

[54] **COMBINED READING AND ENLARGING APPARATUS FOR MICROFILM**[75] Inventors: **Erwin Kohn**, Anzing; **Horst Bickl**, Pullach; **Josef Pfeifer**, Unterhaching; **Hans-Joachim Schrecke**, Puchheim, all of Germany[73] Assignee: **AGFA-Gevaert Aktiengesellschaft**, Leverkusen, Germany[22] Filed: **Jan. 10, 1972**[21] Appl. No.: **216,435**[30] **Foreign Application Priority Data**

Jan. 9, 1971 Germany.....P 21 00 903.0

[52] **U.S. Cl.**..... **355/45, 355/27**[51] **Int. Cl.**..... **G03b 13/28**[58] **Field of Search**..... **355/3, 45, 27; 95/89, 94**[56] **References Cited****UNITED STATES PATENTS**

3,442,254	5/1969	Akiyama.....	118/637
3,183,768	5/1965	Rosenburgh.....	355/45
3,511,564	5/1970	Gawin.....	355/3
3,100,432	8/1963	Limberger.....	95/89
3,500,734	3/1970	Lewis.....	95/94

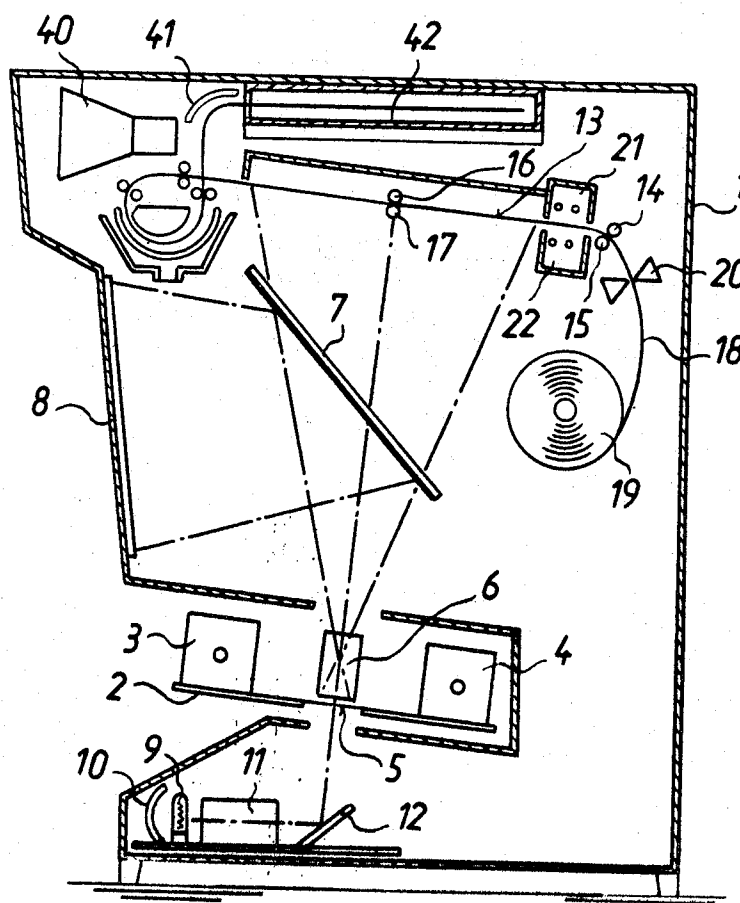
Primary Examiner—John M. Horan

Attorney—Michael S. Striker

[57]

ABSTRACT

A combined reading and enlarging apparatus for microfilm wherein the screen of the reader is located in the front wall and the enlarger is mounted in the upper portion of the housing. The enlarger employs guide rolls which transport freshly cut sheets of ZnO paper in a horizontal plane wherein the sheets are exposed to light passing through that frame of microfilm whose image is projected onto the screen, and thereupon along a looped path spaced sections of which intersect each other and wherein the freshly exposed sheets travel through a developing liquid confined in a tank and filling a gradually widening passage between the concave internal surface of the tank and the convex surface of a developing electrode. The length of that portion of the path which extends from and back to the point of intersection between the spaced sections of the path exceeds the length of a sheet, and the sheets which leave the tank to travel toward the point of intersection move upwardly to facilitate the removal of developing liquid. Each freshly exposed, developed and dried sheet is caused to slide along an inclined discharging surface to emerge through an outlet in a side wall of the housing. An intermediate section of the path wherein the sheets advance during travel through the developing liquid is configured in such a way that the image-bearing sides of the sheets face the convex surface of the electrode and, a nozzle of the enlarger discharges developing liquid onto such sides of the sheets to keep them out of contact with the electrode.

12 Claims, 2 Drawing Figures

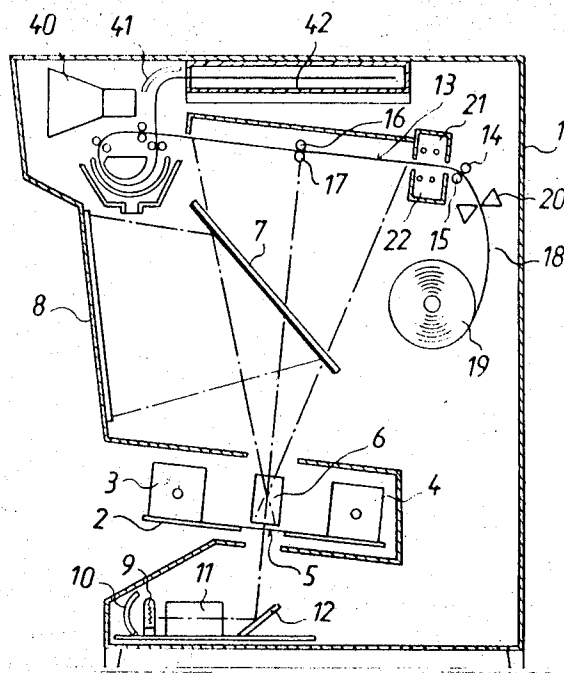


Fig. 1

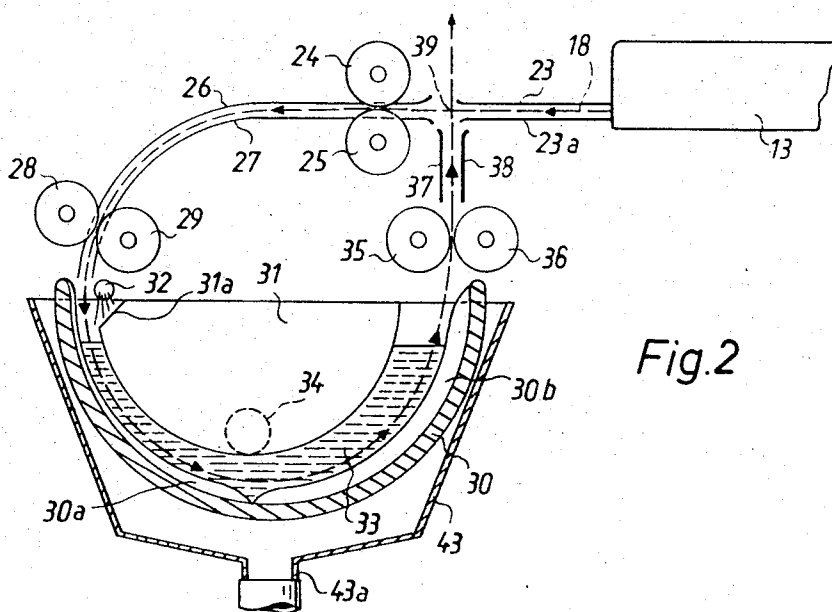


Fig. 2

COMBINED READING AND ENLARGING APPARATUS FOR MICROFILM

BACKGROUND OF THE INVENTION

The present invention relates to improvements in readers and enlargers for microfilm, and more particularly to improvements in combined reading and enlarging apparatus for microfilm.

It is already known to mount the reader of a combined microfilm reading and enlarging apparatus in the lower part of a housing with the exception of the screen which is preferably installed in the front part of the housing, and to install the enlarger in the upper portion of the housing. Such distribution of parts results in a very compact housing and enables the user to gain unimpeded access to the supply of microfilm as well as to the means for guiding and transporting the microfilm across the path of projection light. The enlargers of such conventional apparatus normally employ a tank wherein the freshly exposed image-bearing sheets are subjected to the action of a developing liquid. A drawback of such constructions is that the sensitive surface of an exposed sheet invariably contacts the internal surface of the tank during transport through the developing liquid so that the sheets are likely to be scratched or otherwise defaced with the result that the image on a sheet is improperly developed or otherwise damaged. If the enlarger operates as an electrostatic copier, the contact between the tank and the sheet can result in partial destruction of the enlarged image of a microfilm frame due to non-uniform destruction of the electrostatic charge and to a blurring or removal of toner particles which fail to properly adhere to the sheet.

SUMMARY OF THE INVENTION

An object of the invention is to provide an improved combined reading and enlarging apparatus for microfilm, and more particularly to provide a novel and improved enlarger for use in such apparatus.

Another object of the invention is to provide in an apparatus of the above outlined character an enlarger wherein freshly exposed image-bearing sheets are transported through the developing material in such a way that their image-bearing surfaces are unlikely to be scratched or otherwise damaged.

A further object of the invention is to provide novel and improved guide means for guiding sheets of exposed imagebearing flexible material in the enlarger of a combined reading and enlarging apparatus for microfilm.

An additional object of the invention is to provide the apparatus with novel means for discharging exposed and developed sheets from the housing in an optimum position for removal by the person in charge.

A further object of the invention is to provide a combined reading and enlarging apparatus for microfilm wherein the enlarger occupies less room than and is superior to presently known enlargers.

The invention is embodied in a combined reading and enlarging apparatus for microfilm which comprises a housing, a reader mounted in the housing and having a preferably at least substantially vertical screen positioned in the front portion of the housing to receive enlarged microfilmed images, and a novel enlarger which is preferably mounted in the upper portion of the housing and comprises first guide means for maintaining image-receiving sheets (such as parts of ZnO paper) of

predetermined length in a predetermined plane which is preferably at least substantially horizontal so that a sheet located in such plane can be exposed to light passing through a microfilm whose image is projected onto the screen. The enlarger further comprises second guide means which defines for exposed sheets an elongated looped path having a preferably at least substantially horizontal or downwardly inclined first section which receives exposed sheets from the aforementioned plane, an arcuate second section which preferably extends along an arc of at least 180°, and a preferably straight upwardly extending third section which crosses the first section. The length of the path from and back to the point of intersection between the first and third sections at least equals but preferably exceeds the length of a sheet and the enlarger further comprises a vessel adjacent to the second section of the path and means for maintaining in the vessel a supply of preferably liquid developing material through which the exposed sheets pass during travel through the second section. The aforementioned plane is preferably located above the screen and the reader comprises additional components which are preferably mounted in the lower portion of the housing. Such additional components may include a partly light transmitting mirror which reflects some oncoming light which has passed through a microfilm frame onto the screen and allows the remaining light to pass therethrough and to impinge on one side of a sheet in the aforementioned plane.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a longitudinal vertical sectional view of a combined reading and enlarging apparatus for microfilm which embodies the invention; and

FIG. 2 is an enlarged fragmentary partly elevational and partly vertical sectional view of the enlarger in the apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, the apparatus comprises a housing 1 the lower portion of which accommodates a platform 2 for microfilm 5. The platform 2 is turnable in the housing 1 through at least 90° so as to allow for observation of microfilm frames in upright or horizontal position, and carries a supply cassette 3 and a takeup cassette 4 for microfilm 5. The latter is in the form of a strip or web which is being withdrawn from the cassette 3 and collected by the takeup cassette 4 in response to actuation of a manually or motorically operated transporting mechanism of any known design. The image of that frame of the microfilm 5 which registers with a gate 1a in the lower portion of the housing 1 is projected onto a substantially vertical screen 8 in the front wall of the housing 1 by means of a projector which includes a projection lamp 9 in the lower portion of the housing 1, a reflector 10 behind the lamp 9, a condenser 11, a deflecting mirror 12, an objective lens system 6 and a partially reflecting mirror 7. The hereto-

fore described components constitute the reader of the apparatus which, save for the mirror 7 and screen 8, is mounted in the lower portion of the housing 1.

That portion of light which is directed by the mirror 12 through the film frame in registry with the gate 1a and passes through the partially reflecting mirror 7 impinges upon a sheet 18a of recording material 18 in a substantially horizontal plane 13 located in the upper portion of the housing 1 above the level of the screen 8. The underside of the sheet 18a in the plane 13 is coated with ZnO and such sheet is transported by first advancing and guide rolls 14, 15 and 16-17. The sheet 18a is obtained by severing it from the leading end of a web of recording material 18 which is stored in the form of a roll 19 and passes between the knives of a severing device or cutter 20 on its way toward the first pair of advancing and guide rolls 14, 15. These rolls are located immediately upstream of a twin corotron 21, 22 or an analogous charging device which provides the surface of the freshly formed sheet 18a with the charge necessary for the electrostatic copying operation. The projection lamp 9 is preferably turned off during transport of the sheet 18a into the plane 13, and the lamp 9 is thereupon turned on for a short interval of time so as to provide the underside of the sheet 18a in the plane 13 with a latent image of the film frame in the gate 1a. The sheet 18a is at a standstill during the making of such latent image. The rolls 14-17 constitute a first guide means of the enlarger which serves to transport sheets 18a toward and in the plane 13.

A sheet 18a which has been moved beyond the plane 31 by the second pair of advancing and guiding rolls 16, 17 thereupon enters a novel developing station of the enlarger the details of which are shown in FIG. 2. A looped path P for the sheet 18a which carries a latent image of a film frame is defined by a composite second guide means of the enlarger which includes a first pair of guides 23, 23a which define an elongated straight path section and direct the leader of the sheet 18a into the nip of two advancing rolls 24, 25. The guides 23, 23a are followed by a second pair of guides 26, 27 which define an arcuate path section for the sheet 18a and direct the leader of the sheet into the nip of two further advancing rolls 28, 29. A portion of the path section defined by the guides 26, 27 extends along an arc of about 90°. The leader of the sheet 18a which emerges from the arcuate path section defined by the guides 26, 27 thereupon enters a substantially semicircular developing vessel or tank 30. The concave internal surface of the tank 30 is provided with narrow distancing ribs 30a, 30b which prevent the major portion of the underside of the sheet 18a from coming into direct contact with such concave surface.

The tank 30 accommodates a substantially semicircular developing electrode 31 which defines therewith an arcuate path section or passage 131 which extends along an arc of about 180° and whose cross-sectional area (width) increases in the direction of travel of the sheet 18a, i.e., in a counterclockwise direction, as viewed in FIG. 2. Such configuration of the path section or passage 131 can be readily achieved by eccentric mounting of the electrode 31 in the tank 30. At the inlet end of the passage 131, namely, immediately or closely downstream of the advancing rolls 28, 29, there is provided in the housing 1 a spray nozzle 32 which sprays into the passage 131 a suitable liquid developing material 33, such liquid being recirculated by any suit-

able pumping device of known design and not forming part of the invention. The arrangement is preferably such that the liquid-discharging orifice or orifices of the spray nozzle 32 direct streamlets of liquid developing material 33 against an inclined surface 31a of the developing electrode 31 whereby the surface 31a causes the liquid to trickle into the inlet end of the passage 131. The aforementioned pumping device draws fluid from the passage 131 and/or from a receptacle 43 which receives overflowing liquid from such passage. The liquid which flows in the passage 131 between the concave (image-bearing) upper side of the sheet 18a and the convex underside of the developing electrode 31 invariably prevents adherence of the sheet to the electrode to thus reduce the likelihood of damage to the sensitive coating of the sheet 18a. The drawing shows a suction port 34 which is provided in the rear side wall of the tank 30 (as viewed in FIG. 2) and through which the aforementioned pumping device draws developing liquid 33 for recirculation to the spray nozzle 32. An important advantage of the gradually diverging path section or passage 131 for the sheets 18a between the tank 30 and electrode 31 is that the toner first contacts the sheet 18a in immediate proximity of the electrode 31 (namely, in the region where the convex side of the electrode is nearest to the concave side of the tank 30) to thus reduce the likelihood of the so-called edge effect. Also, a larger quantity of developing liquid 33 is available for the final developing stage in the passage 131. The gradually diverging passage 131 further reduces the likelihood of jamming of sheets 18a between the tank 30 and developing electrode 31.

As the leader of a freshly developed sheet 18a emerges from the liquid bath in the passage 131, it is caused to advance substantially vertically into the nip of two advancing and squeezing rolls 35, 36 which cause it to pass between two additional guides 37, 38 defining the lowermost portion of a substantially vertical path section which crosses (substantially at an angle of 90° the path section defined by the guides 23, 23a and 26, 27 immediately downstream of the plane 13. Thus, the path P of the sheets 18a includes two substantially straight sections which cross each other at 39 and are connected to each other by an intermediate section extending along an arc of at least 180°. The severing device 20 is operated at such intervals that the length of a sheet 18a (at least as considered in the direction of travel of the sheet through the enlarger in the upper portion of the housing 1) is less than the length of that part of the path which is defined by the guides 26, 27, ribs 30a, 30b and guides 37, 38 from the point 39 of crossing and back to such point. Thus, the trailing end of a freshly exposed sheet 18a which has entered the path section defined by the guides 26, 27 cannot interfere with upward movement of the leading end of the same sheet toward and beyond the point 39. An advantage of such guidance of the sheet 18a that its leader moves substantially vertically upwardly after emerging from the liquid bath in the passage 131 is that the liquid which is squeezed off by the advancing rolls 35, 36 can readily return into the passage 131 to be recirculated to the spray nozzle 32. Moreover, a substantial quantity of liquid can flow off the freshly developed portion of a sheet 18a even before such portion reaches the nip of the rolls 35, 36.

The sheet 18a which advances upwardly beyond the crossing point 39 is deflected by the concave surface of a sheet metal guide 41 which is located immediately downstream of a blower 40 for hot air and directs the freshly dried sheet 18a onto a preferably inclined discharging surface 42 whereon the sheet can slide sideways (i.e., forwardly or rearwardly, as viewed in FIG. 1) so that one of its lateral edges emerges through a suitable preferably slot-shaped outlet (not shown) in the corresponding side wall of the housing 1 and can be readily grasped by fingers for withdrawal from the apparatus. The path section wherein the sheet 18a is heated and dried by the current of hot air furnished by the blower 40 is preferably short. The inclination of the discharging surface 42 is preferably sufficient to insure that the freshly developed and dried sheet 18a can slide therealong by gravity; for example, the surface 42 can direct the sheet 18a onto a substantially horizontal supporting surface whereon the sheet remains until removed by the person wishing to obtain an enlarged print of the microfilm frame which registers with the gate 1a. The outlet for developed and dried sheets 18a is preferably located at that side of the housing 1 which is readily accessible to the operator.

FIG. 2 further shows that the tank 30 is surrounded by the aforementioned receptacle or outer tank 43 which serves to intercept eventually overflowing or splashing developing liquid 33 and is provided with a liquid discharging pipe 43a serving to return the intercepted liquid into the range of the pumping device which draws liquid from the tank 30 by way of the port 34.

The exact manner in which the rolls 14-17, 24-25, 28-29 and 35-36 are intermittently driven, in which the severing device 20 derives motion, and in which the aforementioned pumping device is operated to recirculate the liquid 33 forms no part of this invention. The aforementioned second guide means of the enlarger which defines the path P can be said to include the guides 23-23a, 26-27, 37-38, the advancing rolls 24-25, 28-29, 35-36 and the ribs 30a, 30b.

An important advantage of the improved apparatus is that at least the majority of components of the reader are mounted in the lower portion of the housing 1 and that the enlarger is mounted in the upper portion of the housing, preferably at a level above the substantially vertical screen 8 which is positioned in the front wall of the housing 1 so as to receive images of microfilm frames in the gate 1a. Such distribution of parts in the housing 1 insures that the parts occupy a minimum of space, i.e., that they can be accommodated in a compact housing, and that all parts which must be manipulated, inspected or replaced are readily accessible to the operator. This applies in particular for the platform 5 which carries the microfilm-containing cassettes 3 and 4.

The advantages of the improved enlarger in the upper portion of the housing 1 can be summarized as follows: The second guide means which defines the path P insures that the sensitive sides of the freshly exposed sheets 18a face upwardly and away from the concave internal surface of the tank 30 during travel through the liquid-filled passage 131. Since the length of the path P from and back to the point 39 of intersection between the first and third path sections at least equals the length of a sheet 18a (as considered in the direction of transport of the sheet), the trailing end of

a sheet which has entered the path P cannot interfere with movement of the leading end of the same sheet into the range of the heating and drying device 40. The guide means which defines the path P occupies a relatively small amount of space because the first and third path sections cross each other. The flexing of exposed sheets 18a during transport along the path P (namely, in the arcuate intermediate section of such path) in a direction transversely of the movement of sheets produces a highly desirable stabilizing action. Moreover, such flexing reduces the likelihood of sidewise displacement of sheets 18a in the path P. As mentioned above, the sheet portions moving upwardly in the third section of the path P are relieved of a substantial percentage of surplus moisture by gravity flow even before they reach the nip of the advancing and squeezing rolls 35, 36. The final drying action is carried out by currents of hot air furnished by the blower 40. The electrode 31 may be a hollow trough-shaped body. The provision of the inclined discharging surface 42 renders it possible to evacuate freshly developed dried sheets 18a without any flexing and in a very small area whereby the thus discharged sheets 18a can be automatically stacked on top of each other or removed by hand as soon as they emerge from the aforementioned outlet in a side wall of the housing 1.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by letters Patent is set forth in the appended claims:

1. In a combined reading and enlarging apparatus for microfilm, a combination comprising a housing having a front portion and an upper portion; a reader mounted in said housing and having a screen positioned in said front portion to receive enlarged microfilmed images; and an enlarger including first guide means mounted in said upper portion of said housing for maintaining image-receiving sheets of predetermined length in a predetermined plane for exposure of such sheets to light passing through microfilm whose image is being projected onto said screen, second guide means mounted in said upper portion of said housing and defining for exposed sheets in said housing an elongated looped path having a first section which receives exposed sheets from said plane, an arcuate second section and an upwardly extending third section intersecting said first section, the length of said path from and back to the point of intersection between said first and third sections being at least equal to said predetermined length, a vessel adjacent to said second section, means for maintaining in said vessel a supply of developing material through which exposed sheets pass during travel along said second section, each exposed sheet having an image-bearing side which faces away from said vessel during travel of exposed sheets along said second section of said path, and developing electrode means adjacent to said second section of said path opposite said vessel, said means for maintaining in said vessel a supply of developing material comprising noz-

zle means arranged to discharge onto said image-bearing sides a liquid developer.

2. A combination as defined in claim 1, wherein said screen is located in a substantially vertical plane and said predetermined plane is substantially horizontal.

3. A combination as defined in claim 2, wherein said predetermined plane is located at a level above said screen and said housing further comprises a lower portion, said reader further comprising a light source and optical elements mounted in said lower portion.

4. A combination as defined in claim 1, wherein said first and third sections of said path are substantially straight and said second section extends along an arc of at least 180°.

5. A combination as defined in claim 1, further comprising a supply of ZnO paper in said housing, and means for severing such paper to thus form said image-receiving sheets.

6. A combination as defined in claim 5, further comprising means for electrostatically charging said paper upstream of said predetermined plane.

7. A combination as defined in claim 1, wherein the width of at least a portion of said second section of said path increases in the direction toward said third section.

8. A combination as defined in claim 7, wherein said portion of said second section is flanked by the internal surface of said vessel and a convex surface of said electrode means.

9. A combination as defined in claim 1, wherein further comprising means for removing liquid from exposed and developed sheets in said third section of said path.

10. A combination as defined in claim 1, further comprising means for receiving exposed and developed sheets downstream of said third section of said path.

11. A combination as defined in claim 1, wherein

each of said guide means comprises pairs of intermittently driven rollers.

12. In a combined reading and enlarging apparatus for microfilm, a combination comprising a housing having a front portion and an upper portion; a reader mounted in said housing and having a screen positioned in said front portion to receive enlarged microfilm images; and an enlarger including first guide means mounted in said upper portion of said housing for maintaining image-receiving sheets of predetermined length in a predetermined plane for exposure to such sheets to light passing through microfilm whose image is being projected onto said screen, second guide means mounted in said upper portion of said housing and defining for exposed sheets in said housing an elongated looped path having a first section which receives exposed sheets from said plane, an arcuate second section and an upwardly extending third section intersecting said first section, the length of said path from and back to the point of intersection between said first and third sections being at least equal to said predetermined length, a vessel adjacent to said second section, means for maintaining in said vessel a supply of developing material through which exposed sheets pass during travel along said second section, and developing electrode means extending into said vessel so that exposed sheets advancing along said second section of said path pass between said vessel and said electrode means, said electrode means having a convex surface facing said second section of said path and said means for maintaining in said vessel a supply of developing material comprising nozzle means for discharging liquid developer between said convex surface and said vessel, each exposed sheet having an image-bearing side which faces away from said vessel during travel of exposed sheets along said second section of said path.

* * * * *

40

45

50

55

60

65