Sept. 3, 1963 E. R. SABEL ET AL 3,102,449

XEROGRAPHIC MICROFILM ENLARGER

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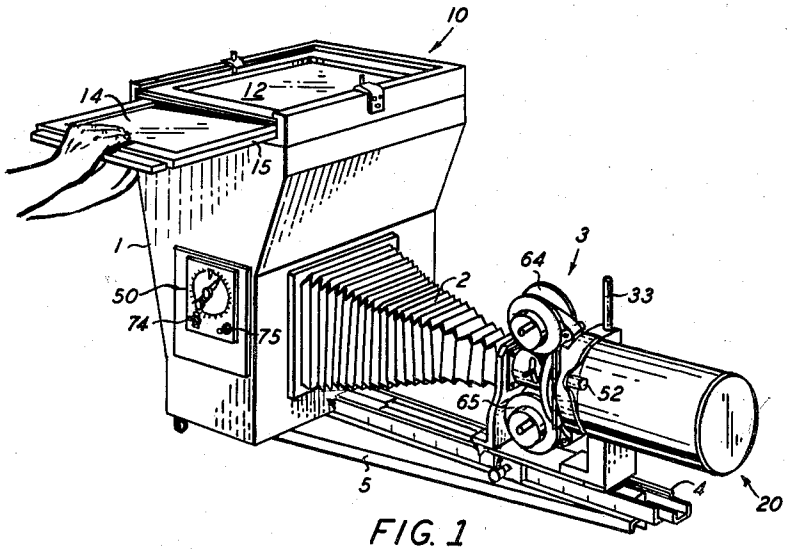


FIG. 1

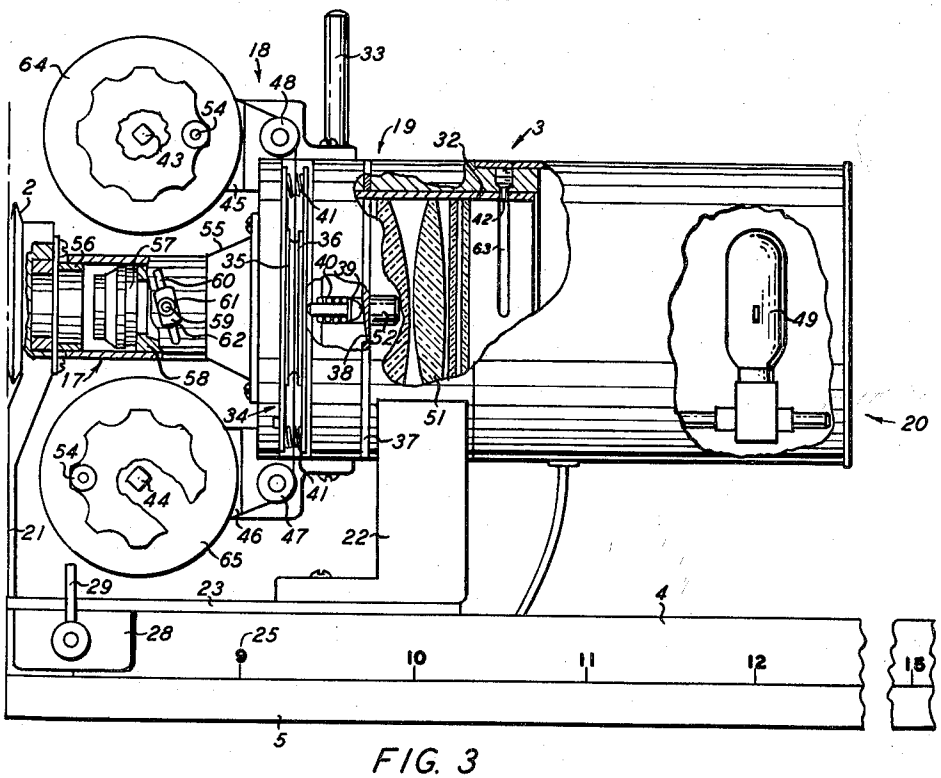


FIG. 3

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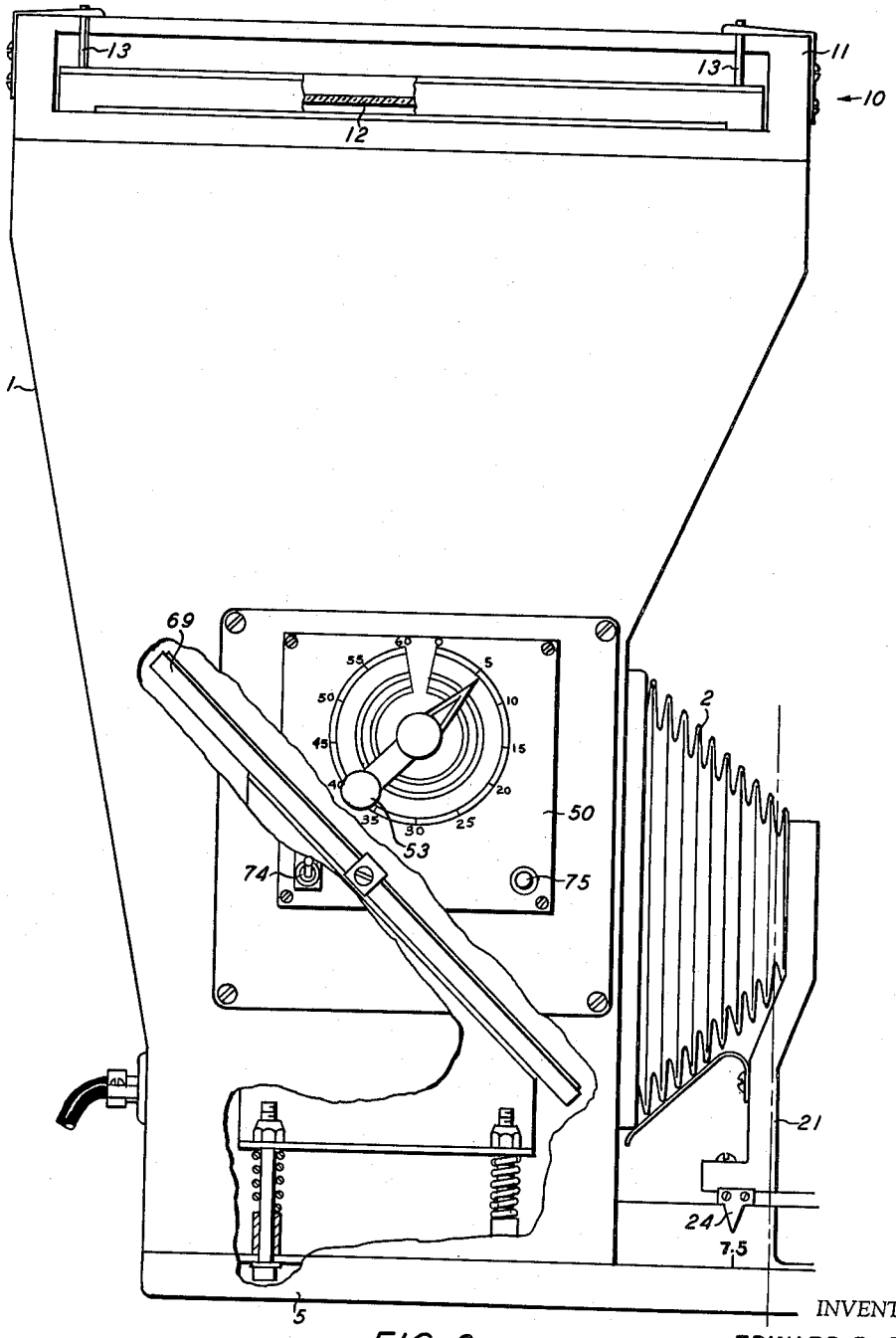


FIG. 2

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XEROGRAPHIC MICROFILM ENLARGER

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7 Claims. (Cl. 88—24)

This invention relates to xerography and particularly to improved apparatus for projecting a microfilm image at increased magnification onto an xerographic plate.

In the process of xerography, for example, as disclosed in Carlson Patent 2,297,691, issued October 6, 1942, a xerographic plate comprising a layer of photoconductive insulating material on a conductive backing is given a uniform electric charge over its surface and is then exposed to the subject matter to be reproduced, usually by conventional projection techniques. This exposure discharges the plate areas in accordance with the radiation intensity that reaches them, and thereby creates an electrostatic latent image on or in the photoconductive layer. Development of the latent image is effected with an electrostatically charged, finely divided material such as an electroscopic powder that is brought into surface contact with the photoconductive layer and is held thereon electrostatically in a pattern coresponding to the electrostatic latent image. Therefter, the developed xerographic powder image is usually transferred to a support surface to which it may be fixed by any suitable means.

Xerography has gained wide commercial success as a convenient and accurate method for the reproduction of copy, producing copy of high resolution. One of the virtues of xerography is its ability to reproduce copy onto a variety of support surfaces from most any original surface bearing image configurations capable of visual reproduction.

A variety of apparatuses for producing xerographic copy from microfilm have been developed and marketed typical of which is disclosed in copending application S.N. 796,561, filed March 2, 1959, in the name of S. R. Johanson, now U.S. Patent No. 3,049,968, issued Aug. 2, 1962. The apparatus therein disclosed is a form of automatic xerographic equipment that permits reproduction from continuously moving microfilm and offers a wide choice of magnification ratios at which the microfilm can be reproduced.

Another form of apparatus for reproducing from microfilm is disclosed in copending application Ser. No. 776,848, filed November 28, 1958, in the name of R. A. Hunt. In the latter copending application the apparatus thereof automatically and in seriatim reproduces from microfilm mounted on conventional record cards of the type widely used in record controlled accounting and tabulating systems. Typical microfilm cards of the type reproduced by the Hunt apparatus are disclosed in U.S. Patents 2,511,859; 2,512,106; and 2,598,022.

Both the Johanson and Hunt apparatuses have gained considerable favor among consumers having a substantially continuous need for reproducing from microfilm as would justify a relatively large expenditure for the relatively complex reproducing equipment. Typical users of this equipment are publishing houses or large manufacturing concerns as, for example, those which for convenience store volumes of engineering drawings on microfilm.

Whereas apparatuses of the type disclosed in the copending applications above-cited have proved successful commodities, their respective markets are limited to large concerns which financially can afford to own or lease the equipment and are able to fully utilize their purpose. However, many consumers could advantageously utilize apparatus to reproduce microfilm but are financially

unable to afford the above apparatuses or have only limited or occasional need to reproduce microfilm. Among these consumers are present owners of xerographic equipment of types as will be described below used for reproduction from opaque documents other than microfilm and who need only a complementing accessory to reproduce from microfilm. The above need is fulfilled with apparatus of the present invention which is an improved microfilm enlarger that is simple, efficient, compact and relatively less expensive than apparatus available heretofore. Additionally, since the need to reproduce microfilm exists among present users of xerographic equipment, versatility of their present equipment is thereby enhanced with the apparatus of the invention.

The principal object of the invention is improved apparatus to xerographically reproduce microfilm that is simple, efficient, compact and relatively less expensive than apparatus available heretofore.

This and other objects of the invention are attained by means of the apparatus of the invention.

A preferred embodiment of the invention is shown in the accompanying drawings in which:

FIG. 1 is a perspective view of the apparatus of the invention shown as for reproducing from microfilm supplied on a reel;

FIG. 2 is a side elevation of the enclosure and bellows portion of the invention partially broken away to facilitate understanding of its construction; and

FIG. 3 is a continuation of FIG. 2 being a side elevation of the projection unit of the invention partially broken away to facilitate understanding of its construction.

As in all xerographic systems based on the concept disclosed in the above cited Carlson patent, a xerographic plate having a photoconductive surface on a conductive backing is sensitized prior to exposure by means of a screened corona generating device which may be of a type disclosed in Mayo Patent U.S. 2,778,946 that has been marketed with a developing apparatus of the type disclosed in Sabal et al. Patent U.S. 2,600,580. After sensitizing, the plate is usually removed in a light-tight cassette, which may be of a type disclosed in Mayo Patent U.S. 2,619,418, to an exposure apparatus which for opaque originals may be of the type disclosed in Mayo et al. Patent U.S. 2,781,704. The cassette is inserted into the exposure apparatus after which the cover of the cassette is removed. Exposure of a radiation light image of copy to be reproduced discharges the photoconductive plate layer in the areas struck by radiation whereby there remains on the surface of the xerographic plate an electrostatic latent image in image configuration corresponding to the image exposed. After exposure the cover is reinserted into the cassette and the plate removed to a developing apparatus, which may be of a type referred to in the above-cited Sabel patent, in which a two-component developing material, which may be of a type disclosed in Walkup Patent U.S. 2,638,416, is cascaded over the plate surface.

After developing, the powder image is electrostatically transferred to a suitable support surface which may be of any convenient type such as paper by means of the corona generating device mentioned above. After transfer the support surface is placed in a suitable fusing device which may conveniently be a heat fuser of the type disclosed in Sabel et al. Patent 2,586,484 or a vapor fuser of the type disclosed in Carlson Patent U.S. 2,776,907 whereby the powder image is permanently affixed to the support surface.

After transfer the plate surface is cleaned and the cycle may be repeated. It is to be noted that the above xerographic apparatuses for charging, developing, trans-

fer and fusing have been extensively marketed and consumers having them can increasingly utilize them in connection with the microfilm exposure apparatus of the invention.

Referring more particularly to the drawings the apparatus of the invention is illustrated in FIG. 1 supported on a table surface at a height which is convenient for an operator to look down on the apparatus. As shown in FIG. 1 the apparatus is supported on base 5 and includes a light-tight housing 1, an extensible bellows 2, and a projection unit generally designated as 3 which is slidable in a horizontal plane on track 4.

For projecting a microfilm image the projection unit includes in operative relation (refer FIG. 3) an objective lens assembly generally designated as 17, a film support means generally designated as 18, a condenser lens 19 and a lamp assembly 20, all being supported on a pair of braces 21 and 22. The braces are joined by plate 23 which is supported for movement on track 4 so that the length of optical path between film in its support means and a xerographic plate in its holder described below, may be varied in accordance with a selected magnification ratio at which the microfilm image is to be reproduced.

For selected positioning of the projection unit in accordance with magnification ratio, track 4 is indexed with guide marks and numbers 25. The guide marks and numbers correspond to magnification ratios from 7.5 to 15 diameters, whereby alignment of pointer 24 (FIG. 2) opposite a guide mark effects proper length of the optical path for a magnification ratio corresponding to the numerical index of the mark. Detent unit 28 having suitable clamping means (not shown) and operable by handle 29, secures plate 23 to track 4 in a selected position.

Film support means 18 is arranged to support microfilm which may be on a continuous web or in a microfilm card of the above mentioned type in projection relation to the other elements hereof. The film support means is secured to condenser barrel 32 and may be rotated therewith by means of handle 33. Stop pin 42, protruding into slot 63 which extends over a 90° arc, limits the angular rotation of the condenser in either direction. The film support means includes a film holder 34 in which film is inserted between parallel glass closure means 35 and 36 which secure the film in front of apertures therein (not shown) in the optical path. The film holder is removable from the apparatus and for each size film to be reproduced and/or for microfilm cards a separate film holder may be provided. Generally, the film sizes most frequently used are 35 mm. and 16 mm. and it has been the practice to employ one size film holder for both sizes of film, permitting light to spill over the edges when using a 35 mm. holder for 16 mm. film. For placing film between the closures, adapter cam 37, arranged as a ring on the barrel, has a knob 52 by which the cam can be partially rotated on the barrel such that wedge-flats 38 permit pin 39 to be urged back by spring 40 to effect separation of closure 36 from 35 by the urgence of a pair of springs 41. After placing the film in the holder the adapter cam is rotated back securing the film between the closures.

When reproducing from microfilm cards, they are individually placed in a microfilm-card holder which is provided with suitable guides and stops for effecting proper alignment of the film relative to the apertures of the film support means. By using a non-positioning type of card holder, it is possible to enlarge a segment of the microfilm frame. This is done by scanning the frame until the segment desired shows on the ground glass. This section is then aligned and the card locked in position.

For reproducing from microfilm wound on a reel, such as illustrated, the supply reel is secured on either of shafts 43 or 44 which are rotatably secured to film support arms 45 and 46 respectively, with the take-up reel being secured to the other shaft. Assuming the supply reel to be on shaft 44, film is threaded around guide roll 47 through a film holder, as described above, around guide roll 48 and onto the take-up reel. Suitable means are provided for aligning the film as desired in the optical path, and by means of a handle 54 on both reels, the film can be advanced or indexed to the desired frame. It is to be noted here, as will be understood by those having knowledge of optics, that the projected image will experience image reversals by the optics of the apparatus described below so that in placing the film in the support means it must be placed to result in an electrostatic latent image on a xerographic plate reversed from the manner in which it is to appear on the support surface.

For illuminating an image on the microfilm the lamp assembly 20 includes a conventional type projection lamp 49 suitably supported in the assembly and supplied from a suitable potential source through automatic timer control 50 (shown on FIG. 2). The timer control includes a presettable time controller 53 and may be a standard commercially available type. The timer includes a single pole double throw switch that controls the light value. One pole provides full line voltage to the lamp for focusing and the other pole shunts the line through a resistor in the timed circuit for exposure. The illumination of the lamp is concentrated by the condenser lens 19 having lens elements 51.

Projection of a radiation image is effected by the objective lens assembly 17 which includes an outer light-tight sleeve 55 suitably supported between the film support means and hub 56 extending from brace 21. Within the sleeve, objective lens 57 is secured in lens barrel 58 and in preferred embodiment the lens has a focal length of 65 millimeters. Lever 59 is secured to the lens barrel through helixical slot 60 of the sleeve and for focusing the lens the lever is moved up or down in the slot. For convenience of gripping the lever, a knob 61 is secured thereon and an expansion spring 62 between the knob and the sleeve sustains the focused position.

The lens projects the image through extensible bellows 2 (FIG. 2) which is secured to envelop the openings (not shown) of brace 21 and housing 1. The image projected through the bellows strikes the reflecting surface of mirror 69, suitably supported within housing 1 at an angle which may be 45 degrees, and from the mirror the image is reflected upwards to either a xerographic plate 14 or ground glass 12 whichever is in place thereon as described below.

For supporting a xerographic plate in the apparatus, housing 1 includes a plate holder generally designated as 10. The holder has a frame 11 secured in light-tight relation to the housing and is adapted to support a ground-glass 12 which is held firmly down on the frame by yieldable detent means 13. For inserting a xerographic plate, the ground glass is raised against the resilience of its detent means (see also FIG. 1) and a xerographic plate in a cassette holder 15 is inserted therebelow whereby the plate's previously charged photoconductive surface can be exposed to the interior of the housing by removing the cassette cover. Without the xerographic plate in place, an image projected by the projection unit can be viewed on the ground glass before inserting the plate.

By means of the right angle projection path, the overall length of the unit is reduced and the focal plane is at a convenient height and position for ground glass reading. With this arrangement and for up to 15 diameter magnification, a unit can be fabricated having approximate dimensions of 48 inches long, 18 inches wide and 21 inches high.

In operation, microfilm on either a microfilm card, continuous strip or the like having an image to be reproduced is placed in the film support means having a film holder appropriate for the size film to be reproduced. Projection unit 2 is then moved on track 4 until pointer 24 aligns opposite an index guide mark 25 of a magnification ratio to be selected at which the image is to be reproduced. Through toggle switch 74 on timer 50, lamp 49 is illumi-

nated and the image projected may be viewed by the operator on ground glass 12. Lever 59 is moved in slot 60 to focus the lens 57 until the projected image on the ground glass appears in sharp outline. If desired, the image may be rotated through any angle up to 90° by rotating the optical system and the film support means by use of connecting handle 33. This allows for orienting an image either horizontally or vertically on the xerographic plate or any orientation therebetween.

The apparatus is then ready for exposure of the microfilm image to a xerographic plate. The lamp is turned off and a xerographic plate is sensitized by a corona generating device as described above. The sensitized plate is carried in a cassette and placed in plate holder 10 below the ground-glass after which the cassette cover plate is removed to expose the sensitized plate surface to the interior of housing 1. Energizing the timer through a push button 75 effects a time controlled radiation image exposure of the microfilm to the xerographic plate. After exposure, the cover plate is reinserted into the cassette and the xerographic plate removed to apparatus for developing the electrostatic latent image thus formed. The devevloped image is thereafter transferred and permanently affixed to a suitable support surface.

By the apparatus thus described there is disclosed an improved microfilm enlarger for projecting microfilm images at increased magnification ratio onto a xerographic plate by means of an apparatus that is compact, efficient and relatively less expensive than apparatus available heretofore.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Apparatus to project microfilm at an increased magnification ratio onto a previously removedly charged flat xerographic plate, including in combination a projection system, said projection system including in operative relation lamp means adapted to be connected to a potential source, a condenser lens, film support means closely spaced and integrally coupled to said condenser lens and arranged to support microfilm to be reproduced in a projection plane, said film support means including a film holding member removably interchangeable therein for holding film of different sizes or mounts, parallel spaced closure means operable to slideably receive said film holding means therebetween and secure the film thereat in the projection plane, and means to operate said closure means to effect separation and closure thereof whereby to receive and secure respectively a film holder containing film to be reproduced, and an adjustable objective lens capable of being foocused to film in the film support means; a box-like enclosure having xerographic plate holding means arranged to receive and support a previously removedly charged flat xerographic plate in a horizontal plane and in light-tight relation to the interior of said enclosure, an extensible bellows secured between the enclosure and said projection system to provide an extensible light-tight enclosure therebetween, and a reflective surface member secured within said enclosure and arranged to reflect an image projected from said projection system normally onto a xerographic plate in the plate holding means.

2. Apparatus to project microfilm onto a previously removedly charged flat xerographic plate at increased magnification ratio approximately within the range of 7½ to 15 diameters, including in combination horizontal support means, a projection system adapted for movement on said support means, said projection system including in operative relation lamp means adapted to be connected to a potential source, a condenser lens, film support means closely spaced and integrally coupled to said condenser lens and arranged to support microfilm to be reproduced

in a projection plane, said film support means including a film holding member removably interchangeable therein for holding film of different sizes or mounts, parallel spaced closure means operable to slideably receive said film holding means therebetween and secure the film thereat in the projection plane, and means to operate said closure means to effect separation and closure thereof whereby to receive and secure respectively a film holder containing film to be reproduced, and an adjustable objective lens capable of being focused to film in the film support means; a box-like enclosure having xerographic plate holding means arranged to receive and support a previously removedly charged flat xerographic plate in a horizontal plane and in light-tight relation to the interior of said enclosure, an extensible bellows secured between the enclosure and said projection system to provide an extensible light-tight enclosure therebetween, a reflective surface member secured within said enclosure and arranged to reflect an image projected from said projection system normally onto a xerographic plate in the plate holding means, an index on said support means correlated to projection distances for the range of said magnification ratios, and means to position said projection system on the support means relative to said index.

3. Apparatus to project microfilm at an increased magnification ratio onto a previously removedly charged flat xerographic plate, including in combination a projection system adapted for movement in a horizontal plane, said projection system including lamp means adapted to be connected to a potential source, a condenser lens, film support means closely spaced and integrally coupled to said condenser lens and arranged to support microfilm to be reproduced in a projection plane, said film support means including a film holding member removably interchangeable therein for holding film of different sizes or mounts, parallel spaced closure means operable to slideably receive said film holding means therebetween and secure the film thereat in the projection plane, and means to operate said closure means to effect separation and closure thereof whereby to receive and secure respectively a film holder containing film to be reproduced, and an adjustable objective lens capable of being focused to film in the film support means; a box-like enclosure having means selectively to support a ground-glass in a horizontal plane for viewing a projected image to be reproduced or to receive and support a previously removedly charged flat xerographic plate in the plane of said glass and in light-tight relation to the interior of said enclosure, said last recited means including yieldable detent means urging said ground glass into said viewing position and displacable for supporting a xerographic plate between the ground glass and said enclosure, an extensible bellows secured between the enclosure and said projection system to provide an extensible light-tight enclosure therebetween, a mirror secured within said enclosure having its mirrored surface arranged to reflect an image projected from said projection system normally onto a xerographic plate in the plate holding means, and means to position said projection system at a distance from said enclosure correlated to the ratio at which magnification is to be effected.

4. Apparatus to project microfilm at increased magnification ratio onto a previously removedly charged flat xerographic plate, including in combination a projection system adapted for sliding movement in a horizontal plane, said projection system including in operative relation lamp means adapted to be connected to a potential source, a condenser lens, film support means closely spaced and integrally coupled to said condenser lens and adapted to support microfilm to be reproduced vertically in a projection plane, said film support means including a film holding member removably interchangeable therein for holding film of different sizes or mounts, parallel spaced closure means operable to slideably receive said film holding means therebetween and secure the film thereat in the projection plane, means to operate said closure means to

effect separation and closure thereof whereby to receive and secure respectively a film holder containing film to be reproduced, and means to rotate said film support means through an angle of rotation whereby to dimensionally orient the film therein to the dimensions of a xerographic plate on which it is to be projected, and an adjustable objective lens capable of being focused to film in the film support means; a box-like enclosure having xerographic plate holding means arranged to receive and support a previously externally charged flat xerographic plate in a horizontal plane and in light-tight relation to the interior of said enclosure, an extensible bellows secured between the enclosure and said projection system to provide an extensible light-tight enclosure therebetween, and a mirror secured within said enclosure having its mirrored surface arranged to reflect an image projected from said projection system normally on to a xerographic plate in the plate holding means.

5. Apparatus to project microfilm at increased magnification ratio onto a previously removedly charged flat xerographic plate, including in combination a projection system adapted for movement in a horizontal plane, said projection system including in operative relation lamp means adapted to be connected to a potential source, a condenser lens, film support means closely spaced and integrally coupled to said condenser lens and which interchangeably accommodates microfilm web or microfilm cards with images to be reproduced and arranged to support microfilm of either type interchangeably in a projection plane, said film support means including a film holding member removably interchangeable therein for holding either web or card mounted film of different sizes, parallel spaced closure means operable to slideably receive said film holding means therebetween and secure the film thereat in the projection plane, and means to operate said closure means to effect separation and closure thereof whereby to receive and secure respectively a film holder containing film to be reproduced, and an adjustable objective lens capable of being focused to film in the film support means; a box-like enclosure having xerographic plate holding means arranged to receive and support a previously removedly charged flat xerographic plate in a horizontal plane and in light-tight relation to the interior of said enclosure, an extensible bellows secured between the enclosure and said projection system to provide an extensible light-tight enclosure therebetween, and a reflective surface member secured within said enclosure and arranged to reflect an image projected from said projection system normally onto a xerographic plate in the plate holding means.

6. Apparatus to project microfilm at an increased magnification ratio onto a previously removedly charged flat xerographic plate, including in combination a projection system, said projection system including in operative relation lamp means adapted to be connected to a potential source, a condenser lens, film support means closely spaced and integrally coupled to said condenser lens and arranged to support microfilm to be reproduced in a projection plane, said film support means including a film holding member removably interchangeable therein for holding film of different sizes or mounts, parallel spaced closure means operable to slideably receive said film holding means therebetween and secure the film thereat in the projection plane, and means to operate said closure means to effect separation and closure thereof whereby to receive and secure respectively a film holder containing film to be reproduced, and an adjustable objective lens capable of being focused to film in the film support means; a box-like enclosure having xerographic plate holding means arranged to receive and support a previously removed charged flat xerographic plate in a plane angularly displaced from the plane of film in its support means and in light-tight relation to the interior of said enclosure, an extensible bellows secured between the enclosure and said projection system to provide an extensible light-tight enclosure therebetween, and a reflective surface member secured within said enclosure and arranged to reflect an image projected from said projection system normally onto a xerographic plate in the plate holding means.

7. Apparatus according to claim 6 in which the angular displacement of the plane of the xerographic plate in the plate holding means is substantially 90° from the plane of film in its support means.

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