Nov. 18, 1947. G. L. GRUNDMANN 2,431,037

SYNCHRONIZING SIGNAL SEPARATING CIRCUIT

Filed July 13, 1945

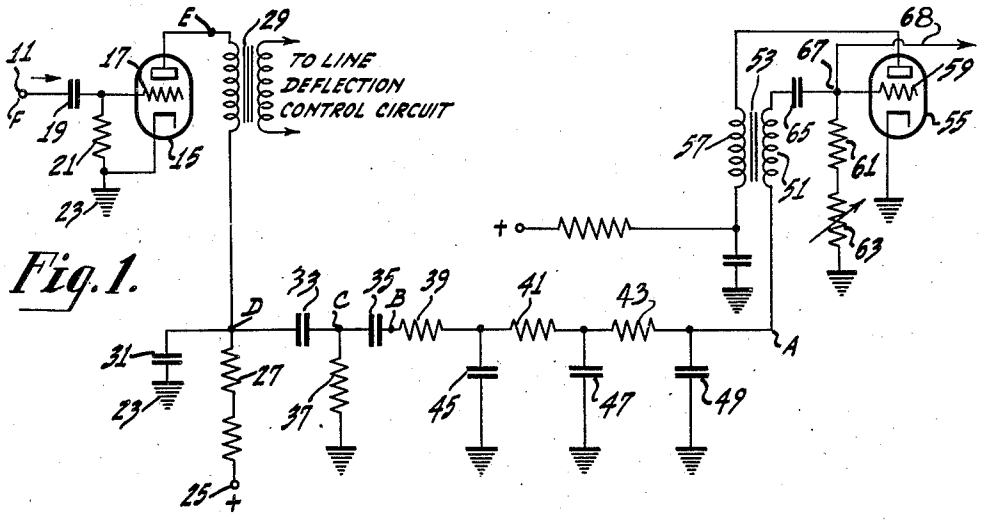


Fig. 1.

Fig. 2.

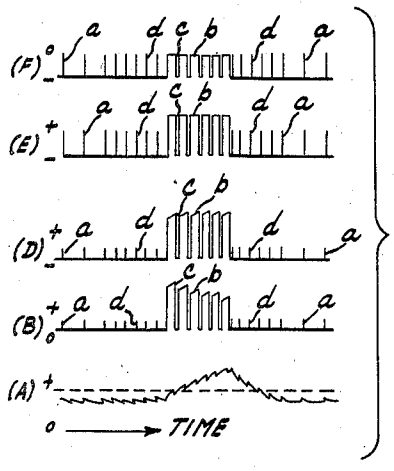
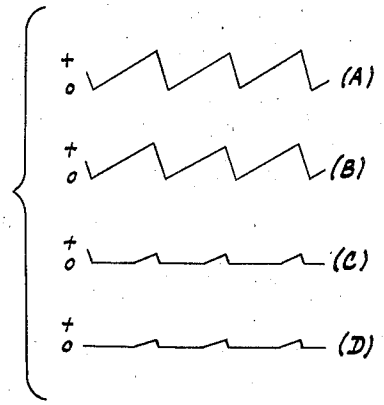


Fig. 3.



INVENTOR.
GUSTAVE L. GRUNDMANN
BY
H. S. Grover.
ATTORNEY

Patented Nov. 18, 1947

2,431,037

UNITED STATES PATENT OFFICE

2,431,037

SYNCHRONIZING SIGNAL SEPARATING CIRCUIT

Gustave L. Grundmann, Westmont, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application July 13, 1945, Serial No. 604,784

3 Claims. (Cl. 178—69.5)

1

This invention is directed to television apparatus with particular emphasis on circuits for use therein to provide ways and means to segregate and separate the incoming sync signals used to provide field or frame deflection from the accompanying sync signals used to control the line or horizontal deflection.

Various arrangements have been proposed in the past to effect the same end result to be achieved by this invention. However, it has been found from experience that the sync signal separating circuits heretofore used to segregate the sync signals used to control the field or frame deflection (usually termed "vertical" sync signals, which will be the term hereinafter used in this specification) from the so-called horizontal sync signals (usually termed the "line" sync, which term will also be referred to hereinafter in this specification) have been found to be subject to considerable noise effects and also to be particularly susceptible to an inter-action between the vertical circuit and the horizontal circuit. The inter-action of the vertical circuit upon the horizontal sync, comes about primarily because a so-called "kick-back" voltage is always developed by the vertical deflection control oscillator following each complete vertical deflection. This voltage tends to feed back into the horizontal sync circuits due to the fact that vertical sync separation has been brought about in the past primarily through a low-pass filter which permitted a certain amount of the relatively low frequency kick-back voltage to pass through it and into the horizontal sync circuit.

The present invention overcomes the difficulties of prior art arrangements by improving the methods by which the vertical sync signals are separated from the horizontal sync signals through the utilization of the combination of a band-pass filter effect, which serves as a high-pass filter section, and the heretofore proposed low-pass filter section.

These two filters are arranged to be connected between the output of the normal sync separator unit of a television receiver system and the controlling vertical oscillator. The high-pass and low-pass filter sections combine to give the effect of a band-pass filter and accomplish two main objectives. Broadly speaking, the first objective is that of eliminating any low frequency or long sustained noise from affecting the vertical oscillator. The second objective is that of preventing the vertical sync oscillator from disturbing in any way the horizontal sync signals at time periods when the vertical kick-back voltage is developed.

2

With these thoughts in mind, it will be appreciated that one of the primary objects of this invention is that of providing increased fidelity of receiver operation by insuring a higher degree of separation between vertical and horizontal sync signals.

Another object of the invention is that of providing a filter circuit to bring about sync signal separation which has a high degree of noise immunity and a higher degree of freedom from cross-modulation of one deflection circuit upon another so that defects and inefficiencies present in arrangements heretofore used in the prior art are very considerably reduced.

Other objects of the invention are those of providing a more efficient sync signal separation circuit without materially increasing the cost of the units utilized, and yet maintaining substantially the same general simplicity of operation.

Still other advantages of the invention will become apparent and promptly suggest themselves to those skilled in the art to which the invention is directed when the following specification is read in connection with the accompanying drawings, wherein Figure 1 schematically represents a portion of a television receiver circuit incorporating the invention; Figure 2 is a series of five curves to explain the operation of the receiver; and Figure 3 is a further series of four curves to assist further in explaining the circuit operation and to show the manner in which the effect of the vertical circuit is substantially eliminated from the horizontal circuit.

Referring now to the drawings, Figure 1 represents a portion of a television receiver and particularly the synchronizing signal selection section thereof. Various forms of circuits for bringing about separation between the video signals, from which the final electro-optical image is constructed on the image producing tube of the ordinary cathode ray type television receivers, and the sync signals for controlling the vertical and horizontal motion of the scanning beam within the image producing tube are known.

Normally the sync impulses for bringing about the horizontal or line deflection control on the one hand and the vertical or field or frame deflection control on the other hand form a part of the composite video signal modulation. The sync signal information is in the direction of black in the image to be reproduced, but extends in the region beyond black and into that which is known as "blacker-than-black" or ultra-black. Separation of these sync signals from the video signal per se is, therefore, usually effected subsequent to de-

tection in the second detector of the receiver instrumentality by means of a suitable sync signal separator frequently operating as a limiter.

One form of circuit utilized for receiving television images and bringing about the signal separations of the above-described character is depicted in the well-known text entitled "Principles of Television Engineering," by D. G. Fink, published by McGraw-Hill Book Co., Inc., in New York in 1940, where a receiver circuit is shown on pages 452 and 453. A system for separating the sync signals from the video signals is also disclosed by Bedford U. S. Patent No. 2,207,775, granted July 16, 1940. A further system for bringing about separation of sync signals from the video signals is depicted by way of illustration in the Tolson U. S. Patent No. 2,207,839, granted July 16, 1940. These prior art arrangements are represented purely by way of example and in no limiting sense.

When the sync signals are separated from the video signals they consist essentially of pulses occurring at line frequency for the horizontal or line sync, although the signals recur at double frequency (called "equalizing pulses") a limited number of times prior to and subsequent to the transmission of the vertical sync signal. The vertical sync signal consists of an elongated pulse (usually of three line periods duration) which is slotted at double line frequency so that the effect of the line sync pulses is retained. The second series of equalizing pulses follows the slotted vertical pulses, after which the horizontal sync pulses are repeated at normal line frequency. The sync signal information of this general form, is generally represented in the above-mentioned "Principles of Television Engineering," particularly at pages 168 and 171, where the sync signals or sync pulses extend in a general region between 75% or 80% and 100% peak voltage.

Separated sync signals of this general character may be considered as being applied at the input terminal 11 of the circuit shown by Figure 1. Such signals are schematically represented also by curve F of Figure 2, although it should be understood that such representation is purely schematic and a substantially accurate representation will be found at page 171 of the Fink text. The signals so applied at the terminal 11, which signals may frequently have noise pulses superimposed thereon are then supplied to a further sync separator and inverter tube 15 through the connection to the grid or control electrode 17 thereof by way of condenser 19. The grid leak element 21 connects to ground 23, as does the cathode of the separator tube. It thus becomes apparent that the separator tube 15 is grid leak biased to provide further selection.

Operating voltage for the separator tube 15 is supplied by connecting a voltage source (not shown) with its positive terminal connected at point 25 and its negative terminal preferably grounded. The operating voltage is thus fed through the load resistor 27 of the tube 15 and through the primary winding of a transformer 29. The secondary winding of the transformer 29 is connected to suitable line or horizontal deflection control circuits (not shown in detail but set forth in the publication and patents above noted) to effect line deflection of the cathode ray scanning beam generated within the cathode ray image producing tube (not shown). Since the present invention is not directly concerned with the line deflection control, no detailed illustration of this portion of the system is shown.

If reference is now made to Figure 2 and to waveform F thereof, it will be seen that the horizontal or line signals shown by this curve are relatively narrow, such as those designated by the pulses *a*, whereas the vertical sync signals which are slotted are relatively wide signal portions *b* separated by slots *c* of narrow width corresponding substantially to the width of the equalizing pulses *d* immediately preceding and following them. Normally the line sync pulse *a* is of a duration equal to 0.08H, where H represents the time to trace one line of the image raster. The equalizing pulses *d* are of duration approximately half that of the line sync pulse. The duration of each of the vertical sync pulses is of approximately 0.43H, as schematically represented by curve F.

Some amplification occurs within the tube 15 so that the resultant sync pulses at the output of the tube and at the primary of the transformer 29 appear at point E and are generally as shown by curve E of Figure 2.

The point D in the system between which point and ground 23 a capacitor 31 is connected, as will be seen from curve D of Figure 2, is the point from which the amplified sync pulses representing the vertical sync are first partially separated from the line sync pulses due to the low-pass filter effect brought about by reason of the capacitor 31. The vertical and remaining horizontal sync pulses, such as those represented by curve D of Figure 2, are then passed through the high-pass filter comprising the series connected capacitors 33 and 35 and the shunt connected resistor 37 so that at the point B (as also shown by curve B of Figure 2) there is a loss of low frequency due to the effect of the high-pass filters.

Such low frequency sync signals as appear at the point B are then passed through the low-pass filter comprising the series connected resistors 39, 41 and 43 and the shunt connected capacitors 45, 47 and 49 to the point A from which they are applied to control the vertical oscillator tube 55. The circuit comprising the series connected resistors 39, 41 and 43 and the shunt connected capacitors 45, 47 and 49 forms a low-pass filter and serves as an integrating circuit so that by the time the sync signals reach the point A, the vertical or field frequency control signals are separated from the horizontal or line control signals by well known integrating methods and appear generally as indicated by curve A of Figure 2.

The vertical sync signals, if thus separated from the line or horizontal sync signals, are applied by way of the winding 51 of the transformer 53 to the input of the vertical oscillator tube 55. The secondary winding of the transformer 53 couples the output signals from the oscillator tube 55 to the input by the coupling between the windings 57 and 51. The tube 55, through the connections shown, is connected essentially as a blocking oscillator and functions in known manner by reason of the explained transformer coupling between the tube plate and grid circuits.

The commencement of current flow in the plate circuit of the tube, as is known, drives the grid or control electrode 59 positive and causes grid current to flow. During the time grid current is flowing, a negative voltage is built up across the grid resistors 61 and 63 so as to charge the condenser 65. Whenever plate current ceases to increase and begins to decrease, the transformer drives the grid very negative and the negative charge which appeared on the grid and the condenser 65 then leaks off through the serially con-

nected resistor combination 61 and 63. The resistor 63 is usually made variable so as to control or modify slightly the normal so-called "free running" time or period or frequency of the oscillator combination. A conductor 68 is connected at point 67 to supply the voltage appearing at that point to the grid of the well known discharge tube to control the development of the sawtooth voltage which is to bring about the vertical deflection of the cathode ray beam generated in the image producing tube (not shown).

Reference may now be made to the curves of Figure 3 where curve A thereof represents the voltage which appears at point A due to the kick-back resulting from the vertical oscillator. Curve B of Figure 3 represents the voltage in the system at point B between the low-pass filter and the high filter combination. It shows that at this point in the system only a slight loss of the effect of the kick-back voltage has been introduced. Curve C of Figure 3 is intended schematically to represent the voltage at the point C in the selection system and indicates some reduction in the effect of the vertical kick-back voltage by reason of the effect of the high-pass filter combination through which the kick-back voltage has passed to reach the point C. At the point represented by D on Figure 1, the voltage which appears due to the kick-back from the vertical deflection circuit is shown by curve D of Figure 3. From this curve, it will be seen that the effect of the vertical kick-back voltage has now been substantially eliminated by reason of the next section of the high-pass filter.

It, therefore, becomes evident that the line or horizontal deflection control circuit will be disturbed only to a very slight degree by any residual kick-back effect which might be introduced into the voltage induced into the secondary winding of the transformer 29, so that by selecting the vertical sync signal and separating it from the horizontal sync signals through the combination of a high-pass and a low-pass filter and the sync separation is attained without considerable loss while the detrimental effects of the kick-back voltage from the vertical circuit are prevented from effecting the horizontal or line circuit by reason of this kick-back voltage being impressed through the combination of the low-pass and the high-pass filter.

Having now described my invention, what is claimed and desired to be secured by Letters Patent is the following:

1. In a television receiver adapted for receiving image synthesizing information in the form of signal pulses of relatively short duration for controlling the line deflection of a cathode ray beam and signals of lower frequency and longer duration for controlling the field deflection and wherein the signals are intermingled with each other and are superimposed upon video signal information, a system for separating the field signals from the line signals so as to supply the field signals to control a suitable field deflection control oscillator which comprises, in combination, a high-pass filter circuit connected to receive the combined signals in its input circuit and a serially connected low-pass filter circuit adapted to receive at its input circuit the output signals from the high-pass filter and to deliver at its output circuit a separated field signal to control the field deflection oscillator, the said low-pass filter circuit serving in the selection particularly

to segregate and exclude the short duration line signals from the desired longer duration field signals and the high-pass filter circuit serving particularly to prevent kick-back voltages due to the oscillator from being fed back to the input circuit where the combined line and field signals are present.

2. In a television receiver circuit wherein line sync impulses and field sync impulses are supplied to control the line and field deflecting circuits associated with a cathode ray image producing tube, the combination which comprises a sync signal separator tube for selecting sync signal information to the exclusion of video signal information transmitted concurrently therewith as a composite signal, a line deflection control circuit connected to receive the output from the sync separator tube, a field sync signal selection circuit also connected to receive the output of the sync separator tube, a field frequency deflection oscillator connected to receive the output of the field frequency selection circuit so as to be triggered thereby, said field frequency selection circuit comprising a high-pass filter connected to receive the output from the sync separator tube and a serially connected low-pass filter connected to receive its input from the output of the high-pass filter and deliver its output to control the field frequency deflection oscillator whereby the low-pass filter selects the field frequency signal input impulses to the exclusion substantially of the line frequency signal impulse input, and the high-pass filter precludes substantially kick-back voltages from the field deflection oscillator from being fed back into the line deflection control circuits.

3. A television receiver for the reception of a composite signal comprising video, line sync impulses of comparably short duration which occur at scanning line frequency and field sync impulses of longer duration which occur at field frequency, comprising a sync signal separator means for removing substantially the sync signal information from the video signal information, separate line and field deflection circuits, a connection from the separator means to the line frequency deflection circuit for supplying line sync impulses thereto, and means comprising a series combination of a high-pass filter circuit including series connected capacity elements and shunt connected resistive elements and a serially connected integrating circuit including a plurality of stages each comprising a series resistive arm and a shunt capacitive arm for supplying the field sync signals to the field frequency deflection circuit with the integrating circuit excluding the effects of the line sync impulses upon the field frequency deflecting circuit and the high-pass filter circuit excluding from the input to the line frequency deflection circuit the reaction effects of the field deflection circuit subject otherwise to be induced into the line deflection circuits.

GUSTAVE L. GRUNDMANN.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,292,148	Moe	Aug. 4, 1942