

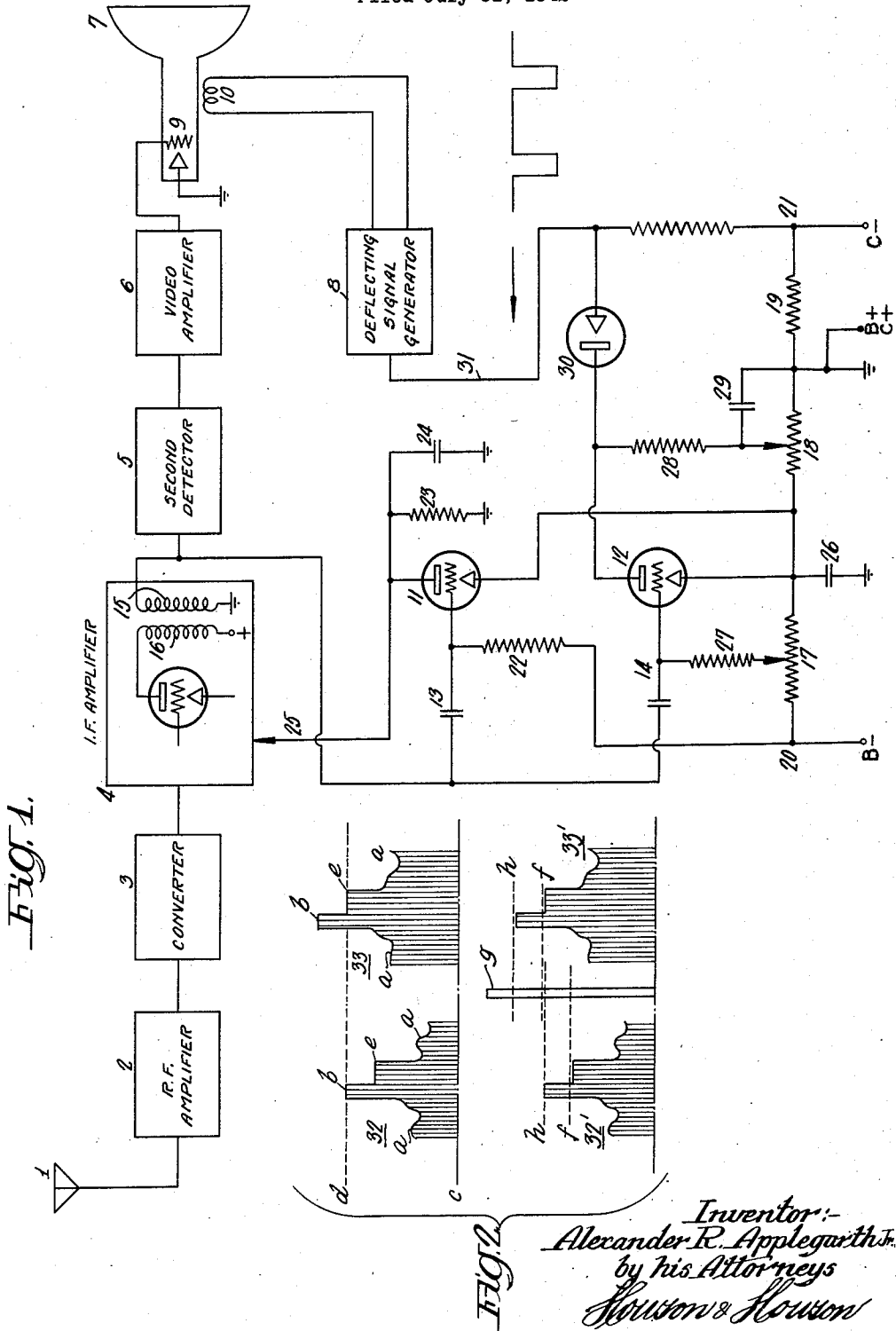
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AUTOMATIC GAIN CONTROL AND AMPLITUDE SELECTION DEVICE

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AUTOMATIC GAIN CONTROL AND AMPLITUDE SELECTION DEVICE

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9 Claims. (Cl. 178—7.5)

This invention relates to a combined automatic gain control and amplitude-selection device for use in electrical systems employing an electrical signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation by amplitude-selection of one component from the others. The device is particularly useful where the amplitude or strength of the signal varies with time but the amplitude of the signal component to be selected bears a constant relationship to the amplitude of the composite signal. In such case the amplitude of the portion of the signal selected by the device is caused to vary with signal strength so that for strong signals the selected portion is of greater absolute magnitude than for weak signals. In addition, the device exercises a gain controlling action which tends to compensate for variations in signal strength, whereby the absolute magnitude of the selected portion tends to be maintained constant. By reason of the operation of the device in this manner, it selects only a desired component of the composite signal to the substantial exclusion of other components irrespective of variations in signal strength.

The device of the invention is particularly adapted to be used in television receivers for receiving a composite television signal comprising video and synchronizing components established at relatively different amplitude levels. As is well known to those familiar with such systems, it is necessary to provide means for separating the synchronizing component from the video component by amplitude selection. The synchronizing component when thus separated is used to maintain synchronization of the receiver-deflecting circuits with reference to those employed at the transmitter. Numerous circuits have been devised and are described in the literature of the art for effecting such a separation. However, it has been found that the operation of many of these circuits is unsatisfactory under certain conditions because they select not only the desired synchronizing component, but also some of the video component. This is particularly the case when the strength of the received signal, and, hence, the amplitude of the synchronizing component, varies. For reasons which need not be set forth in detail, the inclusion in the selected portion of the composite signal of a part of the video component tends deleteriously to affect the synchronization of the deflecting circuits, and, hence, is to be avoided.

Accordingly, it is an object of this invention

to provide an improved combination automatic gain control and amplitude-selection device for use in a television receiver for selecting the synchronizing component of the composite signal to the substantial exclusion of the video component, said device being substantially independent of variations in signal strength as regards its ability to distinguish between these components.

Stated somewhat more generally and without reference to the specific components of an arbitrarily chosen signal, the object of the invention is to provide an improved automatic gain control and amplitude-selection device for use in a system employing a signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation by amplitude selection of one component from the others, said device functioning to select said one component to the substantial exclusion of said other components irrespective of variations in signal strength.

Although the specific novel features of the invention will be pointed out in the appended claims, the organization of the invention will best be understood from the following description with reference to the accompanying drawing wherein the device of the invention is shown associated with a television receiver circuit. It will be understood, however, that although a single embodiment and a single application of the invention will be described herein, the invention is capable of embodiment in other physical forms and of other applications subject only to the limitations imposed by the claims.

In the drawing,

Fig. 1 is a diagrammatic illustration of a television receiver and a detailed illustration of one form of the invention applied to the receiver; and

Fig. 2 illustrates certain signal conditions to facilitate an understanding of the operation of the invention.

Referring now to Fig. 1, the reference numerals 1 to 8 inclusive designate the various conventional parts generally regarded as essential to any television receiver. The legends applied to these parts serve to identify them, and their various functions, both separately and when operating in combination, need not be described in detail since they are well known to those skilled in the art. 1 is an antenna or signal intercepting device. 2 is a radio frequency amplifier coupled to the antenna 1 and adapted to amplify the signal intercepted thereby. 3 is a so-called first detector or frequency converter adapted to

translate the frequency components by a predetermined amount to lower frequencies which are more readily amplified. 4 is an intermediate frequency amplifier for amplifying the signals thus translated. 5 is a so-called second detector for detecting the amplified intermediate frequency signal from 4 to yield a signal corresponding to the composite signal represented by the modulation envelope of the intermediate frequency signal. 6 is an amplifier, usually referred to as a "video amplifier" for amplifying the detected signal. 7 is a cathode ray tube picture-reproducing device, the control grid 9 of which is connected to the video amplifier 6, whereby the intensity of the electron beam is caused to vary in accordance with the variations in the amplified signal. 8 is a circuit for generating a signal which, when applied to a deflecting coil 10, is adapted to produce a deflection in one direction of the electron beam within the tube 7. In practice, it is customary to employ two deflecting coils, one for producing deflection of the electron beam in a horizontal direction and one for producing deflection in a vertical direction at a substantially different rate. Two deflecting signal generators are likewise provided, one for each of said coils. In the present instance, only one deflecting signal generator and its associated deflecting coil have been shown in order to simplify the drawing, such showing being sufficient to illustrate the operation of the circuit which is the subject of the present invention.

According to the invention, there may be provided two space discharge devices 11 and 12, preferably though not necessarily on the triode type. These tubes may have their grids coupled to the output circuit of one of the tubes, preferably the last, in the intermediate frequency amplifier 4. The means employed to effect this coupling may comprise, for example, the condensers 13 and 14 and the coil 15 inductively associated with inductance 16 in the output circuit of a tube in the intermediate frequency amplifier. The tube 11 may be provided with a fixed bias, for example, by the connection of its cathode and control grid to different points on the bleeder comprising the resistors 17, 18 and 19 having its terminals 20 and 21 connected to points of different potential which may be terminals on a battery or other suitable voltage source (not shown). It will be noted that the grid connection may include a leak resistor 22 of appropriate magnitude as determined by the other circuit constants and the mode of operation desired. The anode of the tube 11 may be grounded through a load impedance 23 bypassed by a condenser 24 of such magnitude as to yield a combination having a relatively large time constant by comparison with the time interval between horizontal synchronizing pulses in the television signal. A connection 25 from the anode of the tube 11 to the intermediate frequency amplifier 4 serves to supply the voltage developed across load impedance 23 to the individual stages of the intermediate frequency amplifier in a manner to control the gain thereof. The exact manner of making this connection to the intermediate frequency amplifier tubes has not been shown, as it is well known to those skilled in the art to which this invention appertains.

Due to the connection of the cathode of tube 11 to the bleeder at the juncture of resistors 17 and 18, the cathode current of tube 11 will flow through resistor 17 and will create a voltage drop therein proportional to the magnitude of

the said current. By connecting the cathode and grid of the tube 12 to different points on the resistor 17, as shown, the bias applied to the tube 12 may be caused to vary in accordance with the variations in the anode current of tube 11. In order that the bias of the tube 12 may be made to vary with variations in the average current in tube 11 rather than with instantaneous variations therein, the resistor 17 is effectively shunted by a condenser 26 of sufficient magnitude to yield a combination having a time constant large by comparison with the interval between current pulses in tube 11. The connection between the grid of tube 12 and the resistor 17 may include the leak resistor 27. In the anode circuit of the tube 12 may be connected a load impedance 28, one end of which is connected to the tube anode and the other to an adjustable tap on the resistor 18 from which plate voltage is supplied. Preferably, a by-pass condenser 29 is provided between the movable tap and the high potential end of the resistor 18 in order that the plate voltage may be varied without changing the A. C. load impedance. A connection may be provided directly from a point on load impedance 28 to the deflecting signal generator 8 for supplying thereto the portion of the signal from the intermediate frequency amplifier selected by the tube 11. However, it is preferable to provide means for limiting the amplitude of the selected portion so as to minimize the deleterious effects of unduly large noise pulses and synchronizing peaks. Such means may comprise, for example, the diode 30 whose anode is connected to that of the tube 12 and whose cathode is connected to a point on the resistor 19 so as to provide a biasing voltage for the diode which determines the extent of its limiting action. The connection 31 to the deflecting voltage generator may then be made to the cathode of the diode in the manner shown.

Referring now more particularly to the operation of the circuit whose physical arrangement has just been described, the signal derived from the intermediate frequency amplifier 4 and fed through condensers 13 and 14 to the grids of both tubes 11 and 12 may be as shown at 32 and 33 in Fig. 2, or the corresponding signal representations 32' and 33'. The purpose of duplicating these signals is to explain the action of tubes 11 and 12, as hereinafter set forth. Since the signal is in the form of a symmetrically modulated carrier wave, only that portion of the signal above the zero carrier level (designated by the broken line c) is illustrated. The signal representations shown at 32 and 33 depict different samples of the signal selected during separate intervals of similar duration. Each shows a portion of the video envelope a in the vicinity of a horizontal synchronizing pulse b, but the amplitudes are different, representing different signal strengths. The bias voltage on the tube 11 should be so adjusted that that tube conducts only when the signal impressed upon its grid rises above a certain amplitude level represented by the broken line d. Thus, no change in the voltage across resistor 23 will take place until the signal exceeds this level, for example, as shown at 33. When this occurs, the anode of the tube 11 will assume a more negative potential which it will tend to maintain, due to the large time constant of the circuit comprising the resistor 23 and the condenser 24. This negative

potential, when applied to the grids of the tubes of the intermediate frequency amplifier, will tend to reduce their gain to a point at which the peaks of the signal supplied to the grid of tube 11 no longer rise above the level *d*, and, hence, cease to cause a further decrease in the potential of the anode. It should be observed particularly that the development of a gain controlling voltage is delayed until the signal becomes of sufficient amplitude to exceed the level *d*. Furthermore, it will be noted that the gain controlling voltage will not, in general, depend upon the video content of the composite signal which is established at a relatively lower amplitude level than the synchronizing pulses, since the system may be made sufficiently quick-acting to prevent the blanking level *e* from ever rising above the cut-off level *d* of the tube 11 to any appreciable extent and for any appreciable time interval which might cause the gain of the intermediate frequency amplifier to become dependent upon the video component.

Referring now to the operation of the tube 12, it will be observed that pulses of current in the tube 11 occurring under the circumstances above described will tend to charge the condenser 26, and thereby increase the potential drop across the resistor 17. However, for a given increase in the voltage across the condenser, a smaller change in the grid voltage of the tube 12 will obtain than in that of its cathode. Hence, as signal strength increases and the tube 11 conducts more frequently, the level of selection in the tube 12, designated by the broken lines *f* at 32' and 33', will rise. As will be apparent from the figure, this action will tend to prevent the selection by the tube 12 of any of the video component of the signal applied to its grid. It must be understood that this is due not only to the control of the bias of the tube 12, in response to changes in the average current in the tube 11, but also to the gain control connection from the tube 11 to the intermediate frequency amplifier 4. Thus, not only is the level of selection in the tube 12 varied with the signal strength in a manner to select the synchronizing component to the exclusion of the video component, but the gain controlling action of the circuit tends to reduce the need for such variation in level of selection. The two functions are directly interlinked so that any increase in gain controlling action is accompanied by a correspondingly greater change in the level of selection, and vice versa. As a result of these actions, it is insured that the signal supplied from tube 12 to the deflecting signal generator 8 shall comprise only the synchronizing component and shall not include any of the video component.

In most television signals, there will be present undesired noise pulses of considerably greater amplitude than the synchronizing signal peaks. Such a noise pulse is represented at *g*. To limit such noise pulses to an amplitude comparable to that of the synchronizing pulses, and thereby greatly reduce the deleterious effect upon the deflecting circuits, the bias applied to the diode 30 may be adjusted so as to prevent conduction in the diode for signals in the output circuit of tube 12 which exceed a certain magnitude. Referring this action to the input circuit of the tube 12, it will be seen that the upper limit of the selected portion, as designated by the broken lines *h*, will be maintained constant with reference to the lower level of selection *f* regardless of how that level may vary.

It will, of course, be understood that the spe-

cific adjustments in the circuit above described must be made in accordance with the existing conditions and the results which it is desired to obtain in specific instances. The manner of making such adjustments will be obvious to those skilled in the art from the foregoing discussion of the circuit and its mode of operation. The following values of the various circuit elements were found to operate satisfactorily in the embodiment of the invention described, but they are to be regarded merely as exemplary and not as placing any limitation upon the scope of the invention.

Resistor 23=50,000 ohms
 Condenser 24=2 microfarads
 Resistor 17=10,000 ohms
 Condenser 26=8 microfarads
 Resistor 28=25,000 ohms
 Resistor 18=25,000 ohms
 Resistor 19=25,000 ohms
 Condenser 29=8 microfarads

Tubes 11 and 12 may comprise the two triode sections of a type 6N7.

The novel features of the invention, which have been disclosed herein by reference to a specific structural embodiment, are set forth in the appended claims.

I claim:

1. In a signaling system in which it is desired to select and utilize a portion of the signal traversing said system, a signal channel including variable-gain signal transfer means, means including a first space discharge device having at least an anode, a cathode and a control grid, and having its input coupled to said channel for selecting a portion of the signal above a certain amplitude level determined by the grid bias applied to said space discharge device, a second space discharge device having at least an anode, a cathode and a control grid, coupled to said channel, means for applying a predetermined grid bias to said second space discharge device to render it conductive only when said signal exceeds a predetermined amplitude level, means for deriving a control voltage from the output of said second device and for applying said voltage to said transfer means to control the gain thereof, and means for controlling the bias applied to said first device in accordance with the output of said second device, whereby the portion of the signal selected by said first device is determined by the conjoint gain-controlling and bias-controlling actions of said second device.

2. In a signaling system in which it is desired to select and utilize a portion of the signal traversing said system, a signal channel including variable-gain signal transfer means, a signal-selection tube having at least an anode, a cathode and a control grid, and having its input coupled to said channel for selecting a portion of the signal above a certain amplitude level determined by the grid bias applied to said tube, a control tube having at least an anode, a cathode and a control grid, and having its input circuit coupled to said channel, means for applying a predetermined grid bias to said control tube to render it conductive only when said signal exceeds a predetermined amplitude level, means for deriving a control voltage from the output of said control tube and for applying said voltage to said transfer means to control the gain thereof, and means for controlling the bias applied to said signal-selection tube in accordance with the current flow in said control tube, whereby the portion of

the signal selected by said signal-selection tube is determined by the conjoint gain-controlling and bias-controlling actions of said control tube.

3. In a television system utilizing a signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation by amplitude selection of one component from the others, said system including means for amplifying said signal, a first space discharge device having at least an anode, a cathode and a control grid, and having its input coupled to said system for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the grid bias applied to said space discharge device, a second space discharge device having at least an anode, a cathode and a control grid, coupled to said system and being biased so as to conduct only when said signal exceeds a predetermined amplitude level, means for deriving from the output of said second space discharge device a control voltage proportional to the average current in said second device, means for applying said control voltage to said amplifying means to control the gain thereof, means for controlling the bias applied to said first space discharge device in accordance with the average current in said second space discharge device, and means for utilizing the portion of said signal selected by said first space discharge device to effect synchronization in said television system.

4. In a television system utilizing a signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation by amplitude selection of one component from the others, said system including means for amplifying said signal, a first space discharge device having at least an anode, a cathode, and a control grid, and having its input coupled to said system for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the grid bias applied to said space discharge device, a second space discharge device having at least an anode, a cathode and a control grid, coupled to said system and being biased so as to conduct only when said signal exceeds a predetermined amplitude level, means for deriving from the output of said second space discharge device a control voltage proportional to the average current in said second device, a connection for applying a portion of said control voltage to said amplifying means to control the gain thereof, a second connection for applying a portion of said control voltage to said first space discharge device to determine the bias thereof thereby to vary the amplitude level of selection therein, and means for utilizing the portion of said signal selected by said first space discharge device to effect synchronization in said television system.

5. In a television system utilizing a signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation of amplitude selection of one component from the others, said system including means for amplifying said signal, a space discharge device having its input coupled to said system for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the bias applied to said space discharge device, a second space discharge device coupled to said system and being biased so as to conduct only when said signal exceeds a predetermined amplitude level,

each of said space discharge devices having at least an anode, a cathode, and a control grid, a load impedance common to the cathode circuits of both of said space discharge devices, a load impedance in the anode circuit of said second space discharge device, a connection from a point on said anode load impedance to said amplifying means for applying a part of the voltage developed across said anode load impedance to said amplifying means to control the gain thereof, a connection from a point on said cathode load impedance to the grid of said first space discharge device for controlling the bias applied thereto thereby to vary the amplitude level of selection therein, and means for utilizing the portion of said signal selected by said first space discharge device to effect synchronization in said television system.

6. In a television system utilizing a signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation by amplitude selection of one component from the others, said system including means for receiving and means for amplifying a carrier wave signal modulated by said first signal, a space discharge device having at least an anode, a cathode and a control grid, and having its input coupled to said amplifying means for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the grid bias applied to said space discharge device, a second space discharge device having at least an anode, a cathode and a control grid, coupled to said amplifying means and being biased so as to conduct only when said signal exceeds a predetermined amplitude level, means for deriving from the output of said second space discharge device a control voltage proportional to the average current in said second device, a connection for applying a portion of said control voltage to said amplifying means to control the gain thereof, a second connection for applying a portion of said control voltage to said first space discharge device to determine the bias thereof thereby to vary the amplitude level of selection therein, and means for utilizing the portion of said signal selected by said first space discharge device to effect synchronization in said television system.

7. In a television system utilizing a signal comprising a plurality of signal components established at relatively different amplitude levels so as to permit the separation by amplitude selection of one component from the others, said system including means for amplifying said signal, a space discharge device having its input coupled to said system for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the bias applied to said space discharge device, a second space discharge device coupled to said system and being biased so as to conduct only when said signal exceeds a predetermined amplitude level, each of said space discharge devices having at least an anode, a cathode, and a control grid, a load impedance common to the cathode circuits of both of said space discharge devices, a load impedance in the anode circuit of each of said space discharge devices, a connection from a point on the anode load impedance of said second space discharge device to said amplifying means, for applying a part of the voltage developed across said anode load impedance to said amplifying means to control the gain thereof, a connection from a point on said

cathode load impedance to the grid of said first space discharge device for controlling the bias applied thereto thereby to vary the amplitude level of selection therein, a connection including a non-linear device and biasing means therefor connected across a portion of the anode load impedance of said first space discharge device for limiting the amplitude of the signal developed thereacross, and means for utilizing said limited signal to effect synchronization in said television system.

8. In a television system utilizing a signal comprising a video component and a synchronizing component established at relatively different amplitude levels so as to permit the separation by amplitude selection of said synchronizing component from said video component, said synchronizing component comprising a series of time spaced pulse signals and said system including means for amplifying said signal, a space discharge device having its input coupled to said system for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the bias applied to said space discharge device, a second space discharge device coupled to said system and being biased so as to conduct only when said signal exceeds a predetermined level, each of said space discharge devices having at least an anode, a cathode and a control grid, a load impedance common to the cathode circuits of both of said space discharge devices, a load impedance in the anode circuit of each of said space discharge devices, a condenser shunting the impedance in the anode circuit of said second space discharge device, said condenser in conjunction with said impedance forming a circuit having a time constant large by comparison with the intervals between horizontal synchronizing pulses, a connection from a point on the anode load impedance of said second space discharge device to said amplifying means, for applying a part of the voltage developed across said anode load impedance to said amplifying means to control the gain thereof, a connection from a point on said cathode load impedance to the grid of said first space discharge device for controlling the bias applied thereto thereby to vary the amplitude level of selection therein, a connection including a non-linear device and biasing means therefor connected across a portion of the anode

load impedance of said first space discharge device for limiting the amplitude of the signal developed thereacross, and means for utilizing said limited signal to effect synchronization in said television system.

9. In a television system utilizing a signal comprising a video component and a synchronizing component established at relatively different amplitude levels so as to permit the separation by amplitude selection of said synchronizing component from said video component, said synchronizing component comprising a series of time spaced pulse signals and said system including means for amplifying said signal, a space discharge device having its input coupled to said system for selecting therefrom a portion of the signal above a certain amplitude level, said amplitude level being determined by the bias applied to said space discharge device, a second space discharge device coupled to said system and being biased so as to conduct only when said signal exceeds a predetermined amplitude level, each of said space discharge devices having at least an anode, a cathode and a control grid, a load impedance common to the cathode circuits of both of said space discharge devices, a load impedance in the anode circuit of each of said space discharge devices, a condenser shunting the impedance common to the cathode circuits of said space discharge devices, said condenser in conjunction with said impedance forming a circuit having a time constant large by comparison with the intervals between horizontal synchronizing pulses, a connection from a point on the anode load impedance of said second space discharge device to said amplifying means, for applying a part of the voltage developed across said anode load impedance to said amplifying means to control the gain thereof, a connection from a point on said cathode load impedance to the grid of said first space discharge device for controlling the bias applied thereto thereby to vary the amplitude level of selection therein, a connection including a non-linear device and biasing means therefor connected across a portion of the anode load impedance of said first space discharge device for limiting the amplitude of the signal developed thereacross, and means for utilizing said limited signal to effect synchronization in said television system.

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