May 13, 1930. P. T. FARNSWORTH 1,758,359

ELECTRIC OSCILLATOR SYSTEM

Original Filed Jan. 7, 1927

Fig. 1

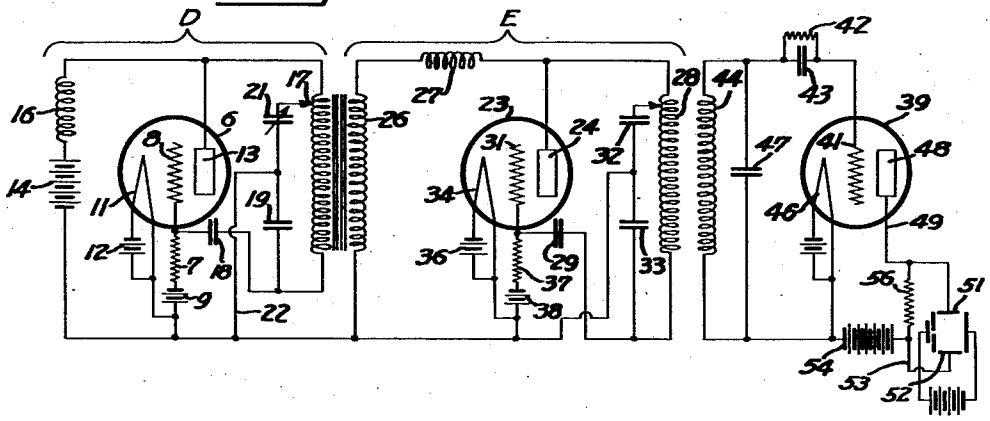
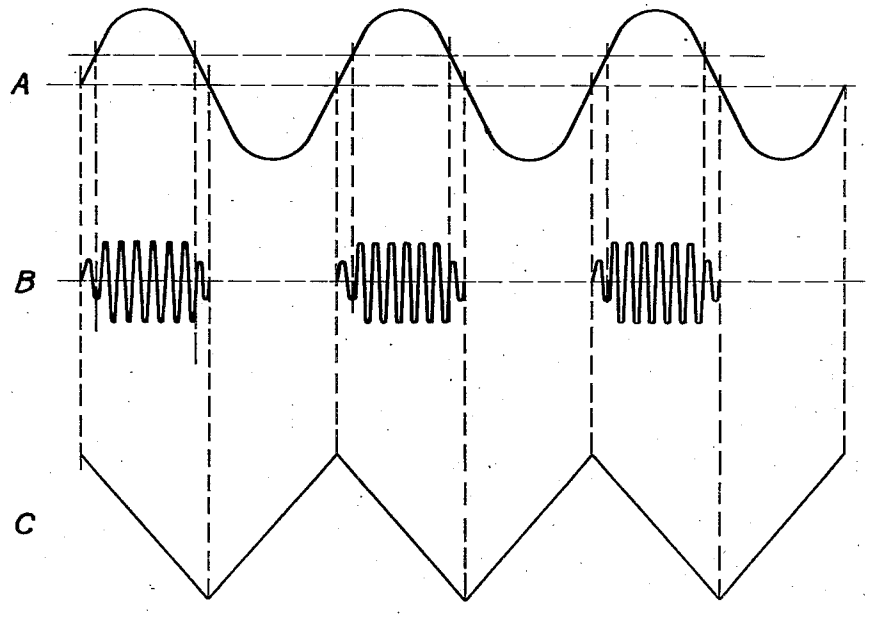


Fig. 2



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UNITED STATES PATENT OFFICE

PHILO T. FARNSWORTH, OF BERKELEY, CALIFORNIA, ASSIGNOR, BY MESNE ASSIGNMENTS, TO TELEVISION LABORATORIES, INC., OF SAN FRANCISCO, CALIFORNIA, A CORPORATION OF CALIFORNIA

ELECTRIC OSCILLATOR SYSTEM

Original application filed January 7, 1927, Serial No. 159,540. Divided and this application filed November 7, 1927. Serial No. 231,690.

My invention relates to systems for producing alternating electrical potentials or waves; and its broad object is to produce a wave in which the potential rises at a substantially constant rate for a definite period, suddenly starts to fall, also at a constant rate and for a definite period, after which it again rises as before, this cycle being repeated indefinitely.

Such a wave is useful in providing scanning potentials in television, this use being fully described in my co-pending application No. 159,540, filed January 7, 1927, of which this application is a division, and it is an object of my invention to provide a source of potentials for this use.

Another object of my invention is to provide a source of potential of the character described which has no moving parts.

My invention has other objects and advantages, some of which, with the foregoing, will be set forth in the description of the preferred embodiment of my invention which is illustrated in the drawings forming part of the specification. It is understood that I do not limit myself to the showing made by the said description and drawings as I may adopt variations of my preferred embodiment within the scope of my invention as set forth in the claims.

Referring to the drawings:

Fig. 1 is a circuit diagram illustrating one form of my invention.

Fig. 2 is a diagram illustrating the wave forms of the potentials developed in the various circuits of Fig. 1, and showing their relationships.

In terms of broad inclusion my invention comprises generating a wave of the desired frequency, and using half-cycles of the said wave in the generation of a second wave of higher frequency. There are thereby produced trains of impulses which are integrated by the charging of a condenser during the trains, the charge dissipating in the intervals between trains. The charge on this condenser therefore rises and falls in the desired manner, and produces the desired wave.

In practice vacuum tube or audion oscillators are used. The potential from an oscillator of this character when delivered to an oscillograph causes the instrument to trace a wave form of approximately sinusoidal character, as is shown at A of Fig. 2. In tracing such a wave the indicator of the oscillograph occupies one third of the cycle in making the central half of the trace, and two thirds in describing the outer half. The outer portion is therefore much more heavily delineated than is the inner portion, and if such a wave is used to actuate the scanning means in television the outer portion of the image will be bright, while the central region is poorly illuminated. As the important parts of a scene are ordinarily in the center of the picture it would be much better if this were reversed, but the most satisfactory results are obtained if the scanning is accomplished by a potential which changes at a constant rate, producing what is called a "straight line wave form." A wave of substantially this form is produced by my device, which will now be described in detail.

The oscillator comprises a tri-electrode valve or audion 6 connected in a circuit, designated by the general reference character D, acting as an oscillator to produce an oscillating energy of low frequency, such for example as 10 cycles per second. It is understood that any customary or preferred form of circuit for this purpose may be employed, the particular circuit described being provided with a grid leak 7 connected with the grid 8 of the tube 6, and hence through a negative bias battery 9 to the filament 11. The filament 11 is indicated as heated by a battery 12. The plate 13 of the tube is connected through a battery 14 and the choke coil 16 to the filament 11. The plate 13 also connects through an inductance 17 and capacity 18 with the grid. The inductance 17 is shunted by a fixed capacity 19 and a variable capacity 21 in series, one end of the series being connected to the end of the inductance 17 and the other end having a variable connection with said inductance. Between these capacities 19 and 21, a lead 22 is connected which connects with the filament 11 of the tube 6.

In this arrangement, the constants of the

oscillating circuit may be any value of inductance and capacity to bring the oscillating circuit in resonance with the frequency desired.

This oscillator in turn provides a source of potential for a second oscillating circuit of similar design, the second oscillator operating at a higher frequency such, for example, as 500 kilo-cycles. The second oscillator, designated by the reference character E, comprises the tube 23, the plate 24 of which is charged with the oscillatory energy of the first oscillator. The first oscillator is coupled through the secondary coil 26 with the inductance coil 17 and hence to the plate circuit of the second oscillator. The inductance 27 may be any suitable radio frequency choke to prevent the high frequencies in the second oscillating circuit from being imposed on the first oscillating circuit. The plate 24 is connected through the primary 28 of a radio frequency transformer and thence through the capacity 29 with the grid 31. Capacities 32 and 33 are shunted around all or part of the primary 28 and a lead is connected from their midpoint to the filament 34 of the tube 23. The filament 34 is heated by the battery 36. The grid 31 of the tube is connected through a suitable leak 37 and negative bias battery 38 with filament 34. It is understood that the second oscillating circuit thus described is only one example of a circuit adapted for this purpose and the various constants of the circuit may be of any value suitable for bringing the circuit into resonance with the frequency of the oscillations desired to be produced therein.

The voltage of the first oscillator D is adjusted to be well above the value required for maximum plate current of the second oscillator E. Hence, since the second oscillator will generate oscillations only when the plate voltage is positive, the current generated by the second oscillator will be similar to that shown in Figure 2B. The harmonic oscillating current developed by the first oscillator is represented in Figure 2A. This current, when imposed upon the second oscillator, develops a current such as illustrated in Figure 2B, in which it will be seen that each positive cycle of the first harmonic current produces a series of harmonic oscillations in the second oscillator of substantially equal intensity, while during the negative period of the first harmonic current, substantially no oscillations are developed in the second oscillator.

The output from the second oscillator is then imposed upon an audion circuit having a tube 39 with its grid 41 connected through the grid leak 42 and grid condenser 43 to an inductance 44 inductively coupled to the inductance 28. Said secondary 44 is connected to the filament 46 of the audion 39. Shunted across the secondary 44 is a condenser 47 of value suitable to produce resonance with the oscillations developed in the second oscillator E. The plate 48 of the audion 39 is connected by the lead 49 with the plate 51 of the photo-electric cell, and the opposed plate 52 of the photo-electric cell is connected by a lead 53 through the battery 54 to the filament 46. The resistance 56 is shunted across the leads 49 and 53 to provide a potential for the plates 51 and 52.

The action of the audion circuit including the tube 39 is to produce an alternating current equal to the frequency developed in the first oscillator but the wave form of said frequency is of substantially straight lines such, for example, as indicated in Figure 2C. In producing this wave form, the audion tube 39 operates due to the bias of the grid leak 42 and condenser 43 to accumulate a charge during the passage of each wave train indicated in Figure 2B, and such accumulated charge leaks off during the interval between successive trains, so that the output of the audion 39 into the plate circuit, indicated by the leads 49 and 53 (passing to the plates 51 and 52 of the photo-electric cells) assumes the straight line form of Figure 2C.

It will be evident to those skilled in the art that many modifications of the particular circuits shown may be made, which will lead to similar results. It will also be apparent that by adjusting the various circuits the wave form may be modified to a considerable degree, even to the extent of making it more peaked than shown, which in the case of television apparatus, would result in an increased illumination of the center of the field at the expense of the edges. All such modifications come within the scope of my invention, which I desire to cover by the following claims:

I claim:

1. In a method of television, the steps of producing a substantially straight line wave form electrical potential comprising forming an alternating potential, utilizing substantially only the positive half cycles of said potential to form an electrical potential of greater frequency, and passing said latter electrical potential into a device wherein the potential is successively accumulated and discharged to form an alternating potential having a straight line wave form.

2. Apparatus of the class described, including an oscillator, an oscillator of higher frequency operated by the first oscillator, thereby producing successive trains of oscillations during the positive half cycles of oscillations of the first oscillator, and a device for accumulating and discharging said oscillations thereby producing oscillations having substantially straight lined wave form.

3. An electrical system comprising an oscillator, a second oscillator operative at a substantially constant amplitude during a portion of the cycle of said first oscillator,

and means for integrating the wave trains produced by said second oscillator.

4. An electrical system comprising an oscillator, a second oscillator operative during a portion of the cycle of said first oscillator, and means for integrating the wave trains produced by said second oscillator to produce a wave equal in frequency to that produced by said first oscillator and differing in wave form.

5. An electrical system comprising an oscillator, a second oscillator operative during a portion of the cycle of said first oscillator, and means for integrating the wave trains produced by said second oscillator to produce a substantially straight lined wave form.

6. An electrical system comprising an oscillator, a second oscillator operative during a portion of the cycle of said first oscillator, and means electrically connected to said second oscillator for accumulating a charge during the wave trains produced by said second oscillator and allowing said charge to dissipate between the trains.

7. An electrical system comprising an oscillator, a second oscillator operative during a portion of the cycle of said first oscillator, means electrically connected to and operated by the wave trains from said second oscillator for charging a condenser, and means for discharging the condenser between the trains.

8. An electrical system comprising an oscillator, a second oscillator operative at a substantially constant amplitude during one half of the cycle of said first oscillator, and means for integrating the wave trains produced by said second oscillator.

9. An electrical system comprising an oscillator, a second oscillator operative at a substantially constant amplitude during the positive half of the cycle of said first oscillator, and means for integrating the wave trains produced by said second oscillator.

10. An electrical system comprising an audion oscillator, a second audion oscillator operative at a substantially constant amplitude during a portion of the cycle of said first oscillator, and means for integrating the wave trains produced by said second oscillator.

11. An electrical system comprising an audion oscillator, a second audion oscillator of higher frequency supplied with alternating plate potential higher than that required to produce maximum plate current by said first oscillator, and means for integrating the wave trains produced by said second oscillator.

12. An electrical system comprising an audion oscillator, a second audion oscillator of higher frequency supplied with alternating plate potential higher than that required to produce maximum plate current by said first oscillator, an audion having a grid circuit coupled to said second oscillator, a condenser in series connection in said grid circuit, and a high resistance thru which said condenser can discharge.

13. An electrical system comprising an audion oscillator, a second audion oscillator of higher frequency supplied with alternating plate potential higher than that required to produce a maximum plate current by said first oscillator, a tuned circuit coupled to said second oscillator, a condenser in series with said tuned circuit, a high resistance shunting said condenser, and an audion having a grid and filament connected in series with said condenser and tuned circuit.

In testimony whereof, I have hereunto set my hand.

PHILO T. FARNSWORTH.