United States Patent

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[54] **RECORDING APPARATUS**
4 Claims, 8 Drawing Figs.

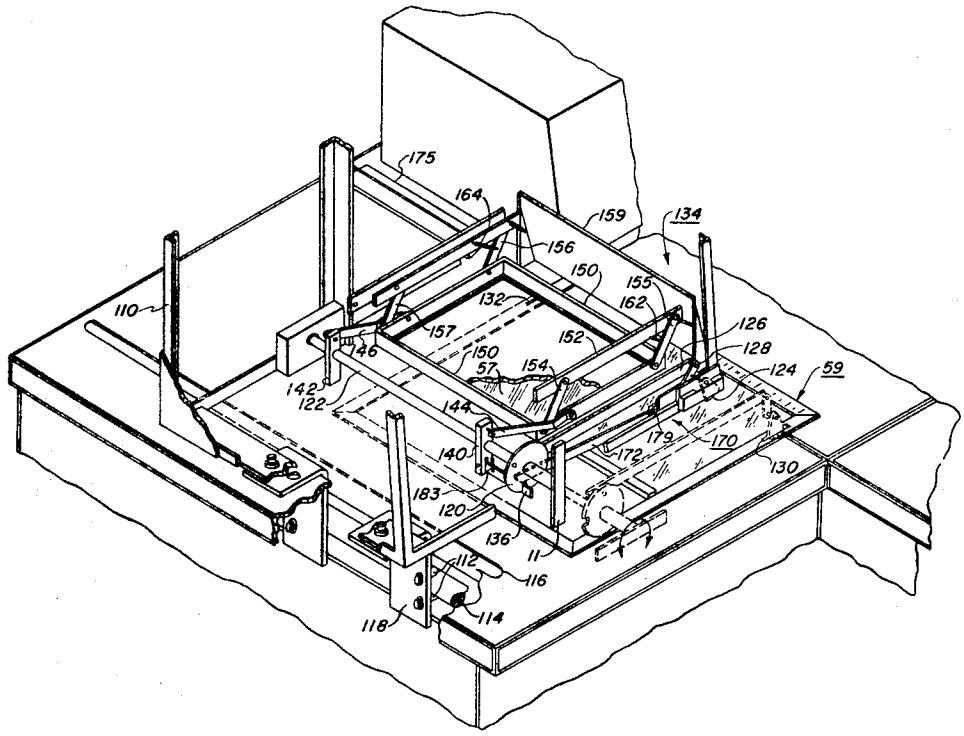
[52] **U.S. Cl.** **355/11,** 355/3, 355/45, 355/60, 355/66
[51] **Int. Cl.** **G03g 15/04**
[50] **Field of Search** 355/3

[56] **References Cited**
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ABSTRACT: Recording apparatus which reproduces enlarged copies of microfilm and/or document material by controlling the position of a reader screen and a lens-positioning assembly in relation to a copier platen. The lens-positioning assembly includes a fixed frame and a movable frame supported from the fixed frame for swinging a lens member toward and away from the focal plane of the apparatus. Control apparatus including sensing devices are used to position the lens member into and out of the focal plane according to whether the recording apparatus is used in the microfilm or document copying mode of operation.



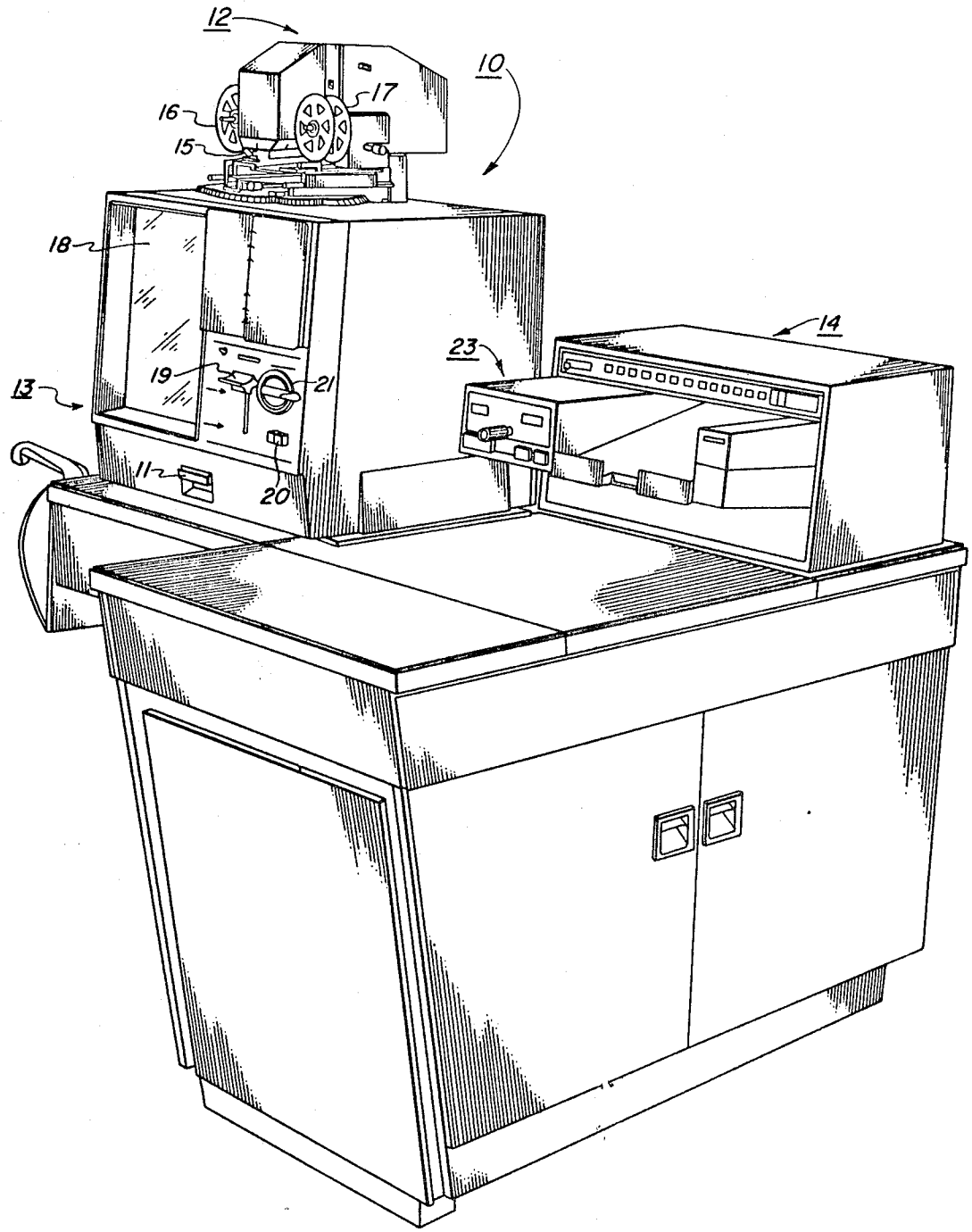


FIG. 1

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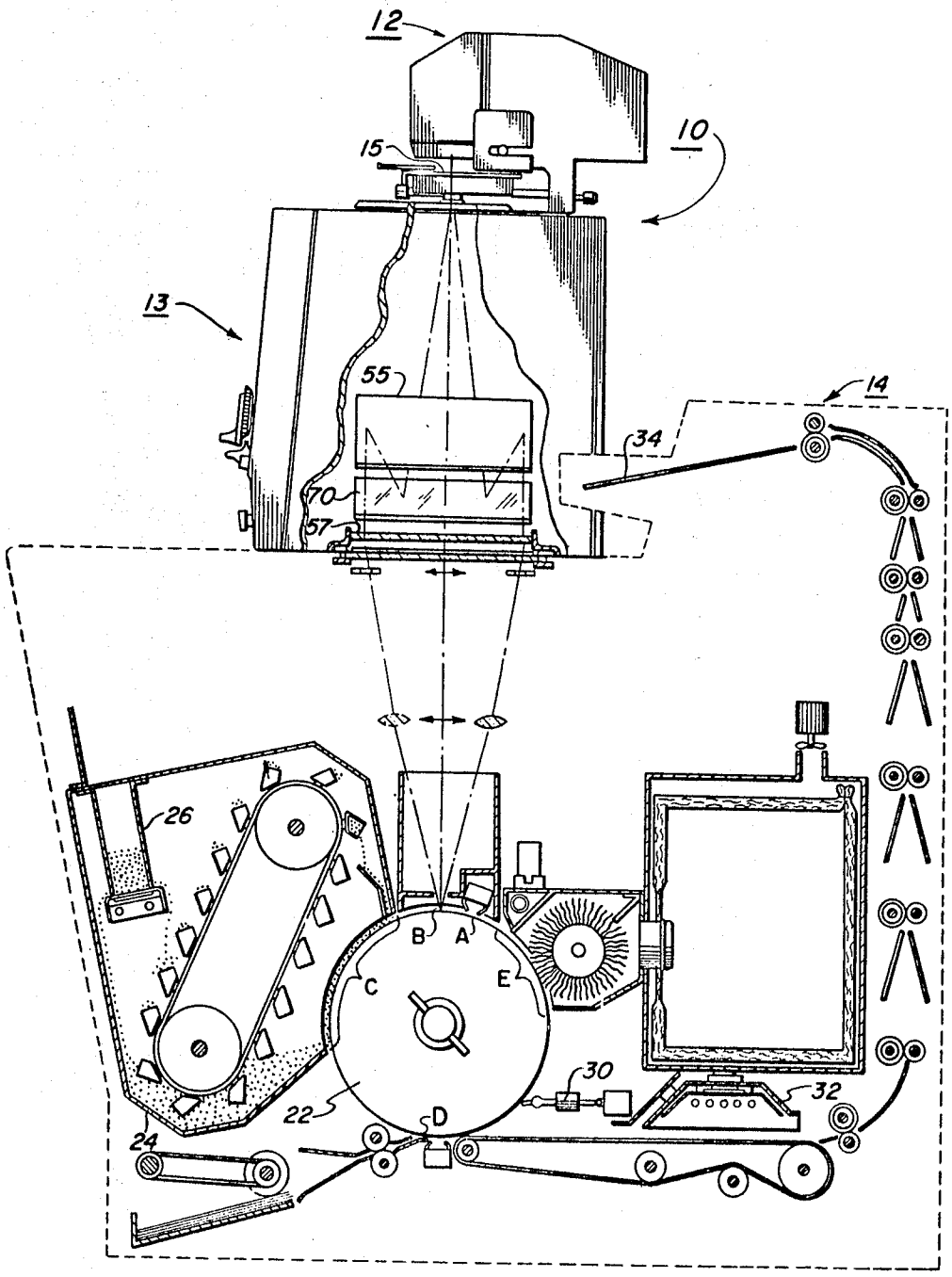


FIG. 2

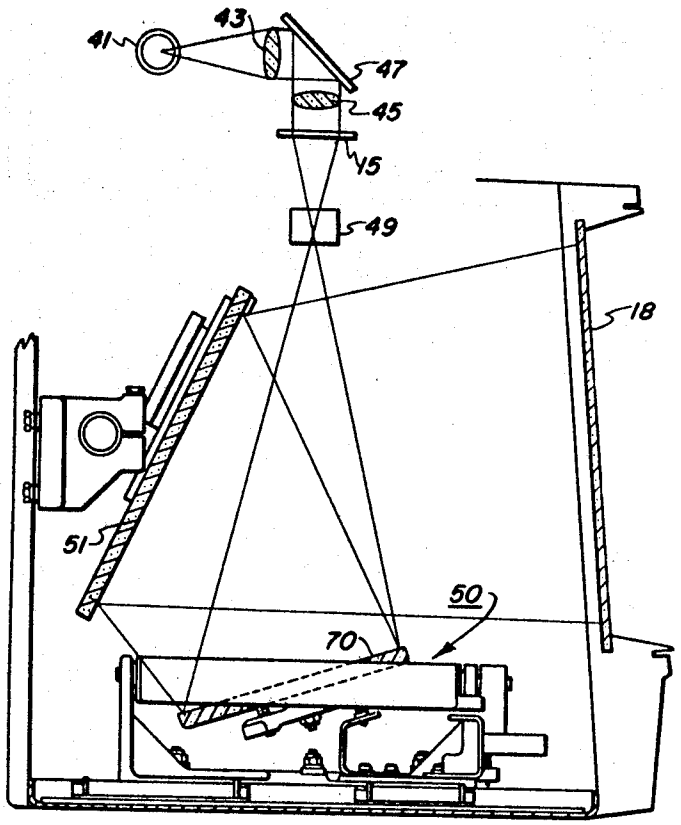


FIG. 3

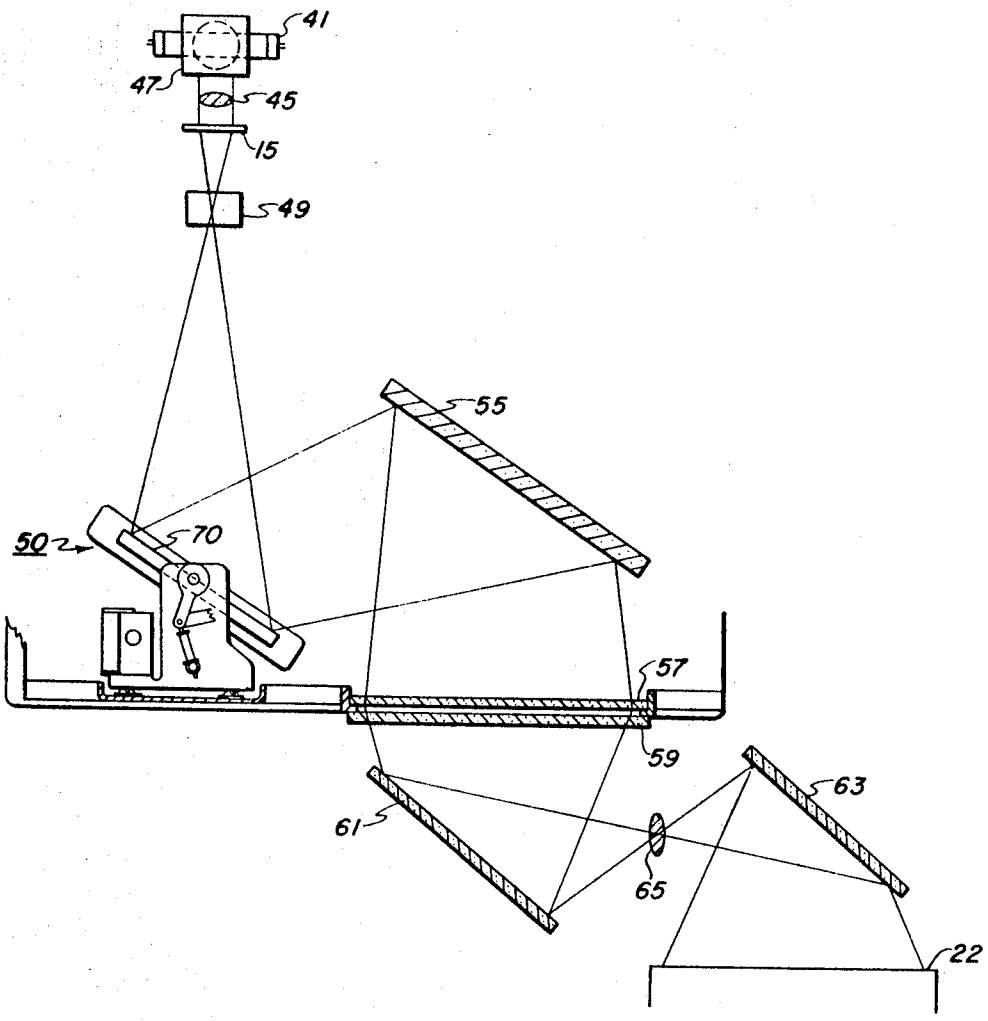


FIG. 4

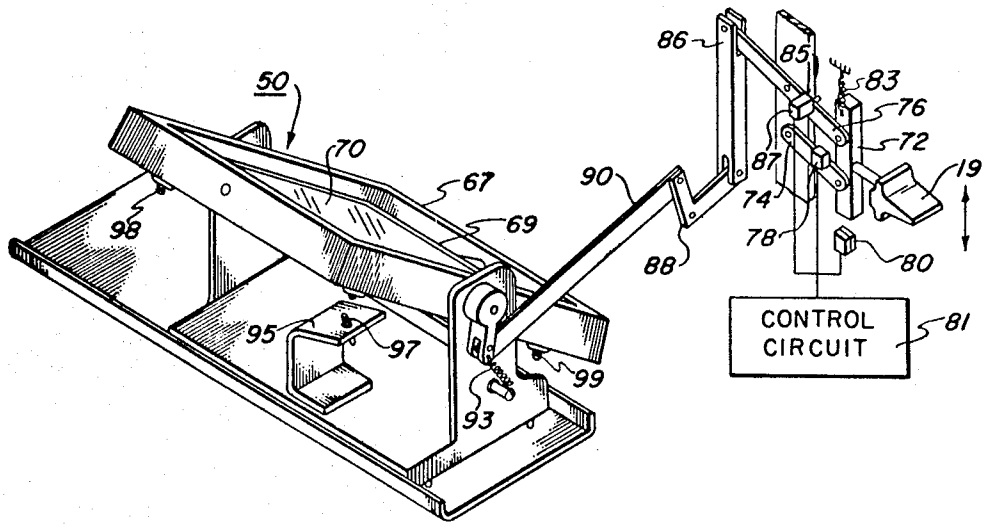

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98
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86
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72
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74
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80
19
CONTROL CIRCUIT
81

FIG. 5

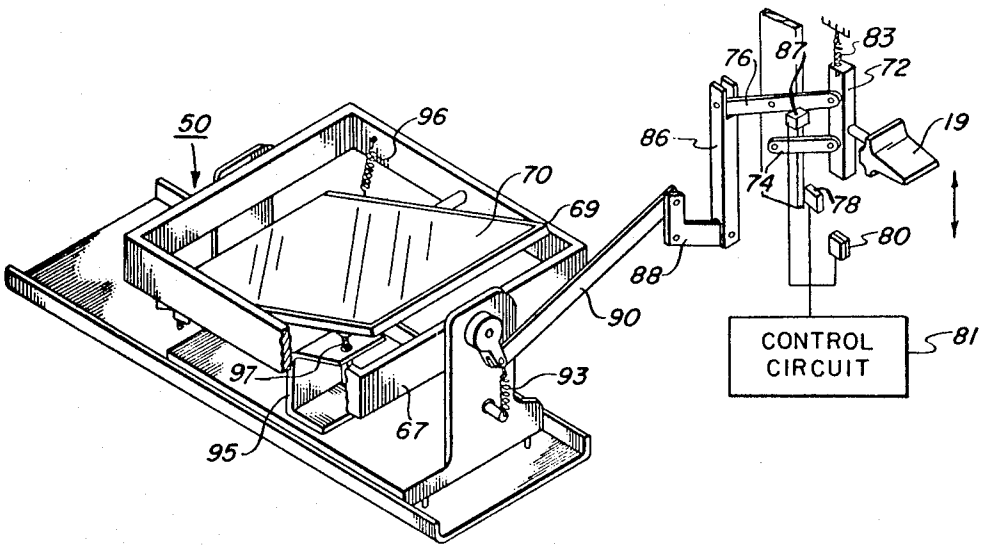

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CONTROL CIRCUIT
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FIG. 6

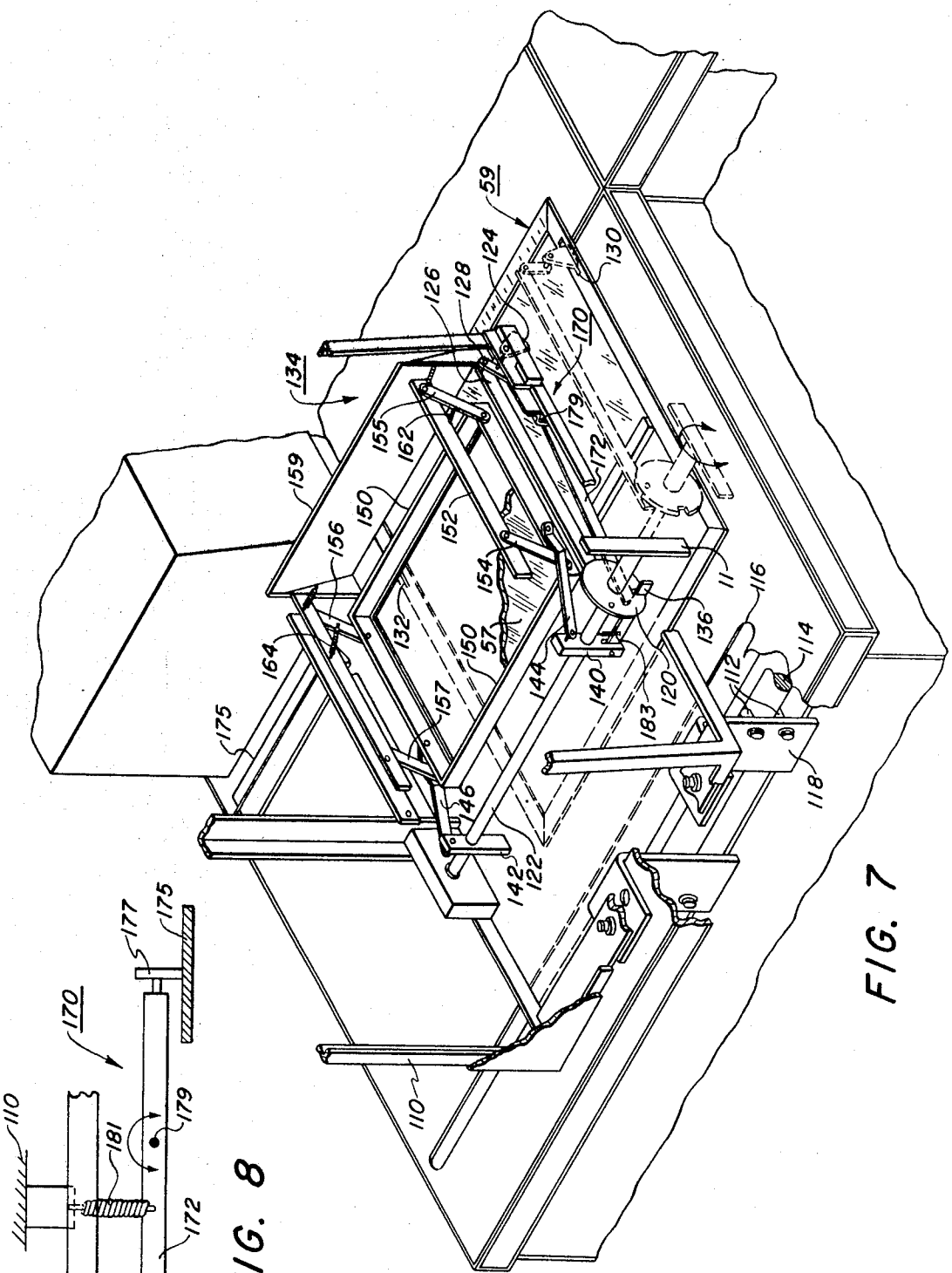

59
124
126
128
130
134
170
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162
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183
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114
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118
146
142
122
110

FIG. 7

175
177
170
110
179
181
172
126
122
136
120

FIG. 8

RECORDING APPARATUS

This invention relates in general to electrostatic recording and in particular to an improved recording system for reproducing enlarged copies from microfilm on ordinary paper.

Man's inability to keep abreast of the volume of data now being generated has resulted in the development and use of rapid recording, indexing, and retrieval methods in which microreproduction plays a great role. As a result there has been a great demand for a machine which produces multiple enlarged copies of high quality from microfilm automatically on ordinary paper for wide distribution.

One of the most commercially successful copying machines is that disclosed in U.S. Pat. No. 3,062,109 to Mayo et al. issued on Nov. 6, 1962. This machine is used for reproducing multiple copies from opaque full size originals which are placed on a platen on the top of its desklike shape. As useful as this machine may be, as evidenced by its commercial acceptance, it is not presently used to reproduce enlarged copies from microfilm. A major problem in the development of such a microreproduction system is the ease of handling the microfilm for viewing to select the desired frame or frames and then imaging in the recording plane to produce high quality enlarged prints.

The present invention is intended to be an improvement over the desk-type electrostatic machine copies described in the Mayo et al. patent above and also over a modified version adapted for the production of multiple prints from microfilm as disclosed in copending application Ser. No. 506,386 in the names of David R. Stokes et al. filed on Nov. 4, 1965. More specifically, an improved optical projector/reader and actuating mechanism of the invention greatly facilitates producing enlarged hard copies from a microfilm input as well as copies from ordinary documents. Although there are devices for effecting microfilm print out there is none for rapidly handling and viewing the microfilm and then automatically producing multiple enlarged copies of a frame or frames on ordinary copy paper or alternatively reproducing opaque originals at the option of a machine operator.

It is therefore an object of this invention to improve electrostatic recording machines.

Another object of this invention is to improve optical systems in electrostatic recording machines to facilitate handling and viewing and then recording microfilm onto ordinary paper.

Another object of this invention is to view and rapidly reproduce a frame or frames of microfilm with no movement of the film relative to the optical centerline.

Another object of this invention is to employ dual recording apparatus capable of viewing and reproducing enlarged copies automatically from microfilm or alternatively reproducing copies automatically from opaque originals.

These and other objects of the invention are attained by the new and improved apparatus of the present invention by enabling microfilm image rays to be projected along different optical paths for rapid viewing and film handling and then for recording purposes in order to make multiple enlarged copies of the microfilm and effecting a different operation for reproducing copies from opaque originals.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective view of an automatic microfilm copying machine adapted for reproducing copies according to the present invention;

FIG. 2 illustrates schematically the various processing stations of the machine adapted for continuous and automatic operation and incorporating an optical scanning system for use with the present invention;

FIG. 3 is a schematic view of the optical system when in the position of viewing and handling microfilm;

FIG. 4 is a schematic view of the optical system when in the position of reproducing enlarged copies of the microfilm;

FIG. 5 is a perspective view of a movable mirror mechanism in position for reflecting light rays along the optical axis for image viewing;

FIG. 6 is a perspective view of the movable mirror mechanism shown in FIG. 5 in a different position for reflecting light rays during the image recording cycle;

FIG. 7 is a perspective view of the lens positioning and release mechanism; and

FIG. 8 is a fragmentary view illustrating details of a sensing mechanism.

Referring now to the drawings there is shown in FIG. 1 microfilm copying apparatus constructed in accordance with the present invention and generally designated **10** comprising a projector assembly **12**, a reader assembly **13** and a copier processing assembly **14**. Microfilm copying apparatus **10** reproduces enlarged copies of microfilm **15** which is supported on a supply roll **16** and takeup roll **17**. It should be understood, however, apparatus **10** is also capable of reproducing microfilm on aperture cards and microfiche sheets which are adapted to be mounted on the projector assembly **14**.

Reader assembly **13** comprises a viewing screen **18** and a control panel having view/print lever **19**, projector on and off switches **20**, a handle **11** and a microfilm scan control knob **21**. View/print lever **19** has two positions and is movable upwardly for viewing and downwardly for the printing cycle. Microfilm **15** is adapted for rapid transport as by a reversible motor unit (not shown) or manual operation as by cranking knob **21** to selectively position the microfilm in the optical path for viewing and/or printing.

Copier processing assembly **14** comprises a xerographic recording plate made up of a photoconductive layer on a conductive backing formed in the shape of a drum **22**. Drum **22** is mounted on a shaft which is journaled in a frame to rotate past a plurality of processing stations to reproduce enlarged copies of microfilm **15**. A control panel **23** controls the number of copies desired as described in the Mayo et al. patent above.

For the purpose of the present disclosure, the several processing stations in the path of movement of the drum surface may be described functionally, as follows:

A charging station A at which a uniform electrostatic charge is deposited on the photoconductive layer of the drum.

Next in the path of motion of the drum is an exposure station B at which an enlarged light or radiation pattern of the microfilm to be reproduced is projected onto the drum surface to dissipate the drum charge in the exposed areas to form a latent electrostatic image.

Adjacent to the exposure station is a developing station C at which there is positioned a developer apparatus including a sump for accumulating developer material **24** comprising toner particles. As toner powder images are formed, additional toner particles are supplied to the developing material in proportion to the amount of toner deposited on the drum by a toner dispenser **26**.

Positioned next adjacent to the developing station is an image transfer station D at which the powder image is electrostatically transferred from the drum surface to a support material, such as paper, in right-reading form.

Immediately subsequent to transfer is a stripping device **30** for removing the support material from the drum surface. After stripping, the powder image is fused to the support material by a fuser device **32** and then transported to copy holder **34** from which multiple enlarged copies of the microfilm are immediately available.

The final station E is a drum cleaning and discharge station at which the drum surface is brushed to remove residual toner particles remaining after image transfer and at which the drum surface is exposed to a relatively bright light source to effect substantially complete discharge of any residual electrostatic charge remaining thereon.

The above brief description of the processing stations is believed sufficient for purposes of the present invention. A more detailed description of the processing stations may be found in U.S. Pat. No. 3,062,109.

MICROFILM OPTICAL SYSTEM

A microfilm optical system comprises light from a lamp **41** passing through a pair of condenser lenses **43, 45** separated by a mirror **47** which projects the light beam downwardly through microfilm **15**. A lens **49** projects the film image onto a movable mirror mechanism **50** which serves to receive and reflect light rays for both viewing and recording as will become more apparent. A fixed mirror **51** receives the light rays for protection onto a viewing screen **18** in one phase of operation so that an operator on the opposite side of the screen is able to view the image from the front of the machine in right-reading form. In another phase of operation microfilm copier apparatus **10** produces multiple enlarged copies of the microfilm **15** onto ordinary paper. To achieve this mirror mechanism **50** is actuated onto a different optical axis so that the image is projected onto the recording plane in a manner as will be understood.

For the reproduction phase the film image is received by mirror mechanism **50** which now reflects the image onto a print mirror **55** which in turn reflects the image through a suitable light gathering device **57** such as a fresnel lens. Typical materials for light gathering device **57** are plastic, frosted glass and mixtures thereof. Additional information on lenses of this type can be found in copending application, Ser. No. 551,584 filed on May 20, 1966. Lens device **57** is placed approximately at the focal plane of the copier assembly optical system which is on platen **59** of the copier assembly. Platen **59** defines an object plane of the copier reproducing system which houses fixed mirrors **61, 63** separated by scan lens **65**. Thus, the portion of the optical system above platen **59** serves to produce an enlarged optical image of microfilm **15** at the platen. In this manner, it is possible to produce a right-reading image on viewing screen **18** or alternatively direct an enlarged image of the microfilm through a copier platen of the copying assembly which in turn scans the image to produce a latent electrostatic image on drum **22**.

Movable mirror mechanism **50** comprises an outer support member **67** pivotally supported on the machine frame and an inner support member **69** carrying a mirror **70** which is pivotally supported on outer support member **67**. A lever member **72** is connected to view/print lever **19** and supported by pivot links **74** and **76**. In operation when view/print lever **19** is in the upward position, microfilm **15** is viewed on screen **18**. For producing enlarged copies of the microfilm, lever **19** is actuated downwardly causing lower pivot link **74** to come into engagement with a lever lock switch **78** mounted in the path of lever member **72**. When lever member **72** is moved in its lowermost position, lever member **72** actuates a copier print switch **80**. Switches **78** and **80** are coupled to a copier control circuit **81** which serves to energize copier processing assembly **14** including the processing stations described above. Upon releasing the view/print lever **19**, a spring **83** causes lever **19** and lever member **72** to move upwardly and therefore deenergize the copier print switch **80** thereby enabling the processing assembly to maintain operation as required for producing multiple enlarged copies of the microfilm. As previously mentioned, the control circuit for the processing assembly is described in the above Mayo et al. patent. A locking member **85** actuated by a solenoid **87** which is electrically coupled to switch **78** and control circuit **81** is moved across the path of upper pivot link **76** thereby preventing lever **19** and lever member **72** from being moved upwardly until the desired number of copies of microfilm **15** have been reproduced. At the proper time, solenoid **87** receives a signal whereby locking member **85** is withdrawn from the path.

To effect the intended operation of mirror mechanism **50** upper pivot link **76** is connected to a vertical line **86** which in turn is connected to pivot arm **88** which serves to impart linear movement to an elongated horizontal link **90**. It will now be appreciated that as view/print lever **19** is moved down link **90** is moved to the left causing outer support member **67** to move in a clockwise direction whereby mirror **70** is optically positioned for reproducing enlarged copies of the microfilm. A compression spring **93** acts to reinforce outer support member **67** in either a viewing or printing position with a togglelike action.

When it is desired to position movable mirror mechanism **50** in position for viewing microfilm **15**, view/print lever **19** is moved upwardly causing horizontal link **90** to move to the right, thereby rotating outer support member **67** counterclockwise. As a result, inner support member **69** carrying mirror **70** is pivoted on an axis through outer support member **67** due to the action of a projection member **95** on mirror **70**. Arranged on projection member **95** is a stop member **97** which is adjustable as by threads to obtain proper mirror alignment during the viewing phase of operation. A spring member **96** serves to maintain mirror **70** in a planar position paralleled to outer support member **67** when in the reproducing phase of operation. Also, adjustable stops **98** and **99** maintain alignment of outer support member **67** when mirror **70** is pivoted to the position for the viewing and print modes of operation.

OPTICAL POSITIONING ASSEMBLY

The invention herein enables enlarged copies of microfilm to be produced on ordinary paper and at the same time enables copying of ordinary documents at original size thereby achieving a dual mode of operation in a unified system. To accomplish this reader assembly **13** is movable relative to copier platen **59** as best shown in FIG. 7. Reader assembly **13** comprises a frame **110** which is slidably supported on copier processing assembly **14** as by bearings **112** which are mounted on a support post **114**. An elongated opening **116** is formed in the surface of copier processing assembly **14** to enable plate members **118** from frame **110** to carry bearings **112** on the support post. Handle **11** in the front of reader assembly **13** is used to move the projector and reader assemblies relative to the processor assembly as by a pulling or pushing action on the handle.

Handle **11** is rotatable and is connected to a clutch wheel **120** which supports an inner shaft member **122** also supported for rotation in the frame **110**. In order to lock the reader assembly in place on the processing assembly, a locking cam member **124** is connected to clutch wheel **120** by arm members **126, 128**. To receive locking cam member **124** there is arranged on copier platen **59** a pair of slots **130, 132** which correspond to the forward and rear positions of the reader assembly. Upon rotation of handle **11** of about one-quarter turn or when in a vertical position, clutch wheel **120** pulls arm members **126, 128** causing locking cam member **124** to move up and out of the slots **130, 132** depending on whether the reader assembly is forward or back. Rotation of handle **11** in the opposite direction or when in the horizontal position again causes locking cam **124** to become engaged thereby locking the reader assembly in a selected fixed position.

When the reader assembly is in the forward most position recording apparatus **10** is in the microfilm copying mode of operation which requires lens **57** to be in overlying relation with platen **59**. To this end a lens positioning assembly generally designated **134** is movably supported from frame **110** and adapted to be lowered in overlying relationship with platen **59**. To accomplish this clutch wheel **120** is engaged with a key member **136** which is received by a notch or keyway formed in the clutch wheel. Upon rotation of clutch wheel **120** key member **136** is carried with it causing blocks **140, 142** and inner shaft **122** to also rotate. Blocks **140, 142** have connected to them link members **144, 146** respectively which are also connected to a lens support member **150** which receives lens **57**. Lens support member **150** is supported from a member **152** by swing link members **154, 155, 156, 157** so as to pivot downwardly as a parallelogram linkage in registration over platen **59**. As lens support member **150** pivots downwardly it pushes a displaceable light cover **159** outwardly. Light cover **59** serves as a light shield to prevent illumination loss when in the microfilm copying mode of operation. A pair of spring members **162, 164** are connected

between swing link members **155**, **156** and member **152** and serve to take up any slack in the lens linkage. Springs **162**, **164** also ensure that the lens support member **159** will be positioned consistently in the print position due to the predetermined spring tension. This is very desirable since the quality of prints produced is directly related to the optical system of the recording apparatus.

When the recording apparatus is in mode of operation for copying document material reader assembly **13** is in the rearmost position locked in place and lens support member **150** is in raised position. This requires that the lens support assembly become disengaged from handle **11**, since the handle is in horizontal position when in locking position. To accomplish this as reader assembly **13** is pushed to the rear position a sensing mechanism **170** (FIG.) is utilized to disengage the lens support assembly. Sensing mechanism **170** comprises a sensor arm **172** pivotally mounted on frame **110** and extending in overlying relation to key member **136** so as to disengage the key member from the notch **138** of the clutch wheel when pivoted. A control ramp **175** arranged on the surface of processing assembly **14** contacts a sensing wheel **177** on the end of sensor arm **172** causing the sensor arm to pivot on a pin **179** against the action of a spring **181** and thus disengage key member **136** from clutch wheel **120** as the reader assembly is moved toward the rear position. When the reader assembly is pulled forward again sensing wheel **177** rides down control ramp **175** and across but slightly above the platen area allowing the sensor arm to pivot due to the action of a spring **181** and enable key member **136** which is biased by a spring **183** to move upwardly into notch **138** of clutch wheel **120** so as to enable the lens assembly to be positioned in a manner previously described.

By this invention there is described a significant improvement in the art of copying microfilm and/or document material. Until this invention persons wishing to copy microfilm and document material onto ordinary paper were required to purchase separate machines for this purpose. With the present invention it is possible to produce multiple enlarged copies of a microfilm input on ordinary copy sheets and yet retain all the advantages of an automatic document copier as well. It will be readily appreciated that such a machine is greatly desired in view of the great volume of data now being put onto microfilm.

While the invention has been described in reference to the structure disclosed herein it is not confined to the details set forth but is also intended to cover such modifications or changes that may come within the scope of the following claims:

What we claim is:

1. In an automatic electrostatic recording machine in which a recording member is continuously moved past a plurality of processing stations to produce copies of input information, an improvement enabling reproduction of enlarged copies of microfilm or original size copies of document information positioned on a platen comprising,

reader means for projecting and reading microfilm and adapted for movement relative to a platen of a recording machine,

shaft means operatively associated with said reader means for moving said reader means from a first position in which copies of microfilm are reproduced to a second position in which copies of document information placed on said platen are reproduced

a lens-positioning assembly for positioning a lens member in the focal plane of said recording machine operatively associated with said shaft means,

said lens-positioning assembly comprising a fixed frame and a movable frame pivotally supported from said fixed frame for swinging movement toward and away from said focal plane, and

control means operatively associated with said shaft means for enabling said lens member to be positioned in said focal plane depending on whether said reader means is in said first or second positions.

2. Apparatus according to claim **1** wherein said control means comprises

a wheel member carried on said shaft means,

a key member operatively associated with said lens-positioning assembly arranged to be received in a recess formed in said wheel member,

means for biasing said key member into engagement with said wheel member,

a sensing arm adapted for pivotal movement and having a sensing member connected thereto, and

a control member arranged in the path of said sensing member to cause said sensing arm to pivot thereby causing said key member to disengage from said wheel member against the action of said spring means.

3. Apparatus according to claim **1** wherein said lens-positioning assembly comprises a parallelogram linkage.

4. Apparatus according to claim **1** wherein said shaft means includes a locking element operatively connected thereto for obtaining registration of said reader means with said platen.