March 19, 1963 W. LIMBERGER 3,081,677

DEVICE FOR PREPARING A COPY BY MEANS OF LATENT ELECTROSTATIC IMAGES

Original Filed Oct. 22, 1957

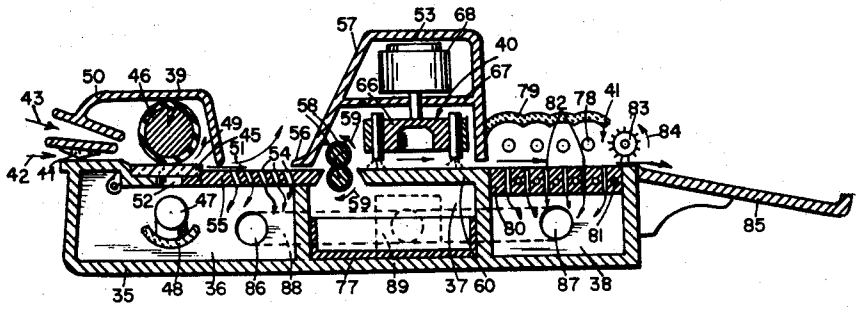


FIG. 1

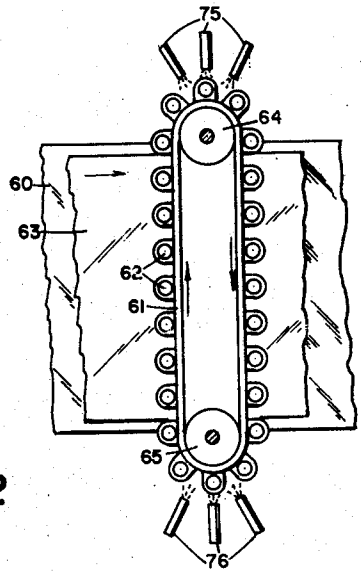


FIG. 2

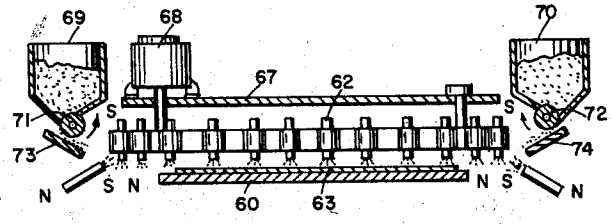


FIG. 3

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DEVICE FOR PREPARING A COPY BY MEANS OF LATENT ELECTROSTATIC IMAGES

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Original application Oct. 22, 1957, Ser. No. 691,691. Divided and this application Nov. 20, 1958, Ser. No. 782,988

9 Claims. (Cl. 95—1.7)

My present invention relates to an apparatus for making prints from a master copy by a xerographic process.

It is known to duplicate a master copy on a flexible sheet by placing the sheet in contact with a second sheet, bearing an electrostatically charged xerographic layer, and illuminating the two sheets so as to form a latent electrostatic copy of the master on the xerographic layer; the latent image can then be developed by dusting the exposed xerographic layer with a toner and fixing the toner particles onto the layer by a fusion process. My present invention has for its object the provision of an improved and conveniently operable device of this character which, in a preferred embodiment, can be designed as a table model.

In accordance with this invention I provide a housing which defines a guide path for the two sheets, this housing enclosing the usual illuminating and developing chambers in such manner as to leave a portion of the guide path exposed between these chambers whereby the master copy can be conveniently separated from the xerographic layer and removed immediately after the latter has been exposed. In order to prevent any undesired entrainment of the xerographic layer by the master copy, I provide suitable retaining means such as, for example, a suction device at the exposed guide-path portion to hold the layer-bearing sheet in place.

In an advantageous embodiment, the developing chamber which follows the exposed portion of the guide path contains a magnetic array adapted to distribute the toner particles over the layer surface in a manner more fully disclosed and broadly claimed in my co-pending application Ser. No. 691,691, filed October 22, 1957, of which the present application is a division.

Further advantages and features of the invention will appear from the following description of an embodiment which is illustrated in the accompanying drawing.

In the drawing:

FIG. 1 shows a side view of the apparatus according to the invention in section;

FIG. 2 shows a plan view of part of the apparatus according to FIG. 1; and

FIG. 3 shows a side view of the part of the apparatus illustrated in FIG. 2.

The apparatus illustrated in the drawing consists of a lower part **35** divided essentially into three chambers **36**, **37** and **38**, which are separated from one another by vertical partitions. The guide path for the layer support is arranged at the upper surface of the lower part **35** of the housing. The division of the lower part **35** of the housing into three chambers **36**, **37** and **38** corresponds to a separation of the apparatus essentially into an illuminating device **39**, a developer device **40** and a fusing device **41**. Extensions **50**, **53** are provided on the upper side of the housing and surround the parts of the apparatus lying above the guide path for the layer support.

Two slots **42**, **43** are provided directly above one another at the operating side of the apparatus, which is preferably constructed as a table device, the slot **42** serving for inserting the layer support with the photoelectric layer while the slot **43** serves for inserting the master copy. This master copy consists for example of opaque paper. The apparatus is suitable also for master copies of normal paper, which are light-permeable and carry an image only on one side.

The forming device **44** is arranged at the upper side of the slot **42** for the layer support and, in the embodiment illustrated, comprises three wire-shaped electrodes. It is possible to provide a contact charge with these electrodes which press the paper onto the lower limiting surface of the guide slot **42**, the latter surface being constructed in the region of the forming device as the counter-electrode. The electrical parts of the apparatus are not shown in the embodiment illustrated, since they are not essential to a comprehension of the present invention.

At the guide surfaces forming the slots **42**, **43** there is mounted the illuminating device **39** which consists essentially of a glass plate **45** with a window **52** in the guide path for the layer support, a pressure and feed roller **46**, preferably with an elastic rubber covering, as well as a bar-shaped light source **47** in front of a reflector **48**. The roller **46**, rotating in the direction of the arrow **49**, causes a simultaneous advance of the layer support and of the master copy through the illuminating device and to the developing device.

The inlet slots **42**, **43** lying above the guide path for the layer support, the forming device **44** and the feed and pressure roller **46** are arranged in housing extension **50** which terminates behind the roller **46** in a steeply inclined wall. This wall extends to the guide path for the layer support and merely leaves a slot **51** above a supporting plate **55** for the passage of the layer support and the master. The plate **55** extends into the housing extension **53** for the developing device and is perforated at least in the section between the housing extensions **50** and **53**. The apertures **54** forming the perforations are arranged obliquely, so that the upper ends of the apertures are inclined opposite to the direction of advance of the layer support. These perforations cooperate with an air aspirator arranged in the lower part of the apparatus, for example the suction side of a blower, so that the layer support is held down by the partial vacuum prevailing in the apertures **54** of the plate **55**. This guiding of the layer support on the plate **55** does not act on the master copy lying above the layer support, which can therefore be readily removed from the intermediate space between the housing extensions **50** and **53**. Automatically operating devices may, of course, be provided for the separation of the layer support and the master copy. There is also the possibility of at least partly covering the section between the extensions **50** and **53**. Preferably, the separation of the layer support and the master copy occurs at an edge **56** constructed especially for this purpose on the inclined forward wall **57** of the extension **53**, so that the layer support provided with the latent electrostatic image is covered during its passage through the intermediate space between the extensions **50** and **53**.

Within the housing extension **53**, which is located over the chamber **37** of the lower part of the apparatus, a pair of feed rollers **58** are provided which are resiliently urged towards each other and are driven according to the arrows **59**. The rollers preferably have a rubber covering on their surfaces for light handling of the layer support. The distance between the pressure roller **46** and the pair of feed rollers **58** is smaller than the length of the copies normally to be prepared, so that the forward edge of the layer support is gripped by the pair of rollers **58** before the layer support is released by the pressure roller **46**.

Behind the pair of feed rollers **58**, the guide path for the layer support consists of a plate **60** over which the developing device **40** is located. This developing device is also represented in different views illustrated in FIGS. 2

and 3. It consists of an endless conveyor belt **61** on which mutually parallel bar magnets **62** are so arranged that like poles face the layer support passing over the plate **60**. The magnets are, for example, vulcanised on to the conveyor belt, which consists of rubber. The conveyor belt **61** is guided on drums **64, 65** arranged above and laterally of the layer support **63**; for example, the conveyor belt **61** may be provided at the side facing the drums with projections which engage grooves in the drums, or vice versa. Special arrangements are provided for preventing downward slipping of the conveyor belt, such as for example, edge strips **66** perpendicular to the direction of the magnets. These edge strips **66** engage in corresponding apertures formed at the upper end of the drum and serve to guide the belt.

The drums **64, 65** are mounted above the plate **60** in a horizontal partition **67**. The shaft of at least one drum is passed through the partition **67** and is coupled, if required over a reduction gear, with the driving motor **68**. This arrangement is readily appreciable particularly in FIG. 3. It can also be seen from this figure that the driving motor **68** is arranged only above the drum **64**, the drum **65** being freely mounted in the partition **67**.

Positioned laterally of the partition **67** in the housing extension **53** are upwardly open partition containers **69, 70** which serve as supply containers for the developer. The supply containers **69** and **70** are funnel-shaped at their lower sides and are provided at this lowest point with a supply opening in which distributing rollers **71, 72** are located. The distributing rollers can be driven with different rotative speeds so that the amount of developer respectively dispensed from the containers **69** and **70** can be individually controlled. Beneath the rollers **71, 72** are chutes **73, 74** which direct the developer particles supplied by the containers to the lower poles of the operating magnets **62**. In the region of the chutes **73, 74**, several directing magnets **75, 76** are so positioned that unlike poles of the operating magnets **62** and of the directing magnets **75, 76** face one another. In particular, the directing magnets are so arranged that they are inclined to the axes of the adjacent operating magnets so that the magnetic field located under the lower poles of the operating magnets is increased. The magnets **75, 76** have the purpose of directing toward the poles of the operating magnets the brush-shaped bundles or tufts of developer particles, which were deformed in wiping over the layer support **63**, before these tufts are again guided over the layer support **63** as a result of the rotation of the conveyor belt **61**. The arrangement of the directing magnets **75, 76** in connection with the powder-distributing device also has the advantage that at the same time tufts of particles are formed on the poles of the directing magnets facing the operating magnets, these stationary tufts preferably coming into direct contact with the moving tufts on the operating magnets. An intensive transfer of fresh, i.e. unused, developer is thus ensured.

After the bundles are formed once on the operating magnets **62** and the directing magnets **75, 76**, it is sufficient merely to supply toner which is added to the bundles from the carrier particles of the developer. Preferably, in order to augment the number of carrier particles released during the wiping of the photo-electric layer, a developer strongly enriched with toner is supplied from the containers **69, 70**.

In one embodiment of the invention, the operating magnets **62** and the directing magnets **75, 76** are made of equal strength and the developer is directed by the chutes **73, 74** approximately in the middle between facing poles of the operating and directing magnets. There is also the possibility, in a modified construction, of making the directing magnets **75, 76** somewhat weaker than the operating magnet **62** or arranging the chutes **73, 74** so that the developer is guided nearer to the poles of the operating magnets than to those of the directing magnets.

In the chamber **37** of the lower part of the apparatus,

which is located beneath the extension **53**, a container **77** is removably arranged to receive released developer particles which fall from the layer support at the sides thereof or fall from the poles of the directing magnets. The developer particles collected in this container can be returned to the supply containers **69, 70** after having been enriched, if required, by the addition of toner.

The fixing device is located behind the extension **53** on the upper side of the apparatus. This device consists essentially of heating elements for fusing in the toner which is applied to the contours of the electrostatic image. Infra-red emitters **78** are arranged above the photo-electric layer, over which reflectors **79** are disposed which direct the upwardly passing heat rays to the layer support. In the region of the fixing device, the guide path for the layer support consists of a plate **80** in which heating elements **81** are arranged. These heating elements cause heating of the layer support from the back. Furthermore, the plate **80** is interrupted by apertures **82** through which, as with the apertures **54**, a partial vacuum is applied to the back of the layer support in order to draw it onto the plate **80**. Furthermore, this partial vacuum acting through the apertures **82** has the object of extracting from the fixing device the fumes which arise in fusing in the toner. These fumes would impair the operation of the apparatus if they were distributed through the whole unit.

At a suitable location, for example, at one side wall of the lower part **35**, a blower **89** is included whose suction side is connected with a pipe **88** to produce the aforementioned partial vacuum. The openings **86, 87** of this pipe **88** lie beneath the openings **54** in the plate **55** and the openings **82** in the plate **80**.

The fixing device **41** is provided with a pin roller **83**, at the exit side for the copies, which is driven in the direction of the arrow **84**. This pin roller extends over the whole width of the exit slot and therefore also forms a cover for this exit slot and constitutes a feeding device which does not disadvantageously affect the prepared copies because of the arrangement of pins on the circumference of the roller. This feed roller **83** advances the prepared copies over a support platform **85** which is arranged at the back of the apparatus, preferably on the lower part **35**.

What I claim is:

1. An apparatus for duplicating a master copy, carried on a first flexible sheet, on a second flexible sheet provided with a photoconductive layer, comprising stationary sheet-supporting means establishing a transport path for said sheets; an illuminating device for forming a latent image of said master copy in said layer and a developing device for rendering said image visible successively positioned along said transport path; a housing surrounding both said devices, said housing having a lower portion below said path and an upper portion above said path, said upper portion forming a first enclosure in the region of said illuminating device and a second enclosure in the region of said developing device, said enclosures being spaced apart by an exposed portion of said path of sufficient length to enable the gripping of a sheet from above, said first enclosure being provided with a slotted portion forming an inlet adjacent one extremity of said path for the admission of both said sheets into said housing, said first enclosure further having a rear wall spaced above said supporting means sufficiently to form a first clearance for the emergence of both said sheets onto said exposed portion whereby said first sheet, on being properly positioned atop said second sheet, may be removed from the latter, said second enclosure having a front wall with a lower sheet-separating edge turned toward said first clearance and spaced above said supporting means sufficiently to form a second clearance for the reintroduction of said second sheet into said housing while said first sheet is deflected upwardly along said second enclosure by said edge, said second enclosure being further provided with an exit slot adjacent the opposite extremity of said path for the

discharge of said second sheet after movement of the latter past said developing device; first feed means ahead of said exposed portion for advancing both said sheets past said illuminating device; second feed means beyond said exposed portion for advancing said second sheet past said developing device; and retaining means at said exposed portion for holding said second sheet in contact with said supporting means during removal of said first sheet.

2. An apparatus according to claim 1 wherein said developing device comprises distributing means for fusible toner particles in said second enclosure, further including a fixing device comprising heating means for fusing said particles onto the photoconductive layer, said fixing device being positioned beyond said distributing means along said path, said retaining means comprising a first apertured plate forming part of said supporting means at said exposed portion, said supporting means including a second apertured plate underneath said heating means, further comprising suction means in said lower portion operatively connected with the aperture of both said plates for holding down said second sheet on its passage over said plates.

3. An apparatus according to claim 2 wherein said lower portion is provided with partition means dividing it into a first chamber underneath said first enclosure and said exposed portion, a second chamber underneath said distributor means, and a third chamber underneath said heating means, said suction means comprising a source of low pressure having outlets in said first and third chambers, said second chamber being provided with receiving means for excess toner particles.

4. An apparatus according to claim 1 wherein said supporting means comprises a plate having apertures at the location of said exposed portion, said retaining means comprising a suction device operatively connected with said apertures.

5. An apparatus according to claim 4 wherein said apertures have axes enclosing with the surface of said plate an acute angle pointing in the direction of advance of said sheets.

6. An apparatus according to claim 1 wherein said supporting means is provided with a gap underneath said second enclosure, said second feed means comprising a pair of cooperating transport rollers positioned in said path at said gap.

7. An apparatus according to claim 1 wherein said sheet-supporting means is provided with a straight path-forming surface in a substantially horizontal plane, said surface extending from said first clearance beyond said exit slot.

8. An apparatus for duplicating a master copy, carried on a first flexible sheet, on a second flexible sheet provided with a photoconductive layer, comprising stationary

guide means establishing a guide path for said sheets; first housing means below said guide path, said guide means being provided with a window in the vicinity of said first housing means; illuminating means in said first housing means for forming a latent image of said master copy in said layer; second housing means above said guide path provided with a slotted portion adjacent one extremity of said guide means forming an inlet for said sheets; first feed means in said second housing means for displacing said sheets along said path past said window, said second housing means being provided with an outlet slot for said sheets opposite said slotted portion; third housing means above said guide means and spaced from said second housing means along said path, said third housing means being provided with an entrance slot for said second sheet aligned with the outlet slot of said second housing means, a sheet-separating edge overlying said entrance slot and turned toward said outlet slot and an exit slot for said second sheet opposite said entrance slot while said first sheet is deflected upwardly along said third housing means by said edge; developing means within said third housing means for rendering visible the image carried by said second sheet; heating means beyond said developing means within said third housing means for fusing said particles onto the photoconductive layer, and retaining means on said guide means between said second and third housing means for holding said second sheet against said guide means whereby said first sheet, after being passed through said second housing disposed above said second sheet, may be manually stripped therefrom in the gap between said second and third housing means while said second sheet is further displaced through said third housing means upon upward deflection by said edge.

9. An apparatus according to claim 8 wherein said guide means is provided with a straight path-forming surface in a substantially horizontal plane, said surface extending from said outlet to the region of said heating means.

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