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[11] **3,732,007**

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[54] **METHOD AND DEVICE FOR INSTANT RECORDING OF LIGHT IMAGES WHILE OBSERVING SAID LIGHT IMAGES**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **355/17,** 355/5, 95/42

[51] **Int. Cl.** **G03g 13/04**

[58] **Field of Search** 355/3, 17, 5; 95/42

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[57] **ABSTRACT**

The present invention relates to a method and a device for instant recording of light images while observing said light images which makes use of a three layer photosensitive plate having photopermeability and serving as a rear screen so as to enable projected light images to be visible, and composed of a high insulating layer, a photosensitive layer having the P.I.P. character, and a conductive layer; the exposure for uniformly irradiating the overall surface of the photosensitive plate is given from one face thereof and simultaneously the voltage of an optional polarity is impressed on the photosensitive plate to give an overall uniform charge thereto, and light images are irradiated onto the photosensitive plate and thus, while observing the light images effected on the rear screen, the voltage of opposite polarity to said polarity is impressed at any time desired to give the exposure of light images and thereby recording of light images is effected onto said photosensitive plate.

19 Claims, 5 Drawing Figures

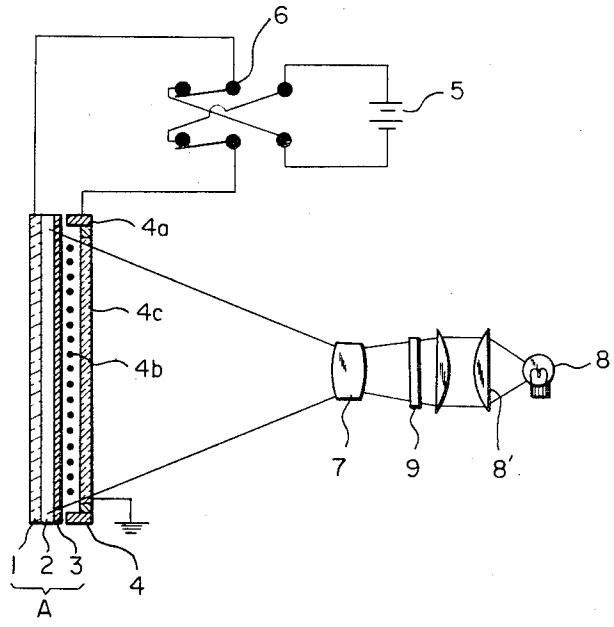

FIG. 1

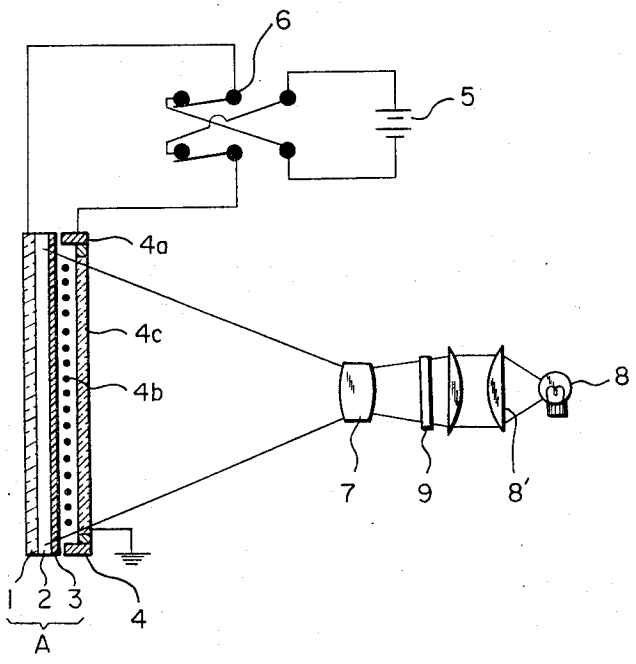

FIG. 2

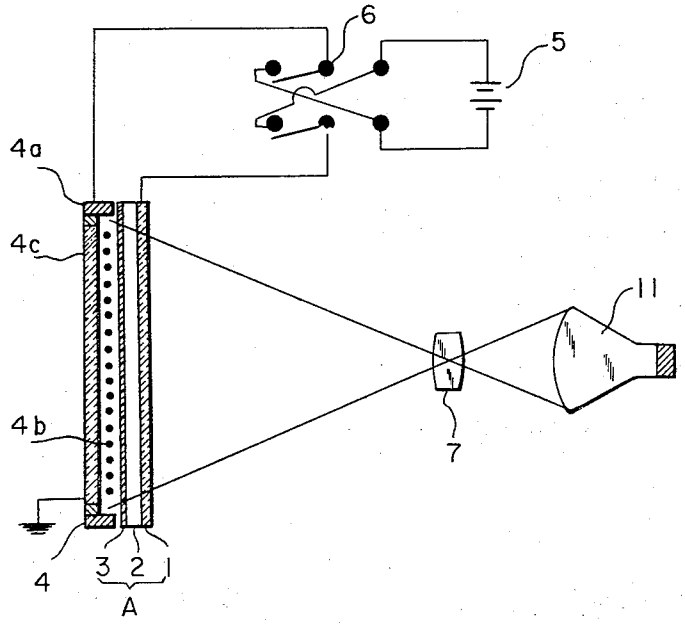

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FIG. 3

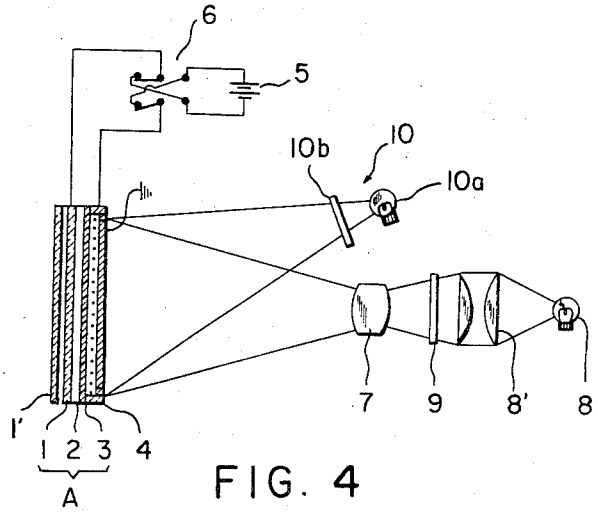


FIG. 4

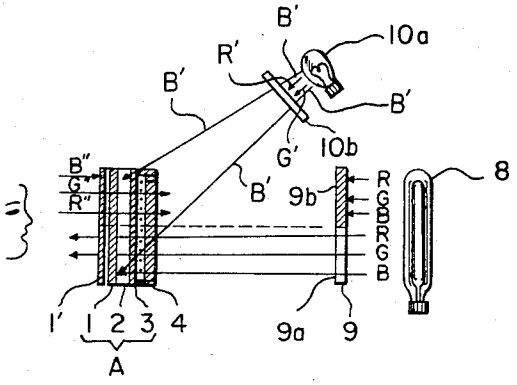
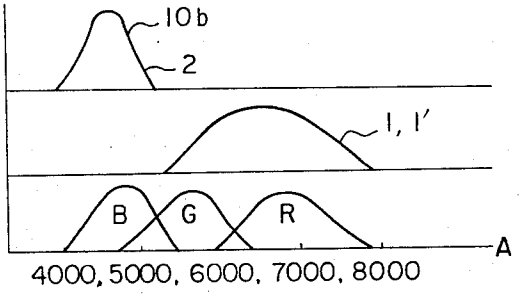


FIG. 5



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METHOD AND DEVICE FOR INSTANT RECORDING OF LIGHT IMAGES WHILE OBSERVING SAID LIGHT IMAGES

BACKGROUND OF THE INVENTION

In conventional photography, it has been impossible to observe the light image projected onto a photosensitive layer and at the same time to photograph and record it when required. So, with photography, cinema, duplication, enlargement, or leader printer operations, it has been necessary to replace, when photographing for recording, the focal plate for observation placed in the light image forming part by a photosensitive layer, or to reflect by means of a mirror the image-forming light rays formed on the part onto the photosensitive layer when recording, or to provide a separate optical system for observation other than the image-forming optical system for recording.

In either case, therefore, it has been impossible to observe the light image on the photosensitive layer at the very moment when it is recorded and particularly to record and observe at the same time the light image which is produced by electronic apparatuses in the cathode-ray tubes and which changes each moment and to record it just as the expected image appears.

SUMMARY OF THE INVENTION

The present invention relates to a method and a device for instant recording of light images on a photosensitive plate while observing said light images projected on said photosensitive plate, said photosensitive plate having the photo-permeability and being used as a rear screen, and more particularly relates to a method and a device for instant recording of light images while observing said light images, making use of a three layer photosensitive plate composed of a high insulating layer, a photosensitive layer having the P.I.P character, and a conductive layer, as the photosensitive plate having the photo-permeability.

One object of the present invention is to provide a method and device for the instant recording of light images while observing said light images formed on a photosensitive layer, and for this purpose a transparent charging part is set at the photosensitive body on which the light image is formed, and also the photosensitive body which consists of a high insulative layer, a photosensitive layer which is a photoconductor having the internal polarization character, and the conductive layer behind the photosensitive layer, is given transparency and a light scattering characteristic and thus is made to be a rear screen.

Another object of the present invention is to provide a method and device for the instant recording of light images while observing said light images, which use the photosensitive layer with a photoconductor which performs the first overall uniform exposure by approximately uniformly radiating the photosensitive layer of the photosensitive body, and the high insulative layer, the photosensitive layer and the conductive layer of the photosensitive body are given transparency, and also the photosensitive body is given a light scattering characteristic, and the light image produced by the light image producing part is projected onto the photosensitive body while at the same time the photosensitive layer is uniformly illuminated by a subsidiary lamp, so that the first overall uniform exposure

can be achieved without being affected by the light image.

Still another purpose object is to provide a method and device for the instant recording of light images while observing said light images which enable the first overall uniform exposure and the observation and recording of the light image at the same time without being affected by the light rays from the observational side behind the photosensitive layer by making the spectral wave-length character of the light from the subsidiary lamp to be of the spectral wave-length range which is approximate to the spectral photosensitivity of the photosensitive layer and also by making the transparency behind the photosensitive layer non-transparent as to the said spectral wave-length range.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view showing the arrangement of the essential parts of a preferred embodiment of the device for the observation and recording of light images,

FIG. **2** is a side view of another preferred embodiment of the present invention for the observation and recording of the light images produced by a cathode-ray tube,

FIG. **3** is a side view of a third preferred embodiment which performs a pre-exposure by subsidiary rays,

FIG. **4** is a theoretical illustration which explains the manner in which it is possible to immediately observe and record the light images in an illuminated area by the present invention,

FIG. **5** is a diagram showing the relationship between the spectral transparency of the filter and the spectral response of the photosensitive layer of the present invention in FIG. **4**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The P.I.P. (persistent internal polarization) method is recognized as a method for the recording of light images. The photosensitive body of this method comprises, as is shown by A of FIG. **1**, of a photosensitive layer **2** which consists of a photoconductor having the character of causing the P.I.P. on both surfaces of the photosensitive layer **2** when voltage is applied onto the conductive layer **1** by the charging part **4** at the same time as the entire surface of the layer **1** is illuminated by approximately uniform rays, and onto the frontal surface of photosensitive layer **2** which has either attached or coated thereon a transparent high insulative layer **3** between which layer and conductive layer **1** at the rear is positioned the photosensitive layer **2**, all three of such layers constituting the photosensitive body. On the frontal surface of the high insulative layer **3** the transparent charging part **4** is detachably set. Between a direct current power source **5**, which supplies voltage through a switch **6** which can set on or off the supplied direct voltage from the power source and also convert its polarity, is electrically connected between layer **1** and charging part **4**. Therefore, when the switch **6** is set on and the direct voltage is applied to charging part **4** as compared to the conductive layer **1** and, at the same time, the uniform radiation is applied from the front thus achieving the first overall uniform exposure, and thus achieving the internal polarization in the photosensitive layer **2**, the switch is thereafter

converted so as to apply the voltage with the polarity contrary to the previously applied voltage onto the charging part 4 and the light image is projected so that the light image may be recorded in the photosensitive body A. When the switch 6 is set off and the charging part 4 and the photosensitive body A are cut off from each other, then, to such rays as the photosensitive body A may be exposed, the electric latent image of the light image can be preserved without change on the surface of the high insulative layer 3, and the latent image can be developed by some toner or be transferred to obtain the recorded picture of the light image.

With the present invention which utilizes such a theory of light image recording as described above and also makes it possible to record the light images while observing them, such a transparent layer as, for instance, NESA glass is used for the conductive layer 1 in order to provide the transparency for the photosensitive body A which comprises photosensitive layer 2 (consisting of the photoconductor having the internal polarization character), the high insulative layer 3 and the conductive layer 1. The light scattering characteristic is given to the photosensitive layer or the conductive layer 1 on the side which does not receive the light image or the high insulative layer 3, so that the photosensitive body A is made into a rear screen. A photoconductor such as [ZnCd]S: Ag, which has a high P.I.P. (viz., the ability to increase the trap density of a charged body and maintain the internal polarization), or such an organic photoconductor as polyvinyl carbazole and its conductor can be used as the photosensitive body A.

Therefore, as shown in FIG. 3 for example, when the object 9 being illuminated by the light source 8 through the condenser lens 8′ is formed into an image by the projecting lens 7 from the direction of the high insulative layer 3 of the photosensitive body A, and the light image is projected onto photosensitive layer 2 through charging part 4 such as a corona charging device or a transparent terminal plate which faces the high insulative layer 3, the light image is scattered by the scattering surface formed on conductive layer 1 on the other side of the photosensitive body A and whereby it can be observed. The corona charging device 4 consists of a corona terminal wire 4*b* (FIG. 2) provided on the conductive frame 4*a* which is connected with the high voltage power source 5 through switch 6 and on which is provided, for insulation, the NESA glass 4*c* which in grounded, so that observation of the light image is made possible. After the first overall uniform exposure of uniformly illuminating the photosensitive body A by the subsidiary lamp 10 takes place, which is performed at the same time as the corona charging with a certain polarity carried out by switching on the switch 6, the switch 6 is switched off and the light image on the photosensitive body A is observed. When recording is required after the image- and projection-adjustment, the light image which is being observed can be recorded by setting the switch 6 onto the opposite polarity, and when the photosensitive body is exposed to the rays or brought into a bright place the electrostatic latent image is formed on the high insulative layer 3 of the photosensitive body and the image can be developed on the high insulative layer 3 by means of a toner and printed there or be further transferred.

When the photoconductive body, such as CdS or organic photoconductor, whose P.I.P. character easily causes dark polarization is used for the photosensitive layer of the present invention, the first overall uniform exposure by the subsidiary lamp 10 at the time of the pre-charging is not needed and the construction becomes as is shown in FIG. 1. In the preferred embodiment of FIG. 3 described above, if the light quantity from the subsidiary lamp 10 is made large enough as compared to the light image, the first overall uniform exposure is not affected by the light image even when the subsidiary lamp is turned on at the same time as the light image of the object 9 is projected and the switch 6 is switched on and the first overall uniform exposure is performed, so that approximately uniform polarization can be achieved on the photosensitive layer 2.

FIG. 2 shows a preferred embodiment in which the image of the cathode-ray tube 11 is projected by the image-forming lens 7 onto the photosensitive body A. As shown in this Figure, even when the image-illumination is completed from the direction of the conductive layer 1 of the photosensitive body A, the same observation and recording of the light image can be performed as in the preferred embodiment shown in the FIGS. 1 and 3. Needless to say, the conductive layer 1 needs to be transparent in this case and either the photosensitive layer 2 or the high insulative layer 3 must have the light scattering characteristic and also the corona charging device 4 must be set in the rear of the photosensitive body A, i.e., on the other side of the light image illumination, facing the high insulative layer 3.

With the preferred embodiment shown in FIG. 4, the recording at the same time as the observation of the light image can be carried out in a bright place, and the photosensitive layer 2, for which the known [ZnCd] S:Ag is used, has the characteristic of varying the spectral response according to the ingredient ratio of the CdS. When the CdS ingredient ratio of the photosensitive layer 2 is adjusted so that the layer 2 has the wavelength response for the Wave-length range of 4,000 to 5,000 A. as is shown in FIG. 5, the photosensitive layer 2 absorbs well and does not allow the rays to pass within said wave-length range. Therefore a blue filter 10*b*, is provided since it has the spectral transparency as to shut off the rays outside said wave-length range coming from the incandescent lamp 10*a* of subsidiary light source 10 and, through this filter 10*b*, the uniform exposure is given onto the photosensitive layer 2. And the spectral wave-length transparency of the high insulative layer 3 or the filter provided with it (when the high insulative layer is provided behind the photosensitive layer) or of the transparent terminal 1 behind the photosensitive layer 2 or the filter 1′ provided with it, is made to absorb and not allow to pass the wave-length range of the spectral response of the said photosensitive layer 2 or allow to pass other wave-length ranges. For the photosensitive layer 2 the organic photoconductive PVC (polyvinyl carbazole) is often used, instead of the said [ZnCd] S:Ag, which has traps in high density and practicable and suitable transparency. The PVC has a good transparency and with it the color sensitivity can be controlled by increasing the pigment sensitivity, so that it is quite effective when used for the present preferred embodiment.

Owing to the construction as described above, because the first overall uniform exposure is done by turning on the subsidiary light source **10***a* at the same time as the corona is charging by means of the voltage with a certain polarity given by the switch **6**, the light image of the object **9** can be observed in the yellow (which is the complementary color of blue) image even while the uniform exposure is being done. That is to say, as is shown in FIG. **4**, in the dark part **9***b* of the object **9**, all the red, green and blue rays R, G, B of the white light of the light source **8** are absorbed and in the bright part **9***a* all the rays R, G, B are allowed to pass. However, at the photosensitive layer **2**, the blue ray B is absorbed and the red and green rays R, G can be observed as a yellow image through the rear screen. In this case, even though the subsidiary lamp **10***a* may be on, the rays R′, G′, are stopped by the blue filter **10***b* and do not reach the photosensitive layer **2** except by the blue ray B′, which is absorbed by the photosensitive layer **2**, so that the rays from the subsidiary lamp **10***a* do not disturb the light-image observation.

Also, when the observation side is light and the rays R″, G″, B″ come in from behind, the blue ray B″ is absorbed by the high insulative layer **3** provided in the rear, or the conductive layer **1**, or the filter set with it and the other rays R″, G″ are allowed to pass but they do not affect the photosensitive layer **2**, so that the recording of the light image is not disturbed at all.

The explanation given above concerns the object **9** illuminated by the white light, but the same action and effect can be achieved concerning the object, such as the cathode-ray tube shown in FIG. **2**, that emits light in itself.

The present invention can be applied, besides the recording of the photography in general as described above, to microscopic photography, X-ray photography, oscillograph photography, cathode-ray tube image photography of TV, making it possible to record the light image at the decisive moment when recording is required, and is useful for academic or medical photography and also for radio newspaper leader printer, and the operation can be made easy for the recording can be done by switching and not by the conventional shutters.

We claim:

1. A method for instant recording of light images while observing said light images, comprising a precharging process for applying a corona discharge device having a transparent corona shield to a photosensitive plate composed of a high insulating layer, a photosensitive layer composed of a photosemiconductor having the ability to produce a persistent internal polarization by light ray irradiation, and a conductive layer provided as a rear screen by providing a diffusing surface in parallel on the back of the surface of said photoconductive plate for receiving the light image irradiation, so as to give a uniform charge of an optional polarity to said high insulating layer of said photosensitive plate, the process further comprising irradiating light images formed by a light image forming member onto said photosensitive plate, using its diffusing surface as a back, and giving the charge of the opposite polarity to said polarity by means of said corona discharge device while observing the light images from the back of said photosensitive plate and said corona discharge device, and thereby giving the exposure of light images to said photosensitive plate.

2. A method for instant recording of light images while observing said light rays as claimed in claim **1**, wherein said photosensitive layer of said photosensitive plate has a color sensitivity characteristic, one of said conductive layer and said high insulating layer being located on the back of the light image irradiation side of said photosensitive layer, a filter having a spectrum permeability characteristic being provided in parallel with said one of said conductive and high insulating layers, said spectrum permeability being characterized by its ability to absorb light rays within the spectral sensitivity wave length range of the spectral sensitivity property due to the color sensitivity in said photosensitive layer and having the permeability for light rays within the remainder of the spectral wave length range, and whereby light rays incident from the light image observing side exert no effect on said photosensitive layer in the process for giving the light image exposure to said photosensitive plate.

3. A method for instant recording of light images while observing said light images claimed in claim **1**, wherein said high insulating layer of said photosensitive plate is transparent and faces the light image irradiation side and is composed of a three-layer photosensitive plate having a light ray, the photosensitive layer of which is translucent.

4. A method for instant recording of light images while observing said light images claimed in claim **3**, wherein said translucent photosensitive layer of said photosensitive plate has the color sensitivity, and the conductive layer not facing the light image irradiation side of said photosensitive plate has a spectrum transmission property, and said spectrum transmission property is characterized by its ability to absorb light rays within the spectral sensitivity wave length range of the spectral sensitivity property in said photosensitive layer and having the permeability for light rays within the remainder of the spectral wave length range, whereby light rays incident from the light image observing side exert no effect on said photosensitive layer in the process for giving the light image exposure to said photosensitive plate, when observing light images from said conductive layer side.

5. A method for instant recording of light images while observing said light images claimed in claim **1**, wherein said high insulating layer of said photosensitive plate faces the light image irradiation side and said conductive layer on the back of the photosensitive layer is semi-transparent and forms a rear screen.

6. A method for instant recording of light images while observing said light images claimed in claim **5**, wherein said photosensitive plate is composed of a transparent high insulating layer facing the light image irradiation side, a photosensitive layer of a photosemiconductor having the internal polarization character which has the color sensitivity, and a semitransparent conductive layer provided on the back thereof; and one of said photosensitive layer, said semitransparent conductive layer, and a filter provided in parallel therewith having the spectrum transmission property; being characterized in that said spectrum transmission property absorbs light rays within the spectral sensitivity wave length range of said photosen-

sitive layer and has the permeability for light rays within the remainder of the spectral wave length range, and irradiates light images onto said photosensitive plate to enable them to be observed from the back of said photosensitive plate; and when applying the light image exposure process by giving the charge of the opposite polarity to the polarity at the time of the precharge process to said photosensitive plate while observing light images, light rays incident from the light image observing side to said photosensitive plate exerts no effect on the light image exposure.

7. A method for instant recording of light images while observing said light images claimed in claim 1, wherein said semi-transparent photosensitive layer has a color sensitivity characteristic, and one of said photosensitive layer, said high insulating layer which is provided on the back of the light image irradiation side of said photosensitive plate, said conductive layer, and a filter provided in parallel on the back of said photosensitive plate, has a spectrum transmission property characteristic; and wherein said spectrum transmission property absorbs light rays within the spectral sensitivity wave length range and allows light rays to pass within the remainder of the spectral wave length range, and irradiates light images onto said photosensitive plate to enable them to be observed from the back of said photosensitive plate, and, when applying the light image exposure process by giving the charge of the opposite polarity to the polarity at the time of the pre-charge process to said photosensitive plate while observing light images, light rays incident from the light image observing side to said photosensitive plate exert no effect on the light image exposure.

8. A method for instant recording of light images while observing said light images claimed in claim 1, wherein said transparent conductive layer of said photosensitive plate faces the light image irradiation side, and one of said photosensitive layer and said high insulating layer is made translucent to turn said photosensitive plate in a rear screen having the photopermeability.

9. A method for instant recording of light images while observing said light images claimed in claim 8, wherein said photosensitive layer has a color sensitivity characteristic, and one of said photosensitive layer, said high insulating layer, and a film provided in parallel on the back of said photosensitive plate, has a spectrum transmission property; and wherein said spectrum transmission property absorbs light rays within the spectral sensitivity wave length range of said photosensitivity layer and allows light rays to pass within the remainder of the spectral wave length range, and irradiates light images onto said photosensitive plate to enable them to be observed from the back of said photosensitive plate, and when applying the light image exposure process by giving the charge of the opposite polarity to the polarity at the time of the pre-charge process to the photosensitive plate while observing light images, light rays incident from the light image observing side to said photosensitive plate exert no effect on the light image exposure.

10. A method for instant recording of light images while observing said light images, comprising a precharge process for applying a corona discharge device having a transparent corona shield to a photosensitive plate using its diffusing surface as the back, said photosensitive plate being composed of a transparent photo-semiconductor having the ability to produce a persistent internal polarization by light ray irradiation, and a transparent conductive layer serving as a rear screen by providing a diffusing surface in parallel on the back of the surface of said photoconductive plate for receiving the light image irradiation, so as to give a uniform charge to said high insulating layer of said photosensitive plate; the process further comprising irradiating light images formed by a light image forming member onto said photosensitive plate, using its diffusing surface as the back, and giving the charge of the opposite polarity to said polarity at the time of said precharge process by means of said corona discharge device while observing the light images from the back of said photosensitive plate and said corona discharge device, and thereby giving the exposure of light images to said photosensitive plate.

11. A method for instant recording of light images while observing said light images claimed in claim 10, wherein said photosensitive layer has a color sensitivity characteristic, and one of said photosensitive layer, said high insulating layer and said conductive layer facing the diffusing surface, and a filter provided in parallel on the diffusing surface has a spectrum transmission property, and wherein said spectrum transmission property absorbs light rays within the spectral sensitivity wave length range of said photosensitive layer and has the transmission property for light rays within the remainder of the spectral wave length range, and irradiates light images onto said photosensitive plate to enable them to be observed from the diffusing surface, and when applying the light image exposure process by giving the charge of the opposite polarity to the polarity at the time of the pre-charge process to the photosensitive plate during the light image irradiation, light rays incident from the light image observing side to said photosensitive plate exert no effect on the light image exposure.

12. A method for instant recording of light images while observing said light images, comprising a precharge process for providing a corona discharge device having a transport corona shield to a photosensitive plate composed of a high insulating layer, a photosensitive layer composed of a photosemiconductor having the ability to produce a persistent internal polarization by light ray irradiation, and a conductive layer serving as a rear screen having a light ray permeability characteristic; for giving the overall irradiation to said photosensitive plate by means of a subsidiary light source device and simultaneously giving the charge of an optional polarity by means of said corona discharge device so as to effect the exposure for giving the uniform charge to said high insulating layer of said photosensitive plate; the process further comprising stopping the overall irradiation for said photosensitive plate effected by the subsidiary light source device and irradiating light images from the same side of the photosensitive plate onto said photosensitive plate, and giving the charge of the opposite polarity to said polarity at the time of said pre-charge process by means of said corona discharge device while observing the light images from the back of said photosensitive plate, and thereby giving the exposure of light images to said photosensitive plate.

13. A method for instant recording of light images while observing said light images, comprising a precharge process for providing a corona discharge device having a transparent corona shield to a photosensitive plate composed of a high insulating layer, a photosensitive layer composed of a photosemiconductor having a spectral sensitivity characteristic for producing persistent internal polarization by the light ray irradiation within the specific wave length range, and a conductive layer, serving as a rear screen by providing a diffusing surface in parallel on the back of the surface of said photoconductive plate for receiving the light image irradiation so as to give a uniform charge of an optional polarity to said high insulating layer, said conductive layer having a light ray-permeability property, turning the spectrum transmission property of the high insulating layer on the back of the light ray irradiation side of one of said conductive layer or a filter provided in parallel therewith for absorbing light rays within the spectral sensitivity wave length range of said photosensitive layer and thereby allowing light rays to pass within the remainder of the wave length range; and for irradiating the subsidial light source device for irradiating light rays within the spectral wave length range approximate to the spectral sensitivity wave length character of said photosensitive layer and the light images at the same time onto said photosensitive plate, and at the same time giving the uniform charge of an optional polarity to said high insulating layer by means of said corona discharge device to effect the exposure, the process further including giving the charge of the opposite polarity to the polarity at the time of said precharge process while observing the light images from the back of said photosensitive plate and thereby giving the exposure of light images, whereby in the process for giving said exposure of light images, light rays incident from the light image observing side to said photosensitive plate exert no effect on the light image exposure.

14. A device for instant recording of light images while observing said light images, comprising a photosensitive plate composed of a high insulating layer, a photosensitive layer composed of a photosemiconductor having the ability to produce a persistent internal polarization by light ray irradiation, and a conductive layer, having a transparent corona shield and a ray diffusion characteristic, a corona discharge device facing said high insulating layer of said photosensitive plate and having a light ray permeability characteristic, a switch for changing over the polarity interposed between said corona discharge device and an electric power source, and a light image forming device for irradiating light images onto said photosensitive plate.

15. A device for instant recording of light images while observing said light images claimed in claim 14, wherein the light image forming device is composed of a braun tube to form images on said photosensitive plate.

16. A device for instant recording of light images while observing said light images claimed in claim 14, wherein on the light image forming device side of said photosensitive plate a subsidiary light source device is provided for irradiating uniformly the overall surface of said photosensitive plate.

17. A device for instant recording of light images while observing said light images claimed in claim 16, wherein said photosensitive layer of said photosensitive plate has a spectral sensitivity property for producing a persistent internal polarization by light rays within the specific wave length range, and wherein said subsidiary light source device irradiates light rays approximate to the spectral sensitivity property of said photosensitive layer, and the spectrum transmission property of the layer on the back of the photosensitive plate facing said subsidiary light source device absorbs light rays within the spectral sensitivity wave length range of said photosensitive plate and allows light rays to pass within the remainder of the wave length range.

18. A device for instant recording of light images while observing said light images claimed in claim 16, wherein said photosensitive layer of said photosensitive plate has a spectral sensitivity property for producing persistent internal polarization by light rays within a specific wave length range, said subsidiary light source device irradiates light rays approximate to the spectral sensitivity property of said photosensitive layer, and on the back of the photosensitive plate facing to said subsidiary light source device there is provided a filter, the spectrum transmission property of which absorbs light rays within the spectral sensitivity wave length range of said photosensitive plate and allows light rays to pass within the remainder of the wave length range.

19. A method for instant recording of light images while observing said light images claimed in claim 1, wherein said photosensitive layer is semi-transparent.

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