June 9, 1936. A. KAROLUS 2,043,800

TELEVISION APPARATUS

Filed June 22, 1931

Fig. 1.

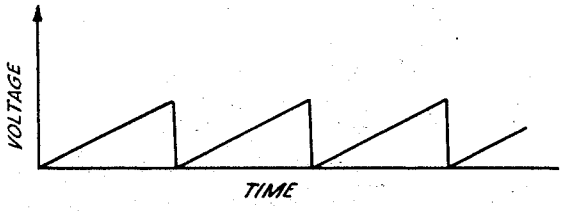


Fig. 2.

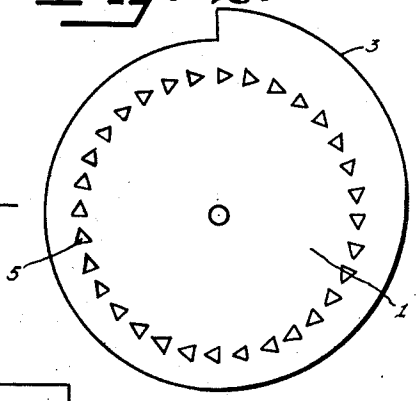
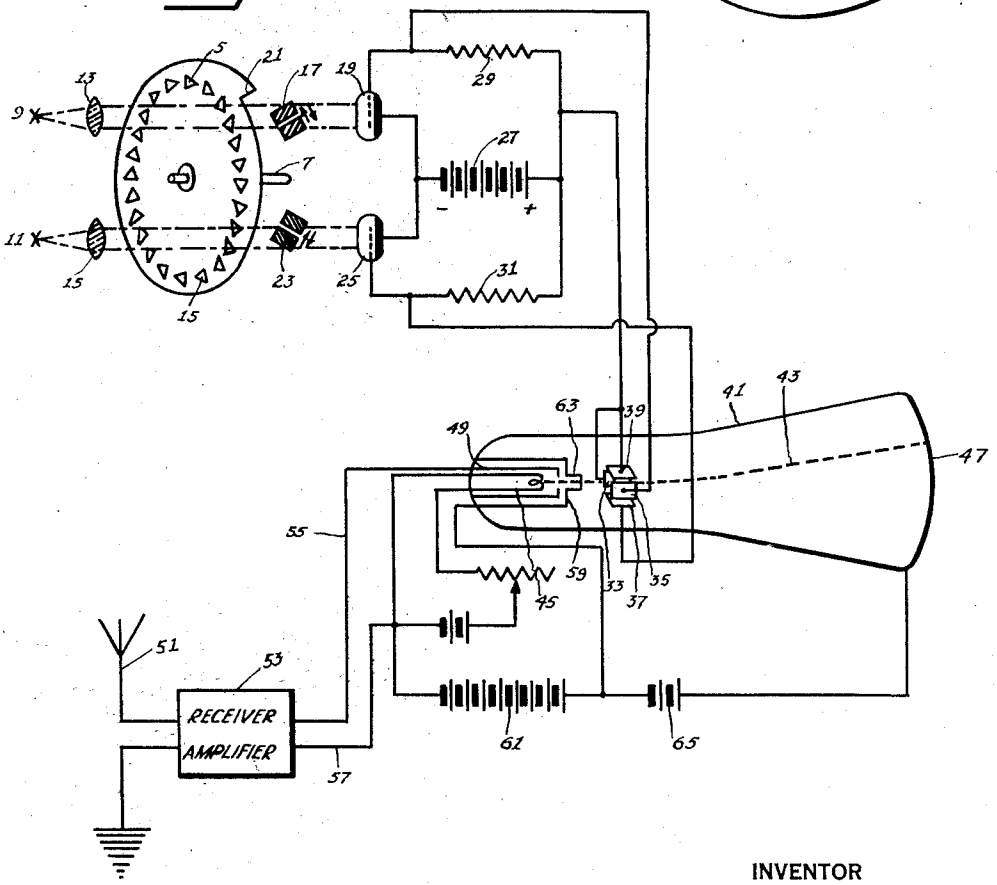


Fig. 3.



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Patented June 9, 1936 2,043,800

UNITED STATES PATENT OFFICE

2,043,800

TELEVISION APPARATUS

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Application June 22, 1931, Serial No. 545,965
In Germany July 15, 1930

2 Claims. (Cl. 178—69.5)

The present invention relates to television apparatus and has particular reference to the receiver end of the system and the manner in which the electro-optical image produced in the receiver may be maintained in synchronism with the transmission of image currents representing the subject located at the point of transmission.

In the employment of the Braun cathode tube acting as a picture unit distributer at the receiving end of a television transmitter system, there arises the problem of supplying the deflection electrodes with two different alternating current potentials of suitable frequency, curve-shape and amplitude which, in conformity with the picture scanning at the sending end, cause the motion of the cathode ray pencil over the surface of the fluorescent screen which is viewed by the observer. Since a transmission of these frequencies from the transmitter end frequently can not be considered because of the necessity of providing two additional communication channels, and, in radio operation, because of the difficulties arising in connection with atmospherics, such as the effects of fading, the Doppler effect, and other disturbances, it is often desirable to generate the necessary synchronizing alternating current potentials in the receiver itself through the use of sufficiently constant generators.

On account of the almost general practice of scanning the television picture along parallel lines at a constant rate of speed, both of the alternating current potentials markedly differ from the sinuous shape, and, in fact, they must exhibit a uniform time-rise up to their crest value followed by an abrupt drop. This results in a potential wave of serrated form which resembles a saw-blade, and in scanning this is known as "saw tooth scanning". This condition holds good for each of the two deflection potentials of the cathode ray pencil. The frequencies applied to each set of deflecting plates bear a fixed relation to each other and coincides with the number of lines of the picture.

For the purpose of the local production of these alternating current potentials it is known from the earlier art that it is possible to employ suitable thermionic tube or gaseous discharge tube schemes operating as "tilting" or intermittence circuit arrangements. However, it has been found that such arrangements are but poorly suited in practice for obtaining the ideal saw-tooth curve shape shown with sufficient approximation, not to mention the fact that the necessary frequency constancy leaves much to be desired.

The present invention, therefore, has as one of its primary obejcts that of disclosing simple ways and means adapted to insure production of the two deflection potentials, by which all demands regarding exact constancy of wave length of the amplitudes and curve shape are largely satisfied.

Still other and further objects will suggest themselves and become apparent to those skilled in the art to which my invention relates by reading the following specification and claims in connection with the accompanying drawing, wherein:

Fig. 1 is a curve obtained by plotting voltage against time to indicate the saw-tooth wave form applied to the cathode ray deflecting means;

Fig. 2 is a view showing a preferred form of disk element to produce synchronizing frequencies; and,

Fig. 3 illustrates conventionally a complete television receiving system using the frequency generator of Fig. 2.

According to this invention, the deflection potentials are obtained by intermittent illumination of two photoelectric or selenium cells responsive to light actions. With this type of frequency generator any desired frequency and curve shape of the alternating current potentials, such as the saw-tooth curve of Fig. 1, may be secured by suitably dimensioning the light increment curve. Periodic action brought upon the brightness of the luminous pencils affecting the photoelectric light translating elements is effected most simply by the agency of a single constant speed disk provided with perforations. The disk may be suitably driven by means of a synchronous motor.

The disk element may have along its periphery two rims or rings of holes arranged to interruptedly pass light to the photoelectric cells through a suitably formed diaphragm or shutter means, so as to generate from the cells energy of a frequency corresponding to the frequency of light interruption. However, by a modification of the invention, one of said rings of perforations in particular cases could also be replaced by a spiral-shaped limitation or contour of the revolving disk and still produce the same result. Fig. 2 shows such a diaphragm disk 1 constructed with spiral border 3 and a number of apertures or diaphragms 5 corresponding to the number of lines of the picture. The various apertures 5 of the disk 1 are preferably of triangular shape to insure the necessary serrated or saw-

tooth current wave by progressively changing the quantity of light passing therethrough from a minimum to a maximum.

Now, describing a complete receiving system, reference may be made to Fig. 3, wherein the perforated disk 1, before mentioned, is carried upon a shaft 7 and is, in some suitable manner, driven in synchronism with the scanning instrumentality at the sending end. In case a synchronous motor (not shown) is employed for driving the disk 1, the stator element thereof is preferably supported in a pivotal manner, as is well known, in order that phase adjustment may be effected during operation by a mere manual rotational movement.

Positioned immediately in front of the disk element 1 are light source 9 and 11 from which the light is directed toward the disk by means of the lenses 13 and 15 respectively. The light from the source 9 passing through the lens 13 may be directed, for example, so as to impinge upon the disk 1 and pass through the triangular apertures or openings 5 arranged concentrically about the shaft 7. The light from the source 11 may then be directed through the lens element 15 toward the periphery of the disk 1 and the quantity of light which passes beyond the disk is varied continuously by means of the spiral periphery 3 of the rotary disk element 1. Thus, as the disk revolves in the direction shown by the arrow, for example, there is a progressively increasing amount of light passing through the triangular openings 5. This light varies from a minimum at the apex of each triangular opening to a maximum at the base of the triangle, and prior to passing through the following triangular apertures is cut off completely and thus reduced to zero. Upon a further rotation of the disk, light varying from a minimum to a maximum again passes through the succeeding triangular openings. The light passing beyond the apertures 5 is arranged to pass through a diaphragm 17 to influence or energize a photoelectric or selenium light translating element 19 and thus generate in the light translating element a photoelectric current varying in strength in proportion to the varying amount of light which excites the photoelectric element. The rise and fall of current produced in the photoelectric element 19 by means of the light chopping action produced by the triangular apertures 5 in the disk 1 upon rotation will produce, it will be seen, the scanning frequencies corresponding to the point for point scanning along a line in one direction across the subject located at the point of transmission.

Similarly, the light issuing from the source 11 and directed by means of the lens element 15 toward the periphery of the disk will, upon rotation of the disk, be a minimum at exactly the point where the outer end of the edge portion 21 blocks the light from the diaphragm 23, and thus there is an absence of light upon the light translating element 25, similar in construction to the light translating element 19. As the disk rotates in the direction shown by the arrow beyond the edge portion 21, it will be seen that light of a progressively increasing amount rising to a maximum after substantially a complete rotation of the disk ending at the inner edge of the same edge portion 21 will control the current output from the cell 25, after which, upon a further rotation of the disk, the quantity of light will again immediately decrease to a minimum and rise to a maximum after a second complete revolution of the disk, and so on. This frequency of rise and fall of current output in the cell or light translating element 25 will then correspond to the scanning frequency of each line of the subject scanned at the point of transmission and will cause, as will hereinafter become apparent, the cathode ray sweeping across the screen in one direction as controlled by the triangular apertures 5 in the disk 1 to move across the screen in a second direction at substantially 90 degrees to the first direction of scanning.

The two light translating elements 19 and 25 are supplied with current from a source 27 connected with a negative terminal toward the cathode of the light translating element and arranged to connect with the anode element of each of the light translating elements 19 and 25 through resistors 29 and 31 respectively. In accordance with the brightness or luminosity which acts upon the photoelectric light translating elements 19 and 25 varying drops in potential will be produced across the resistors 29 and 31 respectively. It is these drops in potential which are utilized to control the potentials which act upon the deflecting plates 33, 35 and 37, 39 of the Braun tube 41 to control the position at which the cathode ray 43 which originates from the source 45 strikes the fluorescent end wall 47 of the tube. From the showing on Fig. 3 of the drawing, it will become apparent that the deflecting plates 33 and 35 are used to control the back and forth motion of the cathode ray 43 along a horizontal path with respect to the fluorescent screen 47 while the deflecting plates 37 and 39 control the vertical motion of the cathode ray 43 sweeping across the fluorescent end wall 47 of the tube 41, and thus the frequencies supplied to the control electrodes 33, 35 are materially higher than the frequencies supplied to the control electrodes 37, 39 and bear a relationship to the lower frequencies equal to the lower frequency multiplied by the number of triangular apertures 5 on the disk element 1.

Frequently it may be necessary or desirable to amplify the photoelectric cell output currents before supplying the same to the tube control electrodes. This amplification may be suitably accomplished by any desired arrangement of thermionic amplifying tubes. In cases where no amplification is desired or provided for, as shown by the drawing, it will be advantageous, as a general rule, to utilize photoelectric cells operated with low gas pressures in order that a sufficiently high potential in the source 27 may be provided for the direct production of an adequate control alternating current potential at the field plates 33, 35 and 37, 39 of the tube 41 without initiation of glow discharges inside the photoelectric cells being produced.

The amplitude of the alternating current potentials acting upon the deflecting plates of the tube 41 may be adjusted in a very simple manner by a control of the intensity of light from the sources 9 and 11 or may be adjusted by changing the size of the diaphragms 17 and 23 respectively.

With the cathode ray 43 issuing from the source 45 controlled as to its position upon the end wall 47 of the tube only, there will be no means by which pictures of a recognizable character can be received, since in order to produce a satisfactory picture it is necessary to control the cathode ray intensity or, at least, the intensity of light produced upon the fluorescent screen 47 which can be seen by an observer. This intensity control may be accomplished in well known manner

as was taught by Nicolson in United States Patent #1,470,696, October 16, 1923, by means of a control grid 49 to which signal potentials are applied. Signals may be received upon a receiving antenna system 51, provided radio transmission is desired, or upon an equivalent means where wire transmission is used, and then suitably amplified in the receiver amplifier conventionally designated as 53. The output from the receiver amplifier 53 is then directed by means of conductors 55, 57 to the grid electrode 49 of the tube 41 and to the cathode 45 thereof respectively forming an input circuit for the tube. In order to accelerate the cathode ray issuing from the source 45, the anode member 59 supplied with potential from a source 61 may be provided and the end 63 of the anode may then be shaped as an electron gun. In order to provide for increased acceleration of the cathode ray stream as it strikes the fluorescent end wall 47 of the tube, an additional source of potential 65 may be connected between the anode and the fluorescent end wall, under which conditions the fluorescent end wall is itself made conducting, as has been taught by Zworykin. Furthermore, it is possible, of course, to utilize other well known schemes for control of intensity and, where desired, I may resort to a system of the type shown by my copending application Serial No. 522,258, filed March 13, 1931 (R. C. A. docket 4631) disclosing a system in which the control of intensity is provided by merely connecting the received signals between the fluorescent conducting end wall and an electrode positioned closely adjacent thereto. Other schemes such as have been taught by British Patent #27,570 of 1907 disclosing a means whereby the effective area of the cathode ray stream striking the end fluorescent wall of the tube is varied in accordance with the received signal, or as was taught in United States Patent #1,161,734, November 23, 1915, wherein the time period of bombardment of the fluorescent end wall of the tube by the cathode ray stream is controlled in accordance with the incoming signal, may be resorted to.

It is, of course, also obvious that in case of a deficient coordinate control proportionality, such as might happen in the system herein disclosed by a decrease in the photo cell potential as the current grows whenever the resistances 29 and 31 are high, this may be easily compensated by choosing suitable forms for the cut-outs in the perforated disk.

Still other and further modifications of the invention are, of course, possible, and I, therefore, believe myself to be entitled to make and use any and all of such modifications such as fall fairly within the spirit and scope of the hereinafter appended claims, wherein:

I claim:

1. In a light chopping device for influencing photoelectric cells by light originating at an external source, a plurality of photoelectric elements, a disk element having a spiral-shaped periphery and a plurality of triangular apertures arranged concentric with respect to the center of rotation thereof, means for projecting a light beam through the triangular apertures of said disk and along the periphery of said disk, a diaphragm positioned in the path of each of said paths of projected light rays, and means provided by rotational movement of the disk for varying the quantity of light passing through said diaphragm and beyond said disk in accordance with variations in the effective area of said triangular apertures through which said light passes and in accordance with the screening effect provided by the spiral periphery of the disk.

2. A photoelectric system for controlling the deflection of a cathode ray beam developed within a cathode ray tube which comprises a pair of constant intensity light sources, a pair of photoelectric elements each subjected to light from one of the sources, a disc element interposed between said light sources and said photoelectric means for controlling the amount of light impinging upon said photoelectric means from said light source, said disc element having its periphery so shaped that during rotation of the disc the light from one of the sources is revealed to one of the photoelectric elements at a rate substantially different than the rate at which the light is eclipsed, said disc element also having provided about the periphery thereof a plurality of triangular apertures arranged along a circular path with one side of each triangle radial so that the light passing through said triangular apertures to the other of said photoelectric means is revealed and eclipsed at materially different rates.

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