United States Patent

Yata et al.

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[54] **APPARATUS FOR FORMING AN ELECTROSTATIC IMAGE IN A CAMERA**

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[51] **Int. Cl.**.....**G03q 15/18**

[58] **Field of Search**.....355/3, 17; 96/1

[56] **References Cited**

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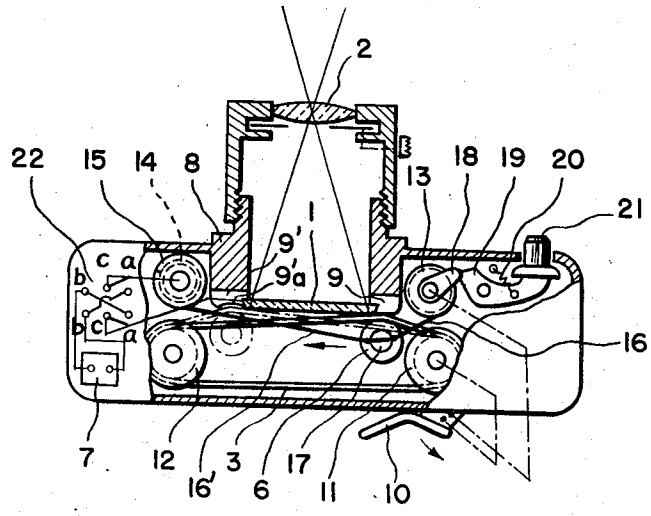
[57] **ABSTRACT**

In a camera wherein images are formed electrostatically, a flexible photosensitive element is spaced from a transparent electrode and an electrode roller engages the flexible photosensitive element into contacting relationship along a narrow width thereof with the transparent electrode. The roller is translated across the transparent electrode so that a latent image is formed on the flexible photosensitive element. The apparatus includes structure for impressing a D.C. voltage between a transparent electrode and an electrode roller to provide the necessary electrostatic field to transfer the image.

8 Claims, 3 Drawing Figures



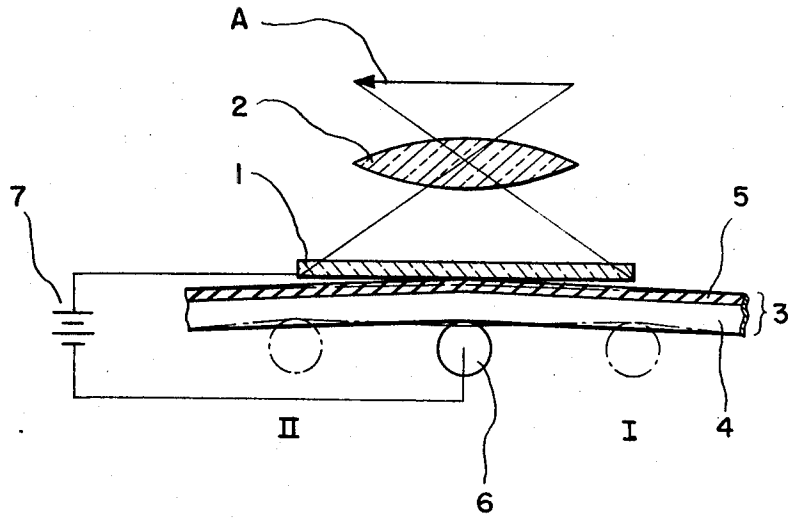


FIG. 1

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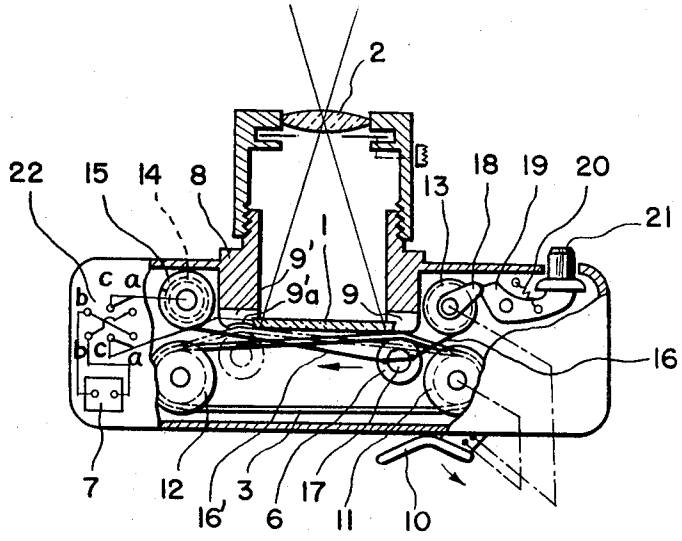

FIG. 2

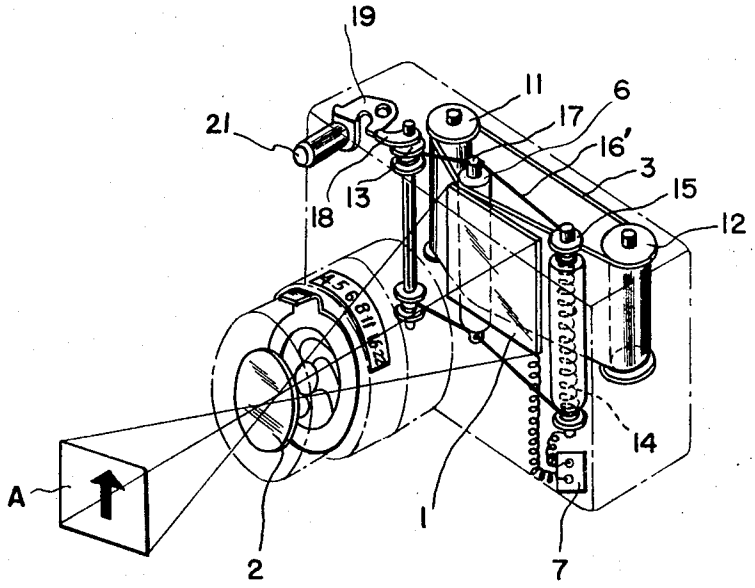

FIG. 3

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APPARATUS FOR FORMING AN ELECTROSTATIC IMAGE IN A CAMERA

BACKGROUND OF THE INVENTION

In the prior art, methods for forming an electrostatic latent image on a flexible photosensitive member made by adhering a transparent layer of electrically high insulating material closely on the surface of a photosensitive layer having persistent internal polarization characteristics or a photosensitive layer affixed to the back of the photosensitive layer with a conductive layer, an insulating thin layer, a high resistant photoconductive insulating thin layer, are well known. For example, one method comprises the following three processes:

a. A process for impressing a DC voltage of a specific polarity on a photosensitive member when the outside light is irradiated (Pre-charging process).

b. A process for impressing a DC voltage of a reversed polarity as in the first process when a light image is irradiated onto the photosensitive member (Light image irradiation and charging process).

c. A process for irradiating light all over the photosensitive member (All over irradiation process).

A second method comprises the following two processes:

b′. A process for impressing the voltage of a specific polarity when a light image is irradiated onto the photosensitive member (Light image irradiation and charging process).

c′. A process for irradiating light all over the photosensitive member (All over irradiation process).

In the well known processes, however, a light image is formed on the surface of a photosensitive member pressed to contact extensively with transparent electrode plate and the voltage is impressed between the transparent electrode and the electrode layer contacted closely with or adhered closely to the back of photosensitive member, and thereby an electric field is induced.

In such processes the electrostatic latent image depends upon the close contact between the photosensitive member and the transparent electrode plate. In the prior processes, on account of very small rumples or like of the photosensitive member itself the close contact between the photosensitive member and the transparent electrode plate is partially non-uniform, so that it is difficult to obtain a good electrostatic latent image. Further, in order to photograph a moving object, when irradiating a light image for a short time it is necessary to provide a means such as a shutter for shutting out the outside light until the photosensitive member is separated from the transparent electrode plate after the light image irradiation.

SUMMARY OF THE INVENTION

The present invention ralates to a device for forming a latent image of an object in an electrostatic photographic camera wherein a flexible photosensitive member is mounted in spaced relation to a transparent electrode plate and pressing the photosensitive member against the transparent electrode plate by means of the electrode roller so as to allow both to contact closely with each other linearly over a very narrow region. The electrode roller is translated parallel to the transparent electrode plate and simultaneously therewith a DC voltage is impressed between the transparent electrode plate and the electrode roller thereby forming an electrostatic latent image of an object successively on the surface of the photosensitive member.

The primary object of the present invention is to provide an improved device for forming a latent image of an object in an electrostatic photographic camera of the type wherein a flexible photosensitive member and a transparent plate electrode have improved even contact so that the electrostatic latent image is uniform.

The second object of the present invention is to provide a device for forming a latent image of an object in a camera of the type described wherein the contact between a flexible photosensitive member and an electrode roller is limited at any given instant to improve the electrostatic latent image.

The third object of the present invention is to provide an improved device for forming a latent image of an object in a camera of the type described wherein the over-all irradiation of the image is simplified.

The fourth object of the present invention is to provide a device for forming a latent image of an object in a camera of the type described having a mechanism for adjusting the moving speed of an electrode roller which causes a traversing contact between the photosensitive member and the transparent electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates the principle of operation of the apparatus in accordance with the present invention.

FIG. 2 is a partial crsss-sectional top view of an embodiment of the present invention.

FIG. 3 is a perspective view showing the internal construction of the embodiment shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, on the surface of a transparent electrode plate 1 the image of an object A is formed through an objective lens 2. A flexible photosensitive member 3 is constructed by adhering a transparent thin layer of electrically high insulating material 5 onto the surface of a photosensitive layer 4 having persistent internal polarization characteristics.

Photosensitive member 3 is held spaced from transparent electrode plate 1 on the back surface thereof, and on the back of member 3 an electrode roller 6 is disposed to press against photosensitive member 3 so as to allow only the very narrow width of photosensitive member 3 to contact closely with the transparent electrode plate.

When electrode roller 6 is moved parallel to transparent electrode plate 1, successive portions of photosensitive member 3 comes into contact with transparent electrode plate 1. Reference numeral 7 designates a DC power source one pole of which is connected to transparent electrode plate 1 and the other pole of which is connected to electrode roller 6.

Now, when electrode roller 6 is moved at the proper constant speed from I to II shown in FIG. 1, photosensitive member 3 comes into close contact with transparent electrode plate 1 by means of electrode roller 6 which is mounted behind photosensitive member 3 so as to induce an electric field across the contacting

members. Thereby, a charging potential caused by the change of capacitance corresponding to the light image of object A is induced on the surface of the photosensitive member. And, soon after this charging potential is induced the contacting portions of photosensitive member **3** are successively isolated from transparent electrode plate **1** and the transferred image is not affected by outside light, therefore, there is no need of a light intercepting plate. Further such an operation enables photosensitive member **3** to be irradiated with external light directly from lens **2** which enhances the contrast of the electrostatic latent image. And, in addition it is also possible to control easily the time during which the voltage is impressed onto the photosensitive member by adjusting the moving speed of electrode roller **6**.

FIG. **2** and FIG. **3** show an embodiment of a transfer type electrostatic photographic camera which utilizes the above-mentioned principle in an electrostatic camera which requires a pre-charging process using a specific voltage polarity, light image irradiation, a reversed voltage polarity charging process, and an over all irradiation process. Transparent electrode plate **1** is fixed to insulating portions **9**, **9'** forming the photographing window frame of a camera body **8** at the position where an image of an object is formed through an objective lens **2**. Insulating portion **9'** is provided with indented portion **9'a** as shown in FIG. **2**. A flexible photosensitive member **3** is disposed in the form of an endless belt in back of transparent electrode plate **1**, and wound over feed roller **11** supported rotatably on one side of the camera body in interlocking relationship with operation of taking up lever **10** and driven roller **12** supported on the other side of the camera body.

Electrode roller **6** is guided by its spindle **17** and supported so as to move parallel to the back of transparent electrode plate **1**, while maintaining a narrow clearance therebetween of approximately the same size as the width of photosensitive member **1**. Spindle **17** is connected to two conductive strings **16**, **16'** at it's upper and lower ends respectively, and the other end of one conductive string **16** is fixed to side winding drum **13** which is pivoted rotatably on the feed roller **11** side of camera body **8**. The other end of the other conductive string **16'** is fixed to side winding drum **15** provided with a rotating tendency through spring **14** on the driven roller **12** side of camera body **8**. And conductive strings **16**, **16'** press photosensitive member **3** so as to contact with the plate of transparent electrode **1** or its insulating portions **9**, **9'**.

The spindle of charge side winding drum **13** is provided with cam **18** engaged always with one end of release lever **19** by means of spring **20** and release button **21** on the other end release lever **19** is projected outside of camera body **8**.

As for DC power source **7**, one pole thereof is connected electrically to transparent electrode plate **1** through polarity change-over switch **22**, and the other pole thereof is connected electrically to electrode roller **6** through conductive string **16'** from the spindle of side winding drum **14**. Depending on whether change-over contact segment is connected to contact *a* or contact *b* the DC voltage impressed by the plate of transparent electrode **1** and electrode roller **3** onto photosensitive member **3** will be of one polarity or the other. Besides, it is not shown in the drawings but noted that when taking up lever **10** is operated, feed roller **11** is rotated and after wind-up is completed, side winding drum **13** is rotated through the successive operations of taking up lever **10**.

The embodiment of the present invention is constructed as described above, so that when wind-up is completed electrode roller **6** is positioned on insulating portion **9** as shown in FIG. **2**, and cam **18** of side winding drum **13** engages with one end of release lever **19** and is restrained in the charge position. Under this condition and after the focal point of the object is adjusted, when contact segment *c* of switch **22** is turned to contact *a* and release button **21** is pushed, release lever **19** and cam **18** are disengaged, side winding drum **15** is rotated through spring **14**, and conductive string **16'** pulls spindle **17**, so that electrode roller **6** rolls along the back of photosensitive member **3** toward side winding drum **15** parallel to transparent electrode plate. Successive narrow width portions of photosensitive member **3** come into close linear contact with transparent electrode plate **1**, and at the close contact positions an electric field is induced so as to form in succession on the surface of electrosensitive member **3** an electrostatic latent image of an image formed on the back surface of transparent electrode plate **1**. And, soon after the formation of the image photosensitive member **3** is separated from transparent electrode plate **1**. In this manner, when electrode roller **6** is located in indented portion **9'a** of insulating portion **9'** it is stopped to open switch **22**. And thus, by facing the camera to the blue sky or the like an over-all irradiation process can be carried out for improving the contrast of the image on photosensitive member **3**. After photographing, by operating taking up lever **10** feed roller **11** is rotated and photosensitive member **3** is moved and transferred to a position for the next development transfer as is well known and at the same time a portion of photosensitive member **3** for the next image is carried to the back of transparent electrode plate **1** and stopped.

Then, when contact segment *c* of switch **22** is turned to contact *b* and taking up lever **10** is operated, side winding drum **13** is rotated in interlocking relationship with lever **10** so as to wind up conductive string **16**. Thereby, electrode roller **6** rolls along in the direction reverse to that described above while energizing spring **14**. Simultaneously, photosensitive member **3** is translated so as to contact with transparent electrode plate **1**. At the contact portions photosensitive member **3** is impressed with an electric field reversing the charging and polarity in the case of light image irradiation and at the same time by receiving incident outside light from objective lens **2** the polarization of photosensitive member **3** is saturated, and the remaining latent image is eliminated and a uniform charge is formed on the surface of photosensitive member **3**, that is, the precharging process for electrostatic photography is completed.

In order to change the time during which a voltage is impressed it is necessary to change the moving speed of electrode roller **6**, therefore, for this purpose the strength of spring **14** provided on side winding drum **15** is controllable, or a well known load mechanism such

as a controllable governor or the like can be provided on side winding drum **13**.

And, in the above-mentioned embodiment, it is possible to interlock constituents thereof mechanically with each other, for example, in switch **22** the contact segment is put in the contact *b* side interlocking with the starting of side winding drum **13** by means of taking up lever **10**, and switch **22** is switched off at the same time that wind-up is completed, and put in the contact *a* side interlocking with operation of the release lever **19** and cut off just when electrode roller **6** is located in indented portion **9a'** of insulating portion **9'** and stopped.

Besides, the above-mentioned embodiment is of the transfer type making use of an electrostatic photographic technique for carrying out the pre-charging process, however, if the precharging process is not to be performed, namely, whenever charging as well as light image irradiation and an over irradiation process are used, polarity over-all switch **22** is not required. However, it is necessary to prevent the outside light from impinging onto the photosensitive member prior to light image irradiation and accordingly an open side shutter is required. Therefore, it is necessary, for example, that a blade shutter which closes in interlocking relationship with the starting of operation of taking up lever **10** and which releases in interlocking relationship with operation of release lever **19**, is provided on the lens barrel. And, it is also necessary that the photosensitive member is carried in one direction from the feed winding drum to the winding drum, instead of making an endless belt form, and the photosensitive member carried after the over-all irradiation process is finished permits the electrostatic latent image to be developed and fixed at the development and fixing station.

What is claimed is:

1. A camera of the electrostatic image forming type having an objective lens comprising:

a flexible photosensitive element including a photosensitive layer having persistent internal polarization characteristics and an insulating layer,

a plate-like transparent electrode interposed between said objective lens and said flexible element with said insulating layer opposing said transparent electrode in spaced relationship thereto,

an electrode roller,

a driving member for moving said electrode roller across said photosensitive layer,

at least two rollers each mounted at opposite ends of said transparent electrode, said flexible element is supported by said at least two rollers, said electrode roller presses said insulating layer into contact with said transparent electrode by deforming said flexible element,

means for impressing a DC voltage between said transparent electrode and said electrode roller as said driving member moves said electrode roller across said photosensitive layer to press said insulating layer in contact with said plate-like transparent electrode only over a limited area, and said flexible element and said transparent electrode are separated along their remaining opposing surface.

2. A camera of the electrostatic image forming type as in claim **1**, wherein said driving member consists of a supply drum rotatably mounted on one side of said transparent electrode, a take-up drum rotatably mounted on the opposite side of said transparent electrode, said supply and take-up drums are interconnected by a flexible shaft, and said electrode roller is rotatably mounted on said flexible shaft between said drums.

3. A camera of the electrostatic image forming type as in claim **2**, wherein said take-up drum is spring-loaded, said supply drum includes a load mechanism, and said spring and said load mechanism control the moving speed of said flexible shaft to adjust the traversal time of said electrode roller across said photosensitive element.

4. A camera of the electrostatic image forming type as in claim **2**, wherein said one of said rollers includes a winding device interlocked with said supply drum, said winding device actuates said supply drum to move said electrode roller to said supply drum against the spring force of said take-up drum and rotates one of said rollers to move said flexible element.

5. A camera of the electrostatic image forming type as claim **2**, further comprising a DC source and wherein said flexible shaft is electrically conductive and electrically connects one pole of said DC source to said electrode roller, and the other pole of said DC source is connected to said transparent electrode.

6. A camera of the electrostatic image forming type as in claim **5** further comprising a double-pole double-throw switch for connecting said DC source between said transparent electrode and said electrode roller, whereby one position of said switch connects said DC source with a specific polarity between said transparent electrode and said electrode roller and said driving member is actuated to move said electrode roller across said flexible element to precharge the surface of said photosensitive layer, and a second position of said switch reverses the polarity of said DC source connected between said transparent electrode and said electrode roller and said driving member is actuated to return said electrode roller and press said insulating element against said transparent electrode to transfer a charge to said photosensitive layer representing a latent image of an object transmitted through said objective lens.

7. A camera of the electrostatic image forming type as in claim **6**, wherein said winding device moves said photosensitive element one picture frame portion at a time to allow said image to be transferred to said photosensitive element.

8. A camera of the electrostatic image forming type as in claim **1** wherein said flexible element is in the form of an endless belt.

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