

[54] **PHOTOCOPYING MACHINE**

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[58] Field of Search 240/1, 3, 2 C, 103 B, 240/41.35 E; 355/67, 84, 8

[56] **References Cited**

UNITED STATES PATENTS

2,189,577	2/1940	Conrad	240/1.3 X
3,428,397	2/1969	Elmer	355/11
3,586,849	6/1971	Starkweather	355/70
3,302,519	2/1967	Young	355/67
3,532,424	10/1970	Miles	355/70 X
540,572	6/1895	Baumhoff	240/41.35

Primary Examiner—John M. Horan

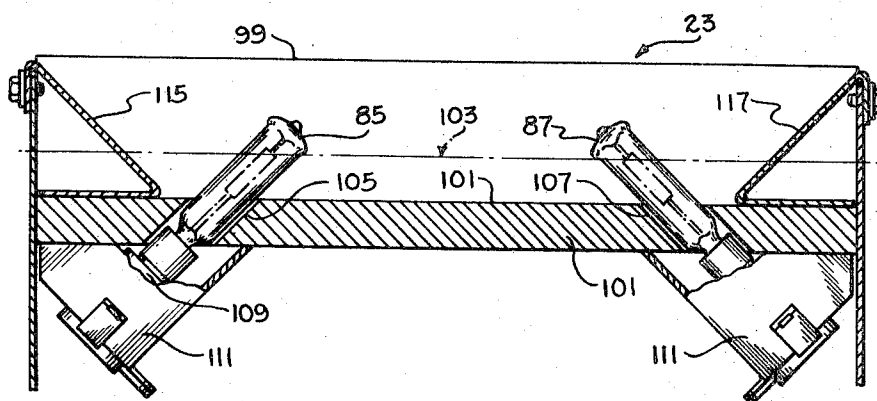
Attorney—Arnstein, Gluck, Weitzenfeld & Minow

[57]

ABSTRACT

A photocopying machine produces a copy of a page of a bound book placed on a stationary window by moving an optical projection system past the window for projecting the images of successive elongated strip portions of the page onto a light-sensitive copy material. The portion of the page placed flat against the window is maximized by providing a downwardly extending wall adjacent an edge of the window to minimize the portion of the page adjacent the binding being pulled out of focus by the binding of the book. Movable past the window with the optical projection system is an illumination system for illuminating an elongated strip portion of the page for projection onto the light-sensitive copy material. The illumination system has a physical configuration substantially coextensive with the illuminated strip portion being projected onto the copy paper, and one end of the illumination system is substantially coextensive with the edge of the window adjacent the downwardly extending wall. The illumination system includes an elongated elliptical reflector having two single-ended tubular-shaped lamps extending obliquely through suitable openings in the reflector with two transverse reflectors at the opposite ends of the elongated elliptical reflector which extend transversely to the obliquely positioned lamps.

9 Claims, 8 Drawing Figures



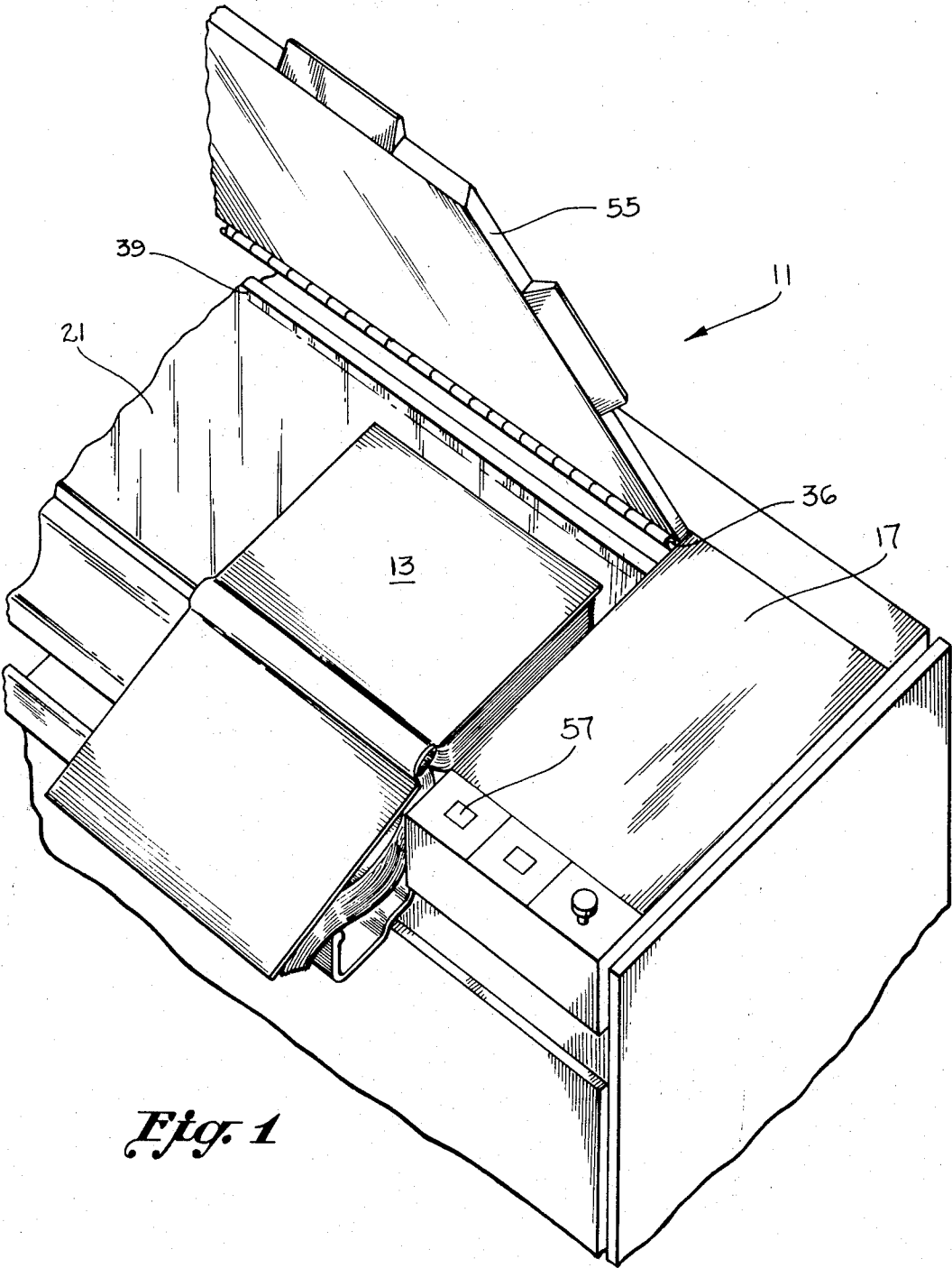


Fig. 1

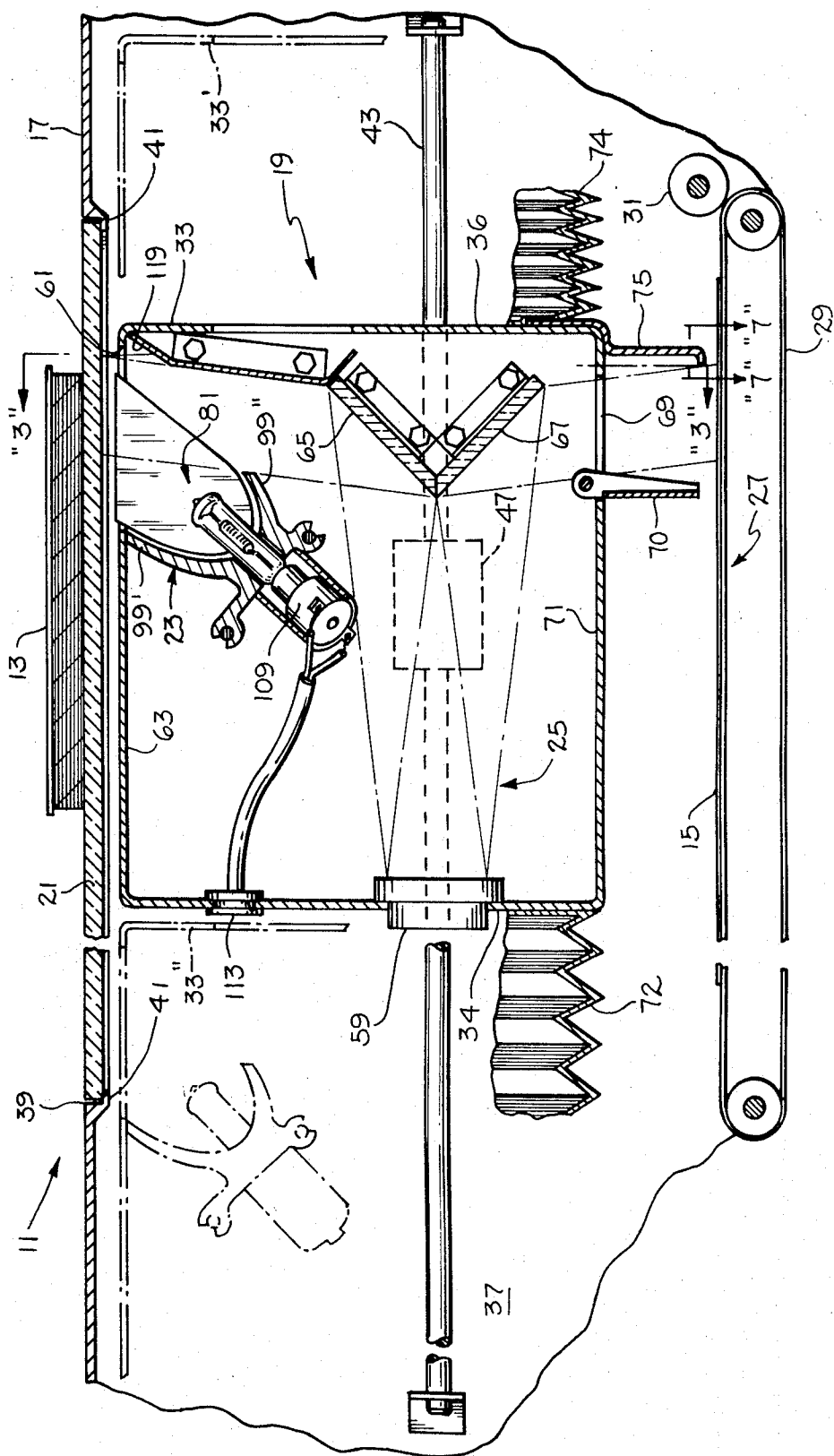
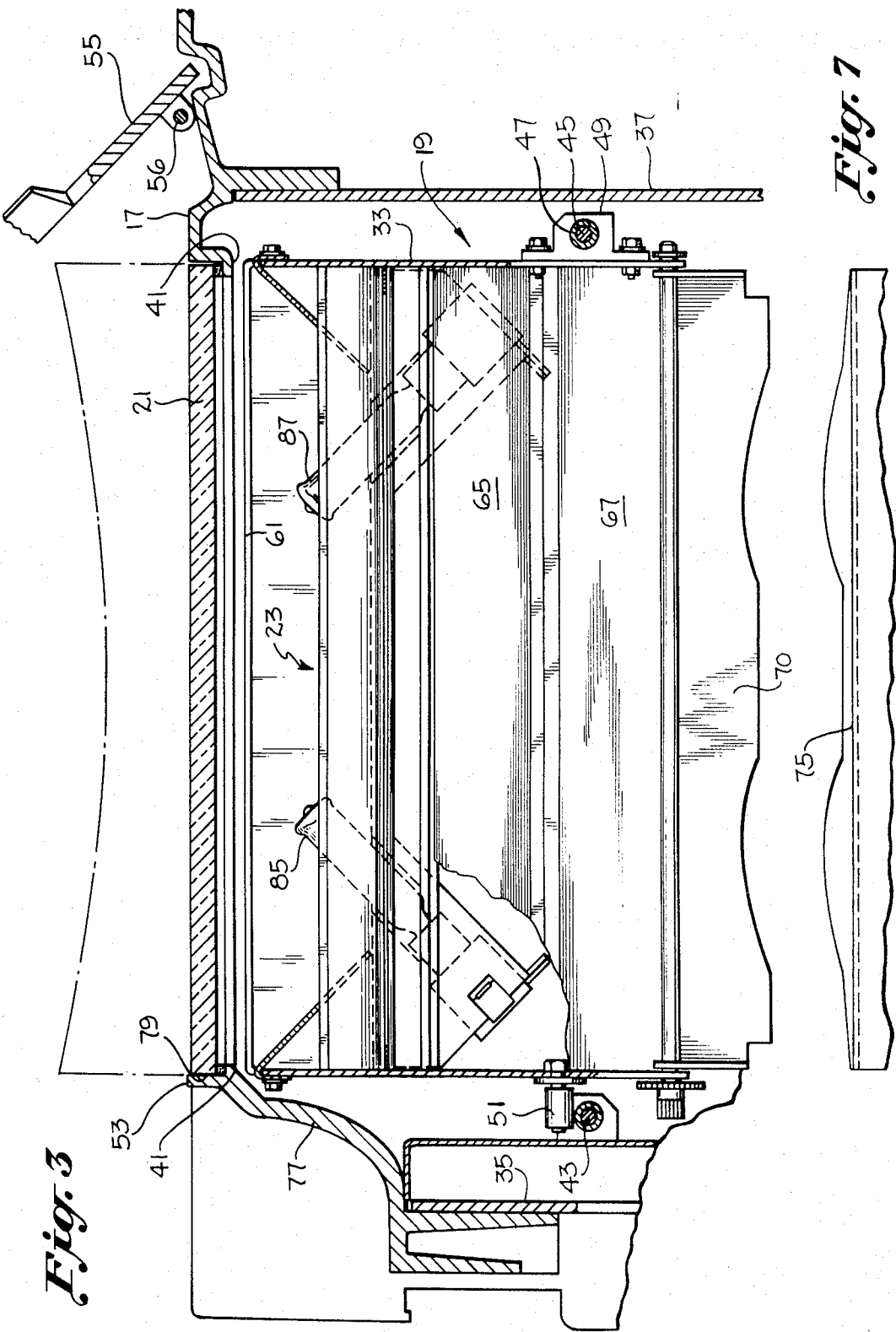
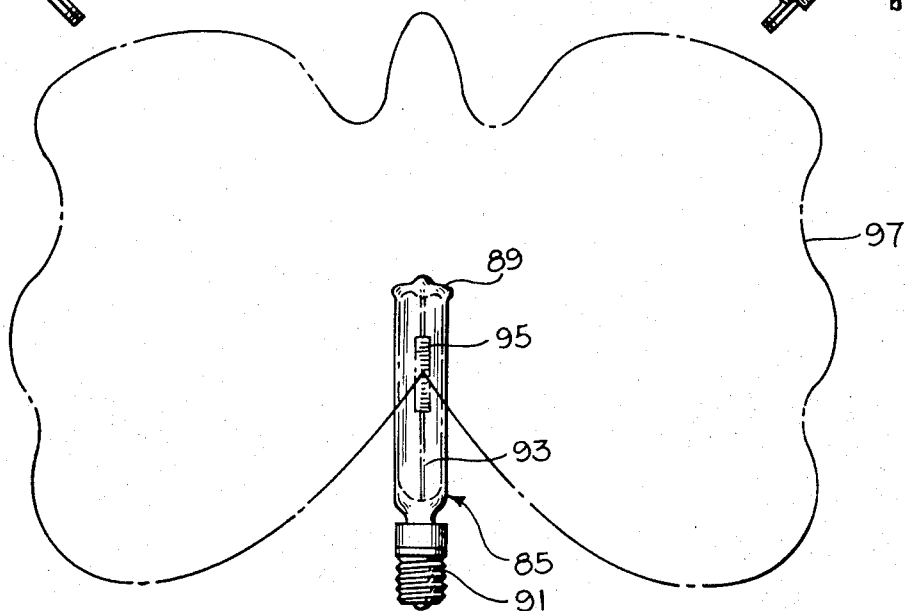
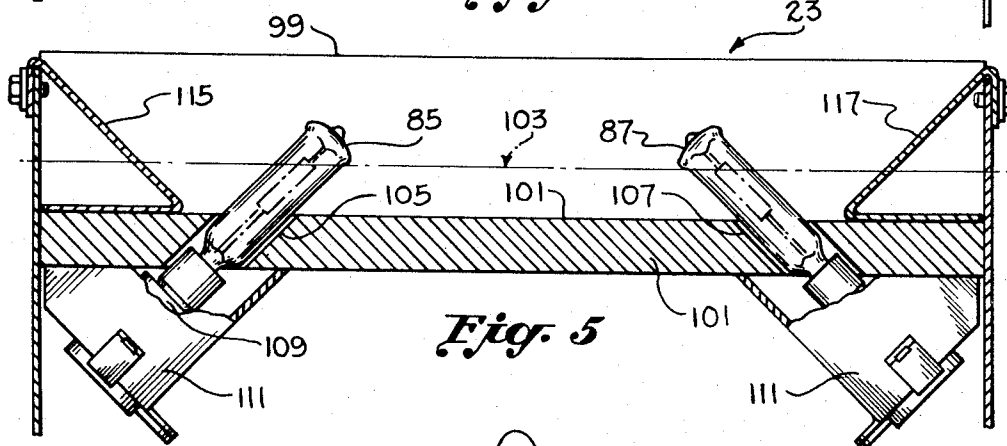
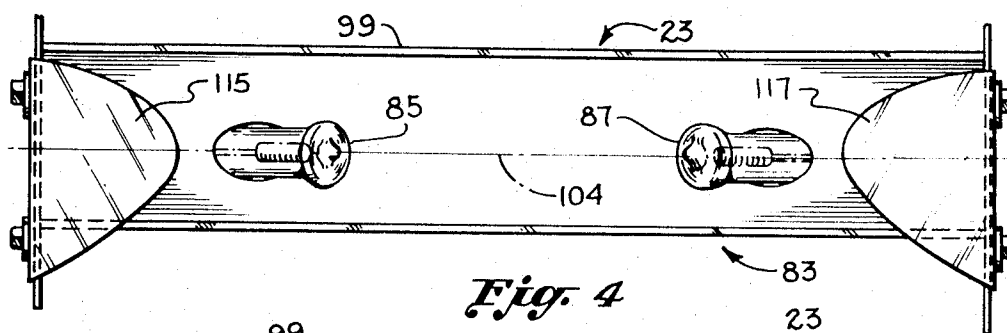


Fig. 2





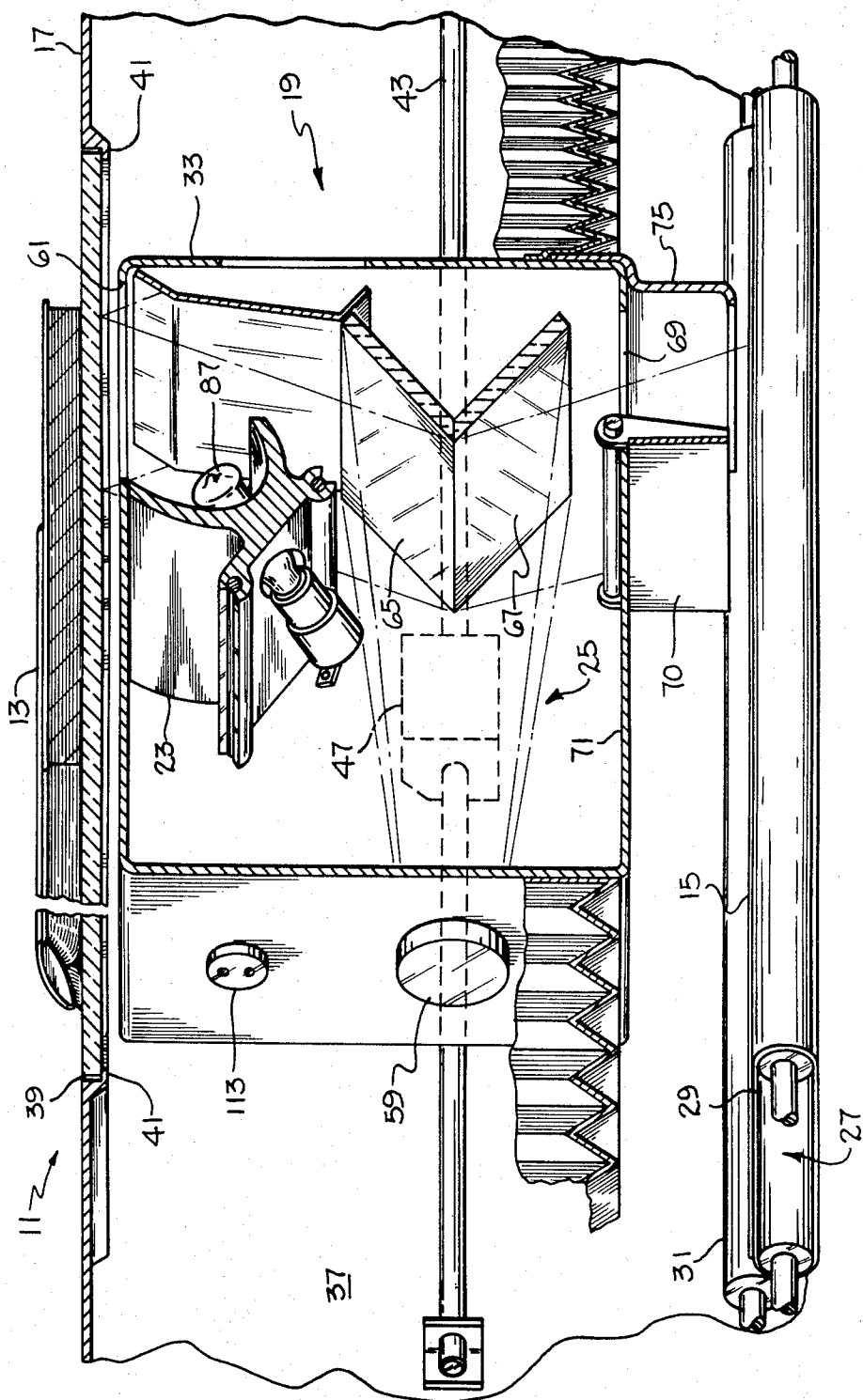


Fig. 8

PHOTOCOPYING MACHINE

This is a division of application Ser. No. 863,013, filed Sept. 26, 1969.

This invention relates to a photocopying machine, and more particularly to an electrostatic photocopying machine for producing a copy of a document which is maintained in a stationary position during the copying process.

In an electrostatic photocopying machine, a copy of a document is produced by illuminating the document and projecting the image thereof onto a photoconductive surface of a copy material having a uniform electrostatic charge. The face of the document is placed against a window, and the image of the illuminated document is projected by an optical projection system which is focused on both the window, which is located at an object plane, and the photoconductive surface of the copy paper which is located at an exposure station. As the photoconductive surface is exposed to the projected image of the document, the uniform electrostatic charge is selectively dissipated according to the light and dark portions of the projected image to form a latent electrostatic image of the document. The portions of the projected image corresponding to the lighter areas of the document have a greater light intensity and hence are more effective in dissipating the electrostatic charge on the copy paper than the portions of the image corresponding to the darker areas of the original. Subsequently, the latent image is developed into a visible image by bringing the photoconductive surface into contact with the visible particles which are electrically attracted to the latent electrostatic image.

To produce an accurate copy of the document, it is necessary for the document to be maintained flat against the window so as to be in focus with the optical projection system projecting the image of the document onto the copy paper. Furthermore, the document must be unevenly illuminated in a manner which compensates for the natural fall off of light intensity due to the angle at which light is radiated from the document and irradiated onto the surface of the copy paper as well as any vignetting inherent with the lens used in the optical projection system. The uneven illumination of the document is necessary so that all portions of the document having the same uniform shade of color will be projected onto the photoconductive surface of the copy paper with a uniform light intensity.

If the document to be copied is relatively stiff and inflexible, then it is desirable that the document be maintained in a stationary position during the copying process to prevent the document from being torn or otherwise damaged as sometimes happens if the document is transported through the photocopying machine during the copying process. However, if the document is to be maintained in a stationary position during the copying process, then it is necessary to provide a window which is sufficiently large to support the document in a stationary position during the copying process. Furthermore, it is necessary to provide an optical projection system which is capable of projecting the image of the entire document onto the copy material.

However, when the document to be copied is a page of a book, then it is not enough to merely provide a window for supporting the page to be copied, because the portions of the page to be copied must be pressed flat against the window to be in focus with the optical projection system and the binding of the book often

tends to prevent adjacent portions of the page being copied from being pressed flat against the window. For example, if the window is surrounded by a flat surface which is level with the surface of the window, then it becomes necessary to place both the page to be copied and the adjacent page flat against the window and the adjacent surface, and this is usually prevented by the binding of the book which tends to pull the adjacent portion of the page being copied out of focus with the optical projection system. This problem becomes particularly acute when the book is relatively thick and has narrow margins, for example, a large dictionary, and attempts to press the entire page to be copied against the window by pushing on the binding often results in breaking the back of the book.

To maximize the portion of the page placed on the window for copying, it is desirable to have an edge of the window closely adjacent a downwardly extending wall. Such an arrangement facilitates placing the page to be copied on the window by enabling the adjacent page and portion of the book not being copied to extend beneath the plane of the window with the binding being pressed towards the edge of the window.

In the past, there have been photocopying machines with a downwardly extending wall adjacent an edge of a stationary window to facilitate copying a page of a book. Such a machine is shown in U.S. Pat. No. 3,416,860. In this type of a machine, the document is placed on the window and the image of the document is projected onto a copy material by an optical projection system having a stationary objective lens. To enable the machine to copy any size document placed on the window, the entire window is illuminated in a manner which compensates for the natural fall off of the light intensity as the image is projected onto the copy material. In addition, the optical projection system has an objective lens with a field of view sufficiently large to enable a document covering the entire window to be projected onto the copy paper.

However, photocopying machines of the type shown in U.S. Pat. No. 3,416,860 and which are capable of copying a page of a book in the manner hereinabove described are often too large for use in a crowded office situation, and this is usually due to the amount of floor space that they occupy. Furthermore, to illuminate the window with a proper uneven illumination intensity usually requires a plurality of lamps spaced from the window. However, the spacing of the lamps from the object window requires the use of lamps capable of producing a greater amount of illumination, and the use of a plurality of lamps increases the electrical power requirements for operating the photocopying machine. Oftentimes, such photocopying machines require special electrical outlets to provide an adequate electrical supply for their operation. Accordingly, such a machine is not easily relocated in an office as conditions may require without incurring the expense of providing a special electrical outlet for the machine. In addition, the optical projection system usually constitutes a substantial cost to the machine, and the use of an objective lens having a field of view sufficiently large to encompass an object covering the entire window necessitates a relatively expensive lens system.

Accordingly, an object of the present invention is to provide a photocopying machine for copying bound books which may be used in a crowded office without occupying any floor space.

Another object of the invention is to provide a photocopying machine which is sufficiently compact so as to be placed on the width of a standard desk without having any movable external portions projecting beyond this length.

A further object of the invention is to provide a photocopying machine for copying bound books, wherein the cost of the machine is minimized by using an optical projection system wherein the lens need not have a field of view sufficient to cover the entire document being copied.

An additional object of the present invention is to provide a photocopying machine wherein the space between the illumination system and the document being copied is minimized to reduce the electrical power required to operate the machine so that it may be operated from a standard electrical outlet in an office.

Another object of the invention is to provide a photocopying machine having a downwardly extending wall adjacent an edge of a window for supporting a document to be copied so as to enable the binding of the book to be placed thereagainst to maximize the portion of the page placed on the window for copying.

Still other objects, features and advantages of the present invention will be apparent to those skilled in the art from a reading of the following detailed description of a preferred embodiment of the invention, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a partial perspective view of a preferred embodiment of a photocopying machine constructed in accordance with the present invention;

FIG. 2 is a longitudinal cross-sectional view of a portion of the machine shown in FIG. 1, and illustrating the projection of an illuminated portion of the object onto a copy paper;

FIG. 3 is a sectional view taken along the line 3—3 in FIG. 2, and illustrating the downwardly extending wall adjacent the edge of the window for enabling a page of a book to be copied;

FIG. 4 is a plan view of the illumination system according to the present invention;

FIG. 5 is a cross-sectional view of the illumination system shown in FIG. 4, and taken along the line 5—5 in FIG. 4;

FIG. 6 is a view of a typical single-ended lamp used in the illumination system according to the present invention, and showing the distribution of the luminous intensity produced by the lamp;

FIG. 7 is a sectional view taken along the line 7—7 in FIG. 6; and

FIG. 8 is a longitudinal cross-sectional view of another embodiment of a photocopying machine constructed in accordance with the present invention, wherein the direction of movement of the copy paper past the exposure station is transverse to the scanning movement of the optical projection system.

Referring generally to the figures in the drawings, there is shown a photocopying machine, generally indicated 11, for copying an original document 13 onto a copy material 15 with a photoconductive surface. The photocopying machine 11 includes a housing 17 having a projection compartment, generally indicated 19, with a window 21 at the top of the machine 11 for supporting the document to be copied. The projection compartment 19 contains an illumination system, generally indicated 23, for illuminating the document 13 and an

optical projection system, generally indicated 25, for projecting the image of the illuminated document 13 onto the copy material 15 at an exposure station, generally indicated 27. The copy material 15 has a uniform electrostatic charge and is transported to the exposure station 27 by suitable transport means, as shown in the form of an endless belt which is driven by suitable means, not shown. At the exposure station 27, the exposure of the photoconductive surface to the projected image causes a uniform electrostatic charge to be selectively dissipated to form a latent electrostatic image of the document 13. Subsequently, the copy material 15 is advanced into the nip of a roller 31 cooperating with the endless belt 29 which removes the copy material 15 from the projection compartment 19 for further processing in the machine 11. The means for driving the endless belt 29 and the cooperating roller 31 have been omitted from the description since they form no part of the present invention.

Inside the housing 17, the illumination system 23 and the optical projection system 25 are mounted in a box-like enclosure 33 which serves as a carriage and is supported beneath the window 21 between front and back side walls 35, 37 respectively. The side walls 35, 37 extend upwardly and support the upper portion of the housing 17 so as to form the projection compartment 19. As more particularly shown in FIGS. 2 and 3, the upper portion of the housing 17 has an opening 39 formed therein with a lateral abutment 41 for supporting the glass window 21 with the upper surface thereof serving as an object plane in focus with the optical projection system 25.

To reduce the cost of the lens used in the optical projection system 25, the width of the window 21 is reduced to a minimum suitable size, for example, $8\frac{1}{2}$ inches, and the copying machine 11 is provided with an optical projection system 25 which is movable past the window 21 so as to scan the document 13 and project successive portions thereof onto the copy material 15. By using a narrow window 21 with a minimum suitable width and by providing the photocopying machine 11 with a scanning optical system, the field of view of the lens may be reduced to encompass only a portion of the document 13, and hence a less expensive lens system may be utilized. As shown, to enable the optical projection system 25 to move past the window 21, the enclosure 33 serves as a carriage and is supported for easy sliding movement past the window 21 by parallel shafts 43, 45 which are secured to the front and back side walls 35, 37 respectively. The shaft 45 is received through a bushing 47 in a bracket 49 attached to the adjacent side of the carriage 33 while the opposite side of the carriage has a block 51 attached thereto which rests on the other shaft 43 secured to the front side wall 35.

To provide easy sliding movement of the carriage 33 past the window 21, the block 51 and the bushing 47 engaging the shafts 43, 45 respectively, are constructed from suitable materials having a relatively low coefficient of friction. For example, the bushing 47 may be constructed from a suitable bearing material, for example, an oil impregnated porous bronze composition, and the block 51 may be constructed from a suitable material, for example, nylon.

When a copy of a document 13 is to be made, the face of the document 13 is placed against the window 21 for projection onto a photoconductive surface of

suitable copy material 15 located at an exposure station 27. As more particularly shown in FIG. 3, to align the document 13 with the exposure station 27, the upper portion of the housing 17 is provided with a ridge 53 extending above the surface of the object window 21 so as to provide an edge against which the document 13 may be registered. With the document 13 properly positioned on the window 21, both the document 13 and the window 21 may then be covered by a lid 55 which is connected to the housing 17 of the photocopying machine by suitable means, for example, a hinge 56 and a switch, generally indicated 57 may be actuated to initiate the operation of the machine 11.

Upon initiation of the operation of the machine 11, the illumination system 23 is energized and copy paper 15, having a uniform electrostatic charge imparted thereto, is transported by the endless belt 29 to the exposure station 27. When the copy paper 15 reaches the exposure station 27, a suitable drive for the carriage 33, not shown, is energized for moving the carriage 33 from a starting position, generally indicated 33' past the window 21 to a stopping position, generally indicated 33''. The means for moving the carriage past the window 21 are not shown, since they form no part of the present invention.

As the carriage 33 moves past the window 21, the illumination system 23 illuminates an elongated strip portion of the window 21 including the portion upon which the document 13 is placed. The illuminated strip portion of the document 13 is then projected onto the photoconductive surface of the copy paper 15 by the optical projection system 25. As more particularly shown in FIG. 2, the optical projection system 25 includes an objective lens system 59 having an optical axis parallel with the window 21 and the exposure station 27 and located equidistant therebetween. The box-like enclosure of the carriage 33 has an opening 61 in the top wall 63 through which light from the illuminated strip portion of the document 13 passes into the enclosure 33. The light from the illuminated portion of the document 13 is reflected through the lens system 59 in one direction by an upwardly facing oblique mirror 65 which is suitably mounted in the enclosure 33. On the opposite side of the lens system 59 is a planar mirror, not shown, which reflects the light back through the lens system 59 in another direction to a downwardly facing oblique mirror 67 which is suitably mounted in the enclosure 33. The mirror 67 reflects the light from the lens system 59 through an aperture 69 formed in the bottom wall 71 of the enclosure 33 and onto the photoconductive surface of the copy paper 15.

When the image of the illuminated document 13 is projected onto the photoconductive surface of the copy paper 15, the uniform electrostatic charge is dissipated in proportion to the intensity of the image. The portions of the image corresponding to the lighter areas of the document 13 have a greater light intensity and hence are more effective in dissipating the electrostatic charge on the copy paper 15 than the portions of the image corresponding to the darker portions of the document 13. The carriage 33 moves past the window 21 at uniform speed, and as an elongated strip portion of the copy paper 15 is exposed to the projected image of a corresponding illuminated strip portion of the document 13, the electrostatic charge is dissipated sufficiently by the portions of the image corresponding to the lighter portions of the original document 13 to form

a latent electrostatic image of the document 13 on the surface of the copy paper 15.

To vary the exposure of the copy paper 15 to the projected image of the illuminated document 13, the carriage 33 is provided with a shutter 70 adjacent the aperture 69 in the bottom wall 71 of the carriage 33. The shutter 70 is pivotally secured to the carriage 33 and may be moved into the path of the light passing through the aperture 69 to reduce the amount of illumination being projected onto the photoconductive surface of the copy paper 15. Since the portions of the image corresponding to the marginal portions of the elongated illuminated strip portion of the document 13 have a greater light intensity than the central portion thereof, the end of the shutter 70 has a configuration to compensate for the uneven light intensity of the image being projected onto the copy paper 15.

Stray light is prevented from distorting the electrostatic image formed on the copy paper 15 by providing suitable light shielding means, for example, bellows 72, 74, which are attached to the front and back sides 34, 36 respectively of the carriage to cover the copy paper 15 and block any stray light in the projection compartment 19 from striking the photoconductive surface. In addition, mask 75 is provided adjacent the aperture 69 in the bottom wall 71 of the carriage 33 to prevent stray light inside the enclosure 33 from passing through the aperture 69 and striking the photoconductive surface of the copy paper 15.

To reduce the electrical power requirements needed to operate the machine 11, the illumination system 23 is placed as close to the window as possible to minimize the luminance that must be produced by the lamps associated with the illumination system 23 to provide the required uneven illumination of the document 13 for the copying process. The spacing between the illumination system 23 and the object window 21 is limited only by the possible scorching of the document 13 due to the heat produced by the illumination system 23 as well as the necessary mechanical clearance for locating the moving carriage 33 adjacent the upper portion of the housing 17. Furthermore, it is desirable that the illumination system 23 include a reflector system which concentrates the amount of light directed onto the portion of the document 13 being copied so as to further reduce the amount of illumination that must be produced by the lamps used in the illumination system 23.

However, to enable a page of a bound book to be copied by the machine 11, it is desirable to provide the machine 11 with a wall 77 extending downwardly from adjacent an edge 79 of the window 21 so that the portion of the page placed flat against the window 21 for copying may be maximized without the binding of the book pulling the adjacent portion of the page out of focus with the optical projection system. However, with the optical projection system 25 being movable past the window 21, the illumination system 23 is likewise movable past the window 21 and must be capable of illuminating the elongated strip portion of the window 21 being scanned by the optical projection system 25, including the edge portion 79 of the window 21 adjacent the downwardly extending wall.

It is desirable that the illumination system 23 be constructed with commercially available parts to reduce the cost of the machine 11. However, with the above-described limitation of a downwardly extending wall 77 adjacent the edge 79 of the window 21, which is re-

duced to a suitable minimum width, for example, $\frac{3}{8}$ inches, conventional illumination systems become unusable because the non-light radiating portions of the lamps as well as the electrical contacts associated therewith would normally extend a material distance beyond the edge 79 of the window 21, and the downwardly extending wall 77 restricts the distance the non-light radiating portions of the lamps and the electrical contacts may extend beyond the edge 79 of the window 21.

From the foregoing, it will be appreciated that it is desirable to have an illumination system which is capable of properly illuminating an elongated strip portion of the window 21, and yet be placed close to the window to minimize the amount of luminance that must be produced by the lamps, and hence the electrical power requirements of the photocopying machine. Furthermore, it will be appreciated that it is desirable that the lamps be arranged in the illumination system in such a manner that non-light radiating portions do not extend beyond the elongated length of the illuminated strip portion of the window, and that the illumination system 23 include a reflector system for concentrating the luminance from the lamps onto the portion being scanned by the optical projection system 25.

A preferred embodiment of an illumination system 23 constructed in accordance with the present invention is shown in FIGS. 2-6 and is mounted inside the box-like enclosure of the carriage 13. The illumination system 23 includes a light source means, generally indicated 81, for radiating light through the opening 61 in the top wall 63 of the enclosure 33 and a reflector assembly, generally indicated 83, for concentrating the light from the light source means 81 onto the elongated strip portion of the window 21 being scanned by the optical projection system 25.

To illuminate the portion of the window 21 being scanned in the manner diagrammatically shown in FIG. 3, the light source means 81 includes two commercially available, single-ended lamps 85, 87. As more particularly shown in FIG. 6, the lamp 85 has a tubular envelope 89 terminating a threaded base 91. The envelope 89 contains a filament 93 with a small light radiating portion 95 which typically produces the illustrated illumination intensity distribution curve 97. The lamp 87 is substantially identical to the lamp 85, and accordingly identical reference numerals have been placed on identical portions thereof. As can readily be seen, the lateral illumination produced by the lamps 85, 87 is greater than that produced at the longitudinal end of the envelope 89, and to maximize the light at the marginal portions of the window, the lamps 85, 87 are obliquely positioned in the box-like enclosure at a 45° angle relative to the window 21 so that the lateral illumination produced by the lamps 85, 87 will be directed toward the marginal portions of the window 21.

The light from the illumination system 23 is concentrated into an elongated strip portion by the reflector assembly which includes an elongated reflector 99 extending between the sides of the carriage 33 and having a cross-sectional configuration in the form of a conic section. As more particularly shown in FIGS. 2, 4 and 5, the reflector 99 has an elliptical cross-sectional configuration with a vertex 101 at the base 103 and a longitudinally extending focal point, generally indicated 104. An oblique bore 105 is formed in the base 103, and the lamp 85 is received through the bore 105 and

threaded into a threaded socket 109 which is secured to the base 103 of the reflector 99. The other lamp 87 is secured relative to the reflector 99 in the same manner as the lamp 85, and accordingly identical reference numerals have been placed on identical parts. The sockets 109 for the lamps 85, 87 are electrically connected by suitable means to an electrical connector 113 located externally of the carriage 33.

As shown in FIG. 2, the optical projection system 25 has an optical path indicated by the phantom lines extending from the window 21 to the photoconductive surface of the copy paper 15. The illumination system 23 is located outside the optical path of the optical projection system, with one side portion 99' of the elliptical reflector 99 engaging the top wall 63 of the carriage 33 while the other side portion 99'' of the reflector 99 extends to the optical path of the projection system 25. The portion 99'' of the elliptical reflector 99 serves to shield the light radiating portions 95 of the filaments 93 of the lamps 85, 87 from the oblique mirror 65 to prevent the image of the filament from being projected onto the copy paper. In addition, light shields 100, 102 are secured to the base 103 of the elliptical reflector 99 to prevent stray light from entering the enclosure 33 through the bores 105, 107 respectively, in the reflector 99.

To further increase the illumination at the marginal portions of the window 21, transverse reflectors 115, 117 respectively are secured to the sides of the carriage 33 at the ends of the elongated reflector 99 for reflecting light from the lamps 85, 87 respectively onto the marginal portions of the window 21. As more particularly shown in FIG. 5, the transverse reflectors 115, 117 obliquely intersect the longitudinally extending focal point of the elliptical reflector 99, for example, at a 45° angle with respect to the window, and transversely with respect to the lamps 85, 87 respectively. In addition, another reflector 119 is located on the other side of the optical path adjacent the opening 61 in the top wall 63 of the carriage 33 to further increase the intensity of the illumination across the entire window 21 and particularly at the marginal portions thereof.

Although the illumination system 23 constructed in accordance with the present invention illuminates the portion of the window 21 being scanned in a manner closely approximating that shown diagrammatically in FIG. 3, slight variations from this desired illumination of the window may be compensated for by providing an additional shutter adjacent the aperture 69 in the bottom wall 71 of the carriage 33. As more particularly shown in FIGS. 2 and 7, the mask 75 has a portion bent laterally toward the optical path of the optical projection system 25, and the end of the mask 75 may serve as a light baffle and have a configuration, as more particularly shown in FIG. 8, to compensate for any deviation in the desired illumination of the window 21.

Although the preferred embodiment of the invention has been shown with the copy paper 15 being transported past the exposure station 27 in the same direction as the motion of the carriage 33 carrying the illumination system 23 and the optical projection system 25, another embodiment of the invention is shown in FIG. 7, wherein the copy paper 15 is transported past the exposure station 27 in a direction transverse to the direction of movement of the carriage 33. In all other respects, the embodiment of the invention shown in FIG. 7 is identical to that shown in the previous figures, and

accordingly identical reference numerals have been placed on identical parts thereof.

While only a limited number of embodiments have been illustrated and described, it will be apparent to those skilled in the art the various modifications and improvements may be made without departing from the scope and spirit of the invention. Accordingly, it is to be understood that the invention is not to be limited by the illustrative embodiment, but only by the scope of the appended claims.

What is claimed is:

1. An illumination system for producing a non-uniform distribution of illumination intensity onto a window at an object plane comprising light source means for illuminating said window at said object plane, an elongated light reflector for reflecting light from said light source means onto the object plane, said light reflector having a longitudinally extending concave reflecting surface with a cross-sectional configuration in the form of the surface of a cylinder generated by translating a conic section along a line normal to said section, said section having a vertex and at least one focal point, said light source means having an elongated configuration whose longitudinal axis intersects the locus of the focus and locus of the vertex of said conic section as it is so translated at an oblique angle, said illumination system producing a non-uniform distribution of illumination onto said window at said object plane with the illumination intensity being produced at the marginal portions of said window corresponding to the ends of said light reflector being substantially greater than the illumination intensity being produced at the central portions of said window.

2. An illumination system according to claim 1, and further comprising a transverse reflector having a substantially planar reflecting surface for reflecting light from said elongated light source means onto the object plane, said planar reflecting surface being transverse to the plane extending through the vertex and the focal point of said elongated light reflector, and said planar reflecting surface obliquely intersecting said longitudinally extending focal point.

3. An illumination system according to claim 1, and further comprising a transverse reflector having a substantially planar light reflecting surface for reflecting light from said light source means onto the object plane, said transverse reflector being mounted on said elongated light reflector with said planar light reflecting surface being transverse to the plane extending through the vertex and the focal point of said elongated light reflector, and said planar light reflecting surface obliquely intersecting said longitudinally extending focal point transversely to the direction of elongation of said elongated light source means.

4. An illumination system according to claim 3, and further comprising a second transverse reflector having a substantially planar light reflecting surface for reflecting light from said light source means onto the object plane, said second transverse light reflector being mounted on said elongated light reflector in spaced relation from said other transverse reflector, said second planar light reflecting surface being transverse to the plane extending through said vertex and said focal point, and said second planar light reflecting surface obliquely intersecting the longitudinally extending focal point at substantially the same angle as said elon-

gated light source means intersects said longitudinally extending focal point.

5. An illumination system according to claim 1, and further comprising a second light source means for illuminating the object plane, said second light source means having an elongated configuration lying in the plane extending through said vertex and said focal point of said elongated light reflector, and said second elongated light source means obliquely intersecting said longitudinally extending focal point at an angle substantially transverse to the direction of elongation of said other elongated light source means.

6. An illumination system according to claim 5, and further comprising a transverse reflector having a substantially planar light reflecting surface for reflecting light from said elongated light source means onto the object plane, said planar light reflecting surface being mounted adjacent said elongated light source means and transverse to the plane extending through the vertex and the focal point of said elongated light reflector, said planar light reflecting surface obliquely intersecting said longitudinally extending focal point transversely to the direction of elongation of said elongated light source means, a second transverse reflector having a substantially planar reflecting surface for reflecting light from said second elongated light source means onto the object plane, said second planar light reflecting surface being mounted adjacent said second elongated light source means and transverse to the plane extending through the vertex and the focal point of said second elongated light reflector, and said second planar light reflecting surface obliquely intersecting said longitudinally extending focal point transversely to the direction of elongation of the said second elongated light source means.

7. An illumination system according to claim 1, and further comprising electrical terminal means mounted on an end of said elongated light source means, said elongated light reflector having an opening formed therethrough extending from the vertex of said light reflecting surface to a backside of said elongated light reflector, electrical contact means mounted on the backside of said elongated light reflector and adjacent said opening formed therethrough for receiving said electrical terminal means in electrical contact therewith, and said elongated light source means being partially received through the opening formed in said elongated light reflector and being supported therein by said electrical contact means engaging said electrical terminal means on the end of said elongated light source means.

8. In a photocopying machine, the combination comprising a window for supporting an object to be copied, an exposure station where copy paper is exposed to the image of the object to be copied, an illumination system for illuminating the object supported by the window, a projection system for projecting the image of the illuminated object onto the copy paper at the exposure station, said illumination system including light source means for illuminating the object supported by said window, an elongated light reflector for reflecting light from said light source means onto the object supported by said window, said light reflector having a longitudinally extending concave reflecting surface with a cross-sectional configuration in the form of the surface of a cylinder generated by translating a conic section along a line normal to said section; said light source means having an elongated configuration whose longi-

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tudinal axis intersects the locus of the focus and locus of the vertex of said conic section as it is so translated at an oblique angle, said projection system including an elongated planar reflecting surface adjacent said elongated light reflector and obliquely positioned beneath said window, and said elongated light reflector shielding said elongated planar reflecting surface of said projection system from direct illumination by said light source means.

9. In a photocopying machine according to claim 8, the combination further comprising a carriage for movement past said window, said carriage supporting said illuminating system and said projection system for

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movement therewith, said projection system including an aperture through which the image of the object is projected onto the copy paper at said exposure station, said illumination system producing an imperfect distribution of illumination intensity over said window, said aperture controlling the quantity of light passing there-through, and means located adjacent said aperture and extending into said path of light passing through said aperture for blocking a portion of the light to compensate for the imperfect illumination of said window by said illumination system.

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