

Jan. 18, 1938.

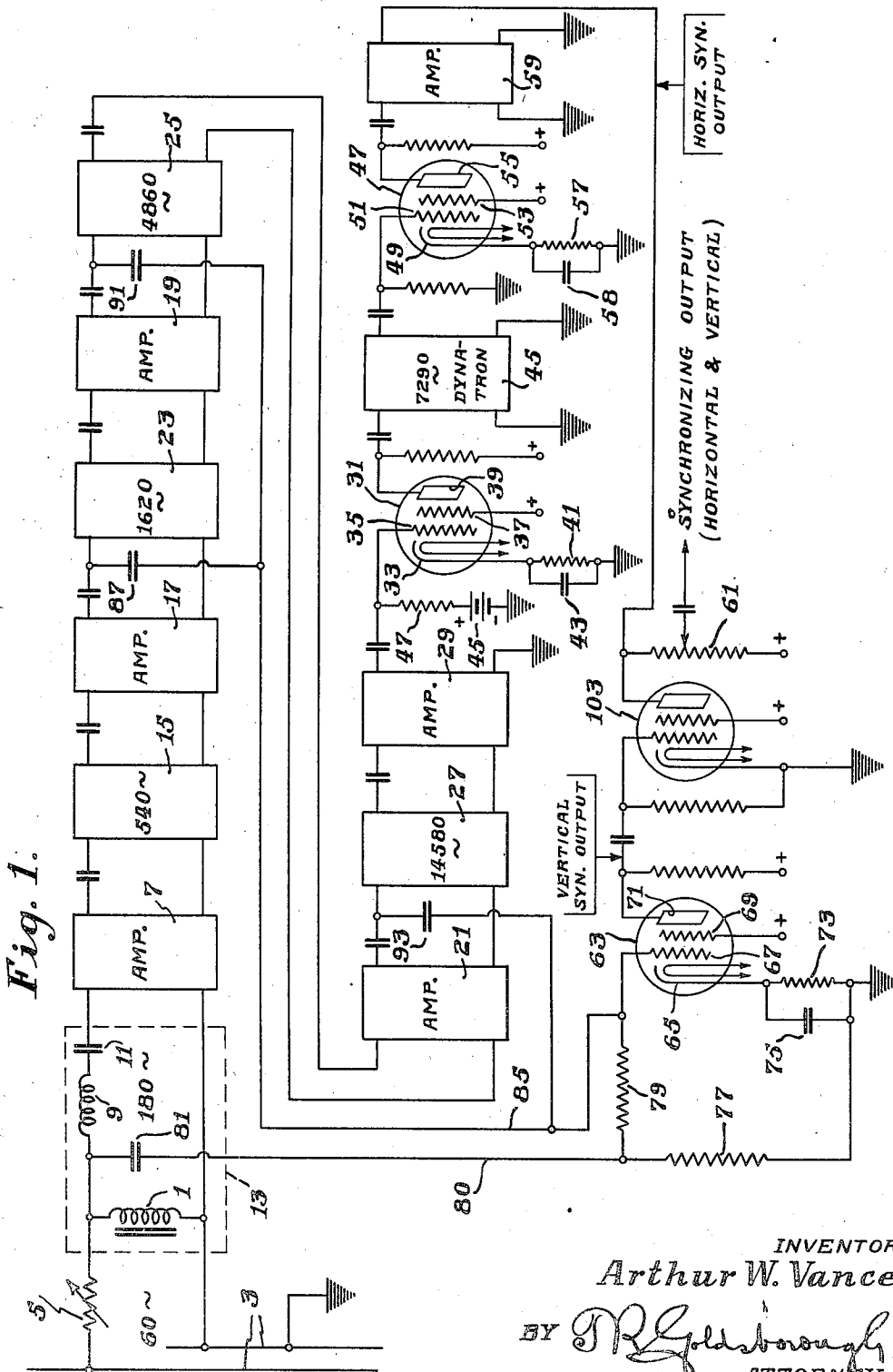
A. W. VANCE

2,105,870

TELEVISION APPARATUS

Filed May 23, 1934

2 Sheets-Sheet 1



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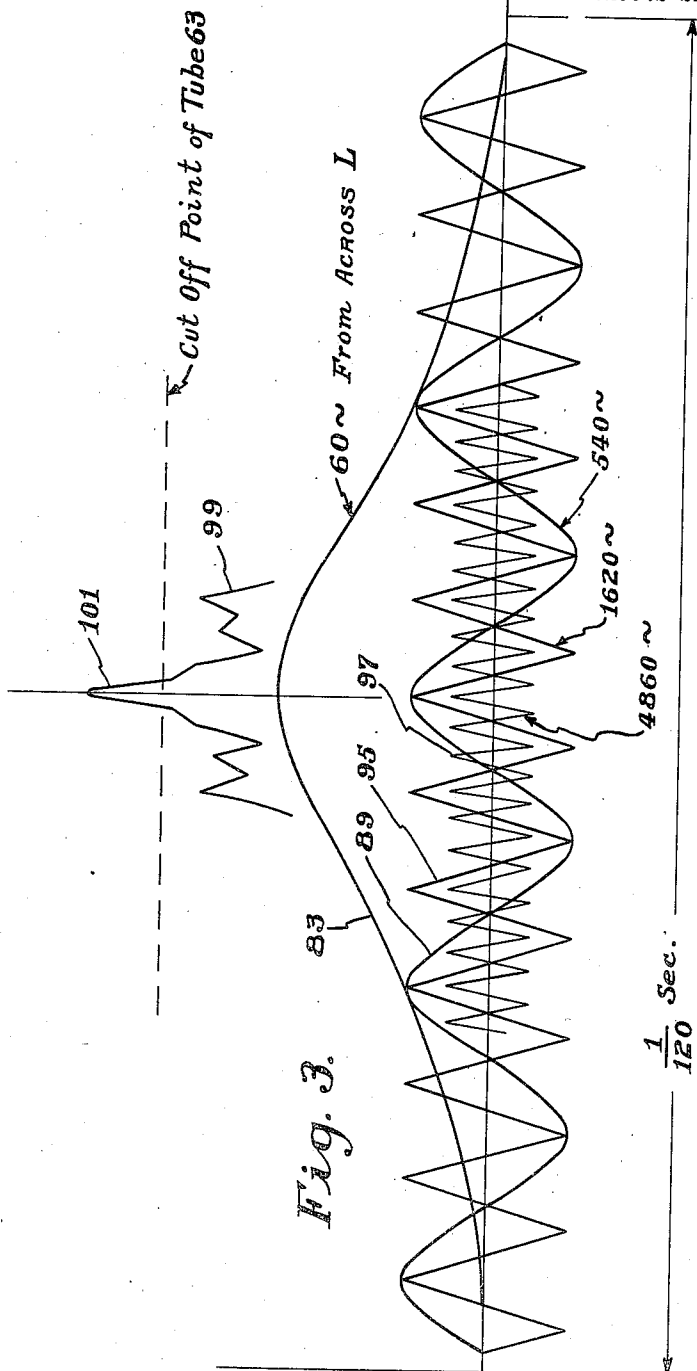
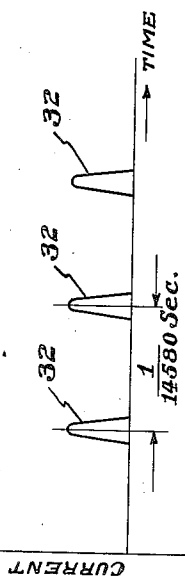
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TELEVISION APPARATUS

Filed May 23, 1934

2 Sheets-Sheet 2



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TELEVISION APPARATUS

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Application May 23, 1934, Serial No. 727,091

10 Claims. (Cl. 178—7.1)

My invention relates to television apparatus, and particularly to a system for generating deflecting and/or synchronizing impulses therefor.

In television systems utilizing a cathode-ray receiver tube, it is the general practice to synchronize the scanning at the transmitter with that at the receiver by transmitting a horizontal synchronizing impulse at the end of each scanning line and a vertical synchronizing or framing impulse at the end of each picture frame. In systems employing what is known as interlaced scanning, the scanning lines of one picture frame fall mid-way between the scanning lines of the preceding picture frame. The result is a picture having substantially the same quality as one having twice the number of scanning lines actually being used.

If the scanning lines of one picture frame do not fall between those of the preceding frame as above mentioned to make the scanning lines for two successive frames equally spaced, the scanning lines are said to be "paired". The result is that the scanning lines become prominent and the quality of the picture is impaired. Whether "pairing" of the scanning lines is avoided or not depends largely upon proper operation of the synchronizing impulse generator.

It is, accordingly, an object of my invention to provide an improved deflecting and/or synchronizing impulse generator for television systems or the like.

More specifically, it is an object of my invention to provide an improved method of and means for generating deflecting and/or synchronizing impulses in a television system employing interlaced scanning.

It is a further object of my invention to provide improved means for generating synchronizing impulses without the use of moving mechanical parts.

It is a further object of my invention to provide a method of and means for generating horizontal synchronizing impulses and framing impulses which occur in a substantially unvarying phase relation to each other.

It is a still further object of my invention to provide a method of and means for generating synchronizing impulses definitely related to a 60 cycle power supply.

It is a still further and more specific object of my invention to provide an improved system in which synchronizing impulses generated from a power line alternating voltage source have an amplitude which is substantially independent of variations in line voltage.

In one embodiment of my invention, I provide an alternating current source, the output of which has a frequency equal to the desired vertical synchronizing or framing frequency. With respect to the horizontal synchronizing impulses, the framing frequency may be considered as a base frequency. The horizontal synchronizing impulses are derived from the aforementioned current source by multiplying the base frequency through a plurality of frequency triplers. After a sufficiently high frequency current has been obtained, its frequency is divided by two (if the synchronizing impulse generator is to be used for interlaced scanning) and only the positive peaks of the resulting alternating current are permitted to appear in the output circuit.

The above-mentioned positive peaks, which are the horizontal synchronizing impulses, and the framing impulses are fed into a common synchronizing output circuit. The above-mentioned framing impulses are derived from current having a complex wave shape made up of a current or voltage from the base frequency source and of harmonic currents or voltages superimposed thereon from the output circuits of several of the frequency triplers. The output currents of the several frequency triplers and the base frequency current are so phased as to provide a complex wave having a single sharp peak. This wave peak is cut-off and the resulting impulse is fed into the synchronizing output circuit and utilized as the framing impulse.

By deriving the framing impulses from a complex wave, in the manner described above, they are given a more definite time or phase relation with respect to the horizontal synchronizing impulses, and phase shifts or hunting of the framing impulses with respect to the horizontal synchronizing impulses is prevented. In interlaced scanning, especially, this is of great importance.

Other objects, features and advantages of my invention will appear from the following description taken in connection with the accompanying drawings, in which

Figure 1 is a circuit and block diagram of a synchronizing impulse generator constructed in accordance with one embodiment of my invention; and

Figs. 2 and 3 are curves which are referred to in explaining my invention.

Referring to Fig. 1, there is illustrated an embodiment of my invention which is designed to produce 60 framing impulses per second and 7290

horizontal synchronizing impulses per second. Since the number of framing impulses per second goes into the number of horizontal synchronizing impulses per second $121\frac{1}{2}$ times, the output of the generator is suitable for interlaced scanning. By selecting a framing frequency of 60 cycles per second, the base frequency may be obtained from a 60 cycle power line.

The generator comprises an iron core inductance coil 1, which is connected across a power line 3 through an impedance unit such as a resistor 5, which may be variable for the purpose of controlling the amount of current passing through the inductor 1. Sufficient current is passed through the inductance coil 1 to saturate the iron core, whereby the 60 cycle current is given a strong third harmonic or 180 cycle component.

The voltage across the inductance coil 1 is impressed upon the input circuit of an amplifier 7 through a series resonant circuit consisting of an inductance coil 9 and a condenser 11 tuned to filter out the 180 cycle component. It will be seen that the circuit enclosed by the dotted rectangle 13 is one form of frequency tripler.

The output circuit of the amplifier 7 is connected to the input circuit of another frequency tripler 15, which preferably is an electric discharge tube operated at plate current saturation and having an output circuit tuned to the harmonic frequency of 540 cycles per second.

The frequency is further multiplied in steps of three by means of a chain of additional amplifiers 17, 19 and 21 and frequency triplers 23, 25 and 27 until the frequency has been brought up to 14,580 cycles per second. The output of the frequency tripler 27 is amplified by an amplifier 29 and impressed upon the input circuit of an electric discharge tube 31 which functions both to permit the passage of only the positive peaks of the input current and to control the magnitude of the peaks automatically.

The tube 31 may be of the screen grid type including a cathode 33, a control grid 35, a screen grid 37, and an anode 39. A self-biasing resistor 41 is inserted in the cathode lead between the cathode 33 and ground where it is common to the input and output circuits of the tube. The resistor 41 has a very high value of resistance and is shunted by a condenser 43 which has sufficient capacity to hold over several cycles of the 14,580 cycle current. In the absence of current flowing through the self-biasing resistor 41, the control grid 35 is positively biased by means of a biasing battery 45 which has its negative terminal connected to ground and its positive terminal connected to the control grid 35 through a resistor 47. This positive bias is rather high.

In order to reach an equilibrium condition, the tube draws sufficient current to make the cathode 33 positive and counteract the positive grid supply until the effective bias is such as to bias the tube 31 almost to cut-off. When the 14,580 cycle current is impressed upon the control grid 35, the self-bias shifts until the average value of the plate current is about what it was before, and the tube permits only the tips of the positive loops of the 14,580 cycle current to appear in its output circuit. The wave-shape of the current appearing in the output circuit of the tube 31 is indicated at 32 in Fig. 2.

The tube 31 acts to provide automatic volume control whereby the current impulses have a uniform amplitude as shown in Fig. 2. This control is obtained because the positive potential of the cathode increases with increase in signal strength

and decreases with decrease in signal strength as a result of the change of current through the biasing resistor 41. A volume control circuit of this type is described and claimed in my copending application Serial No. 732,747, filed June 28, 1934 assigned to the same assignee as this application.

In order to obtain the 7,290 cycle current, the impulses appearing in the output circuit of the tube 31 are impressed upon a suitable frequency divider such as a dynatron 45. The output circuit of the dynatron is coupled to the input circuit of a second electric discharge tube 47 which may be of the screen grid type having a cathode 49, a control electrode 51, a screen grid 53 and an anode 55. This tube is adjusted to function substantially the same as the previously described tube 31, except that its sole function is to permit the passage of only the tips of the positive loops of the 7,290 cycle current, the automatic volume control action being negligible. The tube is held close to the cut-off point by a self-biasing resistor 57 shunted by a condenser 58 to permit the passage of only the positive peaks of the dynatron output. The horizontal synchronizing impulses, which appear in the output circuit of the tube 47, are amplified to the desired value by an amplifier 59 and fed to a synchronizing output circuit which includes a plate resistor 61.

The circuit for developing the vertical synchronizing or framing impulses includes an electric discharge tube 63 which may be of the screen grid type having a cathode 65, a control grid 67, a screen grid 69 and an anode 71. Like the previously described tube 47, it is provided with a self-biasing resistor 73 shunted by a suitable condenser 75 for biasing the tube 63 close to cut-off. It will be understood that biasing batteries may be substituted for the biasing resistors 57 and 73.

The input circuit of the tube 63 includes resistors 77 and 79 connected in series between the control grid 67 and ground. The junction point of the resistors 77 and 79 is coupled through a conductor 80 and a coupling condenser 81 to one terminal of the iron core inductance coil 1 for impressing the distorted wave appearing across said inductance coil upon the input circuit of the tube 63. The voltage wave of this current is shown by the curve 83 in Fig. 3.

The control grid 67 is coupled through a conductor 85 and a coupling condenser 87 to the output circuit of the amplifier 17 for impressing a 540 cycle voltage upon the input circuit of the tube 63. The wave form of this voltage is shown by the curve 89 in Fig. 3. In a similar manner, the 1620 output of the amplifier 19 and the 4860 cycle output of the amplifier 21 are impressed upon the input circuit through coupling condensers 91 and 93, respectively. In order to prevent reaction of one amplifier upon another, the capacity of the coupling condensers 81, 87, 91, and 93 is made very small. The phase relations of these voltages are shown by the curves 95 and 97 in Fig. 3, a triangular wave form being illustrated instead of a sine wave form merely to simplify the drawing.

In the circuit illustrated, each of the coupling condensers 87, 91, and 93 has a high impedance to the current fed therethrough as compared with the combined impedance of the resistors 77 and 79 connected in series. Therefore, the output voltages of amplifiers 17, 19, and 21 cause currents to flow through resistors 79 and 77 which have a value determined mainly by the values of

said voltages and by the impedance values of the coupling condensers.

The several voltages impressed upon the input circuit of the tube 63 combine to give a voltage having a wave form shown by the curve 99 in Fig. 3, providing the phase relations of the several voltages are properly adjusted. It will be seen that the composite or complex wave 99 has a sharp peak 101 which may be selected by the tube 63. In the output circuit of the tube 63, current pulses occur at the rate of 60 per second, these pulses having substantially the same form as those shown in Fig. 2. These framing impulses are amplified by a suitable amplifier 103 and appear in the plate resistor 61 of the amplifier's output circuit. Since the horizontal synchronizing impulses are also impressed upon this resistor, both horizontal synchronizing impulses and framing impulses may be taken off the plate resistor 61 and transmitted to the television transmitting and receiving apparatus.

It will be apparent from an inspection of Fig. 3 that the time at which the peak 101 of the composite wave 99 occurs is determined primarily by the higher frequency components of the wave. Because of this, the framing impulses have substantially no tendency to "hunt" with respect to the horizontal synchronizing impulses.

The complex wave, from which the framing impulses are derived, may be built up in many different ways. Instead of utilizing odd harmonics of the base frequently, as shown in Fig. 3, even harmonics may be utilized providing they are properly phased to give a sharp peak in the complex wave which may be selected as a frame impulse. It will be understood that any tendency of the framing impulses to hunt may be further reduced by adding still higher harmonic frequencies to the complex wave.

It will be apparent from the foregoing description that various modifications may be made in my invention and I desire therefore that only such limitations shall be placed thereon as are necessitated by the prior art and set forth in the appended claims.

I claim as my invention:

1. In a television system, a generator for producing synchronizing impulses, said generator being located at the television transmitter and comprising a source of alternating current having a certain frequency, means for multiplying said frequency to produce a sine wave current having a comparatively high frequency, and means for selecting only the peaks of said sine wave to produce said synchronizing impulses.

2. The method of producing synchronizing impulses at a television transmitter for synchronizing the scanning at said transmitter and at a television receiver which comprises the steps of generating a sine wave current having a frequency definitely related to the desired frequency of the said impulses, and selecting only the peaks of the half sine waves of one polarity to produce said synchronizing impulses.

3. In a television system in which scanning at a receiver is to be synchronized with the scanning at a transmitter, means for producing at said transmitter a sine wave current having a predetermined relation to the scanning frequency, an electric discharge tube having an input circuit and an output circuit, means for biasing said tube beyond cut-off, and means for impressing said sine wave current upon the input circuit of said tube whereby only the positive

peaks of said sine wave appear in said output circuit for transmission to said receiver.

4. In a television transmitter, a source of alternating current having a certain frequency, means for multiplying said frequency to a frequency which is equal to an odd number times said first frequency, means for dividing said second frequency by an even number to produce horizontal synchronizing impulses, means for deriving vertical synchronizing impulses from the current having said certain frequency, and means for combining said impulses for transmission to a receiver.

5. In a television system, a source of alternating current having a certain frequency, means for multiplying said frequency to produce a comparatively high frequency current, means for deriving horizontal synchronizing impulses from said high frequency current, means for combining current of said certain frequency with a plurality of currents having frequencies which are sub-harmonics of said high frequency, and means for deriving vertical synchronizing impulses from said combined currents.

6. In a television system, a source of alternating current having a certain frequency, means for multiplying said frequency to a frequency which is equal to an odd number times said first frequency, means for dividing said second frequency by an even number to produce current having a horizontal scanning frequency, means for deriving horizontal scanning impulses from said scanning frequency current, means for combining with the current having said certain frequency a current having a frequency which is greater than said certain frequency and which is a sub-harmonic of said horizontal scanning frequency, and means for deriving framing impulses from said combined currents.

7. The method of generating high frequency electrical impulses and low frequency electrical impulses which comprises the steps of multiplying the frequency of a current having a base frequency to produce current having a certain frequency, multiplying said certain frequency to produce a current from which said high frequency impulses may be derived, combining the current having said base frequency with the current having said certain frequency, and deriving said low frequency impulses from said combined currents whereby said high frequency impulses and said low frequency impulses have a definite phase relation to each other.

8. In a television system, the method of generating electrical impulses for interlaced scanning which comprises the steps of multiplying the frequency of a current having a base frequency to produce a current having a certain frequency which is equal to said base frequency times a whole number plus one-half, deriving synchronizing impulses from said last-mentioned current, combining current having said base frequency with current having a sub-harmonic frequency of said certain frequency in such phase relation that a wave is produced having its maximum amplitude occurring simultaneously with the maximum amplitude of the current of said base frequency, and cutting off the peak of said wave to produce synchronizing impulses occurring at said base frequency.

9. In a television system, the method of generating synchronizing impulses for interlaced scanning which comprises the steps of multiplying the frequency of a current having a base frequency to produce a current having a certain fre-

quency which is equal to said base frequency
times a whole number plus one-half, deriving
synchronizing impulses from said last-mentioned
current, combining current having said base fre-
quency with current having a sub-harmonic fre-
quency of said certain frequency in such phase
relation that a wave is produced having a sharp
peak therein, and cutting off the peak of said
wave to produce synchronizing impulses occur-
ring at said base frequency.

10. In a television system, the method of pro-

ducing at a transmitter framing impulses defi-
nitely related to higher frequency synchronizing
impulses which comprises the steps of combining
with a current having a base frequency at least
one current having a higher frequency than said
base frequency and having a definite phase rela-
tion with respect to said higher frequency syn-
chronizing impulses to produce a peaked current
wave, and selecting the peak of said wave for use
as a framing impulse.

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