April 11, 1939. A. McL. NICOLSON 2,153,586

RADIATING, TRANSFORMATION AND REINFORCEMENT SYSTEM

Filed March 20, 1934

FIG. 2

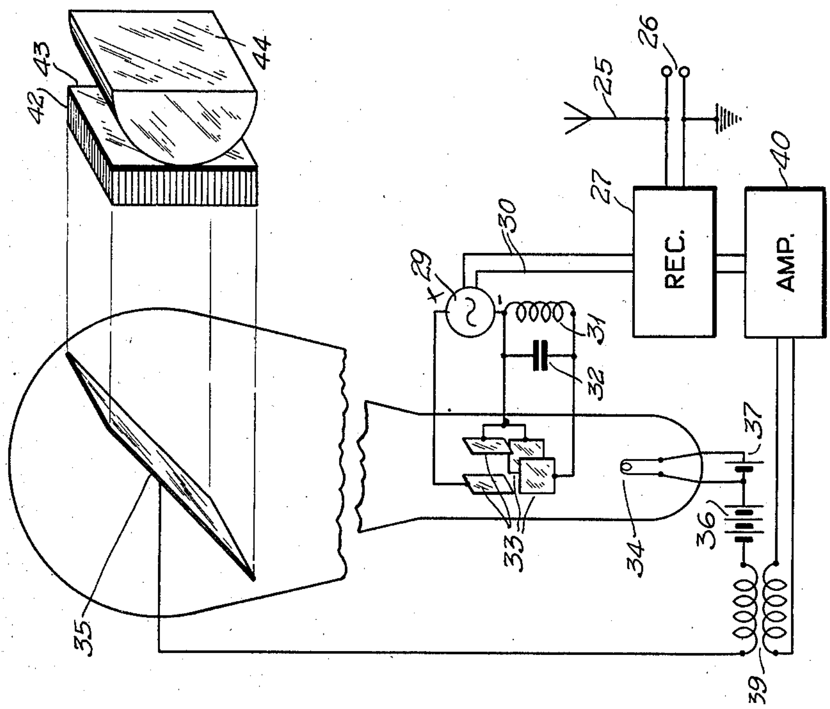


FIG. 1

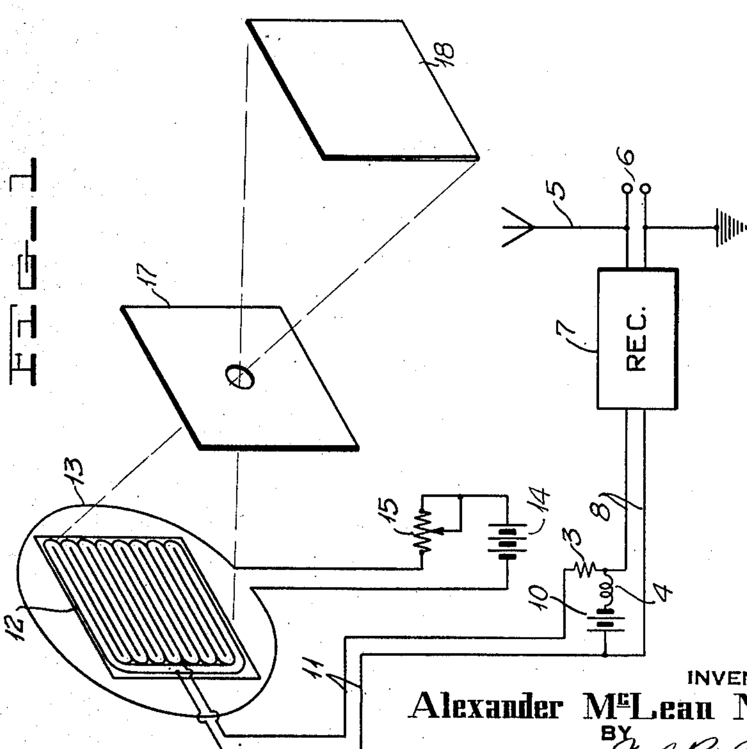
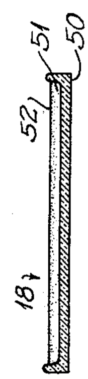


FIG. 3



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RADIATING, TRANSFORMATION AND REINFORCEMENT SYSTEM

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7 Claims. (Cl. 178—7.5)

This invention relates to a method of and means for increasing the efficiency of light reflecting or transmitting mediums whereby a greater amount of visible light is obtained from projected irradiations, and it is particularly applicable to systems for the transmission of images at a rate to produce the illusion of motion.

The primary object of the invention is to increase the efficiency of light sources and particularly such sources as used in light projection systems.

Another object of the present invention is to increase the visible components of a light beam having both visible and invisible components.

Another object of the invention is to translate or transform with an observation medium invisible components of a light beam containing visible components into visible components to reinforce the visible components.

Another object of the invention is to translate solely invisible irradiations into visible irradiations with greater efficiency than heretofore.

A further object of the invention is to reduce the distortion of a scanning beam in an invisible irradiation system caused by sinusoidal components of the beam by resolving them into linear motions.

It is well known that television apparatus and systems suffer from the lack of observable light. This is usually caused by the necessary use of a light source which has small inertia so that it can be modulated at high frequencies. Also where a constant light source is used and other forms of modulation, the observable time and duration of the light spot is too short for full efficiency upon the eye. In the usual television system of 60 lines or 3600 unit areas and scanning at the rate of twenty per second, this observable time is only $^1/_{72,000}$ of a second. This short period is still within the integrating time of the eye, and an intense light source is thus required. The more unit areas there are, the worse this condition becomes. In all these systems the amount of light energy modulated is much greater than that observable because a portion of the energy lies in the invisible spectrum, consisting of either shorter or longer wave lengths than the visible spectrum.

The present invention, therefore, contemplates primarily a method of and means for utilizing this invisible portion of a light source where the light source is modulated, although it is understood that the principles are applicable to a constant light source. The invention also increases the efficiency of a system using solely invisible beams, such as X-rays, where these rays are translated into visible light rays for television purposes. A feature of the X-ray systems is the elimination of the distortion produced by the sinusoidal deflecting plate voltages which produce the scanning required for the system.

The invention will be more fully understood by reference to the following description read in conjunction with the accompanying drawing in which:

Fig. 1 is a diagrammatic showing of a television system employing an electrodynamic arc with a reflecting screen embodying the invention;

Fig. 2 is a diagrammatic showing of an X-ray system embodying the principles of the invention with the feature of sinusoidal rectification, and;

Fig. 3 is a cross-sectional view of an observation screen which utilizes a greater proportion of the irradiations projected upon it.

Referring to Fig. 1, an antenna 5 or wire connections 6 have induced therein television signals which are impressed upon a receiver 7 for amplification and detection. The output of the receiver 7 is impressed over conductors 8 upon a constant voltage source 10 and inductance 4, the voltage source being connected by conductors 11 in series with a limiting resistance 3 to an arc rail screen 12. The screen 12 is placed in a magnetic field provided by a field winding represented by a single turn 13, the winding being supplied from a source 14 under control of a rheostat 15. Such an arc television system is disclosed in my United States Patents Nos. 1,839,696, issued January 5, 1932 and 1,863,278, issued June 14, 1932. A pin hole or lens screen 17 permits the scanning of an observation screen 18 made in accordance with the principles of this invention. It is to be understood, of course, that the screen 18 may be adjacent the arc screen 12 and operate in accordance with the invention.

As described in the above patents, an electrical discharge or arc is formed on the electrode rails, this arc being propagated therealong under the influence of the magnetic field produced by the winding 13. As the arc is propagated along the rails, the incoming television signals are impressed thereon to modulate it in accordance with the light and shade densities of the unit areas of an object scanned at the transmitter. The electrical discharge or arc produced between the rails contains not only the visible light rays, but ultraviolet and infrared rays, which are in the invisible portion of the spectrum. Without this invention, these invisible irradiations are unobservable either by looking directly at the discharge or by looking at the light therefrom projected on the screen 18. It is thus obvious that considerable energy is being wasted in the usual system, since a large portion of the irradiations may be invisible and since this invisible component is modulated along with the visible component. However, the screen 18 is so constructed, as will be described hereinafter, that the invisible energy is translated or transformed into visible energy and supplements the visible irradiations projected thereon. We have thus increased the efficiency of a television system by increasing the efficacy of the light source.

Referring now to Fig. 2, an antenna 25 or wire line 26, impresses television signals upon a receiver 27 which consists of means for separating certain synchronizing impulses from the picture modulation frequencies. These synchronizing impulses are impressed upon an oscillator 29 over conductors 30. The oscillator 29, in conjunction with a tuned circuit 31 and 32, impresses upon the deflecting plates 33, in the well known manner, sinusoidal impulses to cause an electron beam furnished by a cathode 34 to scan an anode or anti-cathode 35 in substantially straight lines. This is well known in the art and need not be further described. The anode 35 receives a fixed voltage from a source 36, while the cathode heating energy is obtained from a source 37. In the anode circuit is the secondary of a transformer 39 which has its primary connected to an amplifier 40, the amplifier being connected to the receiver 27. This last-mentioned circuit modulates the cathode ray beam in accordance with the light and shade densities of an object scanned. That is, the impinging of the cathode ray upon the anode 35 produces X-rays or longer waves and these waves vary in accordance with the intensity of bombardment of the electron stream.

In order to utilize the X-rays, which are projected in different directions, as a scanning medium, a honey-comb type of screen 42 is employed. This unit is made up of small uniform openings having an appreciable length so that their projections upon the anode 35 cover it in unit areas and each unit area of the anode thereby defines a unit area upon a screen 43 placed on the opposite side of the honey-comb structure 42. Screen 43 may be of glass or other transparent material and coated with the material used on screen 18 which will then permit light to be transmitted therethrough.

Placed on a line through the center of the screen 43 is a hemi-cylindrical lens 44 which rectifies the sinusoidal motion of the cathode ray beam. Describing the actions of this lens, there is no magnification of the light produced on a line along the center of the screen 43 or where the lens makes contact with it and the exact speed of the cathode ray beam across this line will be reproduced and observed on the flat side of the lens. However, as the cathode ray moves toward the edge of the anode 35 its speed decreases because of the decrease in voltage on the deflecting plates. However, the magnifying power of the lens 44 maintains the speed of the observable light substantially the same as it was the the center line until out of view or reversal takes place. By this action the eye observes by looking at the flat side of the lens 44, a substantially constant linear motion of the light spot, thus eliminating dim centers and bright edges as is prevalent in the ordinary sinusoidal type of television cathode tubes. Obviously a hemispherical lens may apply under corresponding appropriate conditions.

Referring now to Fig. 3, details of the reflecting screen 18 are shown. A channel base 50 may be of opaque material in case of light reflection or glass or some other transparent material in the case of light transmission. In the channel formed by the base is placed a gelatine or lime wall 51, into which has been either sprayed under pressure, rolled or painted, a dust compound 52 which will now be described. This dust compound has the property of translating invisible irradiations into visible irradiations, as well as reflecting visible irradiations, such a screen thus being not only suitable for television, as heretofore described, but also for motion picture screens wherein the projected energy contains invisible components.

It is well known in the art that diamonds, quartz, wernerite, willemite, calcite and rhodamin are fluorescent, which means that by the projection thereon of ultra-violet light, a visible light in obtainable, this light being of different colors according to the material, and that calcite will fluoresce with the projection thereon of infrared light. It has been found that by taking such materials and powdering them into a fine dust, white light is reflected therefrom and the substance loses the color it had originally or as a crystal. Following is a list of these various materials, together with the colors produced by the projection thereon of invisible light, such as ultra-violet:

Diamonds	Blue-white
Quartz	Blue
Wernerite	Yellow
Willemite	Green
Calcite	Orange
Rhodamin	Red

The above visible light radiations are produced by the projection thereon of a spectrum in the invisible range which extends from the violet to the X-rays, which is a spectrum of many times greater width than the visible spectrum. This large and extensive energy band, not before usable, is now made to augment the present visible range.

At the X-ray end of the spectrum it is well known that barium-platinum-cyanide, zinc sulfide, uranium glass, or an alkaline solution of fluorescein will transform these rays into visible light, particularly in the green and yellow. This is advantageous as the green and yellow vibrations are the most sensitive to the eye.

As stated above, powdering these solid materials into dust does not destroy their ability to produce fluorescence, but it does permit the dust to reflect the visible light projected upon it. The above material also has a short phosphorescence period, a certain retentivity being desirable as long as it does not interfere with the scanning function.

From the above table of materials and colors, a mixture thereof is as follows:

Rhodamin	.05
Diamond	.10
Quartz	.10
Wernerite	.25
Willemite	.20
Calcite	.30

The yellow and blue of the wernerite and quartz, respectively, tend to produce a white light upon the eye, while the orange and green of the calcite and willemite tend to produce white light. However, it may be desirable to have the green and yellow predominate, since those waves are most sensitive to the eye. The calcite, of course, functions for both ultra-violet and infrared. These materials finely divided into a dust may be mixed with a translucent or so-called luminous paint and painted upon a glass surface as in Fig. 2, or blown or rolled into a gelatine, as shown in Fig. 3. It may also be desirable to use a fluorescent solution in a thin flat envelope having a quartz face and a light reflecting back. By the use of a screen so constructed, a greater efficiency is obtained with the present wave sources, whether they be entirely composed of invisible energy, such as X-rays, or of mixed visible and invisible light, such as an arc or neon lamp. Of course, the screen can be used for any purpose where light is projected upon a medium for observation, the scope of the invention being defined by the appended claims.

What is claimed is:

1. A co-ordinate scanning system comprising means for producing a scanning beam having a greater traversing velocity at the mid portion of each traversing path than at the end portions thereof, said scanning beam containing visible light rays having the same variations in velocity, and stationary optical means comprising a plano-convex lens through which said light beam is observed, said optical means serving to increase the apparent scanning velocity of said light rays at the end portions of each traversing path of said beam to substantially compare with the velocity of said rays at the mid portion thereof.

2. A co-ordinate scanning system comprising means for producing a scanning beam having a greater traversing velocity at the mid portion of each traversing path than at the end portions thereof, said scanning beam containing visible light rays having the same variations in velocity, and stationary optical means through which said light beam is observed, said optical means serving to increase the apparent scanning velocity of said light rays at the end portions of each traversing path of said beam to substantially compare with the velocity of said rays at the mid portion thereof, and in which said optical means comprises a cylindrical lens having its curvature facing the source of said light rays, the curvature of said lens being such that it magnifies the scanning velocity of said rays at the end portions of each traversing path in proportion to the difference in the velocities of the beam along its path of travel.

3. A system for increasing the efficiency of light projection comprising means for producing light rays containing visible and invisible rays including ultra-violet rays, means for directing a beam of rays from said light source onto a light receiving medium so that said medium receives both visible and invisible rays, including ultra-violet rays, in substantially the same relative intensities as the rays of said light source, said medium comprising means to reflect visible light rays therefrom and to transform said invisible rays, including said ultra-violet rays, into visible light to supplement said reflected light.

4. In a television system for the reproduction of light images, a source of light containing visible and invisible rays including ultra-violet rays, means for modulating said light rays, means for directing a beam of light rays from said source onto a light receiving medium so that the rays falling upon said medium include visible and invisible rays, including ultra-violet rays, in substantially the same relative intensities as the rays of said light source, means for periodically moving said beam over a definite area of said medium, said medium comprising means to reflect the visible rays of said beam to an observer and simultaneously translating said invisible rays, including said ultra-violet rays, into visible rays which augment the reflected visible rays.

5. The method of increasing the efficiency of a television system using a modulated light source containing both visible and invisible light rays including ultra-violet rays, which method comprises directing a beam of rays including the invisible and ultra-violet rays from said light source onto an observation medium so that the light falling upon said medium contains both visible and invisible light rays, including ultra-violet rays, in substantially the same relative intensities as the rays of said source reflecting the visible rays from said medium, and translating the invisible light rays, including said ultra-violet rays, falling upon said medium into visible light rays.

6. The method of increasing the efficiency of a television system using a modulated light source containing both visible and invisible light rays including infra-red rays, which method comprises directing a beam of rays including the invisible and infra-red rays from said light source onto an observation medium so that the light falling upon said medium contains both visible and invisible light rays, including infra-red rays, in substantially the same relative intensities as the rays of said source reflecting the visible rays from said medium, and translating the invisible light rays, including said infra-red rays, falling upon said medium into visible light rays.

7. A system for increasing the efficiency of light projection comprising means for producing light rays containing visible and invisible rays including infra-red rays, means for directing a beam of rays from said light source onto a light receiving medium so that said medium receives both visible and invisible rays, including infra-red rays, in substantially the same relative intensities as the rays of said light source, said medium comprising means to reflect visible light rays therefrom and to transform said invisible rays, including said infra-red rays, into visible light to supplement said reflected light.

ALEXANDER McLEAN NICOLSON.