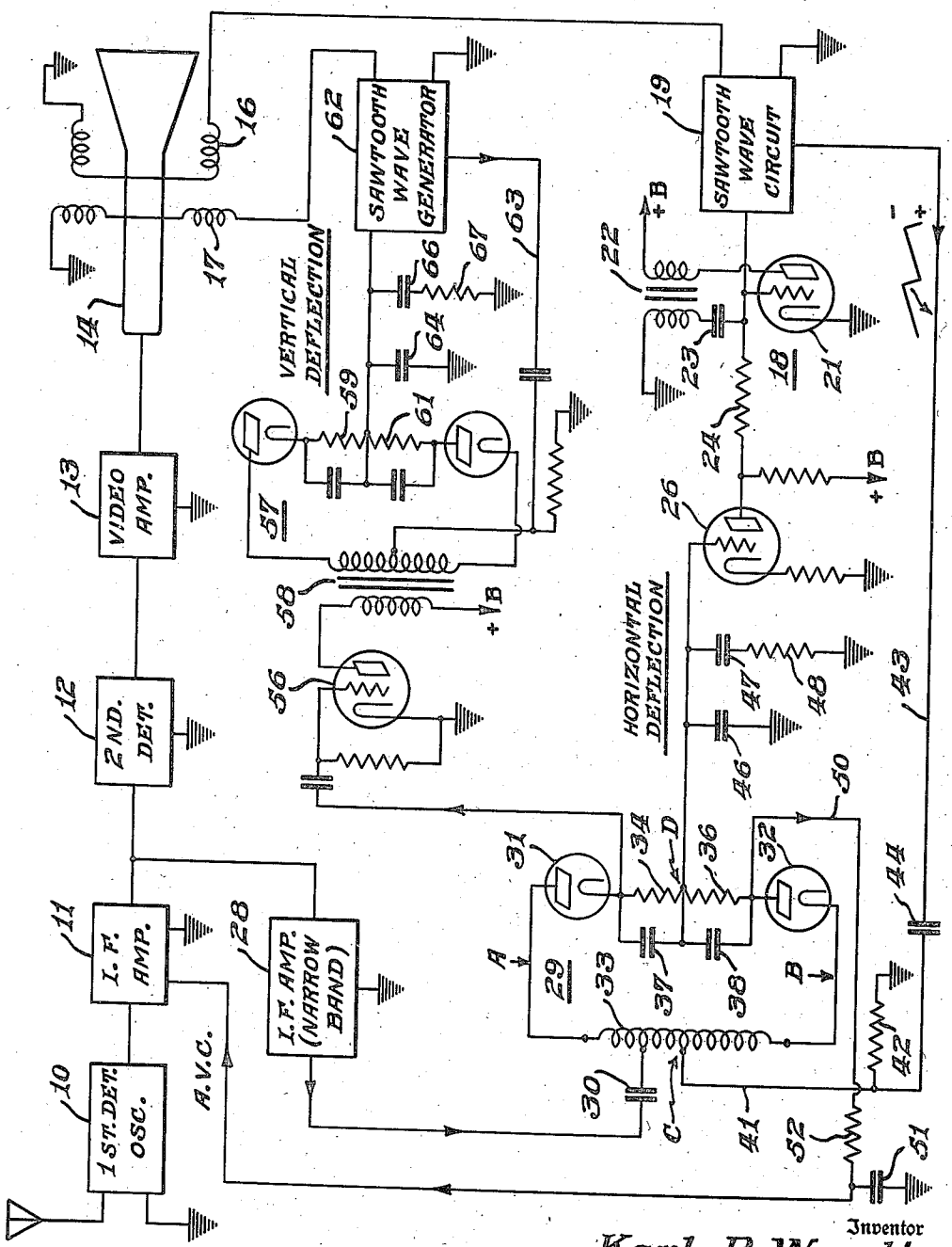
Oct. 26, 1943. K. R. WENDT 2,332,681

SYNCHRONIZING OF DEFLECTING CIRCUITS

Filed Nov. 29, 1941



Inventor

Karl R. Wendt

By

Attorney

Patented Oct. 26, 1943 2,332,681

UNITED STATES PATENT OFFICE

2,332,681

SYNCHRONIZING OF DEFLECTING CIRCUITS

Karl R. Wendt, Audubon, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application November 29, 1941, Serial No. 420,924

6 Claims. (Cl. 178—7.5)

My invention relate to the synchronization of cathode ray deflecting circuits, particularly as employed in television receivers.

An object of the invention is to provide an improved synchronizing system utilizing automatic frequency control in a television receiver or the like.

Another object of the invention is to provide an improved method of and means for synchronizing a cathode ray deflecting circuit in accordance with the output of an automatic frequency control circuit.

A further object of the invention is to provide a television receiver synchronizing circuit that is not greatly affected by noise in the incoming signal.

In one of the preferred embodiments of the invention, a bridge circuit including two or more diodes is utilized for supplying a frequency control potential to a blocking oscillator or the like in the deflecting circuit of a television receiver. A saw-tooth voltage wave may be applied across one bridge diagonal with the bridge circuit biased to prevent the passage of any diode current until a keying signal is applied to the other bridge diagonal.

In accordance with the present invention, the keying pulses are taken from the intermediate frequency or *i–f* channel, preferably through a comparatively narrow pass band filter. The recurring peaks of the modulated *i–f* carrier which are representative of the incoming synchronizing pulses act as the keying pulses for the bridge circuit.

It is assumed that the incoming signal is from a transmitter employing negative modulation and D. C. transmission, the modulating signal comprising the usual mixture of picture signal and synchronizing pulses that extend into the "blacker than black" region. The synchronizing signal preferably consists of horizontal synchronizing pulses of comparatively short duration and slotted vertical synchronizing or framing pulses of comparatively long duration as described in Bedford Patent 2,223,812, for example.

The integrated or filtered output of the bridge circuit provides the previously mentioned frequency control potential. Its amplitude varies in accordance with any changes in the phase relation of the said saw-tooth deflecting waves and the synchronizing or keying pulses.

The invention will be better understood from the following description taken in connection with the accompanying drawing in which the single figure is a block and circuit diagram of a television receiver embodying my invention.

The drawing shows a television receiver comprising the usual first detector and tunable oscillator indicated at 10, an *i–f* amplifier 11, a second detector 12, a video amplifier 13, and a cathode ray tube 14. Horizontal and vertical deflecting coils 16 and 17, respectively, are supplied with saw-tooth current from the horizontal and vertical deflecting circuits for deflecting the cathode ray.

The deflecting circuits may be of any suitable design. As illustrated for the horizontal deflection circuit, an oscillator of the well-known blocking oscillator type indicated at 18 may be employed for supplying pulses to a discharge tube (not shown) in a suitable saw-tooth wave circuit 19.

The oscillator 18 comprises a vacuum tube 21, a feedback transformer 22, a grid condenser 23, and a grid leak resistor 24 which is direct current connected to the plate of the preceding amplifier 26.

The horizontal deflecting circuit is held in synchronism with the corresponding deflection at the transmitter by means of the AFC voltage which is applied to the oscillator tube grid through amplifier 26. The AFC voltage is obtained as follows:

The *i–f* signal, which includes both picture and synchronizing signals, is supplied to an *i–f* amplifier 28 which preferably has a narrow pass band as compared with the amplifier 11. The output of amplifier 28 is applied through a coupling condenser 30 across one diagonal of a bridge circuit 29 which may include a pair of diodes 31 and 32 which are in two arms of the bridge and a center-tapped transformer winding 33, the two halves of which are in the other two arms of the bridge.

The diodes 31 and 32 are connected cathode to plate through biasing resistors 34 and 35 which are shunted by condensers 37 and 38, respectively.

The *i–f* signal from amplifier 28 is impressed across the bridge diagonal A—B through the transformer winding 33 which functions as an auto-transformer, the primary circuit being from the coupling condenser 30 through a section of winding 33 to the center tap and through a conductor 41 and resistor 42 to ground.

A saw-tooth voltage wave from the saw-tooth wave circuit 19 is supplied through a conductor 43 and a coupling condenser 44 to the midpoint of transformer 33. Thus, the saw-tooth wave is

impressed across the other diagonal of the bridge, indicated at C–D, since the point D is connected to ground through a filter or storage condenser 46 to complete the circuit.

The voltage across condenser 46 is the frequency control voltage. It is applied through a D. C. connection to the grid of amplifier tube 26 whereby the bias voltage on the control grid of the blocking oscillator tube 21 will depend upon the charge of condenser 46. Since the oscillator frequency depends upon the bias on its control grid its frequency will depend upon the value of the AFC voltage.

An RC filter comprising a large capacity condenser 47 and a high resistance resistor 48 may be connected in shunt to the condenser 46 to minimize the effect of any noise pulses that may pass through the bridge circuit and to stabilize the feedback circuit as described and claimed in my copending application Serial No. 404,787, filed July 31, 1941.

In operation the pulses of *i–f* signal representing the horizontal synchronizing pulses, for example, cause current flow through diodes 31 and 32 and a bias voltage is built up across resistors 34 and 36 due to the slow time constant of these resistors and their shunting condensers 37 and 38. This bias prevents current flow through the diodes except during the occurrence of the *i–f* synchronizing pulses. It will be noted that the bridge diodes also act as rectifiers, only the positive half cycle of the *i–f* signal causing a flow of diode current.

The bridge is balanced so that the synchronizing pulses do not appear across the diagonal C—D. They act merely as keying pulses to permit the sawtooth voltage to pass through the bridge during their occurrence.

The time relation between the sawtooth wave and the keying pulses is such that the bridge is keyed "open" to pass sawtooth voltage during the steep portion of the sawtooth. The time relation between the keying pulse and the sawtooth wave determines the amplitude of the charging voltage pulse applied to the storage condenser 46 and, therefore, the magnitude of the control voltage applied to the oscillator 18. In this respect the operation is similar to that of my invention described and claimed in my copending application Serial No. 404,787.

Since the diodes 31 and 32 function as peak rectifiers, the voltage appearing across a diode biasing resistor may be utilized for automatic volume control. In the circuit illustrated the voltage across biasing resistor 36 is applied through a conductor 50 and through a smoothing filter comprising a resistor 51 and a condenser 52 to the I. F. amplifier 11.

An important feature of the invention is that the deflecting circuit is made less susceptible to noise in the incoming signal by reducing the band width of the channel supplying signal to the bridge circuit. The *i–f* amplifier 28 is given a comparatively narrow band width, a width of one-half megacycle, for example, as compared with the four and one-half megacycle band width or the like of the *i–f* amplifier 11. The amplifier 28 will pass all the synchronizing pulse information that is required but, at the same time, it will filter out a large part of the noise passed by the I. F. amplifier 11. The fact that much of the picture signal is also filtered out in this channel is immaterial. Since the filtering out of noise signals precedes the amplitude limiting action provided by the bridge circuit.

It will be apparent that my improved circuit makes the use of a synchronizing pulse separating circuit unnecessary and therefore simplifies the design. There is no *i–f* signal appearing across the storage condenser 46 because it is filtered out by the biasing resistors 34—36 and their shunting condensers.

The bridge circuit need not be the specific one illustrated. For example, it may be of the type having a diode in each bridge arm as described in my Patent 2,250,284, issued July 22, 1941.

The vertical deflecting circuit may be synchronized in any suitable manner. For example, a circuit like that described above for horizontal deflection may be employed with the *i–f* amplifier 28 common to the two deflecting circuits.

In the example illustrated, advantage is taken of the fact that separated vertical synchronizing pulses appear across the diode biasing resistors 34 and 36. Thus, these pulses may be taken off resistor 34 as shown, amplified by an amplifier tube 56, and impressed across one diagonal of a bridge 57 through a transformer 58.

The bridge 57 is similar to the bridge 29 and operates in the same way, the only circuit difference being in the choice of constants for the biasing resistors 59 and 61 and their shunting condensers to provide a slower time constant whereby the bias will hold over between successive vertical synchronizing pulses.

Saw-tooth voltage from the vertical deflecting sawtooth circuit 62 is supplied through a conductor 63 to the other diagonal of the bridge 57 whereby the storage condenser 64 receives a charge which depends upon the time relation of the vertical synchronizing and the saw-tooth voltage wave. A filter 66—67 may be employed for the same purpose as the filter 47—48 in the horizontal deflecting circuit.

I claim as my invention:

1. In a television receiver, a cathode ray deflection system comprising an oscillator, a balanced bridge circuit which may be keyed by signal applied across one diagonal to pass signal applied across the other diagonal, means for applying across said one diagonal a carrier wave modulated by picture signal and synchronizing pulses with the carrier wave of maximum amplitude representing said pulses, means for applying voltage waves obtained from said oscillator across said other diagonal, means for integrating the resulting output pulses of said bridge to obtain a frequency control voltage, and means for controlling the frequency of said oscillator in accordance with said control voltage.

2. In a television receiver of the superheterodyne type having an intermediate amplifier, a cathode ray deflection system comprising an oscillator, a balanced bridge circuit which may be keyed by signal across one diagonal to pass signal applied across the other diagonal, means for applying an intermediate frequency signal representative of synchronizing pulses across said one diagonal to key said bridge circuit, means for obtaining pulses from said oscillator, each of which has a steep sloping edge, and applying them across said other diagonal with the steep edges occurring during the occurrence of said *i–f* signal representative of synchronizing pulses, means for integrating the resulting output pulses of said bridge to obtain a frequency control voltage, and means for controlling the frequency of said oscillator in accordance with said control voltage.

3. The invention according to claim 2 wherein said *i–f* signal is applied to said bridge circuit through a channel having a pass band that is narrow compared with the pass band of said *i–f* amplifier.

4. A television receiver of the superheterodyne type which includes a second detector coupled to an intermediate frequency amplifier that amplifies an *i–f* carrier wave modulated by picture signals and recurring synchronizing pulses, said pulses being represented by a carrier wave amplitude greater than the maximum amplitude representing picture signals, a cathode ray deflecting circuit which includes an oscillator, means for synchronizing said oscillator with said synchronizing pulses, said means comprising a bridge circuit having rectifiers in at least two arms of the bridge, means for obtaining from said deflecting circuit a voltage wave having a sloping side and for applying it across one diagonal of the bridge, means for so biasing said rectifiers that said voltage wave will not cause current flow through them unless a keying pulse is being applied to the other diagonal of the bridge, means for applying said modulated *i–f* carrier wave to said other diagonal of the bridge whereby the bridge is keyed open to permit pulses of current therethrough which have an amplitude depending upon the time relation of said synchronizing pulses and the sloping sides of said voltage waves, means for integrating said current pulses to obtain a control voltage, and means for applying said control voltage to said oscillator to control its frequency.

5. The invention according to claim 4 wherein said modulated *i–f* carrier wave is applied to said other bridge diagonal through a channel having a narrow pass band as compared with the pass band of said *i–f* amplifier whereby the effect of incoming noise signals on the deflecting circuit is minimized.

6. A television receiver of the superheterodyne type which includes a second detector coupled to an intermediate frequency amplifier that amplifies an *i–f* carrier wave modulated by picture signals and recurring synchronizing pulses, said pulses being represented by a carrier wave amplitude greater than the maximum amplitude representing picture signals, a cathode ray deflecting circuit for horizontal deflection which includes an oscillator, means for synchronizing said oscillator with said synchronizing pulses, said means comprising a bridge circuit having rectifiers in at least two arms of the bridge, means for obtaining from said deflecting circuit a voltage wave having a sloping side and for applying it across one diagonal of the bridge, means for so biasing said rectifiers that said voltage wave will not cause current flow through them unless a keying pulse is being applied to the other diagonal of the bridge, said biasing means comprising a resistor-capacitor circuit connected between said rectifiers at the junction point of the bridge arms formed thereby, means for applying said modulated *i–f* carrier wave to said other diagonal of the bridge whereby the bridge is keyed open to permit pulses of current therethrough which have an amplitude depending upon the time relation of said synchronizing pulses and the sloping sides of said voltage waves, means for integrating said current pulses to obtain a control voltage, means for applying said control voltage to said oscillator to control its frequency, and means for taking vertical synchronizing pulses off a portion of said resistor-capacitor circuit.

KARL R. WENDT.