Nov. 28, 1939. M. BOWMAN-MANIFOLD ET AL 2,181,572

TELEVISION AND LIKE SYSTEM

Filed April 17, 1936 2 Sheets-Sheet 1

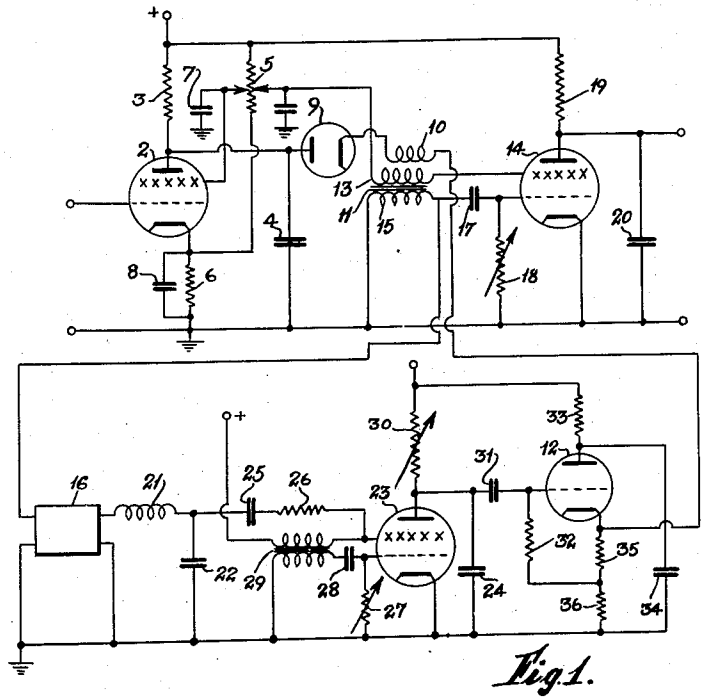


Fig. 1.

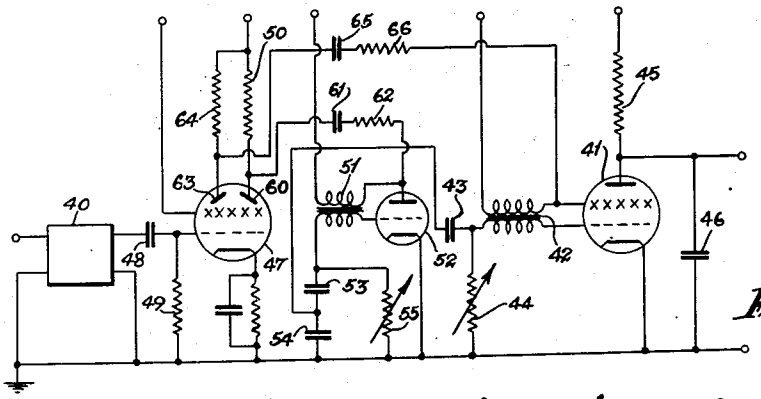


Fig. 2.



Fig. 3.

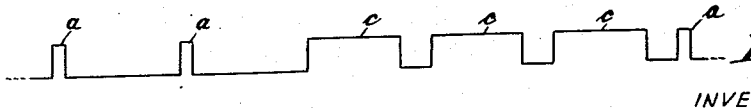


Fig. 4.

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TELEVISION AND LIKE SYSTEM

Filed April 17, 1936 2 Sheets-Sheet 2

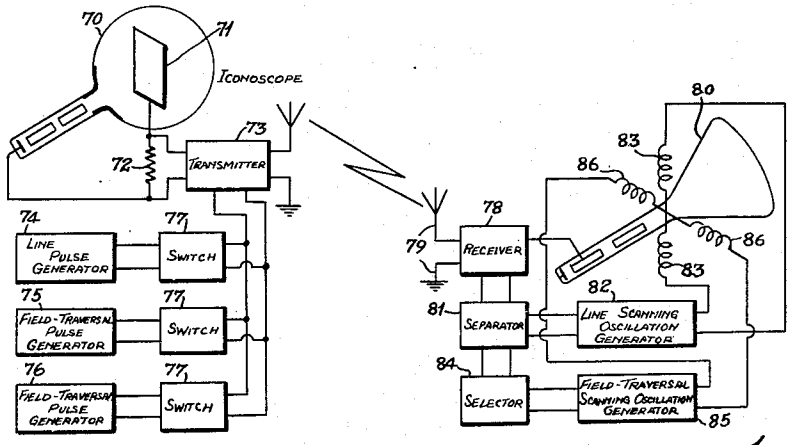


Fig.5.

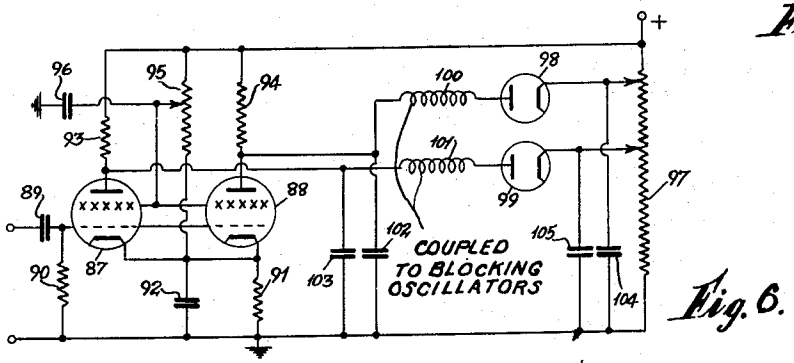


Fig. 6.

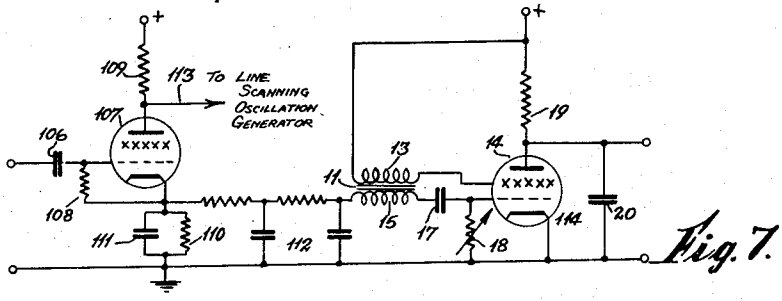


Fig. 7.

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2,181,572

TELEVISION AND LIKE SYSTEM

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Application April 17, 1936, Serial No. 74,944
In Great Britain April 9, 1935

9 Claims. (Cl. 178—69.5)

The present invention relates to television and like systems, and is particularly concerned with systems in which an object of which an image is to be transmitted is completely scanned in a plurality of traversals thereof, the lines scanned in one traversal being intercalated with those scanned in another; for convenience, this method of scanning will be referred to as interlaced scanning, and each of the traversals of the object will be called a field traversal.

Various methods of achieving interlaced scanning are known in which the area traced out by the scanning spot is displaced in the direction of frame scanning—for example, in the vertical direction—after each field traversal; the amount of displacement is made equal to an integral submultiple of the vertical distance moved by the scanning spot in scanning a line. The frame shift thus introduced is reduced to zero after sufficient field traversals have been made to scan the object completely, and the frame-shift frequency is accordingly an integral sub-multiple of the field-traversal frequency.

Three fundamentally different methods of synchronising the frame-shift motion at the receiver with that taking place at the transmitter which are already known are as follows: In the first, the synchronising signals which are transmitted for controlling the field-traversal motion are caused to recur at constant frequency, but successive signals are arranged to be in suitably different phases with respect to the synchronising signals which are transmitted for controlling the line-scanning motion; the latter signals are caused to recur at constant frequency. In the second method, line synchronising signals are generated at constant frequency, and successive field-traversal signals are arranged to occur in different phases with respect to the line signals, the method differing from the first method in that the field-traversal signals do not recur at constant frequency. The third method is characterised in that the field-traversal signals are all arranged to be in substantially the same phase with respect to the line signals; in one known arrangement of this kind, the field-traversal signals are arranged to recur at a constant frequency, although this is not an essential feature, and interlacing is achieved at a receiver by causing the field-traversal signals to control the generation of both a field-traversal scanning oscillation and an auxiliary frame shift oscillation, the two oscillations being superimposed upon one another and applied to control the field-traversal operation of the picture-reconstituting device.

The present invention has for its principal object to provide improved or simplified means for attaining synchronism in television systems in which interlaced scanning is achieved by the use of the third of the three methods outlined above, that is, the method in which the field-traversal signals are all arranged to be in substantially the same phase with respect to the line signals.

The present invention accordingly provides a television or like transmission system comprising means for scanning an object of which an image is to be transmitted to generate trains of picture signals having intervals between trains, the lines scanned in one field traversal of said object being intercalated between the lines scanned in the next field traversal, means for generating line synchronising signals for transmission in said intervals and field-traversal synchronising signals for transmission at the end of each traversal of said object, said field-traversal signals being all arranged to occur in substantially the same phase relationship with respect to said line signals, means for transmitting said picture signals and line and field-traversal synchronising signals, and a receiver arranged to generate under the influence of said field-traversal signals, a field-traversal scanning oscillation of which successive cycles have different durations, the difference between said durations being equal to the time occupied by the scanning of a fraction of a line.

According to a feature of the invention, a receiver suitable for use in a system as set forth in the preceding paragraph comprises a generator for generating field-traversal scanning oscillations under the control of applied field-traversal synchronising signals which are all in the same phase with respect to the said line synchronising signals, wherein frame-shift means are provided for varying in a cyclic manner the phase of said field-traversal scanning oscillation with respect to the applied field-traversal synchronising signals.

The synchronising signals referred to in the two preceding paragraphs may be constituted by pulses having amplitudes lying outside the range of picture signal amplitudes, and transmitted along the same channel as the picture signals; in this case, the synchronising signals can be freed from the picture signals at the receiver by an amplitude selection. The field traversal pulses may be constituted by certain of the line pulses which are made of longer duration than the remainder, as described in British Patent Specification No. 425,220.

The present invention further provides a method of television or like transmission in which,

at the transmitter, an object of which an image is to be transmitted is scanned by a process of interlaced scanning to generate, in each field traversal, trains of picture signals having intervals between trains, which method comprises transmitting a line synchronising signal in each of said intervals, said line signals being of substantially constant frequency and wave form, transmitting a field traversal synchronizing signal in each of the intervals between successive field traversals, the initial portions of said field-traversal signals being arranged to be substantially in phase with the initial portions of said line synchronising signals and each field-traversal signal being of a wave form different from that of the field-traversal signal preceding and succeeding it and from that of the line synchronising signals, and, at the receiver, utilising said field-traversal signals to generate a field-traversal scanning oscillation of such a nature that, in the reconstituted image, lines traced out in successive field traversals are intercalated with one another.

The invention further provides a method of television or like transmission in which, at the transmitter, an object of which an image is to be transmitted is scanned by a process of interlaced scanning to generate, in each field traversal, trains of picture signals having intervals between trains, which method comprises transmitting a line synchronising signal in each of said intervals, said line signals being of substantially constant frequency and wave form, transmitting a field traversal synchronising signal in each of the intervals between successive field traversals, the initial portions of said field-traversal signals being arranged to be substantially in phase with the initial portions of said line synchronising signals and each field-traversal signal being of a wave form different from that of the field-traversal signal preceding and succeeding it and from that of the line synchronising signals, and at the receiver, utilising said field traversal signals to generate a field-traversal scanning oscillation, and utilising certain of said field-traversal signals to control the operation of frame-shift means, said means serving to cause successive cycles of said scanning oscillation to differ in duration by a time substantially equal to that occupied by the scanning of $1/n$th of a line, where n is the number of field traversals in which said object is completely scanned.

In the methods according to the two preceding paragraphs, the field-traversal signals may be arranged to have a duration greater than that of said line synchronising signals, and less than the time period of the line signals, and the line and field-traversal signals may all be arranged to have the initial portions of their wave forms steep and of substantially the same shape, whereby said field-traversal signals may be utilised, at the receiver, to control the operation of line scanning during intervals between field traversals.

The invention also provides a television or like transmission system of the kind in which, at the transmitter, an object of which an image is to be transmitted is scanned by a process of interlaced scanning to generate, in each field traversal, trains of picture signals having intervals between trains, said system comprising a transmitter including means for transmitting a line synchronising signal in each of said intervals, said line signals being of substantially constant frequency and wave form, and means for transmitting a field traversal synchronising signal in each of the intervals between successive field traversals, the initial portions of said field-traversal signals being arranged to be substantially in phase with the initial portions of said line synchronising signals, and each field-traversal signal being of a wave form different from that of the field-traversal signal preceding and succeeding it and from that of the line synchronising signals, and a receiver including a generator of field-traversal scanning oscillations and means for applying to said generator received field-traversal signals, or signals derived therefrom, to control the initiation of successive cycles of said scanning oscillation, said generator being arranged so that, by virtue of the difference in the wave forms of successive field traversal signals, there can be generated a field-traversal scanning oscillation of such a nature that, in the reconstituted image, lines traced out in successive field traversals are intercalated with one another.

Other features of the invention will appear from the following description and appended claims.

Reference is now directed to the accompanying diagrammatic drawings, in which various embodiments of the invention are represented by way of example. In the drawings,

Fig. 1 shows schematically a part of a television receiver according to the invention,

Fig. 2 illustrates a modified arrangement according to the invention,

Figs. 3 and 4 represent a form of synchronising signal which may be employed in carrying this invention into effect,

Fig. 5 is a schematic representation of a television system according to the invention, and

Figs. 6 and 7 illustrate details of the system of Fig. 5.

In the description of the arrangements of Figs. 1 and 2, it will be assumed that the receiver is to be employed for the reception of picture signals and synchronising signals arriving along the same channel, the synchronising signals being injected into the transmission channel, which will be assumed to be constituted by a carrier wave, in the blacker-than-black sense with respect to the picture signals. The synchronising signals will further be assumed to be of the kind described in British Patent Specification No. 425,220, including field traversal or frame signals each of which comprises a single broad pulse occurring in an interval between successive trains of picture signals. It is to be understood, however, that the invention is not limited to the use of synchronising signals of the kind referred to. It will be further assumed throughout the description of the drawings that it is desired to achieve interlaced scanning in two field traversals at the receiver.

Referring to Fig. 1, received picture and synchronising signals are applied for example, from the demodulating detector of a wireless receiver, between the control grid of a screen grid valve 2 and earth, it being arranged that the synchronising signals are in the negative sense and are at such an amplitude that they reduce the anode current of the valve 2 to zero at their peaks. The anode of valve 2 is connected to the positive terminal of a source (not shown) of anode current, the negative terminal of which is earthed, through a resistance 3, and a condenser 4 is connected between the anode of valve 2 and earth. The screen grid and cathode of valve 2 are biased by means of a potential divider comprising resistances 5 and 6, decoupling condensers 7 and 8 being provided as shown.

The anode of valve 2 is also connected to the

anode of a diode valve 9, the cathode of which is connected through the winding 10 of a three-coil transformer 11 to the cathode of valve 12, the function of which will be made clear hereinafter.

The winding 13 of transformer 11 is connected between a tapping on resistance 5 and the screening grid of a valve 14, while the winding 15 has one end connected to earth and its other end connected through a condenser 17 to the control grid of valve 14. A lead is also taken from the junction point of winding 15 and condenser 17 to the input of amplifier 16. A leak resistance 18 is connected between the control grid of valve 14 and earth, while the anode thereof is connected through a resistance 19 to the positive terminal of the source of anode current.

The valve 14 and its associated circuit elements act in well-known manner as a blocking oscillator, a saw-tooth potential wave at the field-traversal frequency being set up across a condenser 20 connected between the anode of the valve 14 and earth. The function of the circuit associated with valves 2 and 9 is to separate arriving field-traversal pulses from line pulses, and to ensure that only the former are effective upon blocking oscillator 14. The operation of the apparatus so far described will be more fully explained hereinafter; it is pointed out here, however, that the method of separation employed forms the subject of co-pending United States application Serial No. 59,022.

As is well known, the blocking oscillator valve becomes alternately insulating and conducting, the change from one condition to the other being initiated by an applied synchronizing pulse which causes an oscillation to be set up between the control and screen grid circuits. The effect of this oscillation is to cause grid current to flow, and the condenser 17 becomes charged to such a negative potential that the oscillation is blocked, anode current ceases to flow, and the cycle is completed. The charge on condenser 17 leaks away through resistance 18, and just before the flow of anode current recommences, a new synchronising pulse arrives, and the cycle recommences.

The potential difference across the winding 15 of transformer 11 thus comprises effectively a series of pulses at the field-traversal frequency, and these pulses are amplified in amplifier 16 and applied, through a delay network comprising series inductance 21 and shunt condenser 22, between the screen grid and cathode of a second blocking oscillator valve 23 which is adapted to set up an oscillation of saw-tooth wave form and of one half the field-traversal frequency across condenser 24. Of these pulses applied to blocking oscillator 23, every alternate one is effective in initiating a change from the insulating to the conducting state. A condenser 25 and a resistance 26 are connected in series between the junction point of elements 21 and 22 and the screen grid of valve 23. The variable resistance 27, associated with grid condenser 28 and transformer 29, permits adjustment to be made of the frequency of the saw-tooth oscillation generated, and the anode of valve 23 is connected to the positive terminal of the anode current source through a variable resistance 30 by means of which the amplitude of the saw-tooth oscillation may be adjusted.

The saw-tooth oscillation set up across condenser 24 is applied through condenser 31 to the control grid of a so-called cathode-follower valve 12, the anode of which is connected to the positive terminal of the anode current source through a resistance 33, and to earth through a decoupling condenser 34. The cathode of valve 12 is earthed through two resistances 35 and 36 in series, and a grid leak 32 is connected between the grid and the join of resistances 35 and 36. The magnitude of resistances 35 and 36 in series is made large compared with the reciprocal of the mutual conductance of valve 12, the potential of the cathode of which accordingly follows substantially accurately changes in the potential of the control grid.

The operation of the arrangement of Fig. 1 is as follows:

Each synchronising pulse arriving at the control grid of valve 2 causes that valve to become insulating, and at each pulse, condenser 4 charges up to a positive potential dependent upon the duration of the pulse. There is thus set up across condenser 4 a series of triangular voltage pulses of which those due to the field-traversal synchronising pulses are of greater amplitude than those due to the line pulses.

The positive potential at the cathode of valve 12, and hence of the cathode of diode 9, is arranged to be greater at all times than the peak voltage set up at the anode of diode 9 on the occurrence of a line synchronising pulse, but it is arranged that on the occurrence of a field traversal pulse, current flows in diode 9, and hence in transformer winding 10, and blocking oscillator 14 is triggered off.

Now the voltage at the cathode of diode 9 is not constant, since a potential difference of saw-tooth wave-form, and of one half the field-traversal frequency, is set up across the two resistances 35 and 36 in series. Thus at the arrival of one field-traversal pulse, the saw-tooth oscillation set up across resistances 35 and 36 may have reached approximately one half of its maximum amplitude, while at the arrival of the next field-traversal pulse, the oscillation will have reached approximately its maximum value and the potential at the anode of diode 9 must reach a greater positive value before current flows in the diode and blocking oscillator 14 is triggered off. By adjustment of the amplitude of the saw-tooth oscillation generated by blocking oscillator 23, it can be arranged that if the first of the two field-traversal pulses causes the blocking oscillator 14 to be triggered off at the end of a line, the next field-traversal pulse will cause the blocking oscillator 14 to be triggered off approximately midway between the end of one line and the beginning of the next. The function of delay circuit 21, 22 is to ensure that oscillator 23 is triggered off slightly later than oscillator 14, at the ends of alternate field traversals, so as to prevent the occurrence of a reaction effect from oscillator 23 to oscillator 14.

It must, of course, be arranged that the set of alternate field-traversal pulses which is effectively retarded in the manner described is the correct set, so that scanning at the receiver takes place in the same manner as at the transmitter: in other words, if lines 1, 3, 5 etc. are scanned in one field traversal at the transmitter, and lines 2, 4, 6 etc. in the next, then oscillator 23 must be so adjusted that it locks in synchronism with that set of alternate pulses from generator 14 that, at the receiver, the sequence of line scanning is 1, 2, 3 etc. and not 2, 1, 4, 3, 6, 5 etc.

By the use of the apparatus described, field-traversal synchronising pulses which are all in the same phase with respect to the line pulses (for

example, field-traversal pulses which all occur in intervals between successive trains of picture signals) are caused to produce interlaced scanning at a receiver in a plurality of scans each of which comprises an integral number of lines plus a fraction of a line. It is to be noted that by causing the blocking oscillator 23, which may be regarded as the oscillator which controls frame shift, to oscillate at an integral fraction of the field-traversal frequency which is smaller than one half, for example, one third, interlaced scanning in more than two, for example in three, field traversals can be achieved. It is also to be noted that it is not essential that the received field-traversal pulses shall be of constant frequency, although in practice this will usually be so.

A modified arrangement according to the invention, which is suitable for use at a receiver in which it is desired to achieve interlacing in two traversals, will now be described with reference to Fig. 2; in the description of this figure, it will be assumed that the received signals have the same form as that discussed with reference to Fig. 1.

Referring to Fig. 2, received picture and synchronising signals are applied, for example from the demodulating detector of a wireless receiver, not shown, to a separator 40 which serves firstly to free the synchronising signals from picture signals and secondly to separate the field-traversal pulses from the line pulses, for example, by frequency selection, or in a manner such as that described with reference to Fig. 1.

The field-traversal pulses are fed in the negative sense to the control grid of a double anode screen grid valve 47 through a grid condenser 48 and leak 49. The circuit of anode 60 of valve 47 includes a resistance 50, and potential differences set up at the anode 60 of valve 47 are applied through a condenser 61 and a resistance 62 arranged to provide a relatively weak coupling to the anode of a triode valve 52, the cathode of which is earthed.

The second anode, 63, of valve 47 is connected to the positive terminal of the anode current source through resistance 64, and to the screen grid of a valve 41 through a condenser 65 and a resistance 66 in series. Valve 41, in association with transformer 42, condenser 43, and resistances 44 and 45, functions as a blocking oscillator to set up across condenser 46 a saw-tooth oscillation at the desired field-traversal frequency. The control grid of valve 52 is connected to earth through the secondary winding of transformer 51, and a circuit comprising two condensers 53 and 54 in series shunted by a variable grid leak 55. The join of condensers 53 and 54 is connected to the pole of condenser 43 remote from the cathode of valve 41.

In operation, valve 52 functions as a blocking oscillator to set up a potential of saw-tooth waveform and one half the field-traversal frequency across condenser 54. Due to the effect of the separator 40 in separating the field-traversal pulses from the line pulses, the field-traversal pulses arriving at blocking oscillator 41 are arranged to be approximately triangular in their general form, and the effect of the auxiliary, or frame-shift saw-tooth oscillation fed to oscillator 41 through condenser 43 from oscillator 52 is that two successive field-traversal pulses arriving at oscillator 41 cause that oscillator to be triggered off after different time intervals from the beginning of the corresponding pulse. By a suitable choice of the value of condenser 54, for example, the time difference referred to may be made equal to the time of scanning of one half of a line, in which circumstances the saw-tooth oscillation set up across condenser 46 may be employed to provide interlaced scanning in two traversals. As in the arrangement of Fig. 1, it is, of course, essential that the correct set of alternate field-traversal pulses should be retarded.

Reference is now directed to Figs. 3 and 4 of the acompanying drawings, which illustrate a further form which the synchronising signals employed may take. Fig. 3 illustrates the synchronising signal in the neighbourhood of one field-traversal signal; the line synchronising pulses are illustrated at *a* and the three broader pulses constituting the field-traversal signal at *b*. Fig. 4 shows the signal in the neighbourhood of the next field-traversal signal, the latter being constituted by three pulses *c* which are broader than the pulses *b* of Fig. 3. The pulses *a*, *b* and *c* all have leading edges which recur, throughout the whole synchronising signal, at the line scanning frequency, and the pulses *b* and *c* can thus serve at the receiver to control the synchronisation of the line scanning operation during the field-traversal intervals. Various ways in which synchronising signals of the kind shown in Figs. 3 and 4 may be utilised according to the present invention will now be described by way of example with reference to the television system shown diagrammatically in Fig. 5.

Referring to Fig. 5, picture signals for transmission are generated by means of an image transmitting tube 70 such as that known by the trade name "Iconoscope" having a mosaic screen electrode 71 associated with a signal output resistance 72; signals set up across the latter are fed to a transmitter 73.

The line pulse generator 74 generates pulses of the kind shown at *a* in Figs. 3 and 4, and field-traversal pulse generators 75 and 76 generate pulses of the kind shown at *b* and *c* respectively, generators 74, 75 and 76 all operating to generate pulses recurring at the line frequency. During the scanning of lines at the transmitter, it is arranged that line pulses from generator 74 are fed to transmitter 73, while at the ends of successive field traversals, pulses from generator 75 or generator 76 respectively are fed to transmitter 73; the selection of pulses from generators 74, 75 and 76 is performed by the automatic switches 77, which may be of any known or suitable type, such as thermionic valve switches. The composite synchronising signal fed to transmitter 73 is of the form shown in Figs. 3 and 4, and is mixed with the picture signals in the blacker-than-black sense. The apparatus for controlling scanning at the transmitter may be controlled by synchronising pulses from generators 74, 75 and 76, and the scanning apparatus at the transmitter may have substantially the same form as that employed at the receiver, which will now be described.

The receiver 78 is fed with signals received from transmitter 73 by a suitable aerial system 79, and supplies picture signals to a picture-reconstituting cathode ray tube 80. The output of the demodulating detector of the receiver 78 is fed to separator 81 which frees the synchronising pulses from picture signals, and feeds the whole series of pulses to a generator 82 of line scanning oscillations, the latter being applied to the horizontal deflecting coils 83 of the tube 80; the synchronising pulses from separator 81

are also fed to a selector 84 which operates to select the field-traversal pulses from the composite synchronising signal and to control the operation of a field-traversal scanning oscillation generator 85 which feeds the vertical deflecting coils 86 of the tube 80.

The generator 85 is arranged to generate a scanning oscillation of such a nature that, in the reconstituted image, lines traced out in successive field traversals are intercalated with one another. One manner in which this may be achieved will now be described with reference to Fig. 6.

Referring to Fig. 6, which illustrates one form which the selector 84 of Fig. 5 may take, the received synchronising signals, free from picture signals, are applied from separator 81 to the control grids of two tetrode valves 87 and 88 through a condenser 89 associated with leak resistance 90. The cathodes of valves 87 and 88 are connected together, and to earth through resistance 91 shunted by by-pass condenser 92. The anode of valve 87 is connected through a resistance 93 to the positive terminal of a source (not shown) of anode current, the negative terminal of which is earthed, and the anode of valve 88 is connected to the positive terminal of the source through a resistance 94. A resistance 95 is connected between the positive terminal of the source and the cathode of valves 87 and 88, and a tapping point on resistance 95 is connected to the screening grids of the valves; the tapping point is earthed through by-pass condenser 96.

A potential divider resistance 97 is connected between the positive terminal of the anode current source and earth, and the cathodes of two diodes 98 and 99 are connected to adjustable tapping points in resistance 97. The anode of diode 98 is connected, through a coil 100 constituted by one winding of a blocking oscillator transformer, not shown, to the anode of valve 88, and the anode of diode 99 is connected through the winding 101 of a second blocking oscillator transformer (not shown) to the anode of valve 87. A condenser 102 is connected between the anode of valve 88 and earth, and a condenser 103 is connected between the anode of valve 87 and earth; decoupling condensers 104 and 105 are connected between the cathodes of diodes 98 and 99 respectively as shown.

The blocking oscillators associated with windings 101 and 100 are arranged to oscillate respectively at the field-traversal frequency, and one half the field-traversal frequency respectively, and the output of the blocking oscillator associated with winding 100 may be employed, in the manner already described with reference to Figs. 1 and 2, to delay the operation of the blocking oscillator associated with winding 101 at alternate field traversals.

Alternatively, the outputs of the two blocking oscillators may be added together in the same sense to furnish a scanning oscillation which may be employed to provide interlaced scanning.

In operation, the received synchronising signals are applied to valves 87 and 88 in the negative sense, and at such a level that the flow of anode current in these valves is interrupted during each synchronising pulse. Accordingly, during each pulse, charging current flows to condensers 102 and 103, these condensers being rapidly discharged during intervals between synchronising pulses. There is accordingly set up across each of condensers 102 and 103 a series of triangular voltage pulses in the positive sense, the pulses due to the signals *b* and *c* (Figs. 3 and 4) being of greater amplitude than those due to signals *a*. The cathode of diode 99 is connected to a point at such a positive potential in resistance 97 that no current flows therein when a line pulse *a* is operative on valve 87, but that current flows when either a pulse *b* or a pulse *c* is operative. The cathode of diode 98, however, is connected to a point at a more positive potential, so that only the broader pulses *c* cause current to flow therein. The blocking oscillators associated with windings 100 and 101 are thus controlled in the manner described.

A further arrangement according to the invention is illustrated in Fig. 7, which shows a form which the selector 84 and field-traversal generator 85 of Fig. 5 may take. Referring to Fig. 7, synchronising pulses from separator 81 are fed through condenser 106 to the control grid of tetrode valve 107 in the positive sense; condenser 106 is associated with leak resistance 108, and it is arranged that the control grid of valve 107 biases itself in such a manner, by flow of grid current, that no current flows in the valve except in the presence of a synchronising pulse.

The anode of valve 107 is connected through a resistance 109 to the positive terminal of a source (not shown) of anode current, the negative terminal of which is earthed, and the cathode of valve 107 is earthed through a resistance 110 shunted by condenser 111. A lead 113 is taken from the anode of valve 107 to the line scanning oscillation generator 83, Fig. 5.

The resistance 110 and condenser 111 serve to integrate the field-traversal pulses *b* and *c* (Figs. 3 and 4) and potential differences set up across resistance 110 are applied, through a resistance-condenser filter 112 which serves to attenuate potential differences due to the line pulses *a*, to the input of a blocking oscillator 114 which is substantially identical with that shown in Fig. 1, except that winding 10 of Fig. 1 is omitted. The blocking oscillator 114 is arranged, by adjustment of variable resistance 18, to be triggered off at a certain critical voltage, and this voltage is so chosen that the potential set up across resistance 110 reaches the critical value after a time, subsequent to the arrival of the leading edge of the first of the pulses *c*, which is less than the time after the arrival of the first of the pulses *b* at which the critical value is attained. This time difference is made equal to that occupied by the scanning of one half of a line, so that the scanning oscillation set up across condenser 20 is of a nature such that it can be employed to produce interlaced scanning in two field traversals.

The arrangements described with reference to Figs. 3 to 7 have employed a synchronising signal in which successive field-traversal signals differ—or comprise pulses which differ—in duration; it will, however, be clear to those versed in the art that, if desired, field traversal signals differing in amplitude, or in both duration and amplitude, may be employed. In such a case, the received field traversal signals may conveniently be converted at the receiver, in any known or suitable manner, into derived signals having different durations, in which case apparatus of the kind described with reference to Figs. 6 and 7 may be employed. It is further to be understood that the invention is not limited to systems in which interlacing is achieved in two field traversals only.

The application of the invention other than to television systems will be clear to those versed in the art.

We claim:

1. A picture transmission system comprising means for scanning an object of which an image is to be transmitted to generate trains of picture signals having intervals between trains, the lines scanned in one field traversal of said object being intercalated between the lines scanned in the next field traversal, means for generating line synchronizing signals for transmission in said intervals and field traversal synchronizing signals for transmission at the end of each traversal of said object, each said field traversal synchronizing signal beginning substantially simultaneously with the beginning of certain line synchronizing signals, means for transmitting said picture signals and line and field traversal synchronizing signals, and a receiver apparatus including means to generate under the influence of said field traversal signals a field traversal scanning oscillation of which successive cycles have different durations, the difference between said durations being equal to the time occupied by the scanning of a line.

2. In a television system, means for interlacedly scanning in a line-for-line manner an image area to produce a sequence of trains of signal energy, means to develop line synchronizing signals representing the completion of each scanned line of the image, means to develop field traversal synchronizing signals at the completion of each field traversal, said field traversal synchronizing signals beginning substantially simultaneously with said line synchronizing signals, means to transmit all of said signals, means to receive said transmitted signals, means at the receiver for generating field traversal scanning oscillations, means for controlling the field traversal scanning oscillations generated in accordance with the received field frequency signals, and means for varying in cyclic manner the phase of the field traversal scanning oscillations with respect to the field traversal synchronizing signals received.

3. In a television system, means for interlacedly scanning in a line-for-line manner an image area to produce a sequence of trains of signal energy, means to develop line synchronizing signals representing the completion of each scanned line of the image, means to develop field traversal synchronizing signals at the completion of each field traversal, said field traversal synchronizing signals beginning substantially simultaneously with said line synchronizing signals, means to transmit all of said signals, means to receive said transmitted signals, a generator at the receiver for generating field traversal scanning oscillations under the control of the applied field traversal synchronizing signal, and in phase with respect to the line synchronizing signals, frame shifting means for varying in cyclic manner the phase of the generated field traversal scanning oscillations relative to the field traversal synchronizing signals received, and means for controlling said frame shifting means by said generator for generating the field traversal scanning oscillations.

4. In a television system, means for interlacedly scanning in a line-for-line manner an image area to produce a sequence of trains of signal energy, means to develop line synchronizing signals representing the completion of each scanned line of the image, means to develop field traversal synchronizing signals at the completion of each field traversal, said field traversal synchronizing signals beginning substantially simultaneously with said line synchronizing signals, means to transmit all of said signals, means to receive said transmitted signals, a blocking oscillator for developing field traversal scanning oscillations under the control of the received field traversal synchronizing signals, frame shifting means including means for developing an auxiliary oscillation at a sub-harmonic of the field traversal synchronizing frequency for controlling the oscillator whereby the phase relationship of the field traversal scanning oscillations may be cyclically varied.

5. In a television system, means for interlacedly scanning in a line-for-line manner an image area to produce a sequence of trains of signal energy, means to develop line synchronizing impulses of unidirectional form following each scanned line of the image, means to develop at the completion of each field traversal a field traversal signal comprising at least one impulse of a duration longer than the line impulse, the field traversal signal frequency being a sub-multiple of the line signal frequency, means for transmitting all of said signals so that the beginning of each said field traversal impulse is substantially coincidental with the beginning of said line synchronizing impulse, means for receiving all of said signals, a blocking oscillator at the receiver for generating field traversal scanning oscillations, means for controlling the developed oscillations in accordance with the received synchronizing impulses, and means for varying in cyclical manner the phase of the developed field traversal impulse oscillations at a frequency which is an integral sub-multiple of the field traversal frequency.

6. In a television system, means for interlacedly scanning in a line-for-line manner an image area to produce a sequence of trains of signal energy, means to develop line synchronizing signals representing the completion of each scanned line of the image, means to develop field traversal synchronizing signals at the completion of each field traversal, said field traversal synchronizing signals beginning substantially simultaneously with said line synchronizing signals, means to transmit all of said signals, means to receive said transmitted signals, a blocking oscillator at the receiver for generating field traversal scanning oscillations in accordance with the received field traversal signals, and an auxiliary blocking oscillator associated with the first blocking oscillator and adapted to generate a saw-tooth oscillation of a frequency which is an integral sub-multiple of the field traversal frequency for varying in cyclic manner the phase of the field traversal scanning oscillations with respect to the field traversal synchronizing signals received.

7. The method of television transmission which comprises interlacedly scanning an image area to generate wave trains of picture signal energy having time intervals separating successive trains, transmitting line synchronizing signals each of substantially constant frequency and wave form in each of said intervals, initiating field traversal synchronizing signals substantially simultaneously with the beginning of certain of said line synchronizing signals, transmitting said field traversal synchronizing signals in each of the intervals between successive field traversals, each field traversal signal being of a wave form different in length from that preceding and suc-

ceeding it and also from the line synchronizing signal, generating at a receiving point a field traversal scanning oscillation, and controlling the generated scanning oscillation at the receiver in accordance with the length of the transmitted field traversal signals so that the lines traced in successive field traversals are interlaced one with the other.

8. The method of television transmission which comprises interlacedly scanning an image area to generate wave trains of picture signal energy having time intervals separating successive trains, transmitting line synchronizing signals each of substantially constant frequency and wave form in each of said intervals, initiating field traversal synchronizing signals substantially simultaneously with the beginning of certain of said line synchronizing signals, transmitting said field traversal synchronizing signals in each of the intervals between successive field traversals, each field traversal signal being of a wave form different from that preceding and succeeding it and also from the line synchronizing signal, generating at a receiving point a field traversal scanning oscillation, and varying in cyclic manner the phase of the scanning operation developed in accordance with the field traversal synchronizing signals to cause successive cycles of the developed scanning oscillations to differ in time duration.

9. In a television system, means for scanning an image in a line-for-line manner according to an interlaced scanning pattern to develop a series of image signals for each scanning field, means for transmitting following each line of scanning a line synchronizing signal, said signals being of constant frequency and wave form, means for transmitting a field traversal synchronizing signal in each of the intervals between successive field traversals, said field traversal signals beginning substantially simultaneously with said line synchronizing signals and each field traversal signal being of a wave form different from that of the field traversal signal preceding and succeeding it and from that of the line synchronizing signal, means for receiving all of the signals, said receiving means comprising a generator for generating field traversal scanning oscillations, means for controlling the initiation of successive cycles of said scanning oscillations developed by said generator from the received field traversal signals, and means for varying in accordance with the wave form of successive field traversal signals the phase of the generated field traversal scanning oscillation so that successive field traversals are interlaced one with the other.

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