

Aug. 11, 1942.

A. V. BEDFORD

2,292,816

PICTURE TRANSMITTING APPARATUS

Filed April 20, 1938

4 Sheets-Sheet 1

FIG. 1.

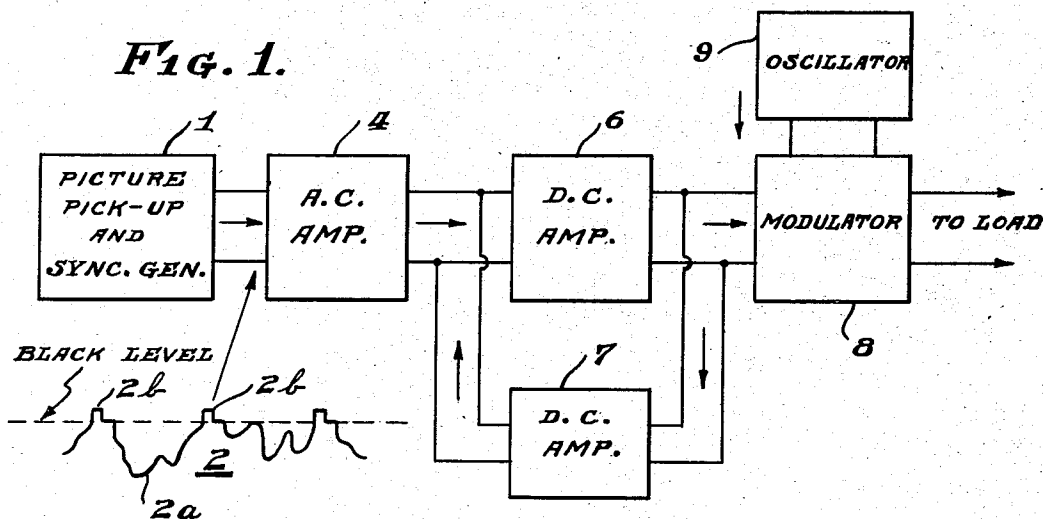


FIG. 2.

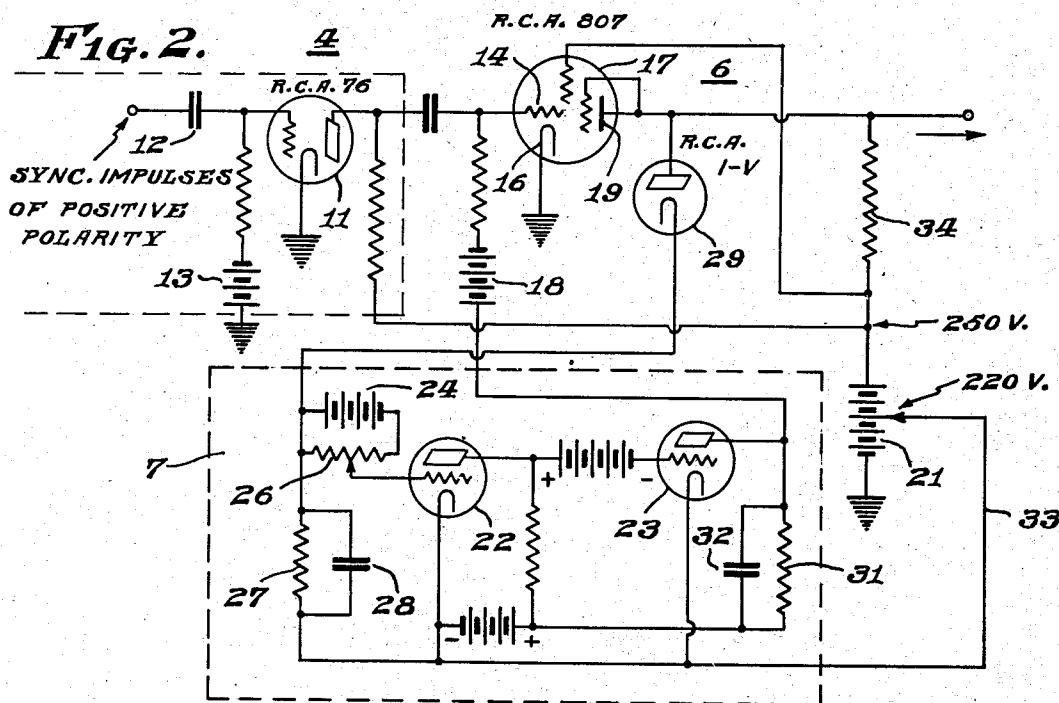


FIG. 3a.

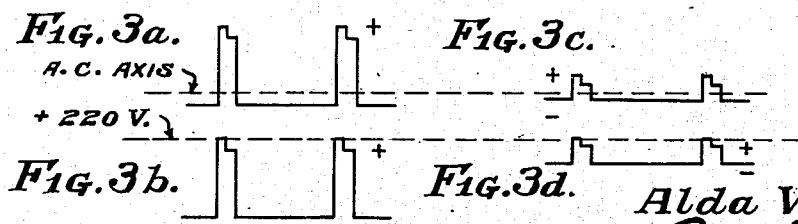
A.C. AXIS

+ 220 V.

FIG. 3b.

FIG. 3c.

FIG. 3d.



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Fig. 4.

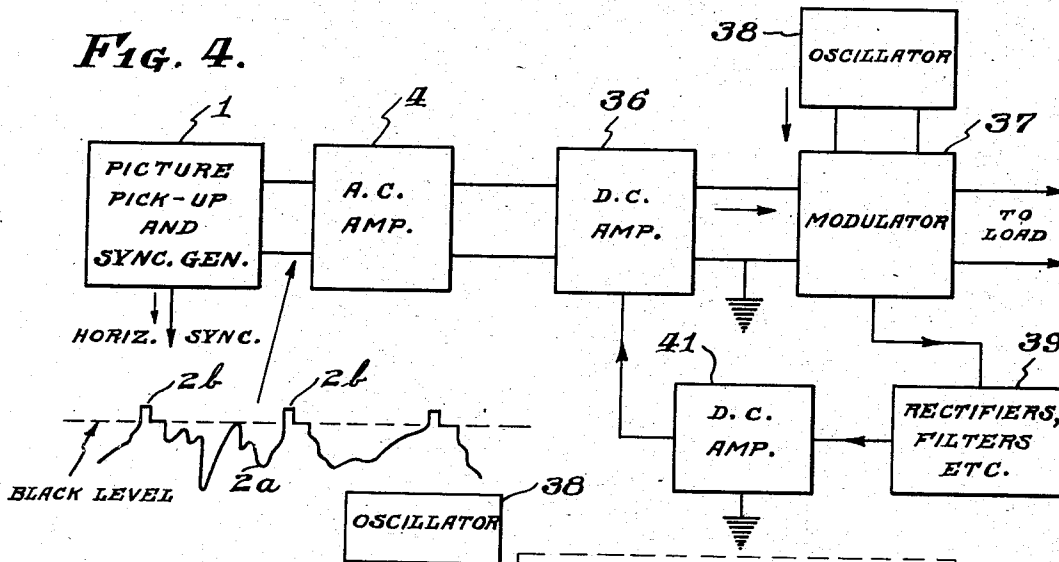
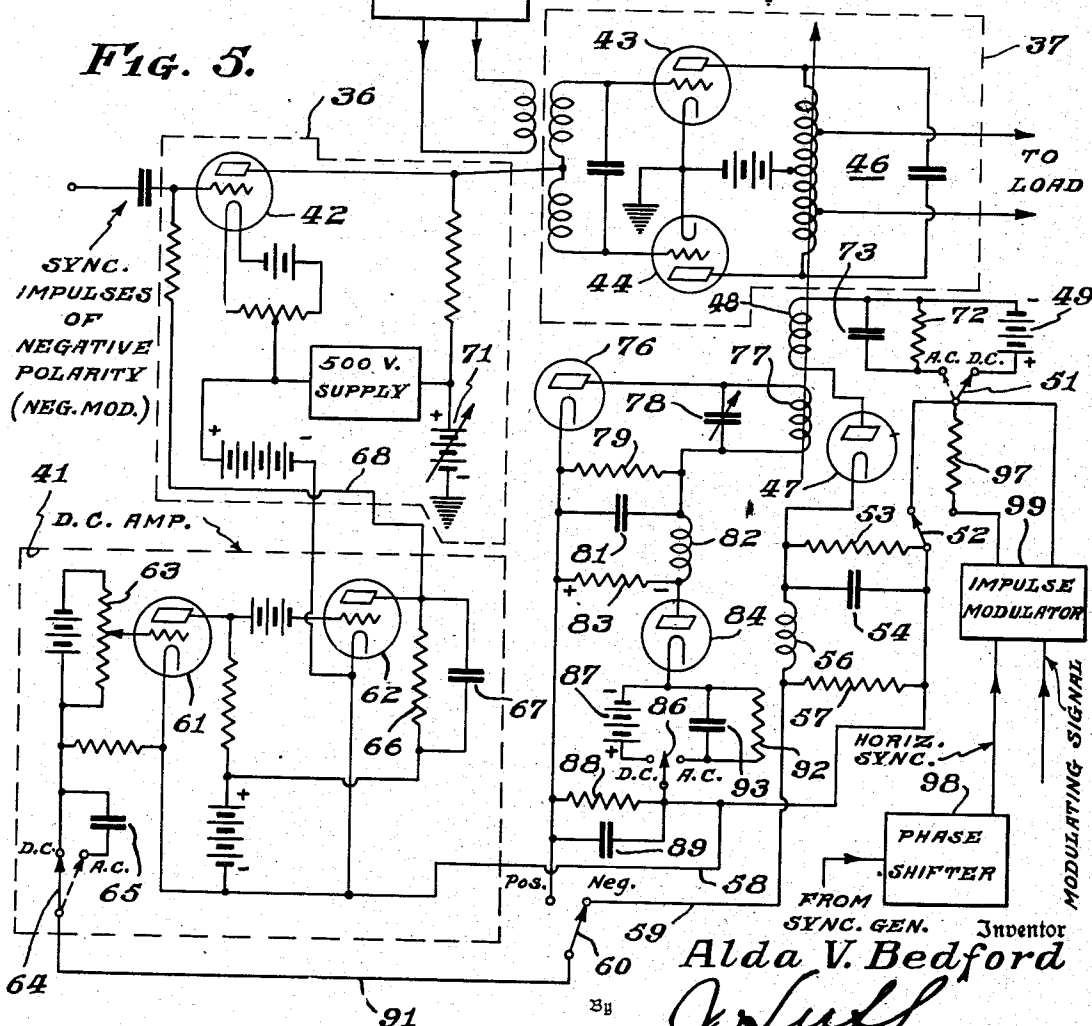


Fig. 5.



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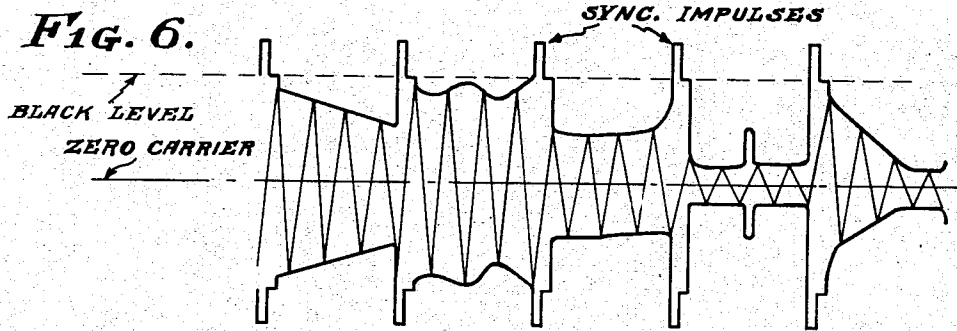


FIG. 7a.

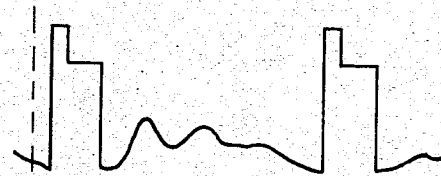


FIG. 7b.

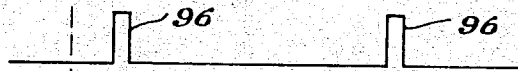


FIG. 7c.

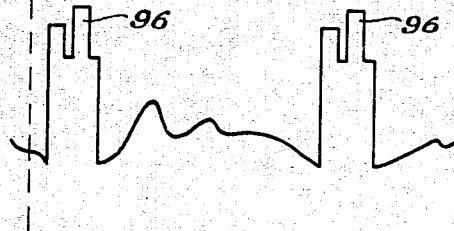


FIG. 8.

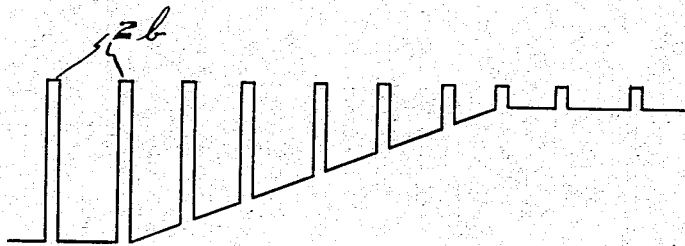
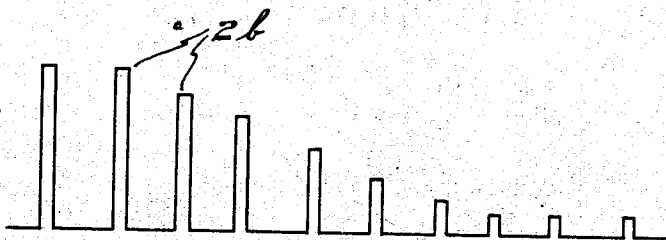


FIG. 8a.



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Fig. 9a.

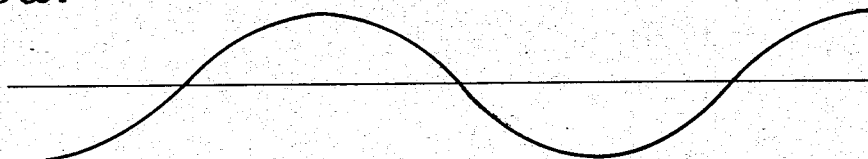


Fig. 9b.

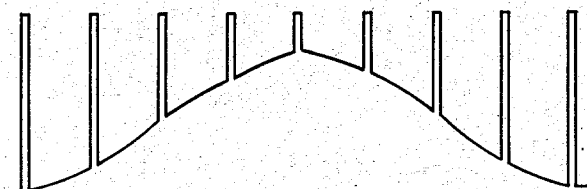
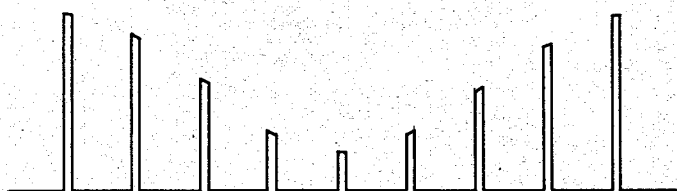


Fig. 9c.



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UNITED STATES PATENT OFFICE

2,292,816

PICTURE TRANSMITTING APPARATUS

Alda V. Bedford, Collingswood, N. J., assignor to
Radio Corporation of America, a corporation
of Delaware

Application April 20, 1938, Serial No. 203,015

7 Claims. (Cl. 178—7.1)

My invention relates to the transmission of electrical signals such as picture signals and particularly to a picture transmitter designed to transmit the direct current component of picture signals.

It has been found advantageous in television systems to transmit all frequency components of the picture signals down to and including zero frequency, that is, direct current. The principal advantage of such transmission is that the large power tubes of the transmitter are used more efficiently for reasons which need not be discussed here.

Transmission of the direct current and very low frequency components of signals cannot be effected conveniently by employing direct current amplifiers in the entire amplifier channel from the input to the output of the transmitter. As is well known, it is much easier to design satisfactory A. C. amplifiers than to design satisfactory D. C. amplifiers, especially if the amplifier must give uniform gain over a wide frequency band of the character required in television transmission.

It is, accordingly, an object of my invention to provide an improved method of and means for transmitting the direct current and low frequency components of picture signals.

A further object of my invention is to provide an improved method of and means for reducing the effects of low frequency disturbances in a picture transmitter.

In the preferred embodiment of my invention, as applied to a television transmitter, horizontal synchronizing impulses are produced at the end of each scanning line and vertical synchronizing or framing impulses are produced at the end of each picture frame. The synchronizing impulses are mixed with the picture signals for transmission therewith.

Suitable means is employed to make the synchronizing impulses have a predetermined amplitude with respect to "black" in the picture signal before they and the picture signals are passed through the main A. C. amplifier of the transmitter.

After the signals have passed through the main A. C. amplifier, the synchronizing impulses would no longer have their original amplitude (because of the loss of the D. C. and low frequency components) unless a special circuit were employed for restoring their original amplitude and thus restoring the lost components.

In accordance with one of the preferred embodiments of my invention this restoration of

lost components is accomplished by supplying the carrier wave, after it has been modulated by the picture signals and synchronizing impulses, to a biased rectifier circuit. This circuit is so adjusted that when the modulated carrier wave exceeds a predetermined amplitude it is rectified and fed back to a D. C. portion of the transmitter amplifier channel to reduce the amplitude of the carrier wave. The carrier wave peaks which are rectified are the peaks representing synchronizing impulses. In this way the synchronizing impulses are restored to their original amplitude whereby the lost D. C. and low frequency components are restored.

Other objects, features and advantages of my invention will appear from the following description taken in connection with the accompanying drawings in which

Figure 1 is a block diagram of one embodiment of my invention,

Figure 2 is a circuit diagram of the embodiment illustrated in Fig. 1,

Figures 3a to 3d, inclusive, are curves which are referred to in explaining the operation of the circuit shown in Figs. 1 and 2,

Figure 4 is a block diagram of the preferred embodiment of my invention,

Figure 5 is a circuit diagram of the embodiment shown in Fig. 4,

Figure 6 is a curve which is referred to in explaining the invention,

Figures 7a, 7b and 7c are curves which are referred to in explaining one way in which the apparatus shown in Fig. 5 may be operated, and

Figures 8 to 9c are other curves which are referred to in explaining the invention.

Referring to Fig. 1, one embodiment of my invention is shown applied to a television transmitter which comprises suitable means represented by the block 1 for generating picture signals and synchronizing impulses. The apparatus indicated by reference numeral 1 may be designed in accordance with the teachings of my Patent 2,192,121, issued Feb. 27, 1940, entitled "Television systems and the method of operation thereof" and assigned to the Radio Corporation of America. The important feature of its design is that the synchronizing signals have a predetermined amplitude with respect to "black" in the picture.

The output of block 1 is represented by the curve 2. It is a composite signal comprising picture signals 2a, and synchronizing impulses 2b which, in the illustration, are the horizontal synchronizing impulses. The output of block 1,

in the example being described, is the same as the output supplied to the transmitter 168 of my above-mentioned patent. The apparatus in the block 1 may be identical with the apparatus shown in the said copending application which supplies a composite signal to the said radio transmitter 168.

It will be noted that in curve 2 each synchronizing impulse consists of a "pedestal" which always comes to the "black" picture level and a "super-sync" impulse which is set on the front edge thereof.

It should be understood that this specific kind of synchronizing signal is not necessary in practicing my invention, that is, the pedestal may be omitted. For example, British Patent 406,672, filed August 31, 1932, shows how to produce background "control" impulses which always reach a level representing "black" in the picture. My synchronizing impulses may be generated in this same way, if desired.

Or, the composite signal may be generated as taught by French Patent 738,475, having the delivered date of October 17, 1932, where the peak of each synchronizing impulse goes to a fixed value beyond "black" in the picture.

The signal supplied by block 1 is impressed upon an alternating current amplifier 4 which greatly amplifies the composite signal. Amplifier 4 is a high gain, wide band pass, amplifier which could not easily be designed to pass direct current.

The amplified signal appearing in the output of amplifier 4 no longer contains the direct current and low frequency components. This means, referring to Figs. 8 and 8a, that the synchronizing signals 2b (shown without pedestals as described in the above-mentioned French patent) no longer reach "black" as in Fig. 8 but reach other levels as in Fig. 8a.

The lost components are restored as follows: The output of amplifier 4 is supplied to a direct current amplifier 6 which is provided with a negative feedback circuit including a D. C. amplifier 7. The feedback circuit is so designed that a bias is applied to the input circuit of amplifier 6 which has a value depending upon the amplitude of the synchronizing impulses which appear in the output circuit of amplifier 6. Thus, as will be more fully explained in the following paragraphs, the synchronizing impulses are again brought up to the "black" level, whereby there is supplied to a modulator 8 a signal of the same character as that shown by the curve 2.

The carrier wave which is modulated in modulator 8 by the composite video signal is supplied from a suitable oscillator 9.

The operation of the direct current and low frequency reinserting circuit will be better understood by referring to the circuit diagram in Fig. 2.

Referring to Fig. 2, the last amplifier tube of the A. C. amplifier 4 is indicated at 11. The number of amplifier stages in the amplifier 4 is such that the synchronizing impulses which are impressed through the coupling condenser 12 upon the grid of tube 11 are of positive polarity. Tube 11 is suitably biased by means of a battery 13 or the like to make it function as an undistorting amplifier or type A amplifier for video signals.

The amplifier tube 11 is coupled by means of resistance capacity coupling to the control grid 14 and cathode 16 of the amplifier tube 17 in the direct current amplifier 6.

The control grid 14 is biased negatively by

means of a fixed biasing source 18 and by means of a biasing potential supplied from D. C. amplifier 7, this last biasing potential being determined, as will be explained hereinafter, by the synchronizing impulses.

The plate 19 of the tube 17 is supplied with a direct current operating potential from a suitable source such as a 250 volt battery 21. In the specific example illustrated, the screen grid of the tube 17 is also supplied with operating potential from the battery 21 while the suppressor grid is connected directly to the plate 19. It will be understood that the tube 17 may be a three-element tube, if desired.

The direct current amplifier 7 includes amplifier tubes 22 and 23, the output circuit of tube 22 being coupled to the input circuit of tube 23 by means of a suitable direct current connection.

The input circuit of tube 22 includes an adjustable fixed bias which may consist of a battery 24 which is shunted by a potentiometer 26. This input circuit also includes in series with the adjustable fixed bias a resistor 27 which is shunted by a condenser 28 whereby a control voltage may be built up across the resistor 27. The relative impedance values of resistor 27 and condenser 28 are such that impulses supplied to this resistor-condenser circuit at the frequency at which synchronizing impulses occur are integrated or filtered to produce substantially a steady direct current.

A control voltage is caused to appear across the resistor 27 by the utilization of a rectifier tube 29 which has its plate connected to the plate 19 of tube 17 and which has its cathode connected to the high potential end of the resistor 27. As will be explained more in detail later, the synchronizing impulses, when they exceed a certain amplitude, cause a flow of current through the rectifier 29 whereby the condenser 28 receives a charge and whereby the direct current output of the D. C. amplifier 7 is changed. This direct current output is applied to the control grid 14 of the tube 17 in negative feedback relation whereby the tendency for current flow through rectifier 29 is reduced.

Preferably the output circuit of the D. C. amplifier 7 includes a filter consisting of a resistor 31 and a condenser 32 for further smoothing out the current impulses supplied by the rectifier 29. The time constant of the filter 31-32 may be the same as that of the filter 27-28, the time constant being such that there is only a small discharge of the condenser 32 through the resistor 31 between successive synchronizing impulses.

Referring more specifically to the operation of the above described circuit, reference will be made to the curves shown in Figs. 3a to 3d. The curves shown in Figs. 3a to 3c represent signals having a light background and having a dark background, respectively. Also, these are the signals with the D. C. component removed as they appear at the grid of tube 11. Considering the "dark" signal shown in Fig. 3c, the circuit may be adjusted as follows: The bias supplied by the battery 18 to the grid 14 is so adjusted that the positive peak of the "dark" signal causes the plate 19 to go to a potential of 220 volts. Also, a bias potential of 220 volts has been applied from the battery 21 through the conductor 33 to the rectifier 29. It will be seen that this is an adjustment for the condition of no-current flow through rectifier 29. Due to the voltage drop in the plate resistor 34 of tube 17, the plate of the rectifier 29 is at the same potential as the cath-

ode of the rectifier 29. It should be remembered that since there is no current flow through the rectifier, there is no voltage appearing across the resistor 27. Therefore, with the above described adjustment, we have in the plate circuit of the tube 17 the condition illustrated in Fig. 3d. In other words, the positive peaks of the synchronizing impulses are at the 220 volt level.

Now, assume that the signal input to the tube 11 changes to the "light" signal illustrated in Fig. 3a. It will be evident that this tends to make the control grid 14 more negative thus reducing the potential drop in resistor 34 whereby the plate of rectifier 29 goes slightly positive to cause charging current to flow into condenser 28. This makes the grid of the tube 22 more positive and therefore the plate of tube 23 and the grid 14 more positive. Thus, the grid 14 has been brought back to almost its original potential. How close it is brought back to its original potential is determined by the gain of the D. C. amplifier 7.

The result of this action is illustrated in Fig. 3b where the "light" signal as it appears in the plate circuit of tube 17 is illustrated. It will be seen that the positive peaks of the synchronizing impulses for this signal as for the "dark" signal go to the 220 volt level.

Comparing the curves in Figs. 3a to 3d with those in Figs. 8 and 8a, it will be seen that where the synchronizing impulses were generated with their peaks at a given level such as that representing "black" in the picture signal and where the signal has later lost the direct current component so that the synchronizing impulse peaks are no longer at this level, as shown in Figs. 3a and 3c and in Fig. 8a, the synchronizing impulses may be brought back to this original level, as shown in Figs. 3b and 3d and in Fig. 8, whereby the lost direct current and low frequency components are reinserted.

It may be noted that the above described negative feedback action under the control of synchronizing impulses is described in Patent No. 2,124,044, issued July 19, 1938, in the name of A. W. Vance, and assigned to Radio Corporation of America. In this Vance patent, there is described the use of an amplifier tube biased beyond cut-off which may be utilized in place of the rectifier 29 shown in Fig. 2.

In Fig. 4 there is shown a block diagram of the preferred embodiment of my invention. Like parts in Figs. 1 and 4 are indicated by the same reference characters. In this embodiment of my invention the picture signal and synchronizing impulses are generated in the manner previously described and amplified to the desired level by means of an alternating current amplifier 4. The amplified signal is then supplied to a direct current amplifier 36 and next impressed upon a suitable modulator 37 for modulating a carrier wave supplied by an oscillator 38.

The lost direct current and low frequency components are inserted by means of a feedback circuit which derives the negative feedback control voltage from the modulated carrier wave. The negative feedback circuit includes suitable rectifiers, biasing sources and filters indicated at 39 and a direct current amplifier indicated at 41.

The preferred embodiment will be better understood by referring to Fig. 5 where parts similar to those in Fig. 4 are indicated by like reference numerals.

Referring to Fig. 5, the amplifier 36 comprises an amplifier tube 42 which is direct current

coupled to the input circuit of the modulator 37 comprising amplifier tubes 43 and 44 connected to push-pull relation.

In this embodiment of the invention (assuming negative modulation) the number of stages in the amplifier 4 is such that the synchronizing impulses when impressed upon the grid of the amplifier tube 42 are of negative polarity. Therefore, they appear on the control grids of modulator tubes 43 and 44 with a positive polarity whereby they cause an increase in the amplitude of the radiated carrier wave. The carrier wave supplied by the oscillator 38 is also supplied to the input circuit of modulator tubes 43 and 44 whereby the carrier wave is modulated by the video output of the tube 42 in a well known manner. This modulated carrier wave appears in the tank circuit 46 of the modulator whereby it may be supplied over a transmission line or the like to the antenna or other load.

The signal which it is desired to radiate and which contains the direct current and low frequency components is illustrated in Fig. 6. It will be seen that the maximum amplitude of the modulated carrier wave represents the synchronizing impulses and that all these impulses come to a fixed value with respect to the predetermined "black" level. It will be understood that without the action of a direct current reinserting circuit, the signal would not have the character shown in Fig. 6 but instead the carrier wave representative of synchronizing impulses would not be at the "black" level.

In accordance with my invention, I reinsert the direct current and low frequency components by rectifying the carrier wave representative of synchronizing impulses when it exceeds a certain predetermined value and feeding back this rectified voltage to the direct current amplifier 26. I accomplish this by means of a rectifier 47 which is coupled to the tank circuit 46 through an inductance coil 48. Rectifier 47 and coil 48 are connected in series with a biasing battery, or the like, 49, these in turn being connected in series through switches 51 and 52 to a filter resistor 53 shunted by a filter condenser 54.

With the switches 51 and 52 in the position illustrated, for direct current transmission, whenever the carrier wave voltage impressed upon the rectifier 47 exceeds the negative biasing voltage of battery 49 a charging current will flow into the filter condenser 54. Because of the time constant of the circuit comprising condenser 54 and resistor 53, the periodic current flow into condenser 54 caused by recurring synchronizing impulses will be substantially steady direct current. This current may be further filtered by means of a filter coil 56 and filter resistor 57.

The control voltage appearing across resistor 57 is supplied through conductors 58 and 59 to the input circuit of the direct current amplifier 41, a switch 60 being set on the position for negative modulation.

The amplifier 41 comprises tubes 61 and 62 coupled in any suitable manner for transmitting direct current.

The input circuit of tube 61 includes variable biasing means 63 and a switch 64 which is shown in position for direct current transmission. As will be explained later, it may be moved to a position for alternating current transmission, the control voltage in this case being fed back through a coupling condenser 65.

The output circuit of the tube 62 preferably includes a filter comprising a resistor 66 and a

condenser 67 for further filtering the feedback control voltage. The plate of the tube 62 is connected through a conductor 68 to the control grid of amplifier tube 42 whereby the direct current output of amplifier 41 biases the tube 42 and thus controls its direct current output.

From the foregoing description it will be seen that, with the switches in the positions illustrated in Fig. 5, the television transmitter will transmit the direct current and low frequency components for the condition of negative modulation of the carrier wave by the synchronizing impulses, that is, for the condition where the synchronizing impulses increase the amplitude of the carrier wave.

In the circuit of Fig. 5, the adjustment is substantially the same as that described in connection with Fig. 2. The circuit is so adjusted by adjusting a biasing battery 71 in the input circuit of the modulator and by adjusting the value of biasing battery 49 that when the carrier wave is being modulated by a dark signal such as represented by Fig. 3c there is little or no flow of current through the rectifier 47. The adjustments are made such that the synchronizing peaks cause the maximum carrier which is desired for any picture condition. Now, when a light signal, such as represented by Fig. 3a, modulates the carrier wave, the peak amplitude of the carrier representing the synchronizing impulses increases to cause charging current to flow into condenser 54 whereby a positive voltage is supplied over conductor 59 to the grid of tube 61. This in turn makes the control grid of tube 42 more positive whereby the control grids of tubes 43 and 44 are made more negative and whereby the peak value of the carrier wave is held down to approximately the original pre-set level.

It will be understood that the above described circuits will remove low frequency disturbances which are introduced at points in the transmitter following the equipment represented by the block 1. For example, if a low frequency disturbance, such as a 60 cycle ripple, occurs in the amplifier 4, or in the oscillator 38, it will cause the synchronizing impulses to follow the form of this sine wave and the D. C. reinserting circuit which follows will remove the 60 cycle ripple by again levelling off the synchronizing impulses.

The action of the circuits in restoring low frequency components which have been filtered out by the alternating current amplifier 4 is illustrated in Figs. 9a to 9c. If the curve in Fig. 9a represents a low frequency component in the picture signal, which it is desired to transmit, the output of the block 1 may be represented by the curve in Fig. 9b. Here it will be noted that the synchronizing impulses all come up to a predetermined level with respect to "black" in the picture signal. In effect, the synchronizing impulses have been modulated by the low frequency component as is evident by referring to Fig. 9c where the low frequency component of Fig. 9a has been filtered out by the A. C. amplifier. It will be apparent that, after the signal shown in Fig. 9c has been passed through the reinserting network and the peaks of the synchronizing impulses brought back to their original level, the low frequency component of Fig. 9a will have been reinserted.

It may be desirable to transmit picture signals without the direct current component but still retain the property of my improved system to buck out low frequency interference and ac-

curately restore low frequency response. To operate the system of Fig. 5 in this manner, switches 51 and 64 are thrown to the dotted line A. C. positions. With the switch 51 in the A. C. position, the biasing battery 49 is removed from the circuit and there is substituted therefor a filter comprising a resistor 72 and a condenser 73. In this case, the condenser 73 gradually charges up to any value required to substantially stop the synchronizing peaks from causing current flow through rectifier 47 so that the voltage across resistor 57 is merely an indication of the height of the impulses. The signal across resistor 57 reaches the direct current amplifier 41 through the coupling condenser 65 which transmits only the A. C. components. The low frequency component of this alternating current progresses through the negative regeneration loop and tends to hold the impulse peaks to a value which is permitted to drift or change only at a very low frequency rate.

According to another embodiment of my invention it may be desired to transmit a signal in which the synchronizing impulses are represented by a decrease in the carrier wave amplitude, this being known as "positive transmission" in R. M. A. standards. In this case the synchronizing impulses are of positive polarity on the control grid of tube 42. With this type of transmission the radio frequency peaks are not representative of synchronizing peaks so that the radio frequency must be detected before it is applied to that rectifier which responds to the height of the synchronizing peaks.

In Fig. 5 this detection is accomplished by means of a rectifier 76. In this case the diode 76 is supplied with energy from the tank circuit 46 by means of a coil 77 coupled thereto and tuned to the carrier frequency by means of a condenser 78. The rectified current is fed into a load circuit comprising a filter resistor 79 and a filter condenser 81. This load circuit 79-81 has a very low impedance compared with the impedance of the circuit comprising rectifier 76 and coupling coil 77 in series whereby tube 76 functions as an ordinary detector. Further filtering may be provided by means of an inductance coil 82 and a resistor 83. The video signal appearing across resistor 83 is now supplied to a rectifier tube 84 which corresponds in function to the rectifier tube 47 for the case of negative modulation.

For the transmission of the direct current component a switch 86 is on the D. C. position whereby a biasing battery 87 is connected in series with the resistor 83, the rectifier 84 and a filter resistor 88, the filter resistor 88 being shunted by a filter condenser 89. The parallel circuit comprising resistor 88 and condenser 89 has a high impedance compared with the circuit consisting of rectifier 84 and resistor 79 and 83 in series therewith, whereby tube 84 functions as a special peak voltage responsive device.

The battery 87 is so poled that it tends to cause a flow of current through the rectifier 84. However, the battery voltage is opposed by the voltage drop across resistor 83, the direction of current flow through resistor 83 being determined by the rectifier 76. Thus, when the modulated carrier representative of synchronizing impulses decreases in amplitude (due to an increase in impulse amplitude at the grid of tube 42) the flow of current through resistor 81 decreases, and current flows through rectifier 84 to charge con-

denser 89, whereby the switch terminal marked "Pos." becomes more negative.

Thus, with the switch 60 in the left hand position for positive modulation transmission, a substantially steady D. C. voltage will appear across condenser 89 whereby a negative potential will be applied through the conductor 91 and through the switch 64 (which is in the D. C. position) to the grid of tube 61 thereby making the grid of tube 42 more negative and making the grids of the modulator more positive, thereby increasing the amplitude of the carrier wave. Thus, as in the cases previously described, any tendency of the peaks of the synchronizing impulses to go beyond a predetermined fixed level is counteracted by the negative feedback circuit.

It will be understood that the filter 88—89 has a time constant such that the condenser 89 discharges only a very small amount between the currents of synchronizing impulses.

For positive transmission, as in the case of negative transmission, my control circuit may be utilized to reduce low frequency disturbances when it is not desired to transmit the direct current component. In this case, the switch 60 being on the positive transmission position, the switches 86 and 64 are set on the A. C. positions. Here, again, the biasing battery in series with the rectifier is replaced by a filter such as the resistor 92 and condenser 93, this filter corresponding to the filter 72—73 in the other embodiment.

In accordance with still another embodiment of my invention, which is claimed in my divisional application Serial No. 426,811, filed January 15, 1942, the switch 52 may be thrown to the right hand position to produce the feedback signal illustrated in Fig. 7c whereby the control voltage is derived from impulses 96 which are set on top of the pedestals. This type of control may be employed for either A. C. or D. C. transmission.

The signal of Fig. 7c is produced by adding the signal of Fig. 7a (representing one side or polarity of a modulated carrier) which appears in the tank circuit 46 and the signal of Fig. 7b which appears across a resistor 97. The side of the carrier represented by Fig. 7c is rectified by the rectifier 47, but because of the biasing battery 49 (or filter 72—73) only the peaks of impulses 96 pass through the rectifier to charge condenser 54.

The impulses 96 may be derived from the horizontal synchronizing impulses supplied from unit 1 and passed through a phase shifter or delay network 98 and amplifier and/or modulator 99 to the resistor 97.

When the control is derived from impulses 96 the pedestals are maintained at a fixed level regardless of what happens to the "super-sync" impulses. This would be useful in case the "super-sync" impulses were subjected to saturation or other alteration causing them to be unsuited for the purpose of reinserting D. C. and low frequency components.

It should be noted that the signal represented in Fig. 7a is the one which is radiated to a receiver even though the signal of Fig. 7c is used in the feedback control.

It may be noted that additional intelligence or information may be transmitted by modulating the impulses 96 before they are impressed across the resistor 97. The effect of such modulation is to introduce an additional modulation on the transmitted composite signal comprising picture signal and synchronizing impulses. At the tele-

vision receiver, this modulation is removed before the signal is impressed upon the cathode ray tube by means of a leveling or D. C. reinserting circuit such as that disclosed in Poch application on Television systems, Serial No. 718,192, filed March 30, 1934, and assigned to the Radio Corporation of America.

For example, a control tone for a volume expander could be transmitted in this way. It would be taken from a portion of the receiver circuit preceding the leveling or D. C. reinserting stage.

I claim as my invention:

1. In a picture transmitter wherein picture signals and synchronizing impulses are transmitted as a composite signal over a common channel with the said impulses of greater amplitude than picture signals of like polarity, means for producing said composite signal with the peaks of said impulses always reaching a certain predetermined level with respect to picture signals representing black in the transmitted picture, an A. C. amplifier connected to amplify said composite signal after said impulses have been leveled with respect to black whereby the D. C. and low frequency components of said signal are lost, a source of carrier wave and modulating means for modulating said carrier wave, means for supplying the output of said A. C. amplifier to said modulating means whereby there is produced a carrier wave modulated by said composite signal, a negative feedback circuit comprising a D. C. amplifier having an input circuit and an output circuit, means for deriving energy from said modulated carrier only during the occurrence of said synchronizing impulses and only in response to said modulated carrier increasing above a predetermined level and for converting said energy into substantially steady direct current, means for applying said steady direct current to said D. C. amplifier input, and means for applying the output of said D. C. amplifier to the input circuit of said modulating means and in negative feedback relation whereby any tendency for that portion of the modulated carrier representing synchronizing impulses to go beyond said level is counteracted.

2. The invention according to claim 1 characterized in that said means for deriving energy from said modulated carrier comprises a rectifier, a biasing voltage source, and a condenser, all connected in series with each other, the series combination being coupled to the output circuit of said modulating means, said condenser being connected in the input circuit of said negative feedback circuit whereby a charge on said condenser causes a change in the voltage feed back, a resistor across said condenser, the time constant of said condenser and said resistance in series being such that said condenser discharges only a slight amount between the occurrence of successive synchronizing impulses, and the value of said biasing voltage being such that current flows through said rectifier only in response to the carrier representative of said synchronizing impulses exceeding a predetermined amplitude.

3. In a device for inserting the D. C. component in a signal, the combination of means for producing a carrier wave, means for producing signals which periodically reach a predetermined level when said signals contain the desired components and do not contain undesired components, modulating means for modulating a carrier wave by said signals in such sense that said predetermined level is represented by maximum

amplitude of said carrier wave, said modulating means having an input circuit and an output circuit and being capable of transmitting low frequency components, a degenerative feedback circuit having an input circuit and an output circuit and being capable of transmitting said low frequency components, means for deriving from said modulated carrier wave a D. C. voltage having a value which is a measure of the amount said periodically recurring signal portions depart from said level, means for impressing said D. C. voltage upon the input circuit of said feedback circuit, and means for coupling the output circuit of said feedback circuit to the input circuit of said modulator whereby any departure of said signal portions from said level is counteracted.

4. The invention according to claim 3 characterized in that said means for deriving the D. C. voltage comprises a rectifier in series with a source of fixed biasing potential.

5. The invention according to claim 3 characterized in that said means for deriving the D. C. voltage comprises a rectifier and a condenser in series, said condenser being shunted

by a resistor, and the circuit comprising said condenser and said resistor in series having a time constant such that the condenser discharges only a small amount between successive periodically recurring signal portions.

6. The invention according to claim 3 characterized in that said means for deriving the D. C. voltage comprises means for demodulating said modulated carrier wave, and means for impressing the resulting demodulated signal upon a circuit comprising a rectifier and a source of biasing voltage in series.

7. The invention according to claim 3 characterized in that said means for deriving the D. C. voltage comprises means for demodulating said modulated carrier wave, and means for impressing the resulting demodulated signal upon a circuit comprising a rectifier and a condenser in series, said condenser being shunted by a resistor of sufficiently high resistance to prevent said condenser from discharging a substantial amount between the successive periodically recurring signal portions.

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