Jan. 10, 1939. S. B. SMITH 2,143,093

WAVE GENERATOR

Filed March 23, 1935 2 Sheets-Sheet 1

Fig. 1

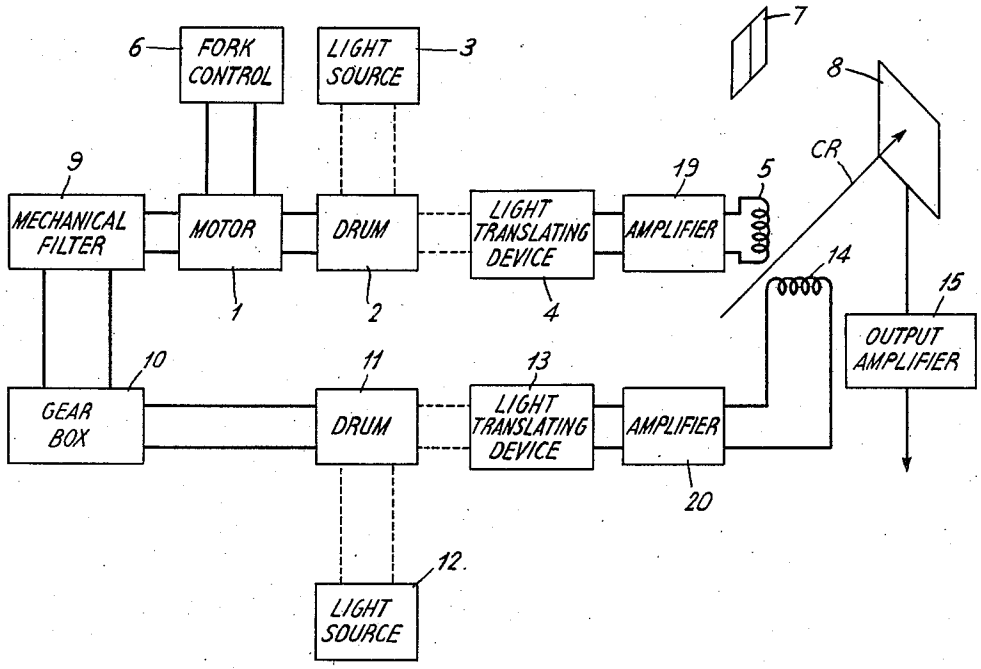


Fig. 2

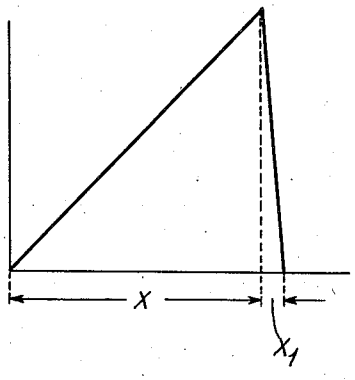
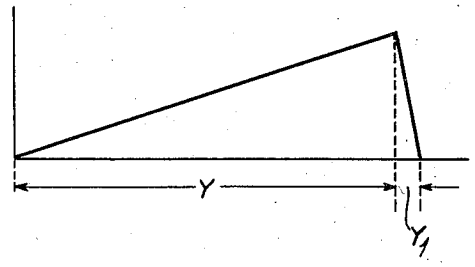


Fig. 3



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Fig. 5

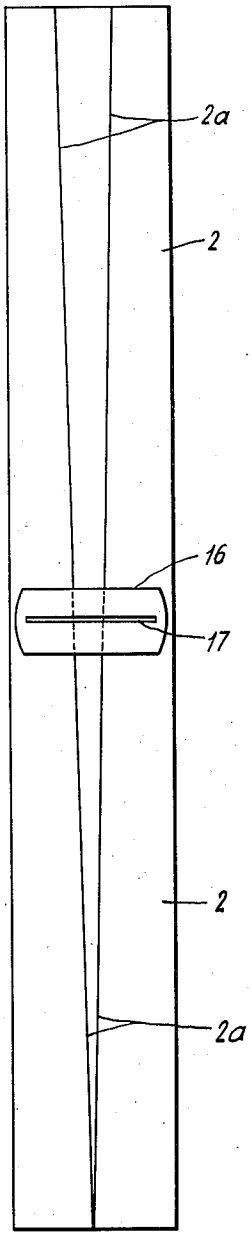
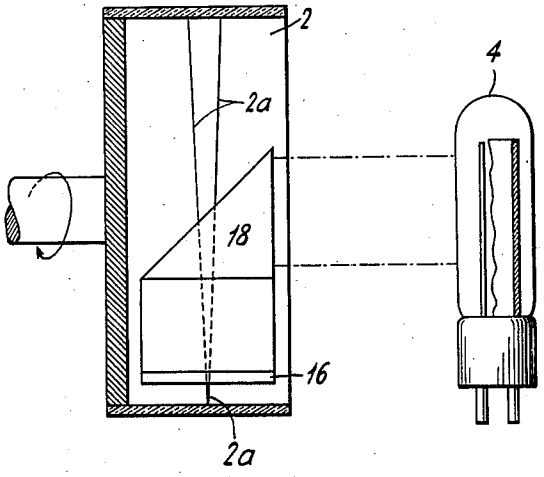


Fig. 4



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WAVE GENERATOR

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Application March 23, 1935, Serial No. 12,750
In Great Britain March 24, 1934

3 Claims. (Cl. 250—41.5)

This invention relates to picture and like telegraph systems, by which expression is meant, in the present specification, systems wherein stationary pictures, documents, and so forth are transmitted in facsimile as distinct from systems wherein moving pictures or actual living scenes are transmitted. In other words, the present invention relates to true picture telegraph or facsimile systems as distinct from television and telecinematograph systems.

The principal theoretical distinction between a picture telegraph system and a television or like system resides, as is well known, in the difference as to the speed at which signal transmission is accomplished, for in the latter class of system the speed of transmission is so high as to produce at the receiver the illusion of a continuous complete picture whereas in the former class of system the received picture is built up relatively slowly so that it does not appear to the eye as a continuous complete picture. For example, in a picture telegraph system wherein the picture signals are transmitted over land lines or over medium or short wave radio channels a time period of between, say, half a minute to twenty minutes will ordinarily be taken to transmit a picture 7" x 5" with satisfactory detail. Of course, these time periods do not apply to cases where the picture signals are transmitted over so-called quasi-optical or ultra short wave channels but only to line and normal short wave or medium wave radio channels wherein more or less unavoidable distortions present a relatively low upper limit to the speed at which satisfactory picture transmission with good detail can be accomplished. As a result of the much slower rate of transmission used in a picture telegraph system as compared to a television system the detail obtained (and required) is generally much better and the various technical problems involved are of a quite different nature.

There have recently been developed television and telecinematograph transmission systems wherein an object or scene is transmitted and received by means by cathode ray tubes. In certain of these known cathode ray tube television and like systems, the cathode ray is caused to scan the picture areas at transmitter and receiver synchronously at very high speeds by means of mutually perpendicular electromagnetic or electrostatic ray deflecting devices which are energized by electrically generated currents or voltages or saw-tooth wave form (generally obtained from some form of relaxation oscillation generator) one saw-tooth wave, which is of the scanning line frequency, being fed to one pair of cathode ray deflecting devices, and the other saw-tooth wave, which is of the picture frequency, being fed to the other or perpendicular pair of ray deflecting devices of the cathode ray tube. The present invention provides improved facsimile transmitters and receivers of the cathode ray tube type and wherein scanning action of the ray is accomplished by means of deflecting saw-tooth waves fed to deflecting means, the said invention consisting in providing such a system which satisfies the requirements of picture telegraph transmission as distinct from television transmission.

A picture telegraph transmitter in accordance with this invention comprises a cathode ray tube device for translating varying values of light and shade in a picture into varying electric currents, said tube having in or in association therewith any known ray deflecting means, and is characterized in that the necessary electric or electromagnetic forces for application to said cathode ray beam deflecting means are generated by mechanically driven saw-tooth wave form generator devices the two generator devices for the two different frequency waves necessary for the two components of scanning movement being interlocked, preferably by being driven from the same driving means.

Preferably each generator means comprises a light source of substantially constant intensity the light from which is projected upon light-electric translating means through a synchronously driven shutter mechanism so shaped as to cause the light activating the said light-electric translating means to vary in amount in acordance with a saw-tooth wave law, the activating light changing substantially rectilinearly in intensity from one extreme to another extreme value and then being changed very rapidly back to said first extreme value.

A picture telegraph receiver in acordance with this invention similarly comprises a cathode ray tube for translating received signals into varying values of light and shade and the ray in this tube is similarly deflected by saw-tooth wave form electric currents or potentials generated by generator means similar to the means above described in connection with a transmitter in accordance with this invention.

Where, as is contemplated, both transmitter and receiver are in accordance with this invention, the saw tooth wave form generator means at transmitter and receiver would be driven each

by a synchronous electric motor the two motors being caused to run in synchronism independently in any manner well known per se, e. g. each may be driven or controlled by electric currents derived from a master time period device such as a tuning fork generator at its own station. If required a degree of inter-dependence may be obtained by causing these generators to be synchronized by signals transmitted over the system but generally it will be sufficient to follow common practice in picture telegraph systems and merely to arrange to ensure that the transmitter and receiver apparatus start together, synchronous action in running being obtained by accurate construction of the motors and tuning fork generators to cause the former to run at a common predetermined speed.

The invention is illustrated in the accompanying schematic and diagrammatic drawings which illustrate one way of carrying out the said invention.

Fig. 1 is a line diagram of the transmitter.

Figs. 2 and 3 are views of the wave form used for actuating the scanning device.

Figs. 4 and 5 are views of a generator for developing the wave forms of Figs. 2 and 3.

Referring first to Fig. 1 which shows diagrammatically the main components of a picture telegraph transmitter in accordance with the invention, the said transmitter comprises a cathode ray tube of the type wherein an image of a picture to be transmitted is projected upon a photoelectric cathode member within the tube, which cathode member is scanned by a cathode ray deflected by mutually perpendicular electromagnetic deflector coils or electrostatic plates of usual well known form. The tube is represented purely schematically by the arrow CR which represents the scanning cathode ray beams, the rectangle 8 which represents the photoelectrically sensitive surface scanned, and the coils 5 and 14 which represent mutually perpendicular cathode ray beam deflecting devices. 7 represents the picture to be transmitted, an image of which is projected upon 8. The transmitter also comprises a synchronous motor 1 which is controlled to run accurately at a predetermined constant speed by means of a tuning fork controlled thermionic valve generator 6. The synchronous motor drives a pair of apertured drums 2 and 11 which will be described in more detail later, these drums acting as shutters each in the path of the light from one or other of two light sources 3 and 12 respectively, to one or other of two photoelectric cells 4 and 13 respectively. One drum 2 is directly driven by the motor 1 and the other drum 11 is driven by the said motor through any well known form of mechanical filter arrangement 9 and a reducing gear box 10 so that the ratio of the rotating speeds of the two drums is equal to the number of scanning lines per picture. The electrical outputs of the two cells 4 and 13 are fed, after amplification in amplifiers 19 and 20, if desired, to the cathode ray beam deflecting devices 5 and 14 respectively of the cathode ray tube. The picture signal output amplifier is represented at 15 and is of well known arrangement and construction. Thus the output from one cell provides the "line direction" component of cathode ray movement, while the output of the other cell provides the "framing" or perpendicular component. Each of the two drums is constructed, as above stated, so that it acts as a shutter controlling the amount of light falling upon its associated cell, the control being such that light increases gradually and substantially rectlinearly from zero to maximum value and then decreases suddenly and as nearly as possible instantaneously to zero thus causing the associated cell to give a saw-tooth wave electrical output.

The arrangement of each drum and associated cell and light source may be similar and a preferred arrangement is shown in Figs. 4 and 5. Referring to Fig. 4 the drum (the case for drum 2 is illustrated) may comprise a hollow rotatable cylinder of glass or other transparent material which is blackened all over with the exception of a V-shaped portion 2*a* extending round its periphery and having its centre line at right angles to the cylinder axis, i. e., the axis of rotation. This V-shaped portion 2*a* is such that in the developed view of the cylinder (see Fig. 5) the said portion appears as an elongated and central V extending from one edge of the developed rectangle to the opposite edge. Within the hollow glass cylinder and adjacent the curved wall thereof is a slitted member 16 having a narrow slit 17 extending at right angles to the centre line of the V, said slit being longer than the maximum width of the V. Mounted centrally within the hollow cylinder is a prism 18 or equivalent mirror arrangement and externally of said cylinder is an electric lamp 3 (preferably of the elongated straight line filament type), or other constant intensity light source. The slitted member 16 and the lamp 3 are so arranged that light from the lamp passes through the area defined by the intersection of the slit 17 with the V 2*a* and thence to the prism 18 whence it is reflected axially of the cylinder on to a photoelectric cell 4. The output of this photoelectric cell is fed to the ray deflecting means 5 of the cathode ray tube after being amplified by amplifier 19.

With this arrangement the activation of the cell will (as shown graphically in Fig. 2) be in accordance with a saw-tooth law, the saw-tooth wave form consisting of a straight inclined portion (corresponding to the period X during which the light activation of the cell increases to its maximum) followed by a much more steeply inclined portion (corresponding to the period X_1 when the activation decreases suddenly to zero). In Fig. 2 the ordinates are values of E. M. F. output from the cell 4 and the abscissae are values of time. Fig. 3 is a corresponding curve for the activation of the "frame component" cell (assured to be the cell 13) and being the time of the growth of output E. M. F. and Y' the time of decrease thereof. For a practical case where the picture to be scanned is 7" x 5" a drum of about 3" diameter may conveniently be used and the slitted member within the drum may have a slot of about 0.003" wide. The time (X) during which the light activation of the cell grows may be, in practice, in the case of the cell which is used for deflecting the ray along the scanning lines (assumed to be the cell 4) a period between say $\frac{1}{16}$th of a second and 2.4 seconds (depending upon the rate of picture transmission employed) while the time of growth Y of activation of the cell (assumed to be 13) which provides the other component of scanning may be between about half a minute and twenty minutes. The time X_1 taken for the activation of the former cell to decrease to minimum represents, of course, lost time, but, in practice, this may be brought as low as .03 per cent of the available time.

It will be noted that since the two shutter drums

are driven by the same motor, there is a direct interlock between the scanning line periodicity and the picture periodicity.

Although in the above description one shutter drum is described as driven directly by the synchronous motor and the other as driven thereby through a gear box, gear boxes—either or both of which may be constructed to enable variable velocity ratios to be obtained—may be inserted in the two drives. Such variable gear boxes are convenient in that they allow of variation, from time to time, of the fineness of scanning and of the periodicity of scanning. It may be pointed out here that the term "gear box" as used in this specification is not intended to be limited to devices of the toothed gear type but to apply to any known type of device enabling a predetermined velocity ratio or ratios to be obtained.

Apparatus at a receiver in accordance with this invention will correspond closely to that above described for a transmitter, the principal difference being, of course, that in the case of the receiver the cathode ray beam in the tube is varied in dependence upon received signals and is caused to build up a received picture, e. g., by photographic recording.

Clearly in apparatus in accordance with this invention the size and shape of the area scanned by the cathode ray at a transmitter or at a receiver will depend, inter alia, upon the magnitudes of the deflecting E. M. F.'s applied to the deflecting means controlling the ray in question. Thus by altering the relative magnitude of the E. M. F.'s applied to the mutually perpendicular deflecting means at the receiver the shape of the reproduced picture may be altered or enlargement or reduction of the size of the reproduced picture as well as, or in addition to, alteration of its shape, may be obtained by suitably adjusting the deflecting E. M. F.'s. Similarly, at the transmitter, it is convenient to provide means for adjusting—preferably independently—the amplitudes of the coordinate deflecting E. M. F.'s and, by making use of such adjusting means efficient scanning may always be obtained and the apparatus efficiently employed for transmission from message surfaces of different sizes and shapes for the E. M. F.'s can always be so adjusted that a given message surface is fully explored while avoiding inefficiency due to scanning a larger area than that of the said message surface.

It will be appreciated that apparatus in accordance with this invention enables the advantages of cathode ray transmission or reception to be obtained and solves those problems peculiar to picture telegraph systems (as distinct from television systems) which render the known saw-tooth wave cathode ray tube television arrangements unsuitable for picture telegraph use, namely, that the saw-tooth wave forms required are of relatively very low periodicity, i. e., they are relatively slow motion wave, and that independent synchronism is generally required at transmitter and receiver.

Having now described the invention, what is claimed is the following:

1. An electrical wave generating apparatus comprising a motor, means to drive the motor at a highly precise predetermined constant speed, a drum having a transparent V-shaped portion extending around the periphery at right angles to the axis thereof, means to rotate said drum by said motor, a source of light, a rectangularly apertured diaphragm, a light translating device, and means to direct light from said source through said diaphragm and said V-shaped portion of the drum onto said light translating device.

2. An electrical wave generating apparatus comprising a motor, means to drive the motor at a highly precise predetermined constant speed, a drum having a transparent V-shaped portion extending around the periphery at right angles to the axis thereof, means to rotate said drum by said motor, a source of light, a rectangularly apertured diaphragm, a light translating device, means to direct light from said source through said diaphragm and said V-shaped portion of the drum onto said light translating device, a second drum, a second source of light, a second rectangularly apertured diaphragm, a second light translating device, a second means to direct light from said second source through said second diaphragm and said V-shaped portion of the second drum onto the second light translating device, all of said second named devices being identical with said devices respectively, and means to rotate said second drum at a different rate from said first drum.

3. An electrical wave generating apparatus comprising a motor, means to drive the motor at a highly precise predetermined constant speed, a drum having a transparent V-shaped portion extending around the periphery at right angles to the axis thereof, means to rotate said drum by said motor, a source of light, a rectangularly apertured diaphragm, a light translating device, means to direct light from said source through said diaphragm and said V-shaped portion of the drum onto said light translating device, a second drum, a second source of light, a second rectangularly apertured diaphragm, a second light translating device, a second means to direct light from said second source through said second diaphragm and said V-shaped portion of the second drum onto the second light translating device, all of said second named devices being identical with said devices respectively, means to rotate said second drum at a different rate from said first drum, whereby saw-tooth electrical waves of different frequency are produced, and means to control the amplitude of each of said produced waves.

SIDNEY BERTRAM SMITH.