United States Patent

[11] **3,580,672**

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[21] Appl. No. **773,167**
[22] Filed **Nov. 4, 1968**
[45] Patented **May 25, 1971**

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[32] Priority **Nov. 14, 1967**
[33] **Japan**
[31] **73193/67**

[54] **ELECTROSTATIC PHOTOCOPYING APPARATUS**
4 Claims, 1 Drawing Fig.

[52] U.S. Cl. **355/3,** 355/10
[51] **Int. Cl.** **G03g 15/10**
[50] **Field of Search** 355/3, 10

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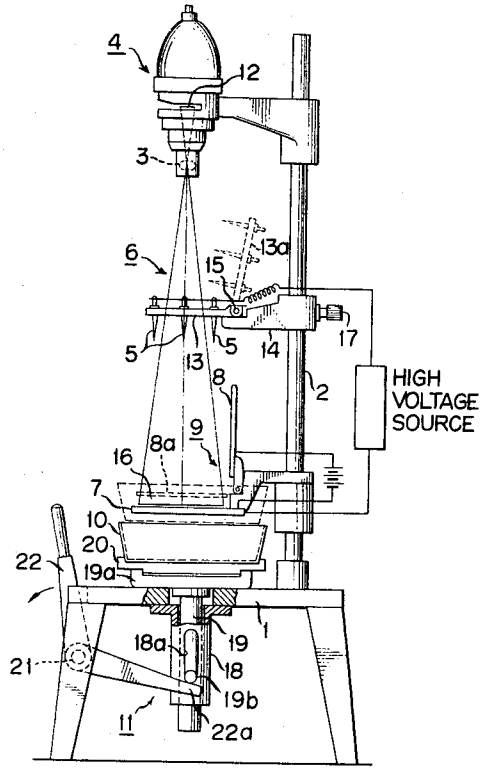
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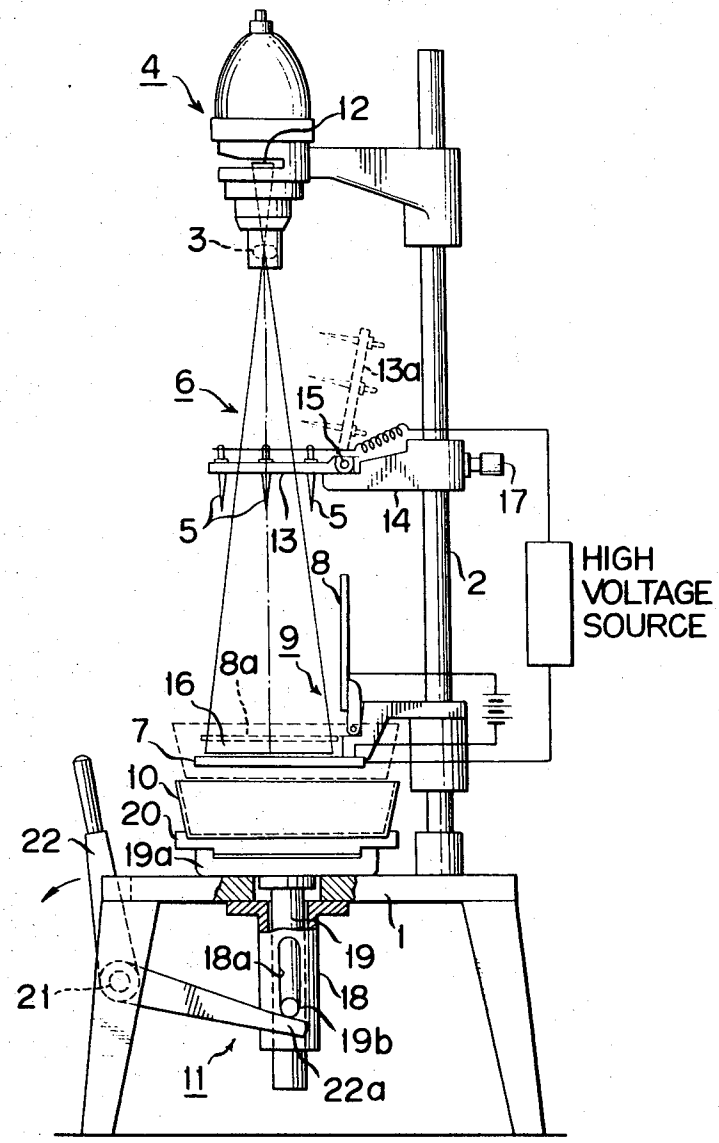
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ABSTRACT: An electrostatic photocopying apparatus having a corona discharge device positioned vertically between a projection optical unit and a copying paper stand which is associated with a developer solution container. The distance between the corona discharge device and the copying paper is maintained sufficiently large to create a weak corona discharge, and the corona discharge device is swingable out of the vertical line to allow operation of the optical unit.





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ELECTROSTATIC PHOTOCOPYING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to an electrostatic photocopying apparatus and more particularly an electrostatic photocopying apparatus wherein a copying paper is located within a weak corona discharge region.

In the electric charge device utilizing corona discharge incorporated in the conventional electrostatic photocopying apparatus, the corona discharge electrodes comprising a plurality of fine wires are disposed closely to a copying paper. The corona discharge due to a high-tension voltage is produced between the corona discharge electrodes and the copying paper holding stand while either of the corona discharge electrodes or the copying paper holding stand is displaced relative to the other, whereby the photoconductive layer of the copying paper is positively or negatively charged. When the corona discharge is produced while the corona discharge electrodes are disposed closely to a copying paper, an extremely high contrast image can be faithfully reproduced when the original to be reproduced consists of very small dots and/or fine lines. However, when the size of the original to be reproduced is rather large, a strong edge effect occurs and a reproduction of an image having a halftone is difficult to obtain. Furthermore, when the strong corona discharge is utilized, the developing marks tend t occur because the copying paper has not been uniformly charged.

SUMMARY OF THE INVENTION

In view of the above, the present invention provides an electrostatic photocopying apparatus wherein corona discharge electrodes are associated with a copying paper holding stand and spaced apart therefrom by a relatively large distance so that the surface of the photoconductive material such as zinc oxide upon a copying paper is located in a weak corona discharge region. The defects encountered in the conventional electrostatic photocopying apparatus can thereby be eliminated and a series of successive operations required for electrostatic photocopying can be effected more advantageously.

When the corona discharge electrodes are spaced apart from the copying paper by a relatively large distance and the corona discharge is generated between the corona discharge electrodes and the copying paper holding stand, the copying paper may be exposed sufficiently within the discharge region without the necessity of relative displacement between the copying paper and the corona discharge electrodes, so that the copying paper may be maintained stationary in position upon the copying paper holding stand and subjected to uniform and relatively weak corona discharge.

According to one preferred embodiment of the present invention, the corona discharge electrodes are spaced apart a copying paper from a considerable distance upwardly thereof so that the copying paper may be exposed in the weak corona discharge region. After the copying paper is charged, the corona discharge electrodes are retracted and the image of an original to be reproduced is projected upon the copying paper, whereby an electrostatic latent image is formed thereupon. After the exposure, the developing solution container which is normally disposed downwardly of the copying paper holding stand is moved upwardly so that the latent image may be developed in this solution.

According to another embodiment of the present invention, a plurality of developing solution containers may be provided so that the exposed copying paper may be processed with a plurality of processing solutions. In this case, said plurality of solution containers are disposed in the order that the exposed copying paper is processed successively. For example, the processing solution containers are successively conveyed as will be described in more detail hereinafter in the predetermined order so that the exposed copying paper may be processed successively with the conveyed processing solution.

Other objects and advantages of the present invention will become apparent from the following description of a preferred embodiment thereof taken in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF DRAWING

A single FIG. is a side view of an embodiment of an electrostatic photocopying apparatus according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A vertical supporting column **2** fixedly secured to a stand **1** carries an exposure device **4** in which are disposed a light source for projection, a condenser lens (both of which are not shown) and a projection lens **3**; a charging device generally indicated by **6** having a suitable number of needle-shaped corona discharge electrodes **5**; and a copying paper supporting device **9** having a copying paper supporting stand **7** and a bias electrode plate **8**. Upon the stand **1** is disposed a developing solution container elevating device **11** which is adapted to move vertically a developing solution container **10** which has an aperture large enough to receive therein said copying paper holding stand **7**.

The projection optical system conventionally used in the enlarger may be used as the aforementioned exposure device **4**. Reference numeral **12** designates a diapositive held in a cassette (not shown) which is set in the exposure device **4**.

An electrode supporting member **13** of the charging device **6** is swingably attached to the extreme end of an arm **14** attached movably in vertical to the supporting column **2**, and can be swung about a shaft **15**. Therefore, when the exposure device **4** is used, the supporting member **13** is retracted as shown by the broken line **13***a* so that the effective exposure by the lights from the exposure device **4** to a copying paper **16** is not prevented. A knob **17** screwed to the back portion of the arm **14** serves to hold the arm **14** stationary after the height of the arm **14** has been suitably adjusted.

At the upper end of an elevating shaft **19** loosely fitted into a cylinder **18** which in turn is securely fixed to the lower surface of the stand **1** is securely fixed a receiving stand **19***a* which is elongated in the direction perpendicular to the surface of the copying paper **16**. Upon the receiving stand **19***a* is disposed a sliding plate **20** upon which is securely fixed the developing solution container **10**. One end **22***a* of a lever **22** pivoted by means of a pivot **21** to a position of the stand **1** on the side of the operator extends below a pin **19***b* which is fitted into an elongated slot **18***a* of the cylinder **18**. The pin **19***b* is securely fixed to the peripheral surface of the elevating shaft **19** and is adapted to be pushed up by means of the one end **22***a* of the lever **22** when the lever **22** is rotated in the direction indicated by the arrow so that the developing solution container **10** may be moved upwardly.

When the height of each corona discharge electrode **5** is adjusted and supplied with a high-tension voltage in order that the copying paper is subject to the corona discharge in the best possible state, the whole surface of the photoconductive layer of the copying paper is uniformly charged. The aforementioned "the best possible state" infers that the copying paper is positioned in the weak corona discharge region where the charge density is uniform and which is spaced apart from the electrodes **5** by a relatively large distance. When the distance between the electrodes to which is supplied a high-tension voltage sufficiently high enough to cause corona discharge and a ground plate (which is the copying paper holding stand in the FIG.) is less than a few centimeters, no weak corona discharge region occurs. However, when the distance is increased to the range from 10 to 50cm., then the weak corona discharge region is generated externally of the strong corona discharge region in the form of a cylinder having a diameter of the range from 5 to 15 centimeters.

Next, the electrode supporting member **13** is retracted toward the position indicated by the broken line **13***a* and the

charged copying paper is exposed, whereby an electrostatic latent image is formed thereupon. Thereafter, the bias electrode plate **8** is placed in the position indicated by the broken line **8***a* upwardly of the copying paper. The developing solution container **10** is moved upwardly so that the copying paper holding stand **7**, the copying paper **16** and the bias plate **8** are immersed in the developing solution, whereby the developing process is accomplished.

When a plurality of developing solutions such as prewet solution, rinse solution or color developing solution are used, a predetermined number of containers containing such solutions are arranged upon the sliding plate **20** which in turn is moved toward or away from the receiving stand **19***a* so that a required developing solution may be placed downwardly of the copying paper holding stand **7** and then moved upwardly, whereby the developing process may be accomplished in this solution.

As described hereinabove, according to the present invention, the discharge device is spaced apart from the copying paper holding stand so that the copying paper may be located within the weak corona discharge region. Therefore, a faithful reproduction of an image without any edge effect can be obtained. Furthermore, it is not required to displace relatively the charging device relative to the copying paper so that the copying paper is maintained stationary in position until the development process has been completely accomplished, whereby means for transferring the copying paper can be eliminated. Furthermore, since the copying paper can be maintained stationary in position throughout the whole photocopying process, the distortion of the image caused by the conventional apparatus, the distortion especially due to the displacement and developing steps of the copying paper can be completely prevented so that a clear and faithfully reproduced image can be obtained. As to means for retracting the charging device from the light path for effective exposure of the copying paper, the electrode supporting member may be rotated about the supporting column instead of swinging the supporting member away from the light path as described above. Furthermore, the exposure device **4** may be disposed laterally of the column **2** by disposing suitable reflecting mirror upwardly of the charging device, instead of being disposed immediately above the copying paper holding stand as described hereinabove.

The present invention has been described with a particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications may be effected within the spirit of the present invention as described hereinabove and as defined in the appended claims.

I claim:

1. An electrostatic photocopying machine having a corona discharge device and comprising:

a main stand;

a vertically positioned supporting column mounted on said main stand;

a projection optical unit having a light source for directing light vertically downwardly, said unit mounted on the upper part of said column;

a copying paper support stand mounted on the bottom part of said column in vertical alignment with said optical unit and adapted to have copying paper placed thereon;

the corona discharge device being mounted on said vertical column between said optical unit and said copying paper support stand and in vertical alignment therewith, said discharge device spaced a predetermined distance from said support stand to create a weak corona discharge region for said copying paper;

container means having developing solution therein and located adjacent to and below said copying paper support stand in vertical alignment thereof, said container means positioned on said main stand, and means provided to selectively move said container means upwardly so that said support stand and copying paper are immersed in said solution;

a bias electrode plate pivotally mounted on said column adjacent the mounting of said support stand, said bias electrode plate being pivoted to an inactive vertical position when said corona device is operable, and said bias electrode plate being pivoted to an active horizontal position to be immersed in said developing solution when said container means has been moved upwardly; and

said corona discharge device being pivotally mounted and swingable to an inactive substantially vertical position thereby exposing said copying paper to the downwardly directed light when the optical unit is operable.

2. A photocopying machine according to claim **1**, in which said container means is of a predetermined size to allow simultaneous immersion therein of said support stand, copying paper and bias electrode plate.

3. A photocopying machine according to claim **1**, in which said container means is mounted on a slidable plate that is positioned on said stand, and said container means comprises a plurality of containers filled with different solutions for different developing treatments, said plate being slidable and vertically movable to sequentially immerse the copying paper in each container.

4. A photocopying machine according to claim **1**, in which the predetermined distance that said discharge device is spaced from said support stand is in the range of 10—50 centimeters.