

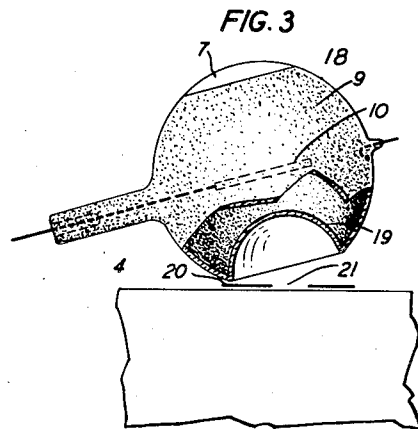
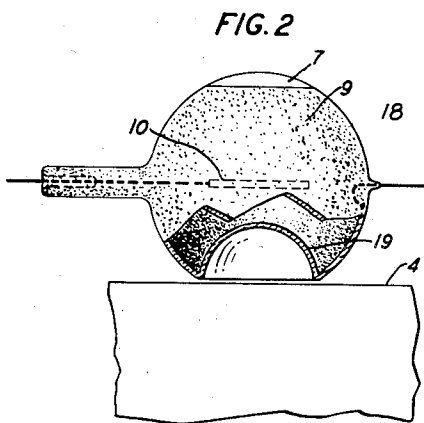
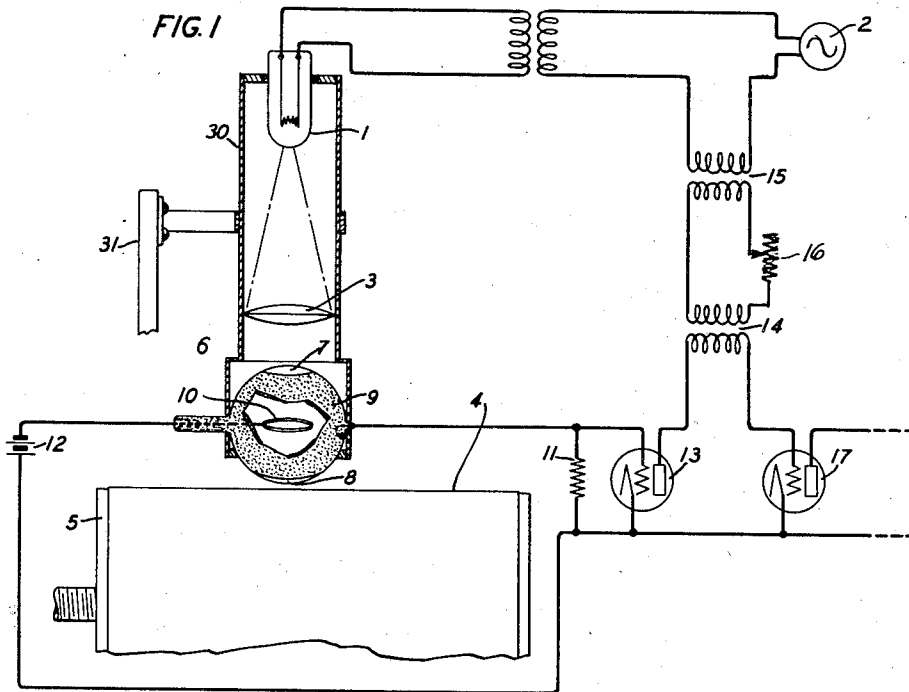
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ELECTROOPTICAL SYSTEM

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ELECTROOPTICAL SYSTEM

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13 Claims. (Cl. 178-5)

This invention relates to electro-optical systems and more particularly to telephotography.

The prior art discloses a system of telephotography in which a picture or other representation is mounted on a drum, successive elemental areas of the picture are illuminated by a beam of light of constant intensity passing through a central opening in a ring-shaped photoelectric tube, which is activated by light reflected from the picture to cause the production of a picture current.

In another prior art system the scanning beam is directed to the surface of the picture and light reflected from the picture is gathered by an ellipsoidal mirror which focuses the reflected light on the light sensitive surface of a photoelectric tube, which is thereby activated to cause the production of a picture.

It has heretofore been proposed to mount a picture on a drum, to illuminate the successive elemental areas by a beam of light chopped at a carrier frequency rate and to utilize the light reflected from the picture to illuminate a photoelectric tube, which is thereby activated to produce a picture modulated carrier current.

The systems described above are unsatisfactory from a practical standpoint, because the first system requires a photoelectric tube of special construction which is difficult to manufacture, and the others require a complicated optical system, the mounting of which in the limited space available constitutes a real problem.

An object of the present invention is to overcome the above mentioned objections.

In accordance with a preferred embodiment of the invention, there is provided a simplified apparatus including a photoelectric tube, manufactured in accordance with well-established practice, which is mounted between the picture or other representation to be transmitted and the light source supplying a fluctuating beam of light for illuminating successive elemental areas of the picture, and which has its light sensitive surface adjacent to and surrounding the successively illuminated areas of the picture, whereby such surface directly receives substantially all of the light reflected from the successive elemental areas of the picture, and the tube is thereby activated to cause the production of a picture modulated carrier current. A light source supplies a beam of light fluctuating at a carrier frequency rate, which passes axially through windows in the opposite walls of a light sensitive tube to a picture wrapped around a drum adapted to be given a motion of rotation and translation with respect to

the beam, which is thereby caused to illuminate successive elemental areas of the picture.

The light sensitive tube is mounted between the light source and the picture and has a light sensitive surface applied to the walls of the tube intervening between the windows and concentrically of the path of the light beam, so that this surface is closely adjacent the successive elemental areas of the picture as they are illuminated by the beam and hence is in a position to receive substantially all of the light reflected from the elemental areas. This arrangement, while permitting a photoelectric tube of well-known construction to be used and allowing it to be mounted in the most advantageous position with respect to the picture being scanned, possesses the disadvantage that a certain amount of light is scattered and/or reflected by the windows of the tube to its light sensitive surface, whereby the tube is activated to cause the production of an unmodulated component of carrier frequency, in addition to the picture modulated carrier current components.

One feature of this invention relates to means for controlling the amplitude of the unmodulated current component supplied to a transmission circuit.

A detail description of the invention follows and is illustrated in the attached drawing in which:

Fig. 1 illustrates a picture transmitting terminal apparatus embodying the invention;

Fig. 2 illustrates a photoelectric tube of slightly different design from that of Fig. 1; and

Fig. 3 shows the photoelectric tube of Fig. 2 mounted differently from that shown therein.

Referring now to Fig. 1, there is shown a terminal apparatus for a picture transmitting system in which a light source 1, herein shown as a glow lamp, is supplied with oscillating current from a source 2 to produce light radiations varying at a carrier frequency rate, such radiations being concentrated by a lens 3 and focused on the picture or other representation 4 wrapped about a cylinder 5.

The glow lamp may be of the type disclosed in United States application of J. B. Johnson, Serial No. 349,628, filed March 25, 1929, provided with a charge of helium, or other rare gas at low pressure. If desired, a small percentage of active gas, for example, hydrogen, nitrogen, carbon dioxide, etc. may be added to the charge of rare gas.

Between the lens 3 and picture 4 is a light sensitive device 6, herein shown as a photoelectric

tube of spherical form, provided with diametrically opposed windows 7 and 8 through which the light beam passes and with a layer of light sensitive material 9 on its inner wall surrounding the path of beam and extending from one window to the other.

In accordance with well-known practice, the cylinder 5 is given a motion of rotation and translation with respect to the light beam, as disclosed for example in United States Patent 1,706,032, March 19, 1929, to Long, to effect scanning of the successive elemental areas of the picture.

Light sensitive tube 6 is mounted so that one of its windows 8 is very close to the surface of the picture and its light sensitive layer 9 completely surrounds the light beam and occupies a position closely adjacent to the elemental areas of the picture as they are successively illuminated. Thus, the light sensitive layer is advantageously positioned to receive substantially all of the light reflected from these areas, as the picture is carried past the spot of light by the cylinder. A ring-shaped anode 10 within the tube 6 is connected by an external circuit, including a resistance 11 and a direct current source 12, to the light sensitive layer 9.

Any suitable mounting may be used for supporting the lamp 1, lens 3 and photoelectric tube 6 in proper relative position with respect to each other and the cylinder 5. For example, they may be mounted on a support 30 carried by a standard 31 secured to the support (not shown) for the apparatus carrying the picture.

Rotation and translation of the cylinder 5 will cause the spot of light to follow a path spirally of the picture, whereby successive elemental areas will be illuminated and light will be reflected therefrom through window 8 to the light sensitive layer 9, and the tube will be thereby activated to cause the production of a carrier current modulated in amplitude in accordance with the tone values of successive elemental areas of the picture. A certain amount of light of the carrier beam will be scattered and/or reflected by the windows 7 and 8 to the light sensitive layer 9, with the result that tube 6 will be thereby activated to cause the production of a current component of carrier frequency and of considerable amplitude.

The picture modulated carrier current and the unmodulated current of carrier frequency flow through the resistance 11, and are impressed upon the input electrodes of the amplifier 13, which serves to repeat them in amplified form in its output circuit, which includes the secondary winding of a transformer 14.

Under certain conditions of operation, transmission of the unmodulated current of carrier frequency may be undesirable, since it corresponds to a dark current and thereby fixes the average tone value of the representation produced at the receiver, or, in other words, it determines the tone of the background and hence may prevent the production of a facsimile of the picture being transmitted. Under other operating conditions, it is desirable to transmit an unmodulated carrier current of fixed amplitude along with the modulated components.

The value of the unmodulated carrier component supplied to the transmission circuit, may be controlled by supplying a current of carrier frequency from the source 2, over a path including transformer 14. Let it be assumed, for example, that the unmodulated component of carrier frequency present in the output circuit of

the amplifier is too great. Carrier current may be supplied to the output circuit of amplifier 13 in phase opposition to this component and of such amount as to reduce its amplitude to a value best adapted to the type of transmission to be effected, or it may even be completely neutralized, if desired. This may be accomplished, as herein indicated by way of example, by providing a transformer 15 in the path including the transformer 14, whereby the current transmitted over this path is in opposite phase to the unmodulated component repeated by the amplifier and by using an adjustable resistance 16, for controlling the amplitude of the current supplied to the transformer 14. By properly adjusting the resistance 16, the amplitude of the carrier current supplied from source 2 to the output circuit of the amplifier may be made less than or equal to that of the carrier component repeated by the amplifier, whereby the latter component is reduced to a fixed value or completely neutralized. Any other well-known means for effecting the phase change and amplitude control may be used. For example, the carrier current path may include a phase adjusting network either provided, or associated, with adjustable means for controlling the amplitude of the carrier current supplied to the output circuit of the amplifier.

The above described apparatus is well adapted for use in single sideband transmission systems, especially those in which, according to well-known practice, an unmodulated component of carrier frequency is transmitted from the sending to the receiving station, along with the sideband. If the unmodulated component reproduced by the amplifier is too great, it may be neutralized to the desired extent in the manner described above. On the other hand, should the amplitude of this component be insufficient for efficient transmission, i. e., to reproduce the picture current at the receiver by combining with the picture modulated components, a predetermined amount of carrier current in phase with this component may be supplied from the source 2 to the output circuit of the amplifier. This may be accomplished by connecting source 2 to the output of the amplifier over a path adapted to supply carrier current in phase with the repeated component and including means for adjusting the amplitude of the current supplied thereover.

Amplifier 17 serves to repeat the modulated carrier current and the unmodulated but compensated carrier component to a transmission circuit connected by a communicating channel to a receiving station provided with a suitable receiving apparatus, such as for example, an apparatus of the type disclosed in the above mentioned patent to Long. The cylinder included in the receiving apparatus must be operated in synchronism and in phase with the cylinder 4 and this may be effected in the manner disclosed in the Long patent.

The apparatus shown in Fig. 1 embodies an objectionable feature, in that, due to the convexity of the window 8, a certain amount of the light reflected from the surface of the picture toward the light sensitive layer of the tube 6 is reflected back to illuminate a more or less extended area of the picture adjacent the elemental area illuminated by the scanning beam. Two arrangements for overcoming this objection are shown respectively in Figs. 2 and 3, each of which includes a photoelectric cell 18, provided with a window 19 of spherical form, which may be sub-

stituted for cell 6 in the apparatus shown in Fig. 1.

According to Fig. 2, the cell 18 is mounted closely adjacent the picture, and its window 19 is so shaped and positioned that light reflected toward the picture by this window is focused on the elemental area illuminated by the scanning beam.

In Fig. 3, the cell 18 is so mounted that the light reflected by its window 19 is focused at a point remote from the elemental area illuminated by the scanning beam. If desired, a mask 20 may be mounted between the cell 18 and the picture. The opening 21 in this mask should be of such size that it does not interfere with the passage of light reflected from the picture to the light sensitive layer 9 of the cell, and the window 19 should be so positioned that the light reflected by it is focused on the upper surface of the mask. As shown, the cell is tilted so that an axis passing through its windows 7 and 19 is inclined to a plane tangent to the surface of the picture and the focal point of the window 19 lies at a point on the upper surface of the mask 20, i. e., beyond the periphery of the opening 21.

What is claimed is:

1. An electro-optical system comprising a source producing light which fluctuates at a carrier frequency rate, a light sensitive device having windows in its opposite walls, mounted between said light source and a representation to be transmitted, means for directing a beam of light from said source through said windows to scan successive elemental areas of said representation, whereby said light sensitive device is activated by light reflected from said elemental areas and also by light reflected and/or scattered by said windows, a means for controlling the amplitude of the current resulting from the activation of said light sensitive device by light reflected from said elemental areas, and other means for controlling the amplitude of the current resulting from the activation of said light sensitive device by the scattered or reflected light.

2. An electro-optical system comprising a light producer energized from a carrier current source, a light sensitive device having windows in its opposite walls mounted between said light producer and a representation to be transmitted, means for directing a beam of light from said producer through said windows to scan successive elemental areas of said representation, whereby said device is activated by light reflected from the elemental areas of said representation and also by light diverted from said beam by said windows, and means supplied with current from said carrier source for controlling the amplitude of the current caused by the activation of said light sensitive device by the light diverted by said windows.

3. A picture transmission system comprising a movable drum carrying a representation to be transmitted, means for producing light varying at a carrier frequency rate, a photo-electric tube provided with a plurality of windows, means for directing a carrier light beam through said windows to illuminate successive elemental areas of said representation, means for mounting said tube closely adjacent said representation whereby said tube is activated by light reflected from said elemental areas and also by light diverted by said windows, a circuit for transmitting current supplied by said tube, and means for supplying said transmission circuit with current varying at said carrier frequency rate for neutralizing at least in part the current caused by the actuation of said

photoelectric tube by the light diverted by said windows.

4. An electro-optical system comprising a movable drum carrying a representation, a source of carrier current, a light producer energized with current from said carrier source, a photoelectric tube having a plurality of windows, means for directing a beam of light from said light source through said windows for illuminating successive elemental areas of said representation, means for mounting said tube whereby it is activated by light reflected from the elemental areas of said representation and also by light diverted by said windows, and means for neutralizing the current caused by the activation of said tube by the light diverted by said windows.

5. An electro-optical system comprising a movable drum carrying a representation, a source of carrier current, a light producer energized with current from said carrier source, a photoelectric tube having a plurality of windows and a light sensitive layer concentric to an axial line passing through said windows, means for directing a beam of light from said light source through said windows for illuminating successive elemental areas of said representation, whereby said tube is activated by light reflected from the elemental areas of said representation and also by light diverted by said windows, means for amplifying the current supplied by said tube, and means for supplying from said carrier source to said amplifier current which neutralizes the current caused by the activation of said tube by the light diverted by said windows.

6. An electro-optical system comprising a movable drum carrying a representation, a source of carrier current, a light producer energized with current from said carrier source, a photoelectric tube having a plurality of windows, one of which is reentrant and curved, and a light sensitive layer concentric to an axial line passing through said windows, means for directing a beam of light from said light source through said windows for illuminating successive elemental areas of said representation, means for mounting said tube with its reentrant window closely adjacent said representation through which light passes to activate said photoelectric tube and with its curved surface positioned to focus light reflected therefrom to the elemental area illuminated by said beam of light.

7. An electro-optical system comprising a movable drum carrying a representation, a source of carrier current, a light producer energized with current from said carrier source, a photoelectric tube having a plurality of windows and a light sensitive layer concentric to an axial line passing through said windows, means for directing a beam of light from said light source through said windows for illuminating successive elemental areas of said representation, one of said windows being reentrant and curved, and means for mounting said tube with its curved window adjacent said representation for focusing light, reflected by said window toward said representation, on a point remote from that illuminated by said beam of light.

8. An electro-optical system comprising an optical system including a source of light, a light sensitive device having a plurality of diametrically opposed windows and a light sensitive layer surrounding said windows, one of said windows being reentrant and curved, and means for directing a beam of light axially of said windows to illuminate elemental areas of a representation to be transmitted, and means for mounting said

light sensitive device to receive light reflected from said representation through said curved window which is positioned to focus light reflected thereby on the area illuminated by said beam.

9. An electro-optical system comprising an optical system including a source of light, a light sensitive device having a plurality of diametrically opposed windows and a light sensitive layer surrounding said windows, one of said windows being reentrant and curved, means for directing a beam of light axially of said windows to illuminate elemental areas of a representation to be transmitted, and means for mounting said light sensitive device to receive light reflected from said representation through said curved window which is positioned to focus light reflected thereby on a point remote from the area illuminated by said beam.

10. An electro-optical system comprising an optical system including a source of light, a light sensitive device having a plurality of diametrically opposed windows and a light sensitive layer surrounding said windows, one of said windows being reentrant and curved, means for directing a beam of light axially of said windows to illuminate elemental areas of a representation to be transmitted, a mask adjacent said curved window, and means for mounting said light sensitive device to receive light reflected from said representation through said curved window which is positioned to focus light reflected thereby on said mask.

11. An electro-optical system comprising a light producer energized with current supplied by a carrier current source, a light sensitive device having windows in its opposite walls, means for mounting said device between said source and an object to be scanned, means for directing a beam of light from said source through the windows of said device to scan successive elemental

areas of said object, whereby light reflected from said elemental areas and light supplied by said beam activate said device to cause the production of a modulated carrier current and an unmodulated current of carrier frequency, and means supplied with current from said carrier source for controlling the amplitude of said unmodulated current of carrier frequency.

12. An electro-optical system comprising a light producer energized with current supplied by a carrier current source, a light sensitive device having windows in its opposite walls, means for mounting said device between said source and an object to be scanned, means for directing a beam of light from said source through the windows of said device to scan successive elemental areas of an object, whereby light reflected from said elemental areas and light supplied by said beam activate said device to cause the production of a modulated carrier current and an unmodulated current of carrier frequency, and means supplied with current from said carrier source for increasing the amplitude of said unmodulated current of carrier frequency.

13. An electro-optical system comprising a light producer energized with current supplied by a carrier current source, a light sensitive device having windows in its opposite walls, means for mounting said device between said source and an object to be scanned, means for directing a beam of light from said source through the windows of said device to scan successive elemental areas of an object, whereby light reflected from said elemental areas and light supplied by said beam activate said device to cause the production of a modulated carrier current and an unmodulated current of carrier frequency, and means supplied with current from said carrier source for neutralizing at least in part said unmodulated current of carrier frequency.

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