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A. A. BARCO ET AL

2,293,528

SEPARATING CIRCUIT

Filed May 31, 1940

FIG. 1.

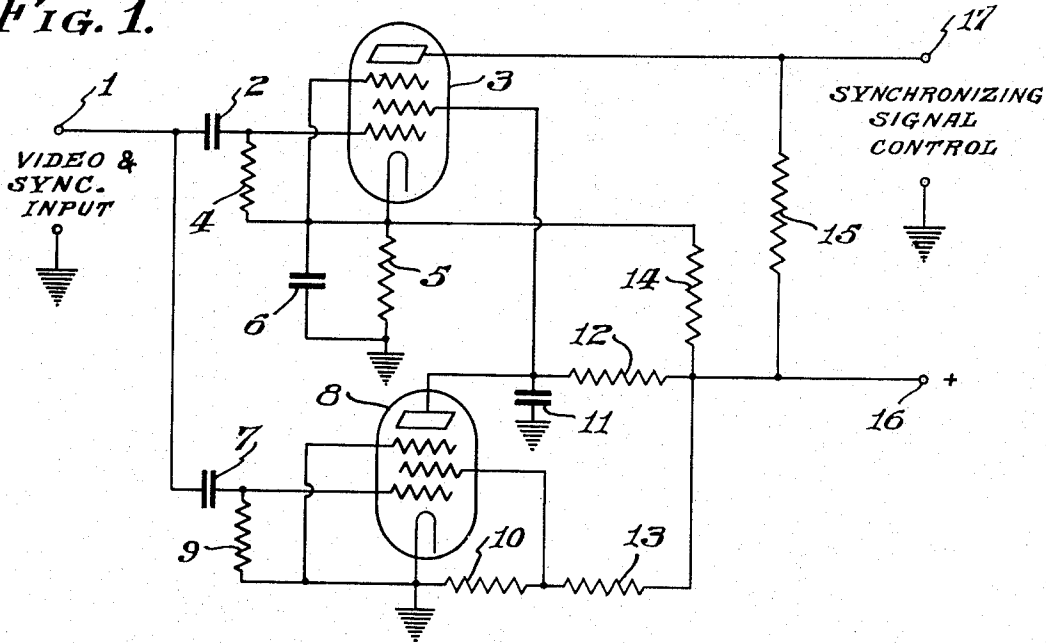


FIG. 2A.

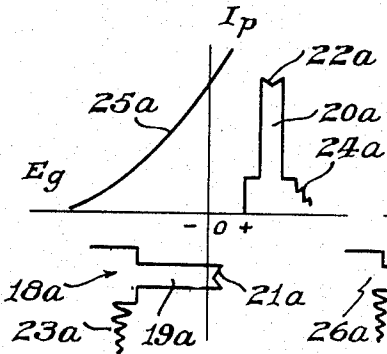


FIG. 3A.

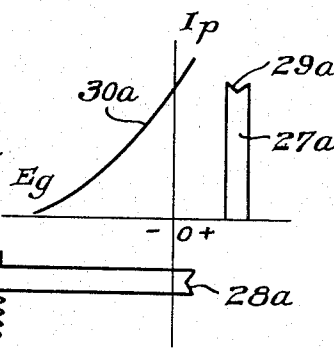


FIG. 4A.

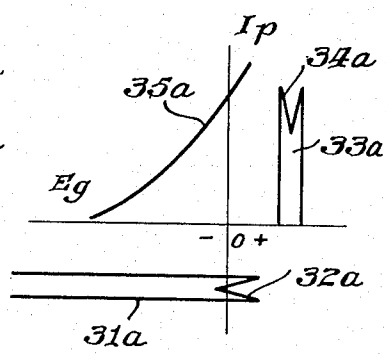


FIG. 2B.

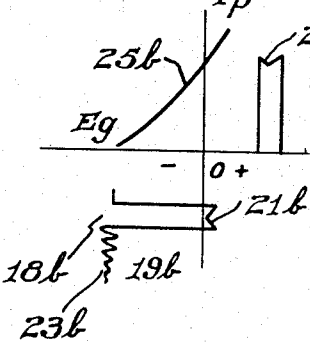


FIG. 3B.

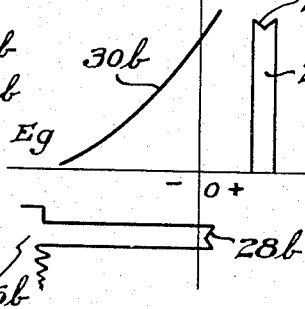
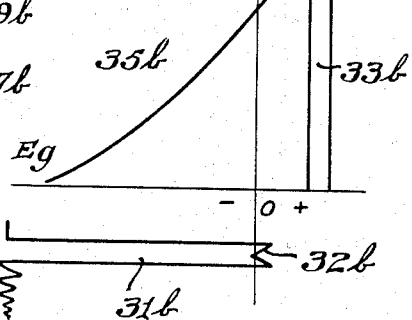


FIG. 4B.



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2,293,528

SEPARATING CIRCUIT

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2 Claims. (Cl. 178—7.3)

This invention relates to television and more particularly to means for separating the synchronizing pulses from the picture signal.

In a television system wherein the synchronizing pulses, both horizontal and vertical, are of greater amplitude than the picture (video) signal and transmitted concomitantly therewith, it is necessary to separate the synchronizing pulses from the picture signal. This is generally accomplished by passing the composite signal through a separator tube adjusted so that only the synchronizing pulses, which are of high amplitude, are clipped from the composite signal and passed to the synchronizing equipment. The composite signal includes both the picture signal and the synchronizing pulses, and one form of such signal is illustrated, for example, in "Electronics" for July, 1938, on pages 28 and 29.

British Patent No. 407,409 describes a television system in which the scanning of the receiver is maintained in synchronism with the scanning of the transmitter by receiving a transmitted horizontal synchronizing pulse of short duration at the end of each scanning line and a vertical synchronizing pulse of the same amplitude but of longer duration at the end of each picture frame and/or field. The synchronizing pulses are of greater amplitude than the picture signals and are preferably in the "black" picture direction and of greater amplitude in that direction than the blackest of the picture signals.

According to the system described in the British patent, the synchronizing pulses are separated from the picture signals by means of a vacuum tube biased to cut-off by a fixed grid voltage of a value which depends upon the tube characteristic. The composite signals are impressed upon the grid of this vacuum tube so that the synchronizing pulses which are in the black picture direction of the composite signal are impressed upon the control grid of this vacuum tube in the positive direction. It follows that only the synchronizing pulses are present in the output signal energy from the tube, and the picture signals have been eliminated by the separating or "clipping" action of the biased tube. The principal objection to this circuit is that the bias on the tube must be adjusted manually for each different amplitude of incoming composite signal.

In an application of William A. Tolson, Serial No. 23,136, filed May 24, 1935, now U. S. Patent 2,207,839, issued July 16, 1940, there is disclosed a separating circuit in which a vacuum tube is provided with a grid leak and condenser in its

grid circuit, the values of capacity and resistance being so chosen that the synchronizing pulses, when applied to the grid of the tube in the positive direction with sufficient amplitude, cause the tube to be biased beyond cut-off so that only the synchronizing pulses are passed. The bias applied to the control grid of the separating tube increases or decreases in accordance with the increase or decrease in the amplitude of the incoming composite signal.

There are other separating circuits in which the bias voltage varies automatically in accordance with the strength of the incoming signal. It is known in the art to provide means for controlling the grid bias in accordance with the change in plate current which changes in accordance with the incoming composite signal strength.

However, when the video signal amplitude varies over a very large range, when a separating circuit is used in test equipment such as oscilloscopes or in television receivers adapted to be used in an area which is supplied with television signals likely to vary over a large range, it is necessary to provide some additional control means to vary the amount of voltage clipped from the composite signal. Otherwise, when the video signal amplitude is very small, part of the picture signal will be clipped off and fed to the synchronizing amplifier. This possible interference caused by the picture signal might throw the synchronizing apparatus out of step by the pulse synchronizing control action. When on the other hand the video signal amplitude is large, only a part of the synchronizing pulse will be extracted from the composite signal and hence any interference or amplitude variation impressed upon the original synchronizing pulses will constitute a greater percentage of the pulse after the clipping action has been completed.

In accordance with this invention, the clipping means or separating tube is controlled over a large range of video signal voltages so that the part clipped from the top of the composite signal varies in accordance with the composite signal field strength, and, therefore, a uniform percentage of voltage and not a uniform voltage is clipped from the composite video signal.

Accordingly, the principal object of this invention is to provide an improved signal separating method and means.

Further objects of this invention are to provide means for separating a uniform percentage of signal from a given signal, and to provide means which will separate substantially all of the

synchronizing pulse from the picture signal over a large range of variations in the amplitude of the composite signal.

Other and incidental objects of the invention will be apparent to those skilled in the art from a reading of the following specification and an inspection of the accompanying drawing, in which

Figure 1 is a wiring diagram of one embodiment of the invention,

Figures 2A, 3A and 4A show explanatory curves relating to the results obtained with the conventional clipper circuit,

Figures 2B, 3B and 4B show similar curves relating to the results obtained by the use of the improved automatic control on the separating tube.

Referring to Figure 1, a composite signal having both picture signals and synchronizing pulses is fed to the input circuit 1. The input circuit of each of the separating tube 3 and the control tube 8 is coupled to the source of composite signals 1 through relatively large condensers 2 and 7 and high resistances 4 and 9. This provides long time constant circuits so that the grid rectification is of the peak detection variety, that is, the direct current voltage developed by rectification on the input grids of each of the tubes is equal to the average of positive-peak values of the incoming composite signal. The composite signal is impressed upon the control grid of vacuum tube 3 through the condenser or capacity element 2. Resistance 4 is connected between the aforementioned control electrode of the tube 3 and its corresponding cathode to allow the accumulated voltage, caused by grid rectification, to leak off slowly to the cathode. The resistance 4 is so chosen that the storage voltage on the control electrode has a value substantially equivalent to the normal synchronizing pulse voltage peak above the pedestal of the composite signal. The pedestal voltage is a transmitted signal voltage greater than the picture signal voltage upon which the signal pulse is superimposed. It is well known that the grid bias of a tube having a grid leak and condenser input circuit increases or decreases in accordance with the incoming signal strength. Therefore, the negative bias on the control grid of the separating tube 3 will be smaller for a small amplitude signal than the bias which is present on the grid for a comparatively large amplitude signal. For signals varying over a very small range of voltages, this automatic bias means is usually sufficient.

The operation of the separating tube 3 depends upon the signal driving the control grid positive with respect to its associated cathode. Each time that the grid is driven positive, the grid-cathode impedance of the tube 3 drops to a comparatively low value. Consequently, the gain of the separating tube drops to a comparatively low value for the duration of the synchronizing pulse. Furthermore, the greater the amplitude of the synchronizing pulse the more the gain of the separating tube is reduced. Thus, all the synchronizing pulses appearing in the output of the separating tube are approximately the same amplitude. This leveling action is important because, although the synchronizing pulses have the same amplitude when they are generated at the transmitter, they frequently are received as signals of uneven amplitude and unless they are leveled off in some way to make them again of substantially like amplitude, they

cause the deflecting circuits to be irregular in operation. Obviously, any such irregularity causes the received picture on the cathode ray tube also to become irregular or ragged. This synchronizing impulse voltage peak is then amplified in tube 3 and passed on to the synchronizing equipment at terminal 17.

The composite signal is also fed to control tube 8 through the condenser 7. The control grid of the control tube 8 also contains a resistance 9 for allowing the grid rectified electrical charge to leak off slowly. This grid rectified electrical charge causes the control tube 8 to operate similarly to the separating tube 3 as previously described in detail.

When the voltage of the incoming composite signal is relatively high, a large negative voltage is built up on the control grid of the control tube 8 thus causing a low plate current in the control tube 8 and correspondingly the potential on the screen grid of the separating tube 3 is relatively high (positive relative to the cathode) because of the voltage drop through the resistor 12 from the voltage source 16 to the control tube anode. When the voltage on the screen grid of the separating tube 3 is highly positive relative to the cathode, the control tube cut-off point is carried more negative than otherwise would be the case. It follows that more of the incoming signal is clipped off under these conditions.

When the voltage of the incoming composite signal is relatively low, a small negative voltage is built up on the control grid of the control tube 8, thus causing a high plate current in the control tube 8 and correspondingly the potential on the screen grid of the separating tube 3 is relatively low (i. e., low positive potential relative to cathode). At low screen grid the control tube cut off point goes more positive. It follows that less signal is clipped off the composite signal under these conditions.

It is desirable to operate the screen grid of the separating tube 3 over a limited range of voltages of which all are relatively low with respect to its associated cathode. Therefore, resistance 14 is connected between the cathode of the separating tube 3 and a voltage source 16. The cathode of the separating tube 3 is connected to ground through resistance 5. It follows that there will be a voltage drop in resistance 5 making the cathode positive with respect to ground. This results in a lower relative screen grid potential. Resistance 5 is provided for thus biasing the screen grid and not for biasing the control grid of the separating tube as the control grid is returned to the cathode through resistance 4 and not to ground.

A battery or other suitable voltage source obviously may be used to provide this separating tube screen grid biasing potential with respect to its associated cathode without departing from the spirit of this invention.

Resistances 5 and 14 are so chosen that the proportion of the voltage clipped from the composite signal will remain substantially constant over the desired working range.

Therefore, it follows that the amount of voltage clipped from the incoming signal is proportional to the signal strength over a far greater range than has heretofore been possible by the use of a separating tube without auxiliary controlling means.

Condenser 11 is placed in the plate circuit of the control tube 8 to act as a control tube out-

put filtering means. The filter is placed in the output circuit of the control tube rather than in the input circuit so that no additional parallel impedance load will be placed upon the incoming signal.

A triode or other suitable tube obviously may be used in place of the pentode tube 8 shown in Fig. 1 without departing from the spirit of this invention.

The anode voltage supply for the separating tube 3 is supplied from the source 16 through resistance 15, the resistance 15 also functioning as an output resistance so that the separated synchronizing pulses may be utilized in apparatus connected at terminal 17. While not illustrated, it is to be understood that the circuits controlled by the output energy at terminal 17 may be of any desired type. One suitable form has been disclosed by Vance Patent 2,137,039, of November 15, 1938, assigned to Radio Corporation of America. Other circuits, such as disclosed by Tolson et al. Patent 2,101,520, of December 7, 1937, may also readily be utilized. Resistances 10 and 13 are so chosen as to supply the proper positive potential to the screen grid of the control tube 8.

Fig. 2A represents graphically the plate current of the separating tube 3 in the conventional clipper circuit with fixed clipping level under conditions of low signal strength. The incoming composite video signal 18a contains a picture signal 23a and a synchronizing pulse 19a, the synchronizing pulse having superimposed thereon a small amount of interference or other amplitude variation 21a. It will be noticed that the component 20a which is separated by the conventional separating tube from the incoming composite signal 18a includes, in addition to its synchronizing pulse 20a, a small amount of picture signal represented by 24a. Curve 25a shows that the cut-off point of the conventional separating tube which remains substantially constant over a wide range of signal strength is low enough to include a portion of the picture signal 23a so that at low amplitude signals a portion of the picture signal 24a is included in the output of the separating tube. A signal of the same amplitude is shown by 18b in Figure 2B which represents the action of this invention on a signal of low amplitude. It will be noticed that the cut-off point designated by the intersection of curve 25b with the horizontal axis is approximately at the pedestal voltage of the incoming signal 18b and consequently there is no picture signal component in the output of the separating tube shown by curve 20b. The interference component 21b being of low value expresses itself in curve 20b as a small irregularity 22b.

The curves shown in Figures 3A and 3B represent the output of the separating tube of the conventional circuit and of this invention under medium signal strength. It will be noticed under conditions of medium signal strength the results of this invention are similar to those of the conventional circuit. Figure 4A shows the curve representing the output of a separating circuit of the conventional circuit under conditions of high signal strength. A portion of the synchronizing pulse 31a having a large interference component 32a is impressed upon the grid of the conventional circuit separating tube. The output of the conventional circuit is represented by

curve 33a having a very large component of interference 34a and should this interference component 34a be large enough, it will cause the synchronizing equipment to lose step. Figure 4B on the other hand shows the action of a separating tube utilizing applicant's invention under conditions of high signal strength. The cut-off point of the separating tube is shifted far enough in the negative direction to include a large portion of a synchronizing impulse 31b and thus the output curve 33b of the separating tube will contain an interference component 34b relatively small in proportion to the substantially complete synchronizing pulse component.

It will be seen that in the conventional circuit curves 2A, 3A and 4A the cut-off point of the separating tube is substantially at the same negative grid voltage under large variations in incoming composite signal amplitudes. However, the curves showing the results obtained by the use of this invention change the negative grid voltage cut-off point in accordance with the incoming composite signal amplitude.

From the foregoing, it will be apparent that various other modifications may be made in our invention without departing from the spirit and scope thereof.

We claim as our invention:

1. In a television system of the type wherein there is employed signals including synchronizing pulses, means for separating the pulses from said signals comprising in combination a separator tube having a control electrode, a cathode and an auxiliary control electrode, a control tube having a control electrode, a cathode and an anode, means for applying signals between each of said control electrodes and their respective cathodes, a grid leak and condenser for each of said discharge devices and a connection between said anode of said control tube and said auxiliary control electrode of said separator tube to vary the current cut-off point of said separator tube such that a decrease in applied signal voltage increases the anode current in said control tube and shifts the cut-off point of the separator tube in a direction to reduce the signal in said separator tube.

2. In a television system of the type wherein there is employed signals including synchronizing pulses, means for separating the pulses from said signals comprising in combination a separator tube having a control electrode, a cathode and an auxiliary control electrode, a control tube having a control electrode, a cathode and an anode, means for applying signals between each of said control electrodes and their respective cathodes, a grid leak and condenser for each of said discharge devices, a connection between said anode of said control tube and said auxiliary control electrode of said separator tube to vary the current cut-off point of said separator tube such that a decrease in applied signal voltage increases the anode current in said control tube and shifts the cut-off point of the separator tube in a direction to reduce the signal in said separator tube, and means to reduce the potential difference between the cathode and auxiliary control electrode of said separator tube including a resistance connected to said cathode and in series with said separator tube.

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