said signal wave into a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, generating a carrier wave, modulating said carrier wave in accordance with said first signal wave and producing therefrom short carrier wave trains having a duration substantially equal to and in synchronism with said synchronizing intervals, transmitting said second partial wave through a channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, and transmitting said carrier wave trains through the same transmission channel during the synchronizing intervals.

6. In a method of communication by means of a wide band signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, the steps of splitting said signal wave into a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, generating successive short signal impulses having magnitudes representative of the momentary amplitude of said first partial wave and following each other at a frequency which is high compared with the highest component frequency of said first partial wave, transmitting said second partial wave through a channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, interrupting the transmission of said second partial wave during short periods substantially equal to the duration of and in synchronism with said signal impulses, transmitting said signal impulses through the same transmission channel during the interrupting periods of said second partial wave, synchronously segregating the received impulses from the second partial wave at the receiver, producing a low frequency wave from the segregated impulses corresponding to said first partial wave, and combining said low fre-

quency wave with the received second partial wave to restore the original wide band signal wave.

7. In a method of transmitting a television signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, said signal wave being interrupted by successive synchronizing intervals, the steps of splitting said signal wave into a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, generating successive short signal impulses having magnitudes representative of the momentary amplitude of said first partial wave and following each other at a frequency equal to and in synchronism with said synchronizing intervals, transmitting said second partial wave through a transmission channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, transmitting said signal impulses through the same transmission channel during the interrupting periods of said second partial wave, synchronously segregating the received impulses from said second partial wave at the receiver, producing a low frequency wave from the segregated impulses corresponding to said first partial wave, and combining said low frequency wave with the received second partial wave to restore the original television signal wave.
8. In a method of transmitting a wide band signal frequency wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, the steps of splitting said signal wave into a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, generating a carrier wave, modulating said carrier wave in accordance with said first partial wave, interrupting the modulated carrier wave into a series of successive short wave trains following each other at a frequency which is high compared with the highest frequency component of said first partial wave, transmitting said second partial wave through a channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, interrupting the transmission of said second partial wave during short periods substantially equal to the duration of and in synchronism with said wave trains, transmitting said wave trains through the same transmission channel during the interrupting periods of said second partial wave, synchronously segregating the received wave trains from the second partial wave, demodulating the received wave trains and producing from the demodulated impulses a low frequency wave corresponding to said first partial wave, and combining said low frequency wave with the received second partial wave to restore the original wide band signal wave.
9. In a method of transmitting a television signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, said signal wave being interrupted by successive synchronizing intervals, the steps of splitting said signal wave into

a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave containing the range of high frequency components only, generating a carrier wave, modulating said carrier wave in accordance with said first partial wave, interrupting the modulated carrier wave into a series of short wave trains following each other at the frequency of and in synchronism with said synchronizing intervals, transmitting said second partial wave through a transmission channel having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, transmitting said wave trains through the same transmission channel during the synchronizing intervals of said second partial wave, synchronously segregating the received carrier wave trains from said second partial wave, demodulating the received wave trains and producing from the demodulated impulses a low frequency wave corresponding to said first partial wave, and combining said low frequency wave with the received second partial wave to restore the original television signal wave.

10. In a method of transmitting a signal wave comprising a direct current component and a band of alternating current components, the steps of splitting said signal wave into a pure alternating current wave and the direct current component, generating successive short signal impulses having amplitudes characteristic of the momentary magnitude of said direct current component, transmitting said alternating current wave through a channel having a frequency pass range substantially equal to the frequency band encompassed by said alternating current wave, interrupting the transmission of said alternating current wave during short intervals substantially equal to the duration of and in synchronism with said signal impulses, transmitting said signal impulses through the same transmission channel during the interrupting periods of said alternating current wave, synchronously segregating said impulses from the alternating current wave, utilizing the segregated impulses to reconstruct the original direct current component, and combining the reconstructed direct current component with the received alternating current wave to restore the original signal wave.

11. In a method of transmitting a signal wave comprising a direct current component and a band of alternating current components, the steps of splitting said signal wave into an alternating current wave and the direct current component, generating a carrier current, modulating said carrier current in accordance with the variations of said direct current component, interrupting the modulated current to produce short successive carrier wave trains, transmitting said alternating current wave through a channel having a pass range corresponding substantially to the frequency band encompassed by said alternating current wave, interrupting the transmission of said alternating current wave during short periods substantially equal to the duration of and in synchronism with said carrier wave trains, transmitting said carrier wave trains through the same transmission channel during the interrupting periods of said alternating current wave, synchronously segregating the carrier wave trains from the alternating current wave, demodulating the segregated carrier wave trains and utilizing the demodulated impulses to reconstruct the original direct current component, and combining the

reconstructed direct current component with the received alternating current wave to restore the original signal wave.

12. In a system for transmitting a wide band signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, means for splitting said signal wave into a first partial wave containing the range of low frequency components and said direct current component and a second partial wave containing the range of high frequency components only, means for generating short signal impulses having magnitudes characteristic of the momentary amplitude of said first partial wave and following each other at a frequency which is high compared with the highest component frequency of said first partial wave, a transmission channel for said second partial wave having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, means for interrupting the transmission of said second partial wave during short periods substantially equal to the duration of and in synchronism with said signal impulses, means for transmitting said signal impulses through said transmission channel during the interrupting periods of said second partial wave, segregating means operating in synchronism with said interrupting means for segregating said signal impulses from said second partial wave at the receiving end of said channel, means including smoothing filter means for reconstructing said first partial wave from the received impulses, and means for combining the reconstructed wave with the received second partial wave to restore the original wide band signal wave.

13. In a system for transmitting a television signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, said signal wave being interrupted by successive synchronizing intervals, means for splitting said signal wave into a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, means for generating successive short signal impulses having magnitudes representative of the momentary amplitude of said first partial wave and following each other at a frequency equal to and in synchronism with said synchronizing intervals, a transmission channel for said second partial wave having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, means for transmitting said signal impulses through said transmission channel during the synchronizing intervals, synchronous segregating means at the receiving end of said channel for segregating said impulses from said second partial wave, means including smoothing filter means for reconstructing the original first partial wave from the segregated impulses, and means for combining the reconstructed wave with the received second partial wave to restore the original television signal wave.

14. In a system for transmitting a wide band signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, means for splitting said signal wave into a first partial

wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, means for generating a carrier wave, means for modulating said carrier wave in accordance with said first partial wave, means for interrupting the modulated carrier wave into a series of successive short carrier wave trains following each other at a frequency which is high compared with the highest component frequency of said first partial wave, a transmission channel for said second partial wave having a frequency pass range corresponding substantially to the frequency band encompassed by said second partial wave, means to interrupt the transmission of said second partial wave during intervals substantially equal to and in synchronism with said carrier wave trains, means for transmitting said carrier wave trains through said transmission channel during the interrupting periods of said second partial wave, synchronous segregating means at the receiving end of said channel for segregating the received carrier wave trains from said second partial wave, means comprising demodulating and filter means to reconstruct the first partial wave from the segregated carrier wave trains, and means for combining the reconstructed wave with the received second partial wave to restore the original wide band signal wave.

15. In a system for transmitting a television signal wave comprising a direct current component and ranges of low frequency and high frequency components lying below and above, respectively, a predetermined frequency, said signal wave being interrupted by successive synchronizing intervals, means for splitting said signal wave into a first partial wave comprising the range of low frequency components and said direct current component and a second partial wave comprising the range of high frequency components only, means for generating a carrier wave, means for modulating said carrier wave in accordance with said first partial wave, means for interrupting the modulated carrier wave into a series of wave trains having a duration substantially equal to and in synchronism with said synchronizing intervals, a transmission channel for said second partial wave having a frequency pass range encompassing substantially the frequency band encompassed by said second partial wave, means for transmitting said carrier wave trains through said transmission channel during the synchronizing intervals of said second partial wave, means for segregating said carrier wave trains from said second partial wave at the receiving end of said channel, means including demodulating and filter means for reconstructing said first partial wave from the segregated carrier wave trains, and means for combining the reconstructed wave with the received second partial wave to restore the full original television signal wave.

16. In a system for transmitting a signal wave comprising a direct current component and a range of alternating current components, means for splitting said signal wave into an alternating current wave and the direct current component, means for generating successive signal impulses having amplitudes representative of the momentary magnitude of said direct current component, a transmission channel for the alternating current wave having a frequency pass range corresponding substantially to the frequency band encompassed by said alternating current wave,

means for interrupting the transmission of said alternating current wave during short periods substantially equal to the duration of and in synchronism with said signal impulses, means
5 for transmitting said signal impulses through said transmission channel during the interrupting periods of said alternating current wave, segregating means synchronized with said interrupting means at the receiving end of said channel
10 for segregating said signal impulses from the alternating current wave, means including smoothing filter means to reconstruct the original direct current component from the segregated impulses, and means for combining the re-
15 constructed direct current component with the received alternating current wave to restore the original signal wave.

17. In a system for transmitting a signal wave comprising a direct current component and a
20 range of alternating current components, means for splitting said signal wave into an alternating current wave and the direct current component, means for generating a carrier wave, means for modulating said carrier wave in accordance with
25 variations of said direct current component,

means for interrupting the modulated carrier wave into a series of short wave trains following each other in rapid succession, a transmission channel for said alternating current wave having a frequency pass range corresponding
5 substantially to the frequency band encompassed by said alternating current wave, means for interrupting the transmission of said alternating current wave during short intervals substantially
10 equal to the duration of and in synchronism with said wave trains, means for transmitting said wave trains through said transmission channel during the interrupting periods of said alternating current wave, segregating means syn-
15 chronized with said interrupting means at the receiving end of said channel for segregating said wave trains from said second partial wave, means including demodulating and smoothing
20 filter means for reconstructing said first partial wave from the segregated wave trains, and means for combining the reconstructed wave with the received second partial wave to restore the original signal wave.

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