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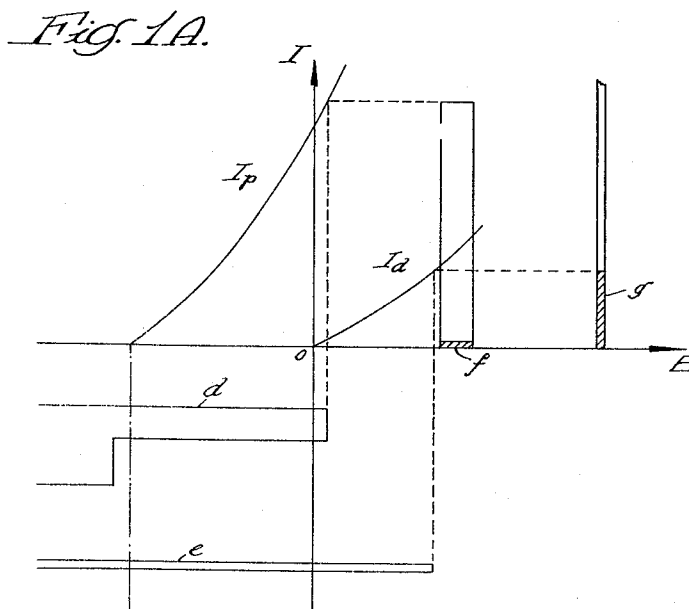
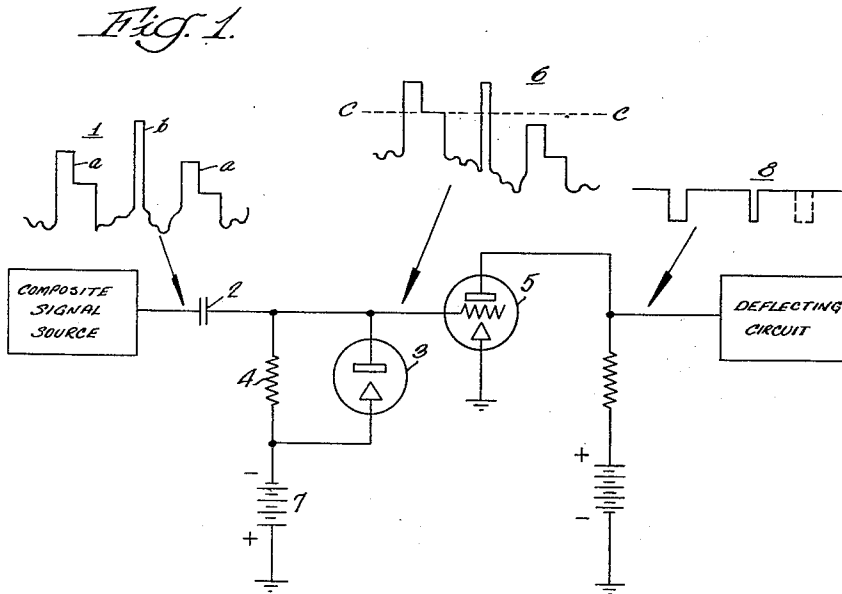
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2,294,341

SYNCHRONIZING CIRCUIT AND THE LIKE

Filed May 31, 1940

3 Sheets-Sheet 1



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Aug. 25, 1942.

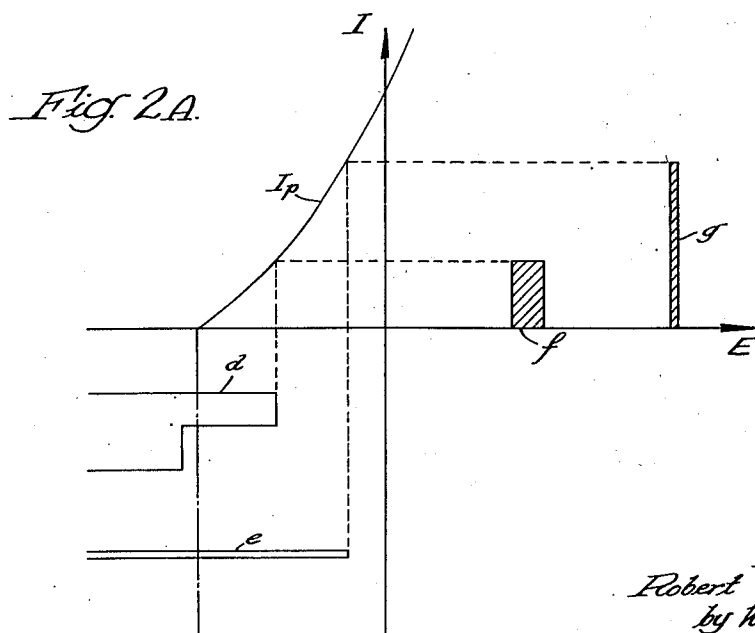
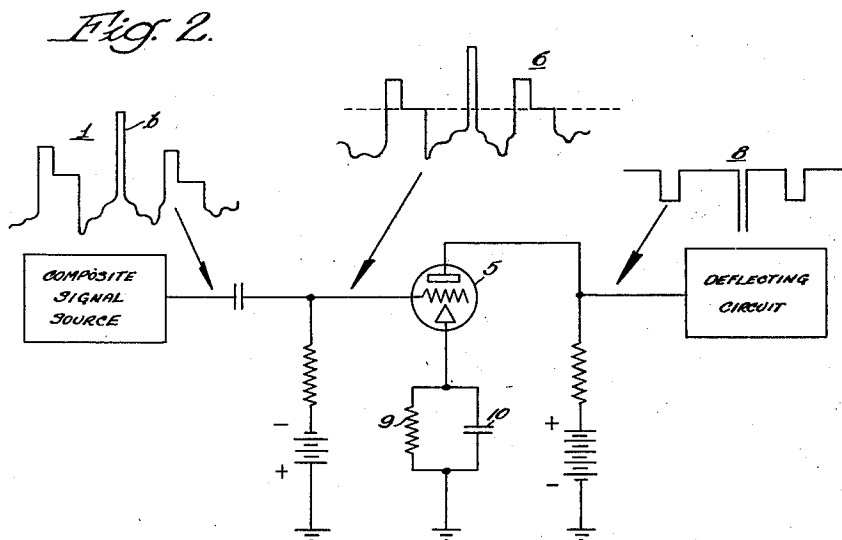
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3 Sheets-Sheet 2



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Fig. 3.

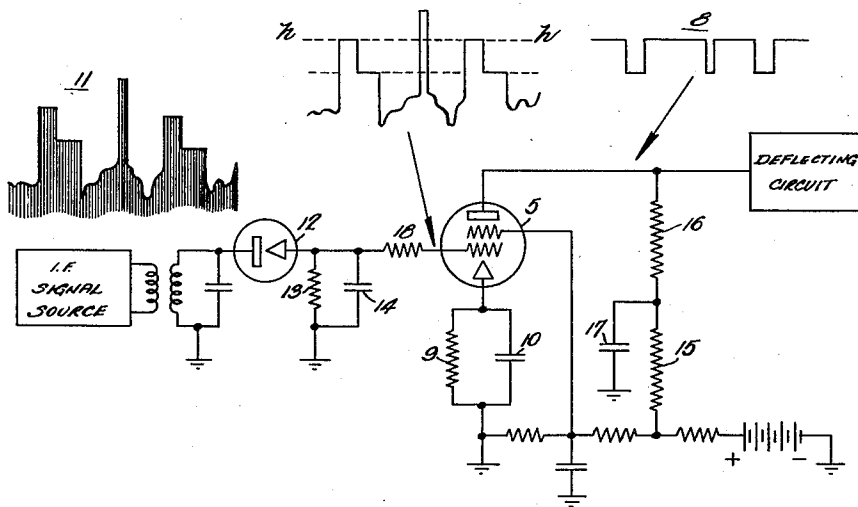
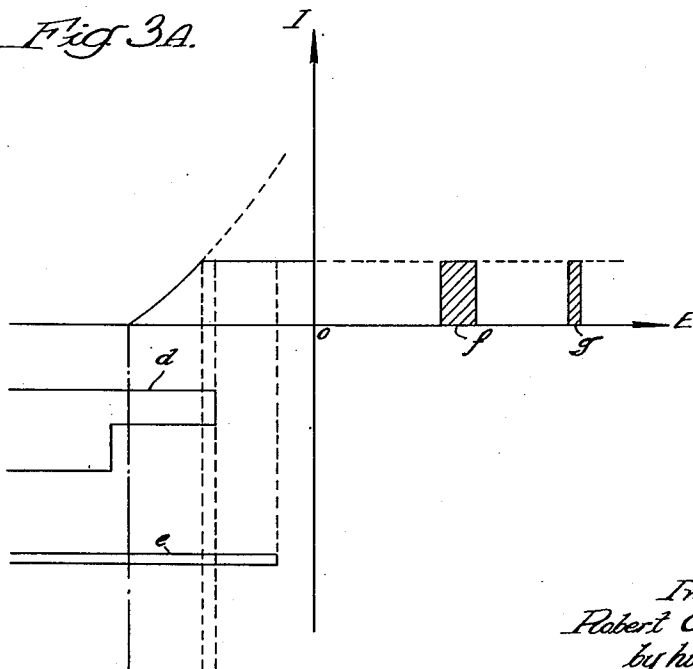


Fig. 3A.



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UNITED STATES PATENT OFFICE

2,294,341

SYNCHRONIZING CIRCUIT AND THE LIKE

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4 Claims. (Cl. 178—7.3)

This invention relates to synchronizing circuits and in particular to synchronizing circuits as used in connection with television receivers and the like. It is adapted to be used in television systems employing a composite signal comprising video and synchronizing components established at different amplitude levels, the ratio of their respective amplitudes being substantially constant. The principal object of the invention is to provide an improved means for selecting the synchronizing component from a composite television signal of the conventional type in which video and synchronizing components are established at different amplitude levels. More particularly, the invention provides a selection or pick-off system which is not appreciably affected in its operation by disturbances in the form of noise voltage pulses, and which provides an output synchronizing signal the voltage of which is substantially constant regardless of variations in input signal to the said system. Furthermore, the devices provided by the invention operate in such fashion as to select a predetermined percentage of the peak input signal which may be so adjusted that the portion selected includes only synchronizing and none of the blanking or video components.

In accordance with the invention, the composite television signal obtained from a suitable source such, for example, as the detector load in a television receiver, is supplied to the input of a space discharge device of the screen grid type, the grid bias of which is dependent upon the peak amplitude of the signal. This bias is obtained by means of a suitable high impedance in the cathode circuit of the space discharge device. As will appear presently, this method of obtaining the desired varying bias has certain very definite advantages in the reduction of the effect of noise pulses upon the operation of the pick-off system. Further, the plate and screen supplies to the space discharge device are of relatively low voltage and a large plate load impedance is employed, thereby giving a limited plate-current versus grid-voltage characteristic which tends to maintain the amplitude of the output signal constant. In addition to this, it is also desirable to provide a plate supply which is a source of substantially constant average current by virtue of which the direct current component of the output current from the space discharge device is prevented from varying appreciably regardless of variations in the input signal, whereby better regulation obtains.

Accordingly, by the present invention, there is

provided in a television or like synchronizing system a source of a composite television signal comprising video and synchronizing components established at different relative amplitude levels, a space discharge device of the screen grid type having said signal applied to its input grid, a relatively large impedance in the cathode circuit of said space discharge device, across which is developed a bias voltage substantially proportional to the peak input signal to said space discharge device, a relatively low voltage source for supplying power to the plate and screen circuits of said space discharge device, and a relatively large load impedance in the output circuit of said space discharge device, across which load impedance is derived the desired synchronizing component of said composite signal.

In order fully to understand the invention, it will be convenient to refer to the figures accompanying this specification.

In the drawings:

Fig. 1 shows a prior art device whose defects are avoided by the present invention.

Figs. 2 and 3 show specific embodiments of the present invention; and

Figs. 1A, 2A and 3A are explanatory diagrams which will be referred to in discussing the operation of the several devices disclosed.

Referring first to Fig. 1, there is shown a source of a composite television signal represented at 1. The source may, for example, be the output of the detector in a television receiver. It will be noted that in the signal at this point the synchronizing signal peaks *a* may vary in amplitude and noise pulses may be present as shown at *b*. In order satisfactorily to select the synchronizing signal peaks, it is first necessary to employ leveling of some form which is customarily accomplished by means of a diode-leveler circuit as shown, consisting of the coupling condenser 2 functioning in conjunction with the diode 3 shunted by a large resistor 4. The operation of such a leveling circuit is well known and need not be discussed; the result being that the signal supplied to the grid of the tube 5 will be of the form shown at 6. The bias battery 7 is made such that this tube passes only those portions of the signal which exceed a predetermined amplitude level *c—c* determined with respect to the signal peaks which, but for the presence of noise pulses, would all be at substantially the same level by reason of the action of the leveling diode. As shown at 6, however, the occurrence of a relatively large noise pulse *b* will tend to lower the immediately succeeding synchronizing pulses so that they may fall below the

line c-c. As a result, this synchronizing pulse will not appear in the output of the tube 5, as shown at 8, and hence will not be supplied to the deflecting circuit to effect synchronization as desired.

The reason for this mode of operation will be seen clearly by reference to Fig. 1A which represents diode current and plate current respectively in the tubes 3 and 5 versus grid voltage. *d* is a synchronizing pulse of sufficient amplitude to cause the diode to draw current, the amount of which is designated by the shaded area *f*. *e* is a noise pulse following immediately upon the synchronizing pulse and which causes diode current to be drawn to the extent indicated by the shaded area *g*. Since the area in each case is a measure of the change in bias on the grid of the tube, it will be seen that the change in bias for a noise pulse will be much greater than that for a normal synchronizing pulse which explains the sudden reduction in amplitude of synchronizing pulses following the occurrence of a noise pulse and the resulting loss of such pulses.

Referring now to Fig. 2, it will be noted that the circuit there shown omits the leveling diode. Instead, in accordance with the invention, there is provided, in the cathode circuit of the tube 5, a large biasing resistor 9 by-passed by a condenser 10, the impedance of which is low relative to that of the resistor for the higher frequencies contained in the composite signal. The magnitude of the resistor is chosen with a view to developing thereacross a bias voltage which is dependent upon the peak amplitude of the signal and which is sufficient to permit the tube to conduct only when the signal amplitude exceeds that of the video component, whereby only the synchronizing component appears across the tube load impedance and is thereby separated from the remaining portion of the composite signal. The operation of this portion of the circuit is comparable in many respects to that of degenerative plate rectification peak detector. In such a detector, the amount by which the signal peaks overshoot cut-off is a function of the tube characteristics, the magnitude of the cathode resistor, and also of the duration of the peaks above cut-off. Since the synchronizing component usually comprises a series of equispaced substantially rectangular pulses a relatively simple relation can be set up between these variables which can be so chosen that the desired amount of overshoot will obtain to permit the passage of the synchronizing component to the substantial exclusion of the video component. This relation is

$$R = \frac{R + B}{xf(e)}$$

where:

- R=the magnitude of the cathode resistor.
- B=the bias voltage developed across the cathode resistor.
- B=additional fixed bias (such as might be provided by the biasing battery in Fig. 2).
- x=the ratio between the duration of a single synchronizing pulse and the duration of the interval between successive pulses.
- f(e)=the plate current in the tube corresponding to a grid voltage which exceeds cut-off by the amount *e*.

In general it is found desirable to make all adjustments at the minimum usable signal level for, if the device is adjusted so as to select sub-

stantially the synchronizing component at this level, it will select less than the entire synchronizing component for signals of higher level. On the other hand, were the adjustments to be made at a higher level, some of the video component would be included at lower signal levels which would not be desirable. It should be understood that these statements are based on the assumption that in the composite signal the ratio of the amplitudes of the video and synchronizing components is substantially constant.

Because of the action of the device above described in "following" the signal peaks and in selecting only a portion of the signal measured with reference to these peaks, there is no need for the leveling diode shown in the circuit of Fig. 1. In many respects the circuit just described is superior to the one employing the diode. For example it is far less subject to disturbance by noise, as will be understood more clearly by reference to Fig. 2A which shows a plot of plate current versus grid voltage for the tube 5 of Fig. 2. In general the tube will be operated so that normally it draws no grid current and there is no leveling action in the grid circuit. The pulses of plate current corresponding respectively to a synchronizing pulse *d* and to a noise pulse *e* are represented by the shaded areas of *f* and *g*. These, it will be noted, are not appreciably different in size as were the pulses of grid current shown in Fig. 1A. Hence large amplitude noise pulses will not produce a disproportionate change in bias voltage tending to disturb the operation of the system.

In Fig. 3 there is shown a preferred form of the circuit. An intermediate frequency signal 11 derived from the source shown may be detected by means of the circuit comprising the diode 12, the resistor 13, and the condenser 14. Preferably the detector output is direct-coupled to the grid of the pick-off tube 5 which may be of the screen grid type (in the embodiment of Fig. 3 a beam-power tube is employed). The circuit functions in substantially the same manner as that of Fig. 2 but, due to the direct coupling between the detector and the grid of the tube, the system tends to pick off almost a constant fraction of the signal. This is highly desirable since the maximum available synchronizing is utilized while the video component tends to be excluded. This is not the case in the circuit of Fig. 2 where, due to the absence of the D. C. component, the amount of signal picked off will depend upon the average value of the video component.

An additional feature of this circuit is the provision in the output circuit of the screen grid type pick-off tube of a very large load resistance comprising resistors 15 and 16, the major portion of which is by-passed by a condenser of relatively low impedance to the higher frequencies contained in the composite signal. One result of employing a large resistive load is to produce the limited mutual characteristic shown in Fig. 3A. It is apparent from Fig. 3A that such a characteristic limits the noise pulses to an amplitude which may be substantially the same as that of the synchronizing pulses. The use of a large resistive load also makes the plate supply a source of substantially constant average current. This improves the regulation of the pick-off system and tends to prevent variations in gain with signal strength. Thus regardless of variations in signal strength the output will be substantially constant. The A. C. impedance is reduced to the desired

value for optimum output by the by-pass condenser 17.

The operation of the circuit of Fig. 3 may be additionally improved by including a resistor 18 in series with the grid lead which will act to limit grid current and thereby prevent noise pulse from disturbing the operation of the device.

Inasmuch as the satisfactory operation of the circuits disclosed is dependent to a substantial degree upon the use of proper circuit element values, the following exemplary values are given:

In Figs. 2 and 3:

Resistance 9=220,000 ohms.

Condenser 10=0.1 microfarad.

In Fig. 3:

Resistor 16=15,000 ohms.

Resistor 15=4 megohms.

Condenser 17=1 microfarad.

In Fig. 2, the tube 5 may be a triode while in Fig. 3, it may be either a beam power tube or a pentode.

I claim:

1. In a television system; a source of a modulated carrier wave signal and of extraneous signals exceeding in amplitude the peaks of said modulated carrier wave signal, said carrier being modulated by a composite television signal comprising video and synchronizing components established at different amplitude levels and the ratio of the amplitudes of which components is substantially constant; a detector for said modulated carrier wave signal; means for separating said synchronizing component from said composite signal and for reducing the amplitude of said extraneous signals, said means comprising a space discharge device of the screen grid type having its grid coupled directly to said detector; means in the cathode circuit of said space discharge device for developing a bias voltage which varies with the amplitude of said composite signal for biasing said space discharge device so as to permit the selection by said space discharge device of a portion of said synchronizing component, the amplitude of said selected portion varying in substantially direct proportion to the amplitude of said composite signal; a load impedance and a source of voltage connected to the anode of said space discharge device, said load impedance being of such magnitude as to effect limitation by means of plate current saturation of the amplitude of said selected portion, whereby output signals of amplitude greater than those corresponding to input signals of the amplitude of said composite signal are at all times prevented from appearing in the output of said space discharge device; and means for utilizing the signal developed across said load impedance for synchronizing purposes.

2. In a television system; a source of a modulated carrier wave signal and of extraneous signals exceeding in amplitude the peaks of said modulated carrier wave signal, said carrier being modulated by a composite television signal comprising video and synchronizing components established at different amplitude levels and the ratio of the amplitudes of which components is substantially constant; a detector for said modulated carrier wave signal; means for separating said synchronizing component from said composite signal and for reducing the amplitude of said extraneous signals, said means comprising a space discharge device of the screen grid type having its grid coupled directly to said detector; said coupling including a resistor adapted to limit

the flow of grid current in said device; means in the cathode circuit of said space discharge device for developing a bias voltage which varies with the amplitude of said composite signal for biasing said space discharge device so as to permit the selection by said space discharge device of a portion of said synchronizing component, the amplitude of said selected portion varying in substantially direct proportion to the amplitude of said composite signal; a load impedance and a source of voltage connected to the anode of said space discharge device, said load impedance being of such magnitude as to effect limitation by means of plate current saturation of the amplitude of said selected portion, whereby output signals of amplitude greater than those corresponding to input signals of the amplitude of said composite signal are at all times prevented from appearing in the output of said space discharge device; and means for utilizing the signal developed across said load impedance for synchronizing purposes.

3. In a television system; a source of a modulated carrier wave signal and of extraneous signals exceeding in amplitude the peaks of said modulated carrier wave signal, said carrier being modulated by a composite television signal comprising video and synchronizing components established at different amplitude levels and the ratio of the amplitudes of which components is substantially constant; a detector for said modulated carrier wave signal; means for separating said synchronizing component from said composite signal and for reducing the amplitude of said extraneous signals, said means comprising a space discharge device of the screen grid type having its grid coupled directly to said detector; means comprising a resistor and a condenser connected in shunt in the cathode circuit of said space discharge device for developing a bias voltage which varies with the amplitude of said composite signal for biasing said space discharge device so as to permit the selection by said space discharge device of a portion of said synchronizing component, the amplitude of said selected portion varying in substantially direct proportion to the amplitude of said composite signal; a load impedance and a source of voltage connected to the anode of said space discharge device, said load impedance being of such magnitude as to effect limitation by means of plate current saturation of the amplitude of said selected portion, whereby output signals of amplitude greater than those corresponding to input signals of the amplitude of said composite signal are at all times prevented from appearing in the output of said space discharge device; and means for utilizing the signal developed across said load impedance for synchronizing purposes.

4. In a television system; a source of a modulated carrier wave signal and of extraneous signals exceeding in amplitude the peaks of said modulated carrier wave signal, said carrier being modulated by a composite television signal comprising video and synchronizing components established at different amplitude levels and the ratio of the amplitudes of which components is substantially constant; a detector for said modulated carrier wave signal; means for separating said synchronizing component from said composite signal and for reducing the amplitude of said extraneous signals, said means comprising a space discharge device of the beam power type having its grid coupled directly to said detector; means in the cathode circuit of said space dis-

charge device for developing a bias voltage which varies with the amplitude of said composite signal for biasing said space discharge device so as to permit the selection by said space discharge device of a portion of said synchronizing component, the amplitude of said selected portion varying in substantially direct proportion to the amplitude of said composite signal; a load impedance and a source of voltage connected to the anode of said space discharge device, said load impedance being of such magnitude as to effect

limitation by means of plate current saturation of the amplitude of said selected portion, whereby output signals of amplitude greater than those corresponding to input signals of the amplitude of said composite signal are at all times prevented from appearing in the output of said space discharge device; and means for utilizing the signal developed across said load impedance for synchronizing purposes.

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