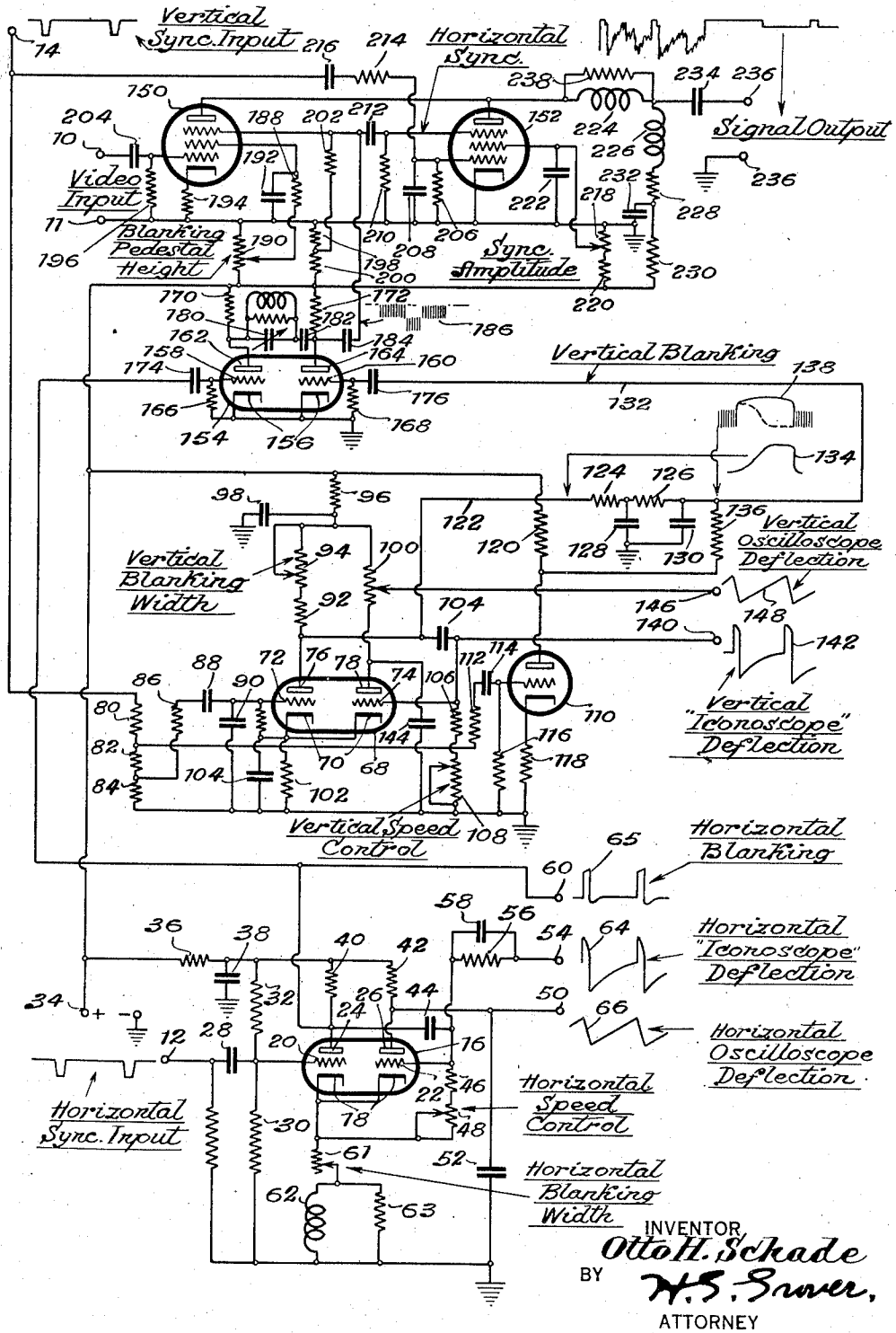
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VERTICAL BLANKING CIRCUIT FOR TELEVISION TRANSMITTER SYSTEMS

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VERTICAL BLANKING CIRCUIT FOR TELEVISION TRANSMITTER SYSTEMS

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3 Claims. (Cl. 178—7.2)

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This invention is a division of U. S. Patent to Otto H. Schade, No. 2,402,091, filed December 31, 1941, issued June 11, 1946, and relates to an improvement in television systems. More particularly, the present invention relates to an improvement in systems for generating synchronizing signals, blanking impulses, and the necessary deflection voltage variations for use in a television transmitting apparatus.

In present-day television systems the receiving apparatus are maintained in synchronous operation with the transmitting apparatus by means of transmitted horizontal and vertical synchronizing signals. These signals are normally transmitted along with the picture signals, the picture signals and the synchronizing signals being used to modulate a single radio frequency carrier wave. In order that the synchronizing signals may be interspersed with the picture signals, the picture signals are entirely eliminated during periods of synchronization and in lieu of the eliminated picture signals the desired vertical or horizontal synchronizing signals are transmitted. It is also conventional practice to transmit the synchronizing signals in such a direction that they are in the direction of black in the picture and extend further in that direction than the blackest black (i. e., they are "blacker-than-black") so that when the composite series is applied to a television receiving tube the synchronizing signals will inherently cause blanking of the cathode ray beam in the receiving tube during return deflection intervals.

Various systems have been used for producing the desired blanking, synchronizing and deflection voltage variations that are necessary at the transmitter but in most instances such systems are rather complicated and involve a considerable number of tubes and circuit components. Furthermore, in some systems, considerable additional circuit arrangements have been included in order to transmit impulses of double horizontal deflection frequency immediately preceding, during, and immediately following the transmission of the vertical synchronizing impulse. Such transmission is generally known as slotted vertical synchronizing and although the use of such a synchronizing method has certain advantages it has been found that by using the circuits of the present invention, as herein described for instance, it is not necessary to include the so-called double line frequency preparatory impulses nor is it necessary to slot the vertical synchronizing impulse at double line frequency. In the absence of such slotting and in the absence of the double line preparatory impulses the horizontal deflection generator may momentarily lose synchronism; however, synchronous operation of the horizontal oscillator will be resumed almost immediately following the vertical synchronizing

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impulse period. Furthermore, it has been found that adequate interlaced scanning at both the transmitter and the receiver may be accomplished even in the absence of the use of the double line frequency impulses.

It is therefore one purpose of the present invention to provide a new, improved and simplified synchronizing signal and wave form generating system which includes a relatively small number of tubes and circuit elements and which will produce a picture and synchronizing signal series which is entirely effective to maintain synchronous operation of all receivers tuned to the transmitting station.

Another purpose of the present invention resides in the provision of a simplified system for producing the necessary picture signal series blanking impulses and the necessary horizontal and vertical synchronizing impulses that are transmitted during the blanking period.

Still another purpose of the present invention resides in the provision of means for simultaneously generating deflection voltage variations which may be used to directly cause deflection of the scanning cathode ray beam in the television transmitting tube or which may be used to drive a power tube for deflecting the scanning cathode ray beam.

Still a further purpose of the present invention resides in the provision of a circuit for generating voltage variations which may be used to deflect a cathode ray beam in a monitoring oscilloscope.

Another purpose of the present invention resides in the provision of a circuit for generating voltage variations of saw-tooth wave form that may be used to control devices for producing shading control signals.

A still further purpose of the present invention resides in the provision of a circuit arrangement which will produce the above referred to voltage variations in response to the application of properly timed horizontal and vertical synchronizing impulses.

A still further purpose of the present invention resides in the provision of a circuit arrangement for producing a desired composite picture and synchronizing signal series which may be used directly to modulate a radio frequency oscillator in order that the composite signal may be transmitted to a remote receiving station.

Still other purposes and advantages of the present invention will become more apparent to those skilled in the art from the following specification and drawings wherein the single figure represents a preferred form of the present invention. Furthermore, the figure also shows various curves of voltage variations appearing at various parts of the circuit.

For controlling the apparatus and circuit ar-

rangement shown in the single figure and described in the following specification, a source of horizontal and vertical synchronizing impulses must be provided. Such a source is not shown in the drawing and it is to be understood that the horizontal and vertical synchronizing impulses may be derived from any appropriate generator. It is only necessary that the horizontal and vertical synchronizing impulses be of the desired frequency and be spaced with respect to each other by the desired amount. By way of example, a generator for supplying such impulses is shown and described in Schade Patent No. 2,254,626, issued on September 2, 1941.

Referring now to the drawing, the picture signals which are derived from a television transmitting tube are applied to terminals 10 and 11, the latter of which is connected to ground. These signals may be derived from any desired television transmitting tube. The horizontal synchronizing impulses from any appropriate source may be applied to the terminal 12 while the vertical synchronizing impulses are applied to the terminal 14.

The system includes discharge tube 16, which in turn includes cathodes 18, two control electrodes 20 and 22, and two anodes 24 and 26. These elements may be enclosed in a single tube envelope (as shown) or they may constitute the elements of two separate triode or multi-electrode tubes. The elements are connected as a multi-vibrator and the operation of the multi-vibrator is synchronized by means of horizontal impulses which are applied to the terminal 12 from any desired appropriate source. The impulses which are impressed upon the input terminal 12 are applied to the control electrode 20 through coupling condenser 28. The control electrode 20 is connected to ground by way of the usual grid resistor 30 and in order that the control electrode may be operated at a proper potential with respect to cathode 18 a resistance 32 is also included between the control electrode and terminal 34 to which a positive potential is applied. The positive supply potential that is applied to terminal 34 is de-coupled from the elements of tube 16 by de-coupling resistance 36 and condenser 38. The anodes 24 and 26 are also connected to the positive terminal 34 by way of anode load resistance 40 and 42, respectively. The anode 24 is coupled to the control electrode 22 by means of coupling condenser 44 while the control electrode 22 is connected to the cathodes 18 by means of resistance 46 and potentiometer 48. One end of the resistance element of the potentiometer 48 is connected to the resistance 46 whereas the other end of the resistance element of the potentiometer, as well as the movable contact thereof, are connected to the cathodes 18. The anode 26 is connected to output terminal 50 and to ground through condenser 52 while the control electrode 22 is connected to output terminal 54 by way of resistance 56. The resistance 56 has connected in parallel therewith a condenser 58. The cathodes 18 are connected to ground by way of variable resistance 61 and inductance 62 while the inductance 62 has connected in parallel therewith a resistance 63. The purpose of providing the inductance in the cathode circuit of tube 16 is to provide an inductive feedback impedance in order that short impulses of high amplitude may be produced. The widths of the produced impulses may be readily controlled by varying the amount of the resistance 61 which controls the cathode impedance. The speed of operation of the multi-vibrator which includes the elements of tube 16 may be controlled by adjusting the potentiometer 48.

When horizontal synchronizing impulses are applied to the terminal 12 with the impulses extending in a negative direction, electronic current from cathode 18 to anode 24 is reduced during application of the individual impulses. This reduction in anodic current causes positive impulses to appear at the anode of tube 24 and these impulses are applied to the control electrode 22 of tube 16 through condenser 44. The heavy cathode current that is caused to flow drives the cathodes in a positive direction causing the current to anode 24 to be completely cut-off and since the anode 24 is connected to terminal 60, the strong impulses produced at anode 24 are then available at terminal 60 and may have a wave form such as that represented by the curve 65. Naturally the impulses extend in a positive direction and occur at a frequency corresponding to the synchronizing impulses applied to the control electrode 20 but of a time duration (or width) determined by the resistance 61.

The circuit also provides a source of deflection voltage variations which may be derived from terminal 54 and which may have a wave form similar to that shown by curve 64. These impulses are derived from the control grid 22 and the parallel resistance and condenser combination 56—58 are included between the control electrode 22 and the terminal 54 in order to produce wave shaping (and biasing of the following tube) to provide the desired voltage variation or wave form. It will be noticed that this wave form is substantially that necessary for driving a power tube for supplying horizontal deflection voltages for deflecting the scanning cathode ray beam in an "Iconoscope" or similar television transmitting tube where electromagnetic deflection is used.

When condenser 52 is connected between the anode 26 and ground, the triode section including anode 26 of tube 16 operates as a discharge tube as well as a part of the multi-vibrator with the result that voltage variations of substantially sawtooth wave form may be obtained from the anode 26. As stated above, these voltage variations are available at terminal 50 and may have a wave form corresponding to the curve shown at 66. In so far as this part of the operation is concerned, the condenser 52 charges through load resistance 42 and de-coupling resistance 36 and is discharged by current flow between cathode 18 and anode 26.

From the above it may be seen, therefore, that the single tube 16, together with its associated circuit elements, operates both as a multi-vibrator and as a discharge tube for producing several sources of voltage variation. From the terminal 60 may be derived horizontal blanking impulses of a width determined by the resistance 61 while from the terminal 54 may be derived voltage variations of a wave form such as are suitable for driving a horizontal deflection power tube. Furthermore, the saw-tooth wave form voltage variations which are derived from terminal 50 may be conveniently used for horizontally deflecting the cathode ray beam in an oscilloscope tube, particularly where the cathode ray beam of the oscilloscope is electrostatically deflected. This voltage, as stated above, may also be used to control a shading signal generating device.

A somewhat similar circuit arrangement is also provided for producing similar voltage varia-

tions at vertical deflection frequency. This circuit arrangement includes tube 68 which in turn includes cathodes 70, control electrodes 72 and 74 as well as anodes 76 and 78. The elements of the tube 68 are connected as a multi-vibrator and the operation of the multi-vibrator is synchronized by vertical synchronizing signals applied to the terminal 14. Resistances 80, 82 and 84 are connected in series and the series arrangement is connected from input terminal 14 to ground. The control electrode 72 is connected to the junction of resistance 82 and 84 by means of series connected resistance 86 and condenser 88. Furthermore, a condenser 90 is connected between the control electrode 72 and ground. The inclusion of the resistance 86 and the condenser 90 provides a time delay circuit in order that the vertical synchronizing impulses which are applied to the terminal 14 will be delayed by a predetermined amount before being applied to the control electrode 72. The anode 76 is connected to terminal 34, to which is applied a positive potential, by means of load resistance 92, potentiometer 94 and de-coupling resistance 96. A de-coupling condenser 98 is connected between the junction of potentiometer 94 and de-coupling resistance 96 while the movable contact of the potentiometer 94 is also connected to the junction of the potentiometer and the de-coupling resistance 96. The anode 78 is also connected to the de-coupling resistance by means of potentiometer 100. The cathodes 70 are connected to ground by way of cathode resistance 102, the resistance being bypassed by condenser 104 in order to round off the front edge of the feedback impulse. This action, in so far as the feedback is concerned, is effective to prevent unstable triggering of the circuit and greatly increases the stability of interlace. Voltage variations which are present at the anode 76 are applied to the control electrode 74 by way of coupling condenser 104 while the control electrode 74 is connected to ground by way of resistance 106 and potentiometer 108. The potentiometer 108 is connected as a variable resistance and is effective to control the free operating speed of the multi-vibrator.

The vertical synchronizing impulses which are applied to terminal 14 are also applied to the control electrode of tube 110. The control electrode of this tube is connected to the junction of resistance 80 and 82 by means of series connected resistance 112 and condenser 114. The voltage variations which are applied to the control electrode of tube 110 are therefore not delayed and precede the voltage variations which are applied to the control electrode 72 by a predetermined amount. The control electrode of tube 110 is also connected to ground by a usual grid resistance 116. The cathode of tube 110 is connected to ground by cathode resistance 118 while the anode of the tube is connected to the positive terminal 34 by means of anode load resistance 120.

When vertical synchronizing impulse signals are applied to the control electrode 72 of the multi-vibrator tube 68 after a predetermined time delay, the operation of the multi-vibrator is controlled and synchronized with the vertical synchronizing impulses and the circuit operates to produce at the anode 76 delayed voltage variations which extend in a positive direction. These voltage variations are present on conductor 122 and are applied to a further delay circuit including resistances 124 and 126 as well as condensers 128 and 130. The combination of resistance 124 and condenser 128 as well as the combination of resistance 126 and condenser 130 provide a further time delay for the voltage variations present at anode 76 and these delayed voltage variations are then available at conductor 132. The wave form of the delayed voltage variations may have a wave form similar to that shown at curve 134. The anode of tube 110 is connected to conductor 132 by means of resistance 136 and since the voltage variations appearing at the anode of tube 110 are not delayed, these voltage variations when combined with the delayed voltage variations from the anode of tube 76 produce a vertical blanking impulse such as shown at curve 138 the duration of which is sufficient to provide the necessary vertical blanking.

Furthermore, the multi-vibrator including tube 68 and its associated circuit elements also produces voltage variations which are available at the control electrode 74 and which are applied to terminal 140, these voltage variations being similar to those shown by curve 142 and suitable for energizing a vertical deflection power tube. These voltage variations are therefore similar to the voltage variations which are available at terminal 54 and may be ultimately used in deflecting the cathode ray beam in the television transmitting tube, particularly where the beam is deflected by electromagnetic means as is the case in an "Iconoscope." Connected between anode 78 and ground is a condenser 144 and this condenser is charged through anode load resistance 100 and de-coupling resistance 96. The condenser 144 is discharged by that portion of tube 68 including anode 78 to operate as a sawtooth wave generator so that voltage variations of sawtooth wave form may be derived from the anode 78. Actually, these voltage variations are available from the movable contact of potentiometer 100 and are applied to terminal 146. They may have a wave form such as that shown by curve 148. As explained above, these voltage variations of sawtooth wave form may be conveniently used for deflecting the cathode ray beam in an oscilloscope particularly where electrostatic deflection is used. The voltage variations may be used directly or after appropriate amplification. They may also be used to control vertical shading tubes.

From the circuit as so far described, it may be seen that a very simple and convenient circuit arrangement has been provided for generating horizontal and vertical blanking impulses and for simultaneously generating horizontal and vertical deflection driving voltage variations. These deflection driving voltage variations, after appropriate amplification, may be used to deflect the cathode ray beam in the television transmitting tube. Furthermore, the circuit arrangement also provides a source of voltage variations of sawtooth wave form and of horizontal and vertical frequency which may be conveniently used for deflecting the cathode ray beam in the monitoring oscilloscope.

As stated above, the picture signals as derived from the television transmitting tube are applied to terminals 10 and 11. These picture signals must be suppressed at various regularly spaced intervals in order that the suppressed picture signals may be replaced by the desired horizontal and vertical synchronizing signals. The circuit arrangement for producing the desired blanking and for interposing the desired synchronizing signals includes tubes 150, 152 and 154. Of these

tubes, tube 150 is the picture signal blanking tube whereas tube 152 is the synchronizing signal insertion tube. Both tubes when supplied with proper voltage variations operate to produce the final composite picture and synchronizing signal series.

Tube 154 includes cathodes 156, control electrodes 158 and 160 as well as anodes 162 and 164. The cathodes 156 are connected to ground while the control electrodes 158 and 160 are connected to ground by way of grid resistors 166 and 168, respectively. The anodes 162 and 164 are connected to the positive terminal 34 by load resistances 170 and 172, respectively.

The horizontal blanking impulses which are available at terminal 60 and which are derived from the anode 24 of tube 16 are applied to the control electrode 158 by way of coupling condenser 174. Likewise, the vertical blanking impulses which are available on conductor 132 are applied to the control electrode 160 by coupling condenser 176. Both the horizontal and the vertical blanking impulses have their voltage variations extending in a positive direction to cause modulation of anodic current in tube 154. Since the blanking impulses extend in a positive direction, the voltage variations at the anodes 162 and 164 will extend in a negative direction upon the application of the blanking impulses to the control electrodes 158 and 160. The anode 162 is connected to the anode 164 by means of a tune circuit including inductance 178 and capacitance 180, this combination being connected in series with condenser 182. The purpose of the inductance 178 and the condenser 180 is to improve the wave form of the horizontal blanking control impulses. If desired, these elements may actually be omitted, in which case the anodes 162 and 164 are directly connected together and a single common load resistance 172 is used. The voltage variations from the anodes 162 and 164 are combined and are applied to the suppressor grid or electrode of tube 150 by way of coupling condenser 184. The wave form of the combined blanking control impulses may be similar to that shown at 186. The screen grid of tube 150 is connected to positive terminal 34 by way of resistance 188 and potentiometer 190. The resistance element of the potentiometer 190 is connected between positive terminal and ground whereas the movable contact of the potentiometer is connected to the screen grid resistor 188. The screen grid is de-coupled for relatively rapid voltage variations by means of condenser 192. The cathode of tube 150 is connected to ground by an unbypassed cathode resistance 194, particularly if good white signals are available and if the television transmitting (camera) tube is operated at normal gamma. Under low light conditions, and where a transmitting tube similar to an Iconoscope is used, a bypass condenser may be used to prevent degeneration and to increase the intensity of picture signals representative of white. The control electrode is also connected to ground by an appropriate grid resistance 196. The anode of tube 150 is connected to positive terminal 34 by means of an appropriate load circuit which will be explained later. The suppressor electrode of tube 150 is maintained at a predetermined positive potential with respect to ground by means of voltage divider resistances 198 and 200. The junction of voltage divider resistance 198 and 200 is connected to the suppressor electrode by means of a further resistance 202.

When picture signals are applied to the control electrode of tube 150 by way of condenser 204 they operate to modulate the electron stream in that tube. The picture signals as applied to terminal 10 are polarized such that black in the picture is represented by a change in the negative direction whereas white in the picture is represented by a voltage change in the positive direction. Accordingly, when signals representing black are applied to the control electrode of tube 150, the voltage variations at the anode of that tube will extend in a positive direction. In order to afford the desired blanking at horizontal and vertical deflection frequency, the voltage variations which are applied to the suppressor electrode by way of condenser 184 from anodes 162 and 164 of tube 154 are effective to cut-off the current flow through tube 150. As stated before, the voltage variations from the anodes 162 and 164 extend in a negative direction and are sufficiently intense to reduce the anode current in tube 150 to zero. Accordingly, during such blanking intervals, applied picture signals are ineffective to produce any potential change at the anode of tube 150 which is driven to its most positive potential. The height of the blanking pedestal or, in other words, the potential change of the anode of tube 150 during blanking intervals may be controlled and determined by the position of the movable contacts on potentiometer 190 which controls the energizing potential in the screen grid electrode of tube 150. The signal at the output of tube 150 therefore represents the picture signals applied to terminal 10 with certain intermittent portions of the picture signals being suppressed or driven to a value representative of black in the picture.

It is the function of the synchronizing signal insertion tube 152 to superimpose upon the blanking signal the actual synchronizing signals which extend in the direction of black and which correspond to blacker than black in so far as their intensity is concerned. The synchronizing signals are not delayed with respect to the front edge of the blanking impulse as is the practice in some synchronizing systems since it has been found that the front edge of the synchronizing impulse and the front edge of the blanking impulse may coincide without producing any undesired results.

Tube 152 includes a cathode, a control electrode, a screen grid electrode, a suppressor electrode and an anode. The cathode of the tube is connected directly to ground whereas the control electrode is connected to ground by resistance 206 in parallel with which is connected a condenser 208. The suppressor electrode is also connected to ground by resistance 210 and is coupled to a suppressor electrode of tube 150 by way of coupling condenser 212. The horizontal synchronizing signals are then applied to the suppressor electrode of tube 152 from the blanking tube 154 but in this connection is included condenser 212 and resistance 210. These elements perform a differentiating action to differentiate the horizontal blanking impulse to thereby produce a shorter horizontal synchronizing impulse. There therefore appears on the suppressor electrode of tube 152 the horizontal synchronizing impulse which is in fact the differentiated horizontal blanking impulse. The vertical synchronizing impulse is applied to the first control electrode or control grid of tube 152 by means of resistor 214 and condenser 216 which are connected between the control electrode of tube 152 and terminal 14

to which is applied the controlling vertical synchronizing impulse. The same signals that are used to control the vertical multivibrator tube 68 are therefore used to supply vertical synchronizing impulses to the control electrode of tube 152.

Since the horizontal synchronizing impulses that are applied to the screen grid electrode 152 and the vertical synchronizing impulses that are applied to the control electrode of tube 152 extend in a negative direction, these impulses operate to reduce the current flow through tube 152 with the result that the anode is driven in a positive direction during such intervals.

The screen grid of tube 152 is connected to the movable contact of a potentiometer 218. One end of the resistance element of the potentiometer 218 is connected to ground whereas the other end of the resistance element is connected to the positive terminal 34 by way of resistance 220. This permits the application of a predetermined relatively small positive potential to the screen grid electrode, the electrode being by-passed to ground in so far as alternating current potentials are concerned by condenser 222. An adjustment of the value of the potential applied to the screen grid electrode which is made possible by an adjustment of potentiometer 218 determines the height or intensity of the synchronizing signal impulses appearing at the anode of tube 152.

The anodes of the blanking tube 150 and the synchronizing signal insertion tube 152 are connected together and are in turn connected to positive terminal 34 through series connected inductance 224, a further inductance 226, a resistance 228 and 230 in order to stabilize the voltage applied to the anode load circuit of tubes 150 and 152. An output circuit is provided between ground and the junction of inductances 224 and 226 through condenser 234 so that the output energy is available from terminals 236. The inductance 224 is paralleled by a resistance 238 in order to slightly modify the wave form at the output terminals.

It may be seen therefore that picture signals when applied to the control electrode of tube 150 cause a corresponding voltage drop in load resistance 228 to produce amplified voltage variations at the output terminal 236. The horizontal and vertical blanking impulses which are applied to the screen grid electrode of tube 150 reduce the current flow through that tube to zero, with the result that the potential at the output terminal 236 is altered in a positive direction. The plate current of the parallel synchronizing insertion tube 152 also causes a voltage drop in the common load circuit resistance 228. The plate current ratio of tube 152 to tube 150 determines the ratio of the synchronizing signals (supersync) to blanking. This ratio can be controlled, as stated above, by varying the screen potential applied to tube 152 by means of potentiometer 218. The vertical synchronizing impulses, as stated above, are applied directly to the control electrode of tube 152 and, accordingly, cause tube 152 to be driven to cut-off during vertical synchronizing intervals. During this time no horizontal synchronizing impulses are present and accordingly no horizontal synchronizing signals are transmitted during the transmission of the vertical synchronizing signals. The inclusion of the inductances 224 and 226 prevents a loss of the high frequency components of the signal series.

Preferably tubes 150 and 152 should be of the high gain type such as, for example, tubes 6AC7

(1852) for example. Such a tube having a screen electrode between the suppressor electrode and the anode may also be used advantageously.

There therefore appears at the output terminals 236 a composite wave form including picture signals and interspersed blanking and synchronizing signals. Such a wave form after desired amplification may be used directly to amplitude or frequency modulate a radio frequency carrier wave in order that the signals may be transmitted.

The circuit shown in the drawing and described above is particularly adapted for portable television equipment and provides the necessary voltage variations for operating such equipment. The principal elements necessary in addition to the circuit described are naturally a source of picture signal, a source of horizontal and vertical synchronizing impulses and a source of radio frequency energy particularly where radio transmission is desired. With these additional elements it is possible to transmit television images and to, in addition, monitor such transmission by means of the usual cathode ray oscilloscope.

The horizontal and vertical synchronizing impulses which are applied to terminals 12 and 14 may be derived from any desired source or, in fact, these signals may be supplied from the main television transmitter so that they are properly related to the 60 cycle power supply line. The horizontal and vertical synchronizing impulses may be transmitted to the portable equipment from the main transmitter by the use of a separate carrier for that purpose or such signals may be separated from the television signal transmitted from the principal transmitting station.

The picture signals may be derived from any television transmitting tube such as, for example, an "Iconoscope," an "Orthicon" or a "Monoscope."

Since the monitoring oscilloscope is generally relatively small and it has a screen of about 3 inches in diameter, the electron beam in such a tube is normally electrostatically deflected and, accordingly, the voltage variations of sawtooth wave form which are available at terminals 50 and 146 may be conveniently used for horizontally and vertically deflecting the cathode ray beam in the monitor tube. If it is desired to observe only the signal trace in the monitor tube then the horizontal deflection of a cathode ray beam therein may be produced by either the horizontal or vertical deflection voltage while the vertical deflection of the cathode ray beam may be produced as a function of energy derived from the output terminals 236.

From the above it may be seen that a relatively compact and simplified synchronizing signal generator has been provided which operates to produce not only the desired blanking and synchronizing impulses but also produces voltage variations which may be used to deflect the cathode ray beam in the television transmitting tube. Furthermore, the same system provides means for generating voltage variations of sawtooth wave form in order that a monitoring cathode ray tube may be used at the portable transmitter. The system described also operates to blank the picture signal series at predetermined intervals and to superimpose upon the blanking signals the desired synchronizing signals in order that a complete composite series of picture and synchronizing signals may be produced.

The vertical synchronizing impulses may be of any desired length but it is preferable if their

length is chosen to equal approximately one line deflection duration as shown by the curve applied to the output terminals 236 in order to reduce the possibility of the horizontal deflection generator in the receiver from momentarily dropping out of synchronism. Vertical synchronizing signals persisting for only one-half a line may even be used without resulting in any difficulty in segregating the horizontal and vertical synchronizing signals.

Although the system is described in more or less detailed form it is to be understood that various alterations and modifications may be made therein and any and all such modifications are to be considered within the purview of the present invention except as limited by the hereinafter appended claims.

I claim:

1. A television transmitting system including a source of vertical synchronizing impulses, a multi-vibrator including means for generating a first electron discharge stream, means for generating a second electron discharge stream, each means including a cathode, a control electrode and an anode, means including separate load impedances for maintaining said anodes positive with respect to their associated cathodes, a condenser for coupling the anode of the first electron discharge stream to the control electrode of the second electron discharge stream, means including a time delay circuit for applying the vertical synchronizing impulses to the control electrode of the first electron discharge stream to produce delayed voltage variations of a predetermined adjustable amplitude and duration at the associated anode, an electron discharge tube including a cathode, a control electrode and an anode, a load impedance for maintaining the anode of said electron discharge tube positive with respect to its cathode, means for applying the undelayed vertical synchronizing impulses to the control electrode of said electron discharge tube to produce voltage variations of a predetermined adjustable amplitude and duration, means to further delay the produced delayed voltage variations, means for combining the further delayed voltage variations produced at the anode of the first electron discharge stream with the voltage variations produced at the anode of said electron discharge tube to produce vertical blanking impulses having a predetermined amplitude and time duration, and a condenser connected between the anode of said second electron discharge tube and a point of fixed potential whereby voltage variations of substantially sawtooth wave form may be derived from the anode of said second electron discharge tube.

2. A television transmitting system including a source of vertical synchronizing impulses, a multi-vibrator including means for generating a first electron discharge stream, means for generating a second electron discharge stream, each means including a cathode, a control electrode and an anode, means including separate load impedances for maintaining said anodes positive with respect to their associated cathodes, a condenser for coupling the anode of the first electron discharge stream to the control electrode in the second electron discharge stream, means including a time delay circuit for applying the vertical synchronizing impulses to the control electrode in the first electron discharge stream to produce delayed voltage variations of a predetermined amplitude and duration at the anode of said electron stream, circuit means to further delay the produced delayed voltage variations, an electron discharge tube including a cathode, a control electrode and an anode, a load impedance for maintaining the anode of said third electron discharge tube positive with respect to its cathode, means for applying the undelayed vertical synchronizing impulses to the control electrode of said electron discharge tube to produce voltage variations of a predetermined amplitude and duration, and means for combining the further delayed voltage variations produced at the anode of the first electron discharge stream with the voltage variations produced at the anode of said electron discharge tube to produce vertical blanking impulses having a predetermined amplitude and time duration.

3. A television transmitting system including a source of vertical synchronizing impulses, a multi-vibrator including a first and a second electron discharge tube, each including a cathode, a control electrode and an anode, means including separate load impedances for maintaining the anodes of the electron discharge tubes positive with respect to their associated cathodes, a condenser coupling the anode of the first electron discharge tube to the control electrode of the second electron discharge tube, means including a time delay circuit for applying the vertical synchronizing impulses to the control electrode of the first electron discharge tube to generate delayed voltage variations of a predetermined amplitude and duration at the anode of said tube, circuit means to further delay the produced delayed voltage variations, a third electron discharge tube including a cathode, a control electrode and an anode, a load impedance for maintaining the anode of said third electron discharge tube positive with respect to its cathode, means for applying the undelayed vertical synchronizing impulses to the control electrode of the third electron discharge tube to generate voltage variations of a predetermined amplitude and duration at the anode of said tube, means for combining the further delayed voltage variations generated at the anodes of the first and the third electron discharge tube to produce vertical blanking control impulses having a predetermined amplitude and time duration, and an electron storage device connected between the anode of said second electron discharge tube and a point of fixed potential whereby voltage variations of substantially sawtooth wave form may be derived from the anode of said second electron discharge tube.

OTTO H. SCHADE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,587,520	Hartley	June 8, 1926
2,153,217	Van der Mark	Apr. 4, 1939
2,241,619	Sherman	May 13, 1941
2,366,307	Anderson	Jan. 2, 1945
2,368,448	Cook	Jan. 30, 1945