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S. W. SEELEY

2,256,530

SYNCHRONIZING SYSTEM

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2 Sheets-Sheet 1

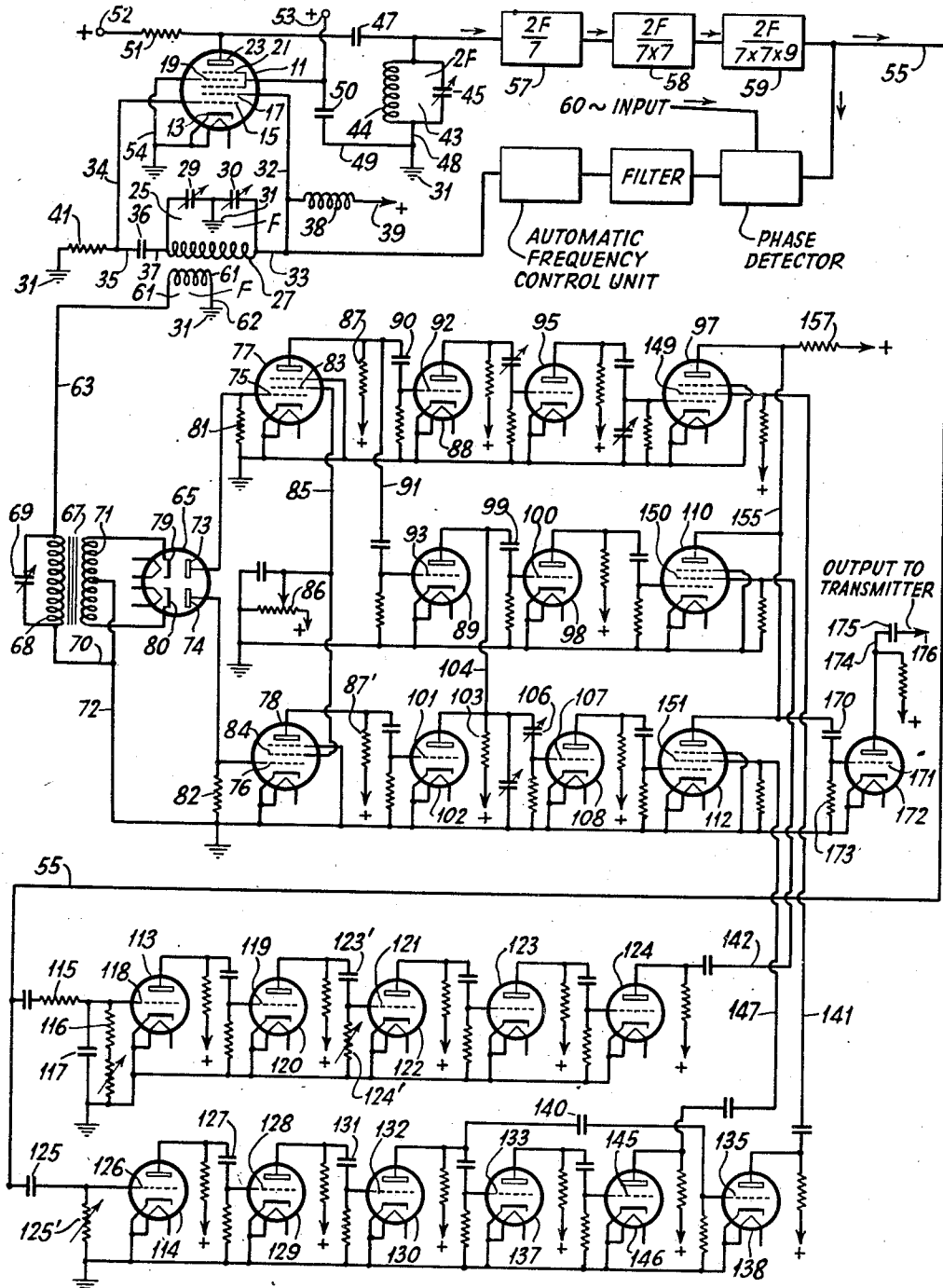


Fig. 1

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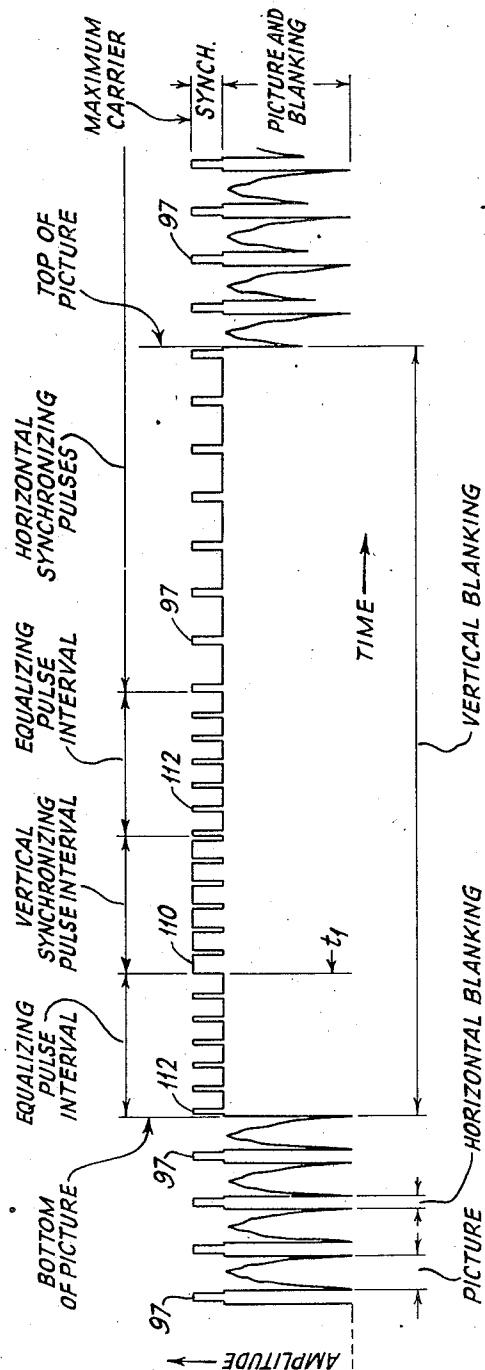
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2 Sheets-Sheet 2

Fig. 2



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2,256,530

SYNCHRONIZING SYSTEM

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6 Claims. (Cl. 178—69.5)

The present invention relates to television systems and is particularly directed to a system for controlling the production of the so-called "odd-line" type of interlaced television images. The invention also relates generally to circuits for controlling the repetition of such types of produced television images in receiver apparatus so that the received image is at all times properly and adequately synchronized and the spacing between the lines of each field of the interlaced images accurately maintained in constant relationship.

In its fundamental form the invention, as it is to be described herein, includes a suitable form of oscillator from which is developed or produced oscillatory electrical energy of a substantially pure sine wave form or pattern. This sine wave form of energy is generated at a frequency corresponding to that frequency at which the various lines making up the received image are repeated in the image reproduction. In order to accomplish the aims and objects of this invention there is produced from successive halves of like polarity of the developed sine wave energy a series of electrical impulses which are caused to become recurring at repetition frequency of each line of the picture. Further, as a part of the invention means are also provided to derive from the developed sine wave energy further successions of uniform impulses which are caused to occur at twice the frequency and repetition rate of the line synchronizing impulses.

The invention further contemplates making suitable provision for combining all of these several forms of different frequency in a proper sequence to form a complete chain of control impulses which serve to synchronize the line and field repetition rates of a received television image reproduction.

In the July 1938 issue of "Electronics" there is described on pages 28, 29 and 55 a certain form of television signal pattern which has been recommended by a committee on standards of the Radio Manufacturers Association as constituting a desirable form for transmission in order to synchronize the television receiver with the transmitter. In such a form of signal both television synchronizing and blanking signals are developed to accompany the video signals and, at certain times during the transmission, signals of double the normal line frequency are developed for controlling the synchronizing operation in the vertical direction while maintaining complete synchronization in the horizontal direction between successive picture fields.

According to the presently used methods of transmitting television signals television pictures of 441 lines are produced. These television pictures are repeated at the rate of 30 picture frames per second. However, because of a desire to interlace the produced pictures, in order that the flicker may be substantially reduced, each picture frame is transmitted in the form of two picture fields of $220\frac{1}{2}$ lines each with a result that the transmitted field frequency is 60 picture fields per second. This particular field frequency is quite desirable because it permits interlocking the field repetition frequency with the usual power supply frequency of 60 cycles per second. Proper synchronization and interlock of the field frequency and the power supply frequency reduces hum bands in the received picture which might result from ripple in the deflection and the supply circuits. The interlacing of the various picture fields one with the other occurs as a natural consequence of the non-integral relationship between the field repetition frequency, herein assumed as 60, and the line repetition frequency herein assumed as 13230 (this being formed from picture fields of 441 lines each repeated 30 times per second).

As was explained, however, in the "Electronics" publication, herein above referred to, during the time period when the field patterns are changing in the interlacing operation and during the vertical synchronizing interval a special form of signal is transmitted in order that the horizontal synchronism may not be lost and it is further an object of the present invention to provide ways and means for producing these signals and further to provide for controlling the time period when they become effective in the transmission.

Other objects of the present invention are to provide a greatly simplified arrangement for transmitting synchronizing signals which shall cause television images to be repeated at the desired frame and field repetition rates for a given number of picture lines and also to provide for the production of synchronizing signals which shall follow in proper time relationship the complete train of image signals which result from scanning the subject of which the electro-optical image is to be produced on the viewing instrument.

It is a still further object of my invention to provide an improved form of pure electronic type of generator for generating the above described forms of impulses which shall be used at receiver points for synchronization of television images.

A further object of my invention is to provide

an improved method of and means for controlling, delaying, shifting or otherwise determining the time at which such produced electrical impulses shall become effective in the transmitting circuits.

Further objects, features and advantages of my invention, of course, will become apparent and at once familiar to those skilled in the art to which the invention is directed by reading the following specification and claims in connection with the accompanying drawings, wherein:

Fig. 1 diagrammatically illustrates one form of arrangement and circuit for producing the impulses of the type hereinabove described; and wherein

Fig. 2 illustrates schematically the wave form of the several impulses which result from the operation of the circuit of Fig. 1.

Referring now to the drawings there is provided an electronic oscillating tube 11 which may be of the general type known in the art as the 6A8 which is adapted to generate electric oscillations of sine wave formation at a frequency assumed to be 13230 cycles for a 441 line television picture to be repeated thirty times per second. The tube 11 includes a cathode 13, a No. 1 grid 15, and a No. 2 grid 17 which electrodes cooperatively function as a first part or section of the tube which is termed the oscillator section. In addition, there is provided within the tube 11 a No. 4 grid 19 and a No. 5 grid 21, as well as the usual output electrode or anode 23. The oscillating portion of the tube includes the cathode 13 and the No. 1 and 2 grids 15 and 17, respectively, of which the latter serves as an anode or output element. These grid elements are connected to the terminals of a tuned circuit 25 comprising the inductance element 27 and the two capacity elements 29 and 30 of which one or both may be variable. The capacity elements 29 and 30 are serially connected and the junction point is connected to ground (or fixed potential) at 31 as indicated. The series connected capacity elements 29 and 31 are shunted by the inductance element 27 so that with the No. 2 grid 17 connected by way of the conductors 32 and 33 to one end of the resonant circuit 25 and the No. 1 grid connected by way of the conductors 34 and 35 through the capacity element 36 to the other end 37 of this tuned circuit 25 oscillations will be developed when suitable energy is supplied to the tube 11. Such operating energy is supplied by way of the choke coil 38 connected to a source of positive potential at the terminal 39 and bias voltage is supplied to the No. 1 grid 15 by way of the bias resistor 41 connected to ground.

The connection of the oscillatory circuit immediately above described is essentially a form of the well known Colpitts oscillator so that with suitable operating potentials applied there will be generated or developed in the tuned circuit 25 electrical energy of a frequency determined by the circuit constant and of a sine wave characteristic. Electrical energy of a frequency double that appearing in the circuit 25 can be developed in the output section of the tube 11 by connecting the tube (as indicated) so that it operates as a frequency doubler. In the form in which the tube is connected the tuned tank circuit 43, comprising the inductance 44 and the capacity 45 (variable, if desired), is tuned to twice the frequency of the tuned circuit 25. This tuned circuit 43 is connected by way of the coupling condenser 47 at one end to the anode element 23 of

the tube 11 and at the other end to ground at 31 by way of the conductor 48 and then also by way of the conductor 49 and the coupling condenser 50 back to the electrode 21 of the tube 11.

Suitable anode voltage for the tube 11 is supplied by way of the resistor 51 connected to terminal 52. Operating voltage for the electrode 21 is supplied by way of the terminal connection 53 and the electrode 19 is operated at cathode potential by way of the connection to ground at 54. In view of the well recognized desire to develop the synchronizing impulses to initiate the frequency division which is finally to equal the field frequency from the same source that develops the line synchronizing controls, it is desirable that energy of double the frequency of the initially developed oscillations shall result in order that ultimate frequency division shall be equal to the field frequency desired. This is substantially due to a condition imposed by the odd-line interlacing with the line frequency (that frequency developed in the tuned circuit 25) shall constitute no harmonic of the field frequency and further that the second harmonic of the line frequency which appears in the tuned circuit 43 shall constitute no even harmonic of the field frequency.

Accordingly, as is well known in the art and as has already been explained in the patent of John Paul Smith, No. 2,132,654, issued Oct. 16, 1938, frequency division of the double frequency appearing in the tuned circuit 43, which is at twice the frequency which appears in the tuned circuit 25, may be divided by a chain of stabilized multi-vibrators. Such a chain of multi-vibrators may, where it is assumed that the system is operating to produce a 441 line picture repeated at 60 picture fields per second, comprise three separate multi-vibrator stages 57, 58 and 59 where the output from the multi-vibrator stage 57 will be equal to

$$\frac{2F}{7}$$

where F is the frequency of the fundamental or the frequency developed and appearing in the tuned circuit 25. This output is then fed to the second multi-vibrator stage 58 whose output is equal to

$$\frac{2F}{7 \times 7}$$

and likewise the output from this multi-vibrator stage is fed to a third multi-vibrator 59 whose output frequency may be selected as being of a value

$$\frac{2F}{7 \times 7 \times 9}$$

This latter frequency, it will be observed will be 60 cycles per second for the assumed picture with the frequency appearing in the tuned circuit 25 and from the oscillatory portion of the tube 11 being 13230 cycles.

In practice it is usually desirable to feed a portion of the energy from the output of the multi-vibrator 59 through a suitable form of detector, such as a phase detector to which is also supplied energy of the power supply frequency, wherein the phase of the developed energy is compared with the phase of the 60 cycle power supply frequency. The output of such a phase detector may be through a suitable form of filter network and thence to an automatic frequency control unit of known character to control or

stabilize the frequency of the oscillator 11. However, such a control feature is not specifically a part of the present invention, and, therefore, it is desirable to consider a second portion of the output of the multi-vibrator 59 which is to control the timing and wave shaping units which shall produce the synchronizing signals of the form indicated by Fig. 2 of the drawings.

For this purpose, there is coupled to the inductance element 27 of the tuned circuit 25 a coupling coil 61 having one terminal thereof grounded by conductor 62 at ground 31 and the other terminal thereof is connected by way of conductor 63 to be supplied to a suitable form of rectifier element such as the push-pull rectifier 65. The other portion of the output multi-vibrator 59 is then supplied by way of conductor 55 to control, in a manner later to be described, the keying of the horizontal synchronizing impulses in the output of the wave shaping unit connected with the output of the rectifier 65.

It was above explained that the oscillatory energy for developing the synchronizing impulses was in the form of sine wave energy since it was relatively easy accurately to control and stabilize an oscillator to develop sine wave energy as contrasted with units, such as uncontrolled multi-vibrators and the like, to develop energy of an impulse form.

According to the form of transmission now most commonly used experimentally, it has been found that the duration of the synchronizing interval occurring at the end of each picture field shall be of the order of 7% of a $\frac{1}{60}$ of a second. Accordingly, the synchronizing control which shall control the vertical motion of the cathode ray beam used to reproduce the television picture must become effective during this time period and, in some sense, of course, provision must be made so that the horizontal synchronizing control does not cease operating during such time period. Unless a very definite interlock is to be obtained, as a practical matter, due to the return time during the reproduction of each picture field being a relatively large percentage of the time required to reproduce each picture field, there might result a substantial drift in horizontal line production of the initial portion, at least, of each produced picture. Hence, by the arrangement described herein the sine wave energy developed at line frequency and derived by way of the coupling coil 61 from the tuned circuit 25 is caused to pass through the wave shaping unit connected to the output of the rectifier 65 and therein be so modified by the so-called clipping, integrating, differentiating and keying processes, which will be later described herein, in order to produce the desired form of control signal.

In this form of apparatus the line frequency sine wave energy supplied from the tuned circuit 25 through conductor 63 is applied to each half of the tube 65 (which tube may be one of the type known in the art as type 6HC) in phase opposition through the transformer 67 having its primary winding 68 shunted, for tuning purposes if desired, for purposes of symmetry in each half of the wave, by a condenser 69 connected to ground at 70 and having its secondary winding 71 center-tapped to ground in the usual manner by way of the conductor 72. The anode elements 73 and 74 of the double diode 65 are connected respectively to the control electrodes 75 and 76 of wave shaping tubes 77 and 78. It is quite desirable in such a connection, however, that the

half of the secondary winding 71 of the transformer which is connected between the cathode elements 79 and 80 of the two halves of the tube 65 be accurately balanced with respect to ground 70 and for this purpose the winding 71 should preferably be bifilar and the core of the transformer 67 should be such that it does not show excessive loss at the assumed line frequency supplied through the conductor 63.

Connected between the control electrodes 75 and 76 of the tubes 77 and 78 and the cathode elements thereof are the usual diode resistors 81 and 82. The voltages which appear across these diode resistors 81 and 82 are negative in sign so that when rectified half wave portions of the energy in conductor 63 are impressed upon the tubes 77 and 78 (which tubes are preferably, although not necessarily, tubes of the type known in the art as the type 1851) the control electrodes 75 and 76 will be driven well beyond a cut-off potential so as to "clip" in this way the two alternate half waves.

It is frequently desirable, however, to vary the cut-off voltage on the tubes 77 and 78 and hence the so-called screen electrodes 83 and 84 are provided with an adjustable screen potential through their connection by way of the conductor 85 to the resistor element 86 as indicated. This form of arrangement permits a variation of the width of the clipped half waves.

Anode or plate potential for the tubes 77 and 78 is provided by way of the plate resistors 87, 87' from suitable voltage sources (not shown) connected to the free end of each of the anode resistors. The output energy from the tube 77 is supplied in parallel to a pair of tubes 88 and 89 respectively through suitable conductors 90 and 91 and the coupling condensers so as to be impressed in parallel upon the control electrodes 92, 93 of these tubes. The output energy from the tube 88 is fed by way of the resistance coupling to a further wave shaping tube 95. Output from this tube is then fed to a keying tube 97, later to be described.

Similarly, the output of the tube 89 is fed to the input of the further wave shaping tube 98 by way of the coupling condenser 99 so as to be impressed upon the control electrode 100 thereof. In addition, the output from the wave shaping tube 78 is supplied upon the control electrode 101 of a wave shaping tube 102 of a generally similar characteristic to the tube 88 connected to receive the output of the first wave shaping tube 77. The tube 102, it will be seen, has, together with the tube 89, a mutual plate or anode resistor 103 through which operating potentials are supplied. With the connection shown the output energy from the tube 102 is also supplied to the control electrode 100 of the tube 98 by way of the coupling condenser 99 and the conductor 104. In addition, the output energies from the tubes 89 and 102 are also combined by way of the conductor 104 and a coupling condenser 106 to be impressed upon the control electrode 107 of a wave shaping tube 108.

It will thus be seen from what has been above described that there is impressed upon the tubes 88 and 95 impulses of rectified current occurring at the line frequency corresponding to the frequency of the sine wave energy generated in the oscillator portion of tube 11 and appearing in the tuned circuit 25. Upon the tubes 98 and 108 there is produced the combined output of tubes 77 and 78 so that in the output of the tubes 98 and 108 there results relatively square bottom

pulses of a frequency double that which is impressed upon the rectifier tube 65 through the transformer 67. The output energy from the tubes 98 and 108 is supplied to additional keying tubes 110 and 112, later to be described in more detail.

In general, the wave shaping channel including the tube 98 is similar to that channel including the tube 108, except that the values of resistance and capacity in these two channels are chosen of somewhat different value from that in which is included tube 108 so that the resultant impulses which are supplied to the control electrodes of the keying tubes 110 and 112 shall, in the one instance, be of relatively long duration and, in the other instance, of relatively short duration for a purpose later to be described and for a purpose which becomes more apparent with a further consideration of the diagrammatic illustration of the signal wave form shown by Fig. 2.

Referring now to the output connection from the frequency divider or multi-vibrator 59, which is supplied by way of the conductor 55, it will be noted that this output energy is impressed in parallel upon the tubes 113 and 114 by way of the suitable coupling condensers. Through a suitable choice of resistance and capacity elements 115, 116 and 117 the impulse which is supplied to the control electrode 118 of the tube 113 is delayed for a short time period which is equal to the equalizing pulse interval (see Fig. 2) immediately following the last line of picture or video signals and occurring prior to the time when the vertical synchronizing pulses appear.

The output energy from the tube 113 is then fed by way of the resistance coupling connection, comprising the usual output and leak resistors and the coupling condenser to the control electrode 119 of tube 120. This tube 120 functions as a signal inverting tube. It has its output energy impressed upon the control electrode 121 of a tube 122 in the input circuit of which the capacity element 123' and the leak resistor 124' are suitably chosen in value to shape and delay the impulse as necessary. The width of the pulse applied upon the control electrode 121 of the tube 122 is controlled and the pulse is narrowed by this wave shaping and narrowing circuit. The output energy from tube 122 is then so connected as to energize a plurality of cascade connected tubes 123 and 124 serving to amplify and isolate the output energy from the tube 122. The output energy from the tube 124, wherein appears impulses which occur at the field frequency, hereinabove assumed for the purpose of convenience, present practice and illustration only as occurring 60 cycles per second, may then be used to key, in time delay determined by the time constant of the resistor and condenser arrangement 124' and 123', one of the produced groups of impulses resulting from the rectification of the impulses impressed by way of the conductor 63 and transformer 67 upon the rectifying tube 65.

During the time period when impulses occurring at the field frequency of 60 cycles are supplied to the tube 113 by way of the conductor 55 and the suitable coupling means, these same impulses are being supplied by way of the coupling condenser 125 upon the control electrode 126 of the tube 114 of a second keying channel. It will be seen from the arrangement indicated that the impulses occurring at the field fre-

quency are impressed upon the control electrode 126 of the tube 114 substantially without delay, as contrasted to the delay introduced in the application of these impulses upon the tube 113.

The output energy from the tube 114 is fed by way of the coupling condenser 127 to the control electrode 128 of an inverting tube 129 whose output is, in turn, coupled to the input of a tube 130 by way of a coupling condenser 131 so as to be impressed upon the control electrode 132 of the tube 130. The output energy from the tube 130 is supplied in parallel upon the control electrodes 133 and 135 of a pair of tubes 137 and 138 of which the latter functions, as will be hereinafter explained, as a tube for keying one of the series of impulses resulting from the rectification of the sine wave energy developed by the tube 11 at line frequency and supplied to the rectifier 65. Those impulses which are fed from the output of the tube 130 to the tube 138 are passed by way of the condenser 140 to the control electrode 135 thereof.

It will be seen that the tube 138 serves substantially as an isolating and buffer amplifier in whose output circuit there is fed by way of the conductor 141 a pulse of negative polarity during time intervals when one of the several channels energized from the rectifier 65 is to be keyed. Contrasted with this polarity of output signal, the output from the tube 124 which is connected by way of the conductor 142 to key another of the series of impulses formed from the output of the rectifier 65 is of the opposite polarity, for a purpose which will be hereinafter made more apparent.

As was above explained the output from the tube 130 while fed to the control electrode 135 to tube 138 is simultaneously caused to energize the control electrode 133 of a further tube 137. This tube serves to invert the polarity of the impulse appearing on the output of the tube 130. Therefore, the pulse, as it appears in the output of the tube 137 and as it is fed or supplied to the control electrode 145 of the tube 146 is of like polarity to that impulse which appears in the conductor 141. However, the tube 146 functions again to invert the polarity of this impulse and in the output circuit of the tube 146 there appears in the conductor 147 an impulse of a polarity opposite that in the conductor 141 and of a polarity like that in the conductor 142.

It can be seen from the connections shown that the output energy from the tube 138 is supplied by way of the conductor 141 to the screen electrode 149 of the tube 97. Similarly, the output energy from the tube 124 is supplied by way of the conductor 142 to the screen electrode 150 of the tube 110 while the output from the tube 146 is fed by way of the conductor 147 to the screen electrode 151 of the tube 112. The polarity of the signal appearing in the conductors 142 and 147 is positive in sign during time periods when impulses occurring at the field frequency are supplied from the multi-vibrator unit 59 by way of the conductor 55 so that it will be apparent that the screen electrodes 150 and 151 of tubes 110 and 112 which are connected with these conductors will be carried decidedly positive relative to the cathode at these time periods so that the normal bias (that is, as shown in the present case, at ground or cathode reference potential) which is supplied to these tubes to maintain them in an inoperative or non-conducting state is removed and the pulses of double frequency which appear in the output circuits of the tubes 98 and

108 respectively will be caused to energize the common output conductor 155 for all of the tubes 97, 110 and 112. Each of these tubes 97, 110 and 112 has its anode or plate voltage supplied from a common source by way of suitable resistor 157.

In view of the fact that the field frequency impulses supplied to the tube 113, by way of the conductor 55, are delayed, as above described, for a predetermined time interval by delay networks comprising the resistors 115, 116 and condenser 117, it will be seen that the keying action applied to the tube 112 is such that the tube 112 is carried to a conductive state just slightly prior to the time when the tube 110 is rendered conductive by reason of its connection through conductor 142 to the output of the tube 124. However, at the instant when the tube 112 becomes conducting by reason of the positive potential applied to its screen electrode 151 by way of the conductor 147, there is applied to the screen electrode 149 of the tube 97 by way of the conductor 141 a potential which is negative in sign or, in other words, opposite sign to that applied to the tube 112. Consequently, the tubes 97 and 112 are keyed in such a manner that during the time periods when the tube 97 is operative to pass current the tube 112 is inoperative to draw plate current, so that during time periods when the tube 112 is operative, the tube 97 becomes inoperative. These periods of operation have been indicated in a relative time relationship by the numerical designations applied to the synchronizing pulses shown in Fig. 2.

It will be seen further that during the period of time of the marked vertical synchronizing pulse interval, certain synchronizing impulses of longer duration are occurring. These are the impulses due to the keying provided by way of the channel including the tubes 113, 120, 122, 123, 124 and conductor 142 serving to supply positive voltage upon the screen electrode 150 of the tube 110. It was pointed out above that the time delay constant for controlling the delay in which the energy in the conductor 55 was supplied to the control electrode 118 to the tube 113 was such as to delay the pulse at the field frequency which is supplied by way of the conductor 55 is of a time indicated by the period vertical blanking in Fig. 2. However, with the relay of the time when this pulse should become effective of the control electrode 118 of the tube 113 being of a time period equal to the first equalizing pulse interval reading left to right in Fig. 2 the effects of this pulse for keying purposes will not be realized in this instant.

It was pointed out hereinabove, however, that the tube 122 functioned as a pulse narrowing tube and that one of the principal reasons for this narrowing effect is because of the parameters chosen of the resistor 124' and condenser 123'. This narrowing effect is such that an actually effective time period of the pulse applied by way of conductor 142 to key the tube 110 is narrowed from the time period normally expected so that it commences at a time period indicated by the legend marking the beginning of the vertical synchronizing pulse interval. These pulses are then continuing until the next time when picture signals are transmitted and until such time the actual modulation of the transmitter is only that given and indicated by the vertical synchronizing pulse interval on Fig. 2.

Further than this, there is some slight narrowing effect which takes place in the keying channel including the tube 114 which becomes effected by 75

reason of the parameters chosen for the coupling condenser 125 and the resistor 125'. This is evident from Fig. 2 of the drawing, wherein it will be seen that the horizontal synchronizing pulses start prior to the time period when the vertical blanking pulses would normally terminate and at which time the video picture reproduction again takes place. This then permits the tube 97 to transmit to the common output circuit 155 line frequency impulses which result from the sine wave energy applied through conductor 63 to the transformer 67 and the narrowing effect of the vertical blanking is according to the schematic illustration of the wave form shown equal to the duration of seven picture lines, although there can be a reasonable degree of tolerance in this value and the blanking signal may be of slightly longer duration, in which event the narrowing effect produced in the channel including the tube 113 will have to be still greater than above explained for the same number of equalizing impulses indicated in Fig. 2 of the drawings. It is, of course, apparent that the number of equalizing pulses, as well as the vertical pulses is not of a particularly critical nature but for practical considerations the number of such values indicated in the present disclosure represents that number which has been found to be most satisfactory for general usage.

Under such conditions and with the tubes 97, 110, 112 all feeding their output into a common circuit including the conductor 155 whose output energy is then transferred by way of a coupling condenser 170 to be impressed upon the input or control electrode 171 of a tube 172 which functions by reason of the bias applied by way of the resistor 173 as a clipping tube. As indicated by Fig. 2 of the drawings during the entire period represented by the production of the vertical synchronizing pulses, the tube 112 will have rendered operative by reason of the positive bias applied to the screen electrode 151 by way of the conductor 147 so that there is superimposed upon the edge of each of the vertical synchronizing pulses a pulse substantially like the equalizing pulses indicated immediately to the left of the vertical synchronizing pulses in Fig. 2. The tube 172, therefore, functions to clip this pulse from the vertical impulse since it is of no material use in the synchronizing control exercised upon the receiver. The output from the tube 172 may then be fed to a tube of substantially similar characteristics except that it is arranged to clip the impulse in the opposite direction. The output energy from the tube 172 is then supplied by way of the conductor 174 and the coupling condenser 175 to the output terminal 176, from which it is introduced into a selected television transmitter where the picture synchronizing and blanking signals are mixed. There practically has been suggested different points in the transmitter in which this signal may be introduced but for practical purposes the combined signal may be introduced in one of the amplifier stages preceding the modulation or in many instances should be introduced promptly into the modulator.

From what has been above described it is apparent that many modifications and changes may be made in the arrangement and circuit disclosed and it is, therefore, contemplated that any and all such modifications and changes which fall fairly within the spirit and scope of the invention as hereinafter claimed may readily be made

without departing from that subject matter herein described.

I claim:

1. A system for producing line and frame synchronizing impulses for use in a television system comprising means for producing a substantially sine wave of electrical energy at line repetition frequency, means for deriving impulses of line synchronizing frequency from successive halves of like polarity of said produced sine wave, means for deriving from each half of said produced sine wave without regard to polarity a succession of uniform impulses at twice repetition rate of the first named produced impulses, means to produce a first series of impulses of frame synchronizing frequency, means to produce a second series of impulses of frame synchronizing frequency delayed with respect to said first series of impulses of frame synchronizing frequency, and means to control the transmission of the impulses of line synchronizing frequency and the impulses of twice line synchronizing frequency by the first and second series of impulses of frame synchronizing frequency.

2. A system for producing line and frame synchronizing impulses for use in a television system comprising an electronic oscillator producing substantially sine waves of electrical energy at a predetermined line repetition frequency, electronic wave shaping means for deriving impulses of line synchronizing frequency from successive halves of like polarity of said produced sine waves, means for deriving from each half of said produced sine wave without regard to polarity a plurality of successions of uniform impulses at twice the repetition rate of the first named produced impulses, means to produce two series of impulses of frame synchronizing frequency, said two series of impulses being displaced in phase relationship by a predetermined amount, and means to control the transmission of the impulses of line synchronizing frequency and the impulses of twice line synchronizing frequency by the two series of impulses of frame synchronizing frequency.

3. A system for producing line and frame synchronizing impulses for use in a television system comprising oscillator means for producing a substantially sine wave of electrical energy at line repetition frequency, wave shaping means for deriving impulses of line synchronizing frequency from successive halves of like polarity of said produced sine wave, a full wave rectifier means, means for deriving from the rectified alternating halves of said produced sine wave a succession of uniform impulses at twice the line synchronizing frequency, means for producing two series of impulses of frame synchronizing frequency, said two series of impulses being phase displaced by a predetermined amount, and means to control the transmission of the impulses of line synchronizing frequency and the impulses of twice line synchronizing frequency by the two series of impulses of frame synchronizing frequency.

4. A system for producing synchronizing impulses for controlling the production of electro-optical patterns each of a predetermined number

of line traces and repeated at a predetermined pattern repetition rate from alternating fields in a television system comprising, means for producing substantially sine wave oscillations at a frequency corresponding to the line repetition rate, means for producing line synchronizing impulses from successive halves of like polarity of the developed sine waves, means for producing impulses at twice the line frequency from each of the produced sine waves by inverting alternate halves of the sine waves to produce impulses of substantially uniform configuration and polarity, means to produce under the control of the sine wave oscillation impulses of a frequency corresponding to the field repetition rate, a keying circuit, means for energizing the keying circuit by said field frequency energy, means controlled by the keying circuit for combining the impulses produced at line frequency and at twice the line frequency alternately and successively, and an output circuit for all of said impulses.

5. A synchronizing system for producing interlaced electro-optical patterns each of a predetermined number of line traces and repeated at a predetermined pattern repetition rate from alternating fields in a television system comprising means for producing substantially sine wave oscillations at a frequency corresponding to the line repetition rate, means for producing line synchronizing impulses from successive halves of like polarity of the developed sine waves, means for producing impulses at twice the line frequency from each of the produced sine waves by inverting alternate halves of the sine waves to produce impulses of substantially uniform configuration and polarity, means to produce under the control of the sine wave oscillations impulses of a frequency corresponding to the field repetition rate, and means for alternately and sequentially combining the impulses produced at line frequency and at twice the line frequency under the control of the impulses produced at field frequency.

6. The method of developing synchronizing signals for producing interlaced electro-optical patterns each of a predetermined number of line traces repeated at a predetermined pattern repetition rate from alternating fields in a television system comprising the steps of producing substantially sine wave oscillations at a frequency corresponding to the line repetition rate, producing synchronizing impulses at the line repetition frequency from successive halves of like polarity of the developed sine waves, inverting alternate halves of the sine waves to produce impulses of substantially uniform configuration and polarity to produce impulses at twice the line frequency from each of the produced sine waves, generating from the sine wave oscillations impulses of a frequency corresponding to the field repetition rate, and alternately and sequentially combining the impulses produced at line frequency and at twice the line frequency under the control of the impulses produced at the field repetition rate.

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