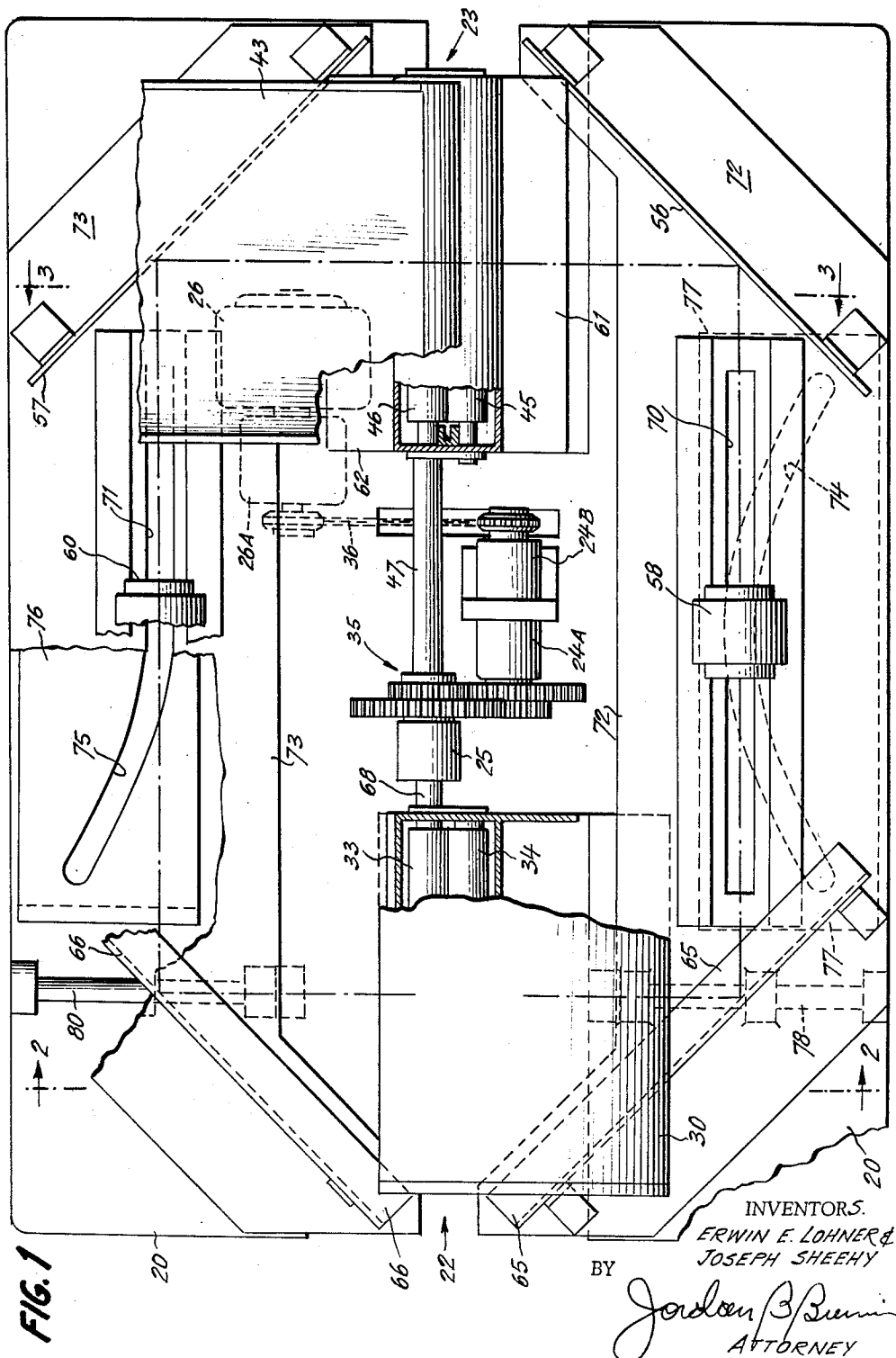


3,079,839

8 Sheets-Sheet 1



March 5, 1963

E. E. LOHNER ET AL

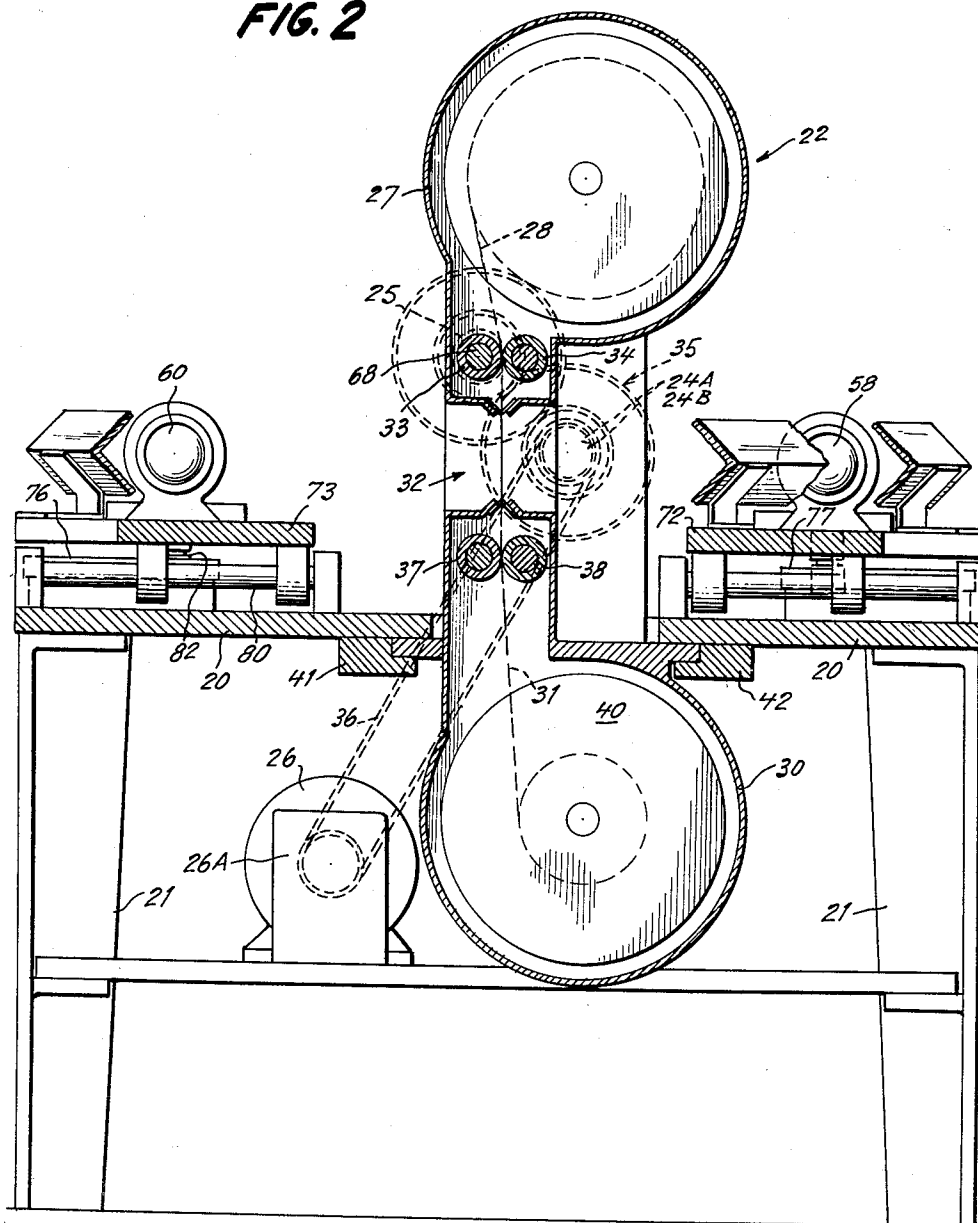
3,079,839

DUPLEX PHOTOCOPIER

Filed June 22, 1959

8 Sheets-Sheet 2

FIG. 2



INVENTORS.
ERWIN E. LOHNER &
JOSEPH SHEEHY

BY

Jordan B. Bernman
ATTORNEY

March 5, 1963

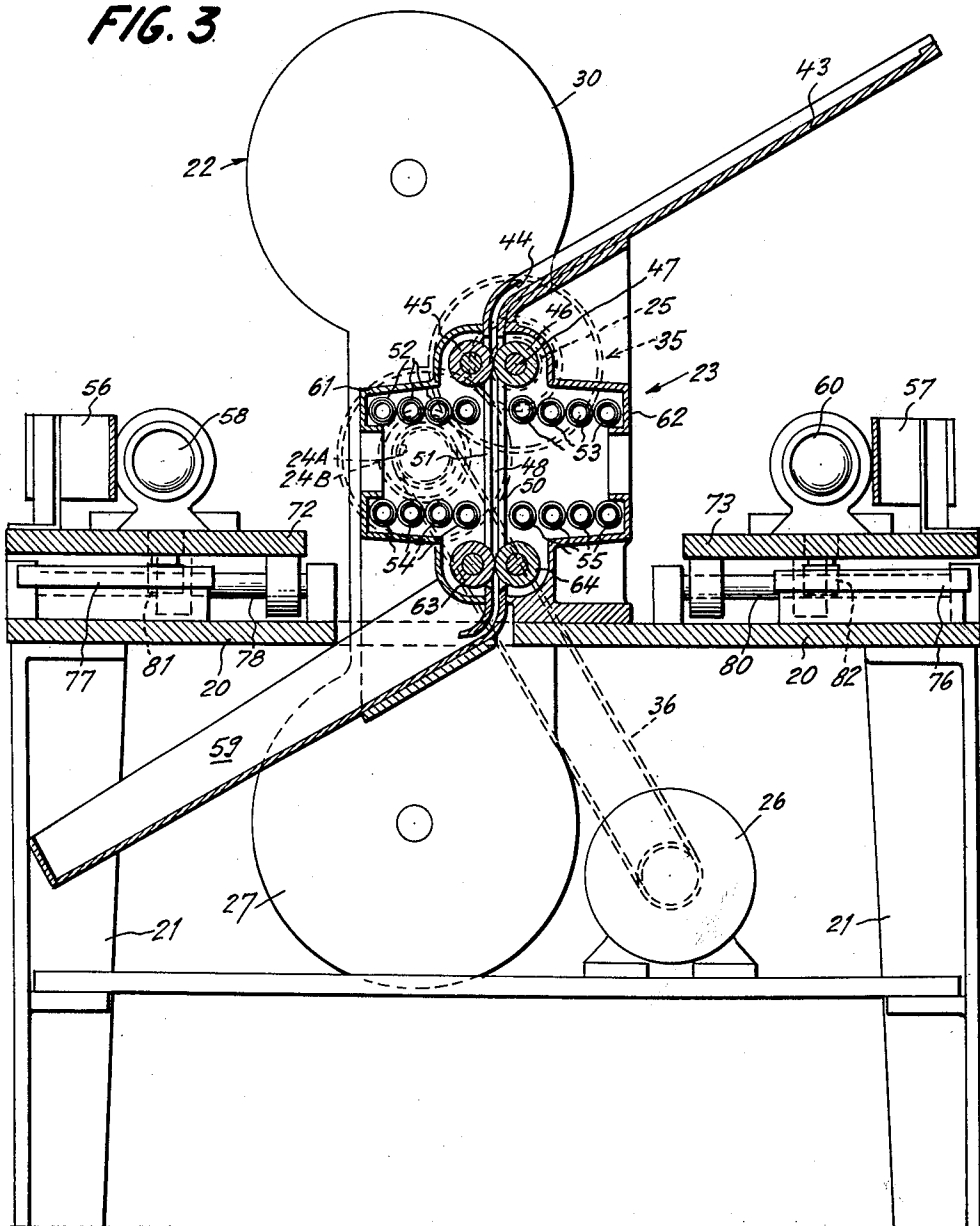
E. E. LOHNER ET AL
DUPLEX PHOTOCOPIER

3,079,839

Filed June 22, 1959

8 Sheets-Sheet 3

FIG. 3



INVENTORS.
ERWIN E. LOHNER &
JOSEPH SHEEHY

BY

Jordan B. Bunn
ATTORNEY

March 5, 1963

E. E. LOHNER ET AL

3,079,839

DUPLEX PHOTOCOPIER

Filed June 22, 1959

8 Sheets-Sheet 4

FIG. 5

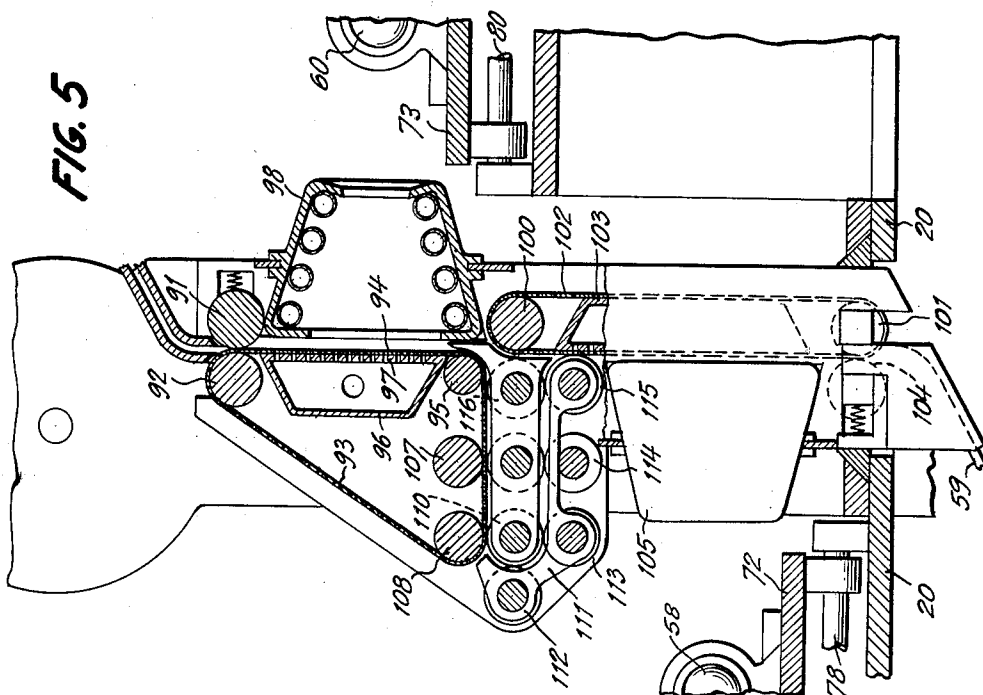
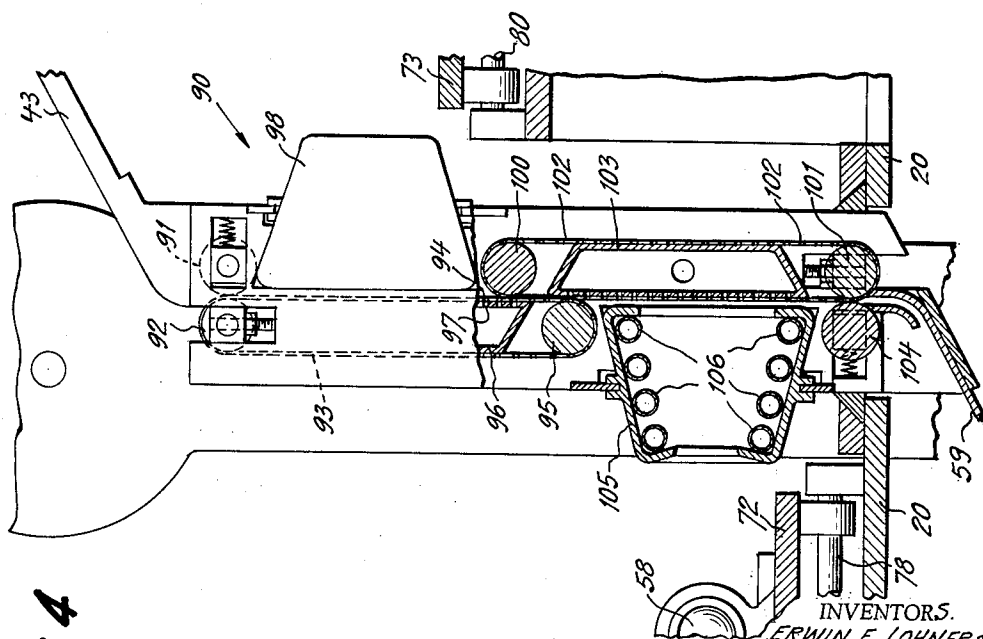


FIG. 4



INVENTORS.
ERWIN E. LOHNER &
JOSEPH SHEEHY
BY
Jordan B. Bunn
ATTORNEY

March 5, 1963

E. E. LOHNER ET AL

3,079,839

DUPLEX PHOTOCOPIER

Filed June 22, 1959

8 Sheets-Sheet 5

FIG. 7

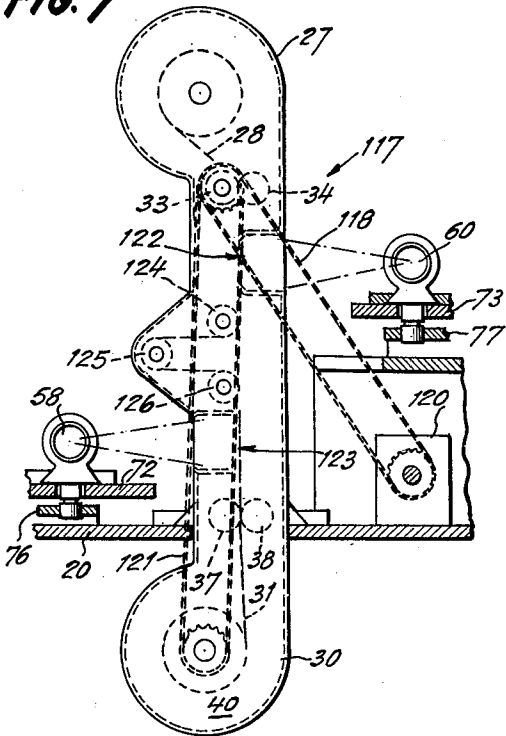


FIG. 8

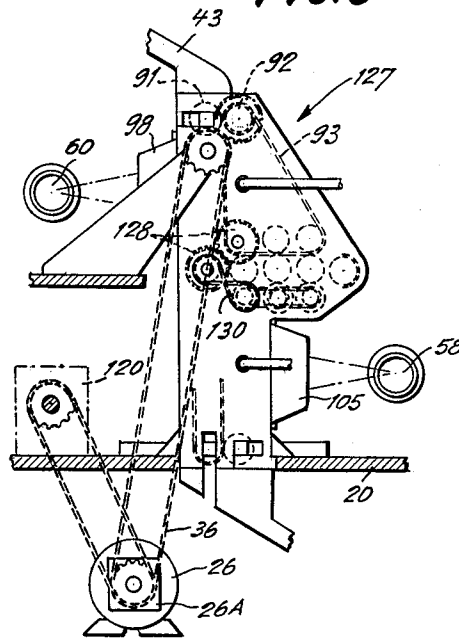
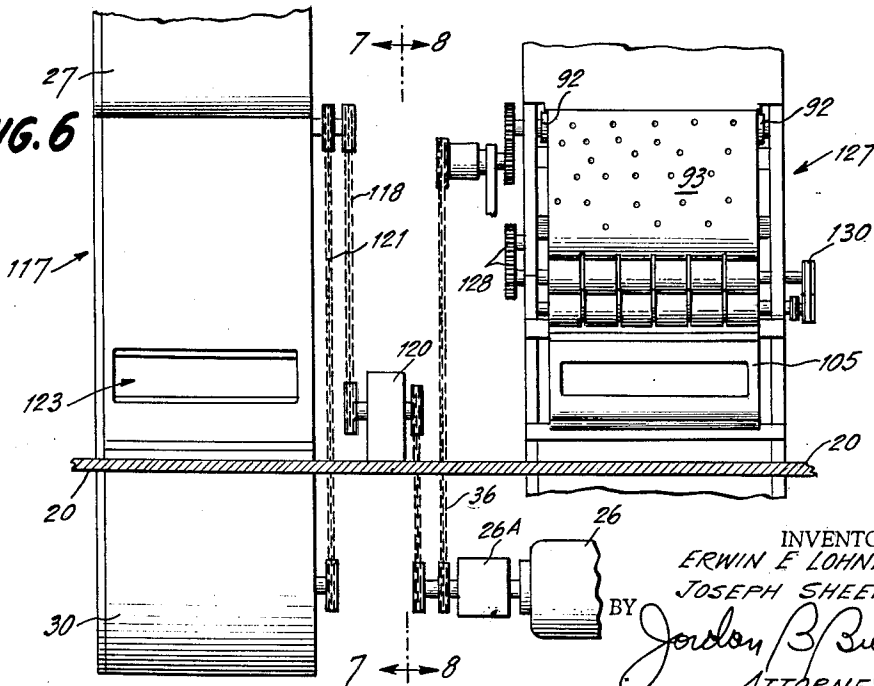


FIG. 6



INVENTORS:
ERWIN E. LOHNER &
JOSEPH SHEEHY

BY *Jordan B. Breen*
ATTORNEY

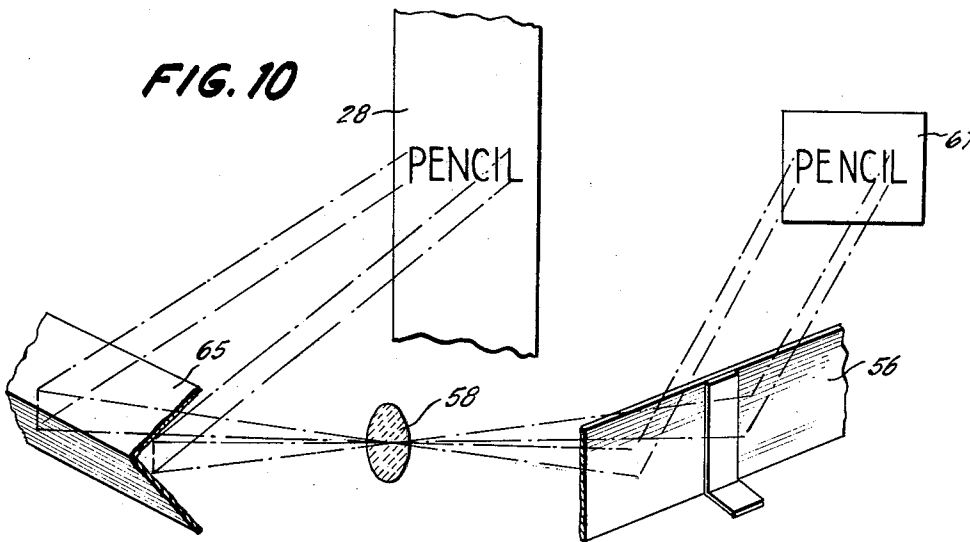
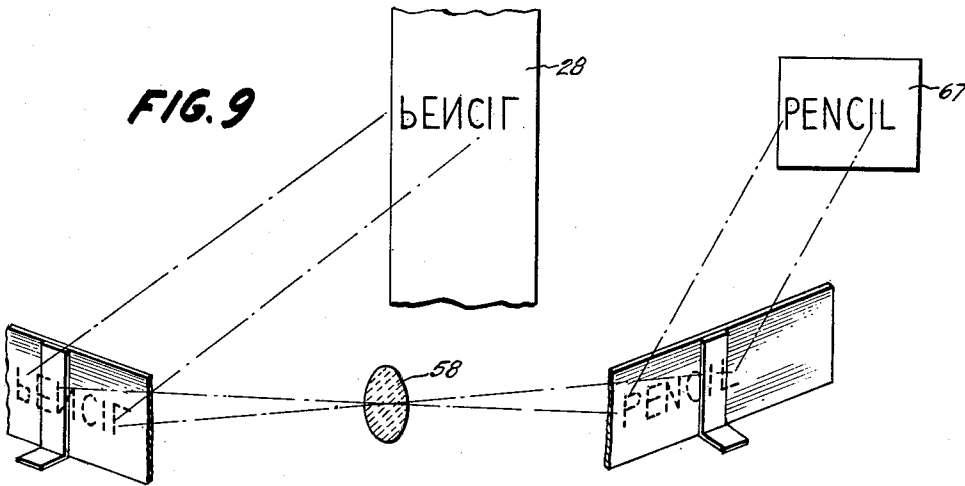
March 5, 1963

E. E. LOHNER ET AL
DUPLEX PHOTOCOPIER

3,079,839

Filed June 22, 1959

8 Sheets-Sheet 6



INVENTORS
ERWIN E. LOHNER &
JOSEPH SHEEHY
BY *Jordan B. Breen*
ATTORNEY

March 5, 1963

E. E. LOHNER ET AL
DUPLEX PHOTOCOPIER

3,079,839

Filed June 22, 1959

8 Sheets-Sheet 7

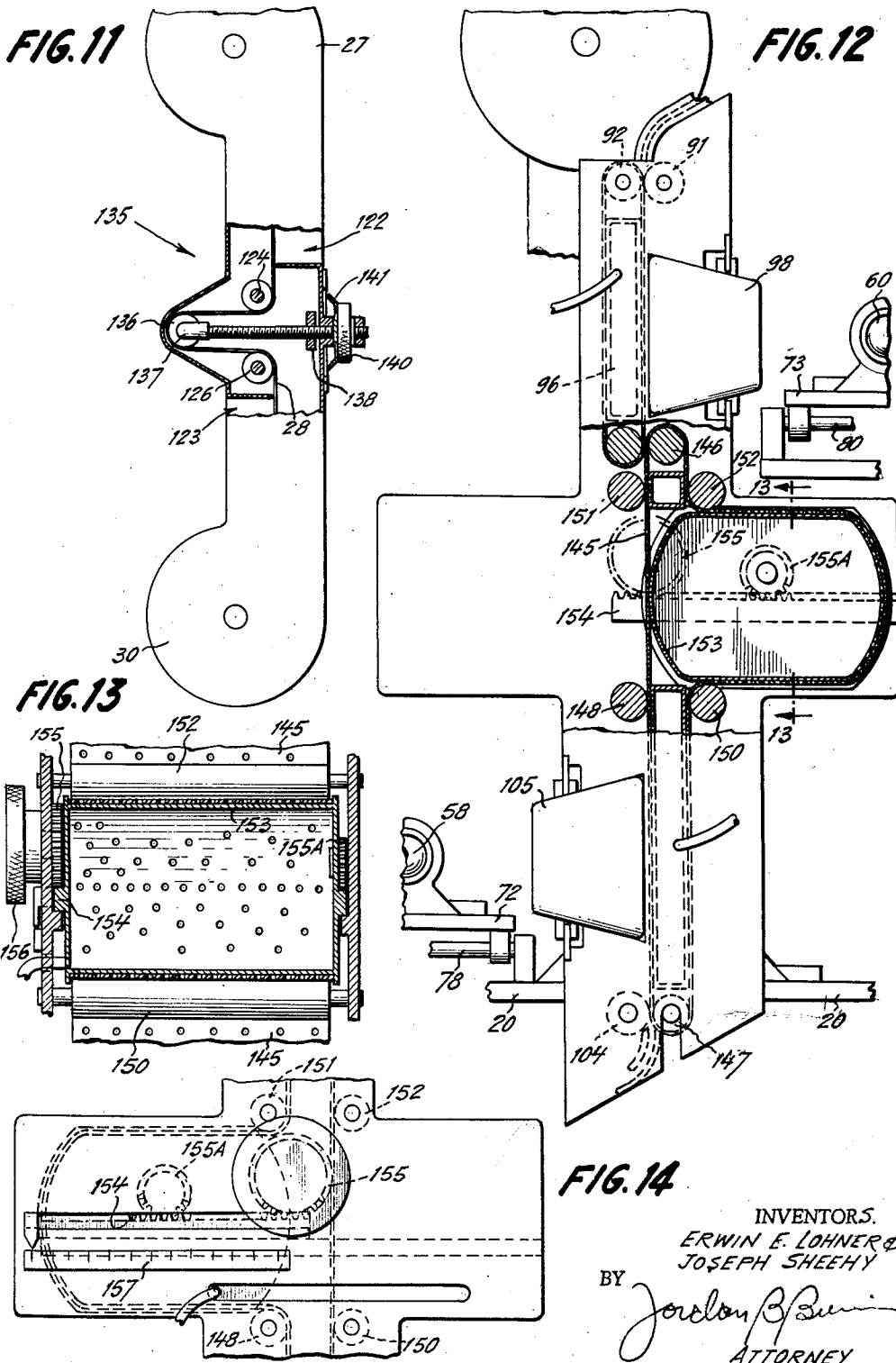


FIG. 14

INVENTORS.
ERWIN E. LOHNER &
JOSEPH SHEEHY

BY

Joseph B. Sullivan
ATTORNEY

March 5, 1963

E. E. LOHNER ET AL

3,079,839

DUPLEX PHOTOCOPIER

Filed June 22, 1959

8 Sheets-Sheet 8

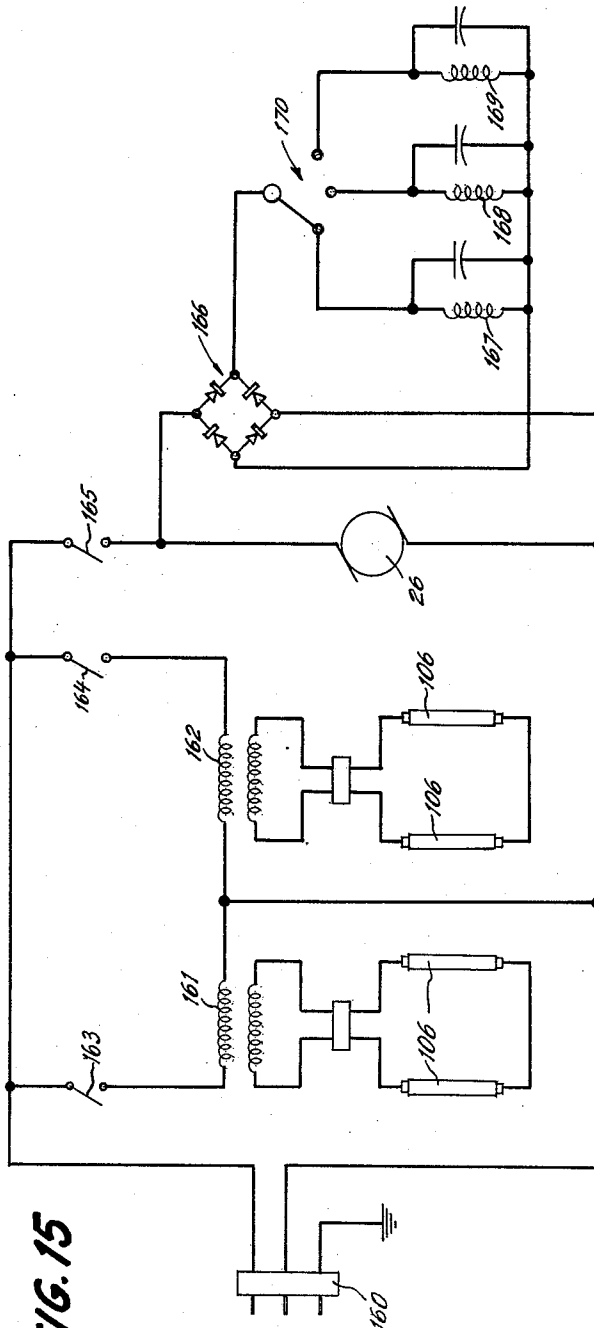


FIG. 15

INVENTORS.
ERWIN E. LOHNER &
JOSEPH SHEEHY
BY *Jordan B. Berman*
ATTORNEY

1

3,079,839

DUPLEX PHOTOCOPIER

Erwin E. Lohner, 70 Strawberry Hill Ave., Stamford, Conn., and Joseph Sheehy, R.R. 1, Ridgefield, Conn.

Filed June 22, 1959, Ser. No. 822,061

11 Claims. (Cl. 83—24)

This invention relates to a camera for photographing both sides of a document. It has particular reference to a camera using a film which includes an opaque base with photographic emulsion on both sides of the base material.

Exposure devices have been constructed and used which first photographed one side of a document and then automatically turned the document over and photographed the other side on another area of a single emulsion base. This resulted in the two images positioned adjacent to each other on the same side of the base, an arrangement with many unsatisfactory features. The present invention records the images in a back-to-back alignment which corresponds to the alignment of the original document. With this result there can be no doubt regarding the corresponding image sides and considerable space is saved when a large number of such recorded images are collected in a storage space.

One of the objects of this invention is to provide an improved copying camera which avoids one or more of the disadvantages and limitations of prior art arrangements.

Another object of the invention is to photograph both sides of a document on both sides of an opaque emulsion bearing film in corresponding alignment.

Another object of the invention is to direct and focus the light from the document sides so that the images of such sides are applied to the photographic emulsion in exact correspondence.

Another object of the invention is to simplify the operation of copying cameras by providing a belt conveyor means for the documents synchronized with the movement of the film.

Another object of the invention is to provide a gear shift for either the document drive or the film drive so that enlargements or reductions of the document size can be photographically recorded.

Another object of the invention is to increase the path of travel of either the document or the film to provide storage space between exposures and thereby maintain back-to-back correspondence during enlarging or reduction.

Another object of the invention is to provide a vacuum system which maintains the document in correct register while being photographed.

The invention includes a copying camera for photographically recording both sides of a document and comprises a film container having storage spaces for the unexposed and exposed film, and an exposure space intermediate the two containers where both sides of the film may be exposed. The invention also includes a document conveyor having a guiding means which maintains the document in an object plane while both sides are illuminated, and two optical systems each of which includes a lens and a triple reflecting mirror arrangement which directs a light beam from one side of the document and focusses it on one side of the film. A motor operated mechanical means moves the film through the exposure space and operates the document conveyor to move the film and the document in synchronism.

For a better understanding of the present invention, together with other and further objects thereof, reference is made to the following description taken in connection with the accompanying drawings.

FIG. 1 is a plan view of the camera with some parts cut away to show details of the mechanism.

2

FIG. 2 is a sectional view of the machine shown in FIG. 1 taken along line 2—2 of that figure.

FIG. 3 is a sectional view of the camera of FIG. 1 taken along line 3—3 of that figure.

FIG. 4 is a side view, with some parts in section, of a document guiding means, showing an alternate structure.

FIG. 5 is a side view, similar to FIG. 4, but showing another alternate guiding means for the document.

FIG. 6 is a schematic side view of both the document guiding means and the camera to show the application of the motor operated mechanical means which powers both components.

FIG. 7 is a side view of the camera shown in FIG. 6 and is taken along line 7—7 of that figure.

FIG. 8 is a side view of the document guiding mechanism shown in FIG. 6 and is taken along line 8—8 of that figure.

FIG. 9 is a schematic diagram of an optical system having a single lens and two mirrors.

FIG. 10 is a schematic diagram of an optical system having a single lens and three mirrors.

FIG. 11 is a side view of an alternate form of a film holder with some parts in section to show how the loop distance may be changed.

FIG. 12 is a side view of an alternate form of a document machine with some parts in section showing how the loop distance may be changed.

FIG. 13 is a cross-sectional view of a portion of the machine shown in FIG. 12 and is taken along line 13—13 of that figure.

FIG. 14 is a side view of a portion of the document machine shown in FIG. 13.

FIG. 15 is a schematic wiring diagram of connections of the camera showing the light, motor, and clutch controls.

Referring now to FIGS. 1, 2 and 3, the copying camera components are mounted on a base 20 which may be supported by any convenient means, such as a number of angle irons 21. The base supports a film holder 22, two optical systems, and a document conveyor 23. Both the film and the document are moved by mechanical means, coupled through clutches 24A and B, and 25 and driven by an electric motor 26 mounted under the base 20.

The film holder 22 includes a container 27 for a roll of unexposed film 28. The film used in this camera is made of an opaque flexible base coated on both sides with a photographic emulsion. The film holder also includes a second container 30 for a roll of exposed film 31 and, intermediate between the two containers, is an exposure space 32 where the film is directed through an image plane and is in alignment with both optical systems for receiving focussed images.

The film 31 is directed through the exposure space 32 by two rollers 33—34, roller 33 being connected directly to clutch 25 which is turned by a gear mechanism 35, a belt 36, and the motor 26 through a speed reducer 26A. Idler rollers 37 and 38, below the exposure space, hold the film in moderate tension and a slipping belt (not shown) engages a pulley coupled to the roll in container 30 to wind the film on a spool 40. The entire film holder 22 may be detached from the base by sliding along ways formed by members 41—42 for refilling and development of the exposed film.

The document conveyor 23 includes an inclined flat shelf 43 where documents are placed prior to being fed into a narrow opening 44 and engagement with rollers 45 and 46. Roller 45 is power operated and is secured to shaft 47 which is connected directly to clutch 25 and film roller 33. After passing rollers 45—46, the document enters an object plane 48 defined by edge guide pieces 50 and 51. At this position both sides of the document

3

are illuminated by a series of lamps 52, 53, 54 and 55 and the light from the document sides is collected by plane, vertical mirrors 56 and 57 and directed toward lenses 58 and 60. The lamps are partially enclosed by hoods 61 and 62 to confine the light to the object space.

After the document has passed through the object space it is engaged by rollers 63—64 and ejected into a receiving compartment 59.

Documents are fed into the machine in rapid succession and move down through the object plane at the same time and at the same rate as the film 28 moves down through the image plane in the film holder 22.

The optical systems receive the light from both sides of the document in the object plane 48 and focus the light on both sides of the film 28. The systems include two similar lenses 58—60, two similar plane mirrors 56—57, and two reflecting mirrors 65—66, each composed of a rectangular pair of plane mirrors. The rectangular pair combination need be no larger than the plane mirrors but this combination reflects the light rays twice and thereby, with the other plane mirror, reflects the light three times as it moves from the object to the image.

A schematic representation of this form of optical system is shown in FIG. 10 where a document 67 provides a source of light, plane mirror 56 introduces a first reflection, lens 58 focusses the light and inverts the image, and the rectangular pair of mirrors 65 introduces the second and third reflection to direct the focussed beam to the image plane on film 2, thereby producing an image which is erect and non-reversed. FIGURE 9 is shown by way of comparison where a lens 58 and only two reflecting mirrors are used. The image is inverted but not reversed, this results in an image which is upside down and backwards.

The copying camera described above is for a one-to-one reproduction where the image is the exact size of the object. When such a result is desired, shaft 47 (FIG. 1) which turns rollers 45 and 46, can also run shaft 68 and rollers 33 and 34 as previously described. The gears 35 will then be comparatively simple, requiring a speed reduction to only one shaft 68 and 47. However, it is possible to adjust the optical components to produce either a reduction or an enlargement of the image and when this is done, the speed of the film rollers 33—34 must be changed accordingly. The changing of gears for producing varying speeds is a well-known expedient and will not be described in detail.

When other than a one-to-one reproduction is desired the lens position along the optic axis must be changed and the optical distance between object and image must be lengthened. This adjustment can be made by the mechanism shown in FIG. 1 where each lens 58 and 60 is restrained by a slot 70 and 71 to move in a direction along the optical axis between the two mirrors. When the lenses are so adjusted the mirror platforms 72—73 are moved away from the camera components because of the curved slots 74—75 cut in cam plates 76 and 77 mounted below the platforms and secured to the base plate 20. The mirror platforms 72—73 are each slidably mounted on two parallel rods 78—80 so that they can be moved in one direction only. The lens mountings 58—60 are each secured to a stud 81—82 which passes through and engages both the straight slot and the curved slot. Moving the lens to the right or left not only changes the ratio of the object distance to the image distance but also increases the total optical path while still keeping the image in focus on the film.

The curvature of slots 74—75 does not conform to a simple mathematical formula but the result required can be easily calculated. For example if, a lens having a focal length of two units is used, a one-to-one reproduction arrangement requires a total optical path of 8 units. If, now, a change is to be made to an enlargement of one-to-two or to a reduction of two-to-one, the lenses must be

4

moved one unit along the optical axis while the mirror platforms must be moved one-half unit away from the image-object line to produce a total optical path of 9 units.

The operation of this copying camera is obvious from the above description. As soon as the motor 26 is started, rollers 33—34 direct the film down through the image space 32 (FIG. 2) while rollers 45—46 turn to pull documents down through the object plane 48 (FIG. 3). Documents are now fed from shelf 43 through opening 44, are illuminated on both sides by lamps 52—53—54—55, and pass into compartment 59. During the passage through the object plane 48, light from both sides of the document is reflected by mirrors 56—57—65—66 and focussed by lenses 58 and 60 to both sides of the film 28 in the image plane.

For reduction or enlargements of the documents, an alternate form of camera (shown in FIGS. 4, 5, 6, 7 and 8) may be used. These figures show the details of a vacuum system (FIGS. 4 and 5) which holds a large document in a well defined flat plane while it is being illuminated and photographed. Since the vacuum must be applied by a cavity structure which is opaque, both sides of the document cannot be photographed at the same time and hence two exposure positions are necessary, requiring an offset positioning of the two optical systems. When a one-to-one recording is desired, no further changes need be made but when any other transfer is desired a storage loop in the film or document is necessary to conserve space and not waste film area nor overlapping of document images.

FIG. 4 shows the alternate form of document conveyor without a loop but employing two vacuum plates. The conveyor 90 is mounted on the usual base 20 and includes a document shelf 43 and a container 65 for the documents which have been conveyed through the two object planes. In this machine the documents are fed to two rollers 91 and 92, one of which is encircled by an endless belt 93 having a large number of small holes 94 cut in its surface. The endless belt 93 encircles another roller 95 and the space between parallel belt surfaces is occupied by a vacuum chamber 96 connected by suitable piping to a vacuum pump (not shown). The side of the chamber adjoining belt 93 is formed with a large number of holes 97 similar to the holes in the belt. The usual lamp hood 98 is positioned in front of the perforated belt 93 whose outer surface defines one of the object planes.

A second system of three rollers similar to those described above is mounted directly below the first system with a cooperating junction adjoining the roller 95. Rollers 100 and 101 are in vertical alignment and are encircled by a second perforated belt 102 which encloses a second vacuum chamber 103 also connected to a vacuum pump. The second belt moves at the same speed as the first belt 93 and the two make rolling contact at the space adjacent to rollers 95—100 where the document is transferred from one system to the other. Near the bottom of belt 102, an idler roller 104 makes resilient contact with the belt and helps to eject photographed documents into the receiving compartment 59. A second lamp hood 105 is positioned in front of the second perforated belt 102 and encloses a plurality of lamps 106.

It will be obvious that when the above structure is in use the document, fed from shelf 43, is engaged by roller 91 and belt 93 and is started on its downward movement. As soon as the document is moved in front of the holes 97, which draw air through belt holes 94, the document is held in position by a partial atmospheric pressure and remains fixed to the surface of the belt until it is transferred to the second belt when the same action takes place but with the other side of the document exposed to the lamps and the other lens system. The lens systems which project the document characters by reflection and lens focussing action onto the film are the same as described in connection with FIGS. 1, 2 and 3.

5

The camera used with the above described document conveyor is the same as that shown in FIG. 2, except that two exposure spaces are used, one for each optical system, and each displaced vertically in a manner similar to the exposure planes in FIG. 4. This combination of document conveyor and film holder is for a one-to-one recording of images.

When it is desired to enlarge or reduce the image in comparison to the document, a loop is used. FIG. 5 shows the construction of a document conveyor which reduces the image by a ratio of four-to-one. The same components are employed but, in addition, an extra path, or loop, is provided for the document so that it travels three times the distance between the exposure apertures that the film travels. This permits the four-to-one ratio of speeds necessary for the reduction and still leaves a small margin between recorded images.

The extra loop is introduced between the two exposure apertures by directing the document around roller 95 to travel horizontally under rollers 107 and 108 (which also carry belt 93), then around roller 110, guided by deflection plate 111, and roller 112, to again travel horizontally over rollers 113, 114 and 115 to be again deflected downward by plate 116. At this point belt 102 engages the document and directs it onto the surface of the belt in front of vacuum compartment 103. By proper design of the length of the loop, the leading edge of the document arrives at the lower aperture to be photographed on the back of the film at the corresponding place where the leading edge was photographed through the upper aperture on the front of the film.

There may be times when very small documents are to be copied using the vacuum containers for maintaining their flatness and enlarging the image on the film. In such an application the document conveyor shown in FIG. 4 may be used in cooperation with the film holder 117 shown in FIGS. 6 and 7. This film holder is similar to the film holder 22, shown in FIG. 2, having a storage compartment 27 for unexposed film 28, a second film compartment 30 where the exposed film 31 is wound on a roll 40, and rollers 33, 34 which control the speed of the film through the exposure image planes. Roller 33 is driven by a belt 118 from a reduction gear 120 and the lower film spool 40 is kept in tension by means of belt 121 which slips on the lower pulley.

Since this film holder cooperates with a document conveyor having two separate object planes, the holder is arranged with two separate exposure spaces 122 and 123. The exposure spaces are separated by a distance equal to the document image planes so that the optical systems, which transfer the light from object to image, operate in a pair of horizontal planes. For most applications the film 28 will be directed in a straight line from rollers 33—34 to the lower pair of rollers 37—38, but sometimes, when the document is to be enlarged, a loop is necessary to increase the length of film between the two exposure spaces. This is done by threading the film around rollers 124, 125 and 126, as shown in FIG. 7. No belts or deflection plates are necessary. It is obvious that this film holder may be used without the loop by simply threading the film directly from rollers 33—34 to rollers 37—38.

The document conveyor 127 shown in FIGS. 6 and 8 is identical to the conveyor shown in cross sectional detail in FIG. 5. FIGS. 6 and 8 show how the power for the rollers is applied from motor 26, speed reducer 26A, and belt 36, to power roller 92. As is evident from FIG. 5, the power applied to roller 92 turns most of the other rollers due to the power transmitted by belt 93. However, an additional gear combination 128 is employed to transfer power from roller 95 to roller 100, and a belt 130 is used to turn roller 115; this arrangement insuring that the document is conveyed around the loop without danger of buckling or tearing.

The camera assembly described above (FIGS. 5, 6, 7 and 8) can be adjusted to copy documents on a one-to-one

6

basis by threading the film straight through the container 117 without using roller 125. The document conveyor is adjusted to send the documents straight through the conveyor without use of the extended path around roller 110.

When a reduced size copy is to be made of two-to-one, the film speed is reduced by one-half and the path is unchanged. The document speed is retained but the documents are routed through the extended path around roller 110.

When an increased size is to be made of one-to-two, the film speed is kept constant and the film is threaded around roller 125 (FIG. 7) to give the required extended path necessary to prevent overlapping. The document speed is reduced by one-half and the documents are routed straight through the machine. The optical systems obviously must be adjusted for each change of reproduction size.

The above described adjustments can be made only when the camera motor is stopped and parts of the camera removed. An alternate arrangement of camera components is shown in FIGS. 11, 12, 13 and 14 where a fast change of reproduction size can be made without removal of any of the camera parts. Adjustments can even be made while the motor is running. The film holder 135 is similar to the film 117 shown in FIG. 7, having storage containers 27 and 30, and exposure openings 122 and 123. The film 28 passes over rollers 124 and 126 as before but the loop roller 136 is secured to a bracket 137 which in turn is moved by a long threaded shaft 138 which is positioned by a knurled nut 140 equipped with an indicator dial 141. The operator may change the length of the loop path by turning the nut 140 and by this means provide an extended path as shown in the drawing or the roller 136 may be moved to the right as shown in FIG. 11 and the film will then be moved through the intermediate portion of the film container in a straight line, passing directly from the exposure opening 122 to the lower exposure opening 123. No other adjustment is necessary since the slipping belt on the lower portion of the film container takes up any slack that may be produced when the extended path is shortened.

A similar adjustment can be made in the document conveyor as is indicated by FIG. 12. This document conveyor is similar to the conveyor shown in FIG. 5 and has the usual power belts which turn feed rollers 91 and 92 and convey the document past the vacuum compartment 96 while being illuminated by the lamps in hood 98. This document conveyor also contains hood 105 and the usual lenses 58 and 60 mounted on bases 72 and 73.

In order to vary the length of path between the two object planes a flexible belt 145 is mounted on power rollers 146 and 147. Belt 145 is held in place by idler rollers 148, 150, 151 and 152 and in addition passes over the outside surface of a movable vacuum chamber 153. As shown in FIG. 12 the vacuum chamber 153 is moved to the right to permit the belt 145 to move in a straight line between the object planes where the documents are illuminated. Since the chamber 153 is connected to a vacuum pump which produces a reduced pressure and since the container 143 is perforated the documents will be held in position on perforated belt 145 as they move between the two object planes.

The vacuum chamber 153 is provided with a rack 154 which meshes with a pinion 155 journaled in a portion of the camera case. The pinion 155 is manually controlled by a knurled wheel 156 and by turning this wheel an operator can move the chamber to the left as shown in FIG. 12 and produce an extended path or loop between the two object planes as illustrated in FIG. 14. It should be noted that the adjustment of the vacuum chamber 153 retains the belt 145 in its proper tension because, as the loop to the left is made longer the loop that passes around the right hand side of the chamber is made smaller. In order to show the operator the extent of the loop a scale 157 is provided on the outside of the camera case. It will be obvious that this adjustment also may be made by an

operator without dismantling any portion of the document conveyor and may be made while the motor is running.

The foregoing description indicates how a copying camera can be used to copy both sides of a document on opposite sides of a strip of recording film. The exposures are made while the document and film are both moving in the same direction.

The schematic diagram of connections shown in FIG. 15 illustrates one form of the electrical connections necessary for running the camera. The plug 160 is inserted into any socket which is connected to a source of alternating current. Transformers 161 and 162 are connected in series with switches 163 and 164 to the alternating current supply. The secondaries of the transformers are connected to the lamps 166 for lighting the document as it passes through the camera's object planes. A motor switch 165 controls motor 26 and also connects the alternating current supply to a bridge rectifier 166 which supplies direct current to the three clutch windings 167, 168 and 169 enclosed in clutches 25, 24A and 24B. A dial switch 170 controls the direct current supply to any one of the three clutch windings at the same time insuring that only one clutch can be energized at any time.

The foregoing disclosure and drawings are merely illustrative of the principles of this invention and are not to be interpreted in a limiting sense. The only limitations are to be determined from the scope of the appended claims.

What is claimed is:

1. A copying camera for photographically recording both sides of a document on both sides of a film comprising; a film holder including a first storage container for an unexposed film roll, a second storage container for an exposed film roll, a first exposure plane where one side of the film may be exposed, a second exposure plane where the other side of the film may be exposed, said first and second exposure planes spaced apart for sequential exposure as the film moves from the first to the second storage container; a document conveyor for moving the document through a first object plane where one side of the document is illuminated, additional conveyor means for moving the document through a second object plane where the other side of the document is illuminated, said first and second object planes spaced apart for sequential illumination; a first optical system for focussing light rays from the first object plane onto the first exposure plane, a second optical system for focussing light rays from the second object plane onto the second exposure plane, said optical systems each including a focussing lens, a plane mirror and a double rectangular mirror for providing the equivalent of three reflections; and a motor operated mechanism which controls the speeds of the documents and the film to move in the same direction and in synchronism with each other.

2. A copying camera as set forth in claim 1 wherein the documents are maintained in their object planes by a perforated belt and a reduced pressure volume adjoining the belt.

3. A copying camera as set forth in claim 1 wherein said documents and film are coupled by gear means to move at the same speed and the optical systems are adjusted to produce an image the same size as the object.

4. A copying camera as set forth in claim 1 wherein said document conveyor is coupled to the film by gear means so that the documents are moved faster than the film and the optical systems are adjusted to produce an image smaller than the object, the ratio of the object size to the image size being substantially equal to the ratio of the document speed to the film speed.

5. A copying camera as set forth in claim 4 wherein said document conveyor and film are coupled by gear means to move the documents through an extended path greater than the distance between the first and second object planes to thereby produce the images of both sides of a document in corresponding alignment on both sides of the film.

6. A copying camera as set forth in claim 1 wherein said film is coupled to the document conveyor by gear means for moving the film faster than the document conveyor and the optical systems are adjusted to produce an image larger than the object, the ratio of the object size to the image size being substantially equal to the ratio of the document speed to the film speed.

7. A copying camera as set forth in claim 6 wherein said film is coupled to the document conveyor by gear means for moving the film through an extended path greater than the distance between the first and second image planes to thereby produce the images of both sides of a document in corresponding alignment on both sides of the film.

8. A copying camera for photographically recording both sides of a document on both sides of a film including a document conveyor comprising, means for moving the document through a first object plane where one side of the document is illuminated, belt conveyor means for moving the document through a second object plane where the other side of the document is illuminated, said means for moving the document including two perforated belts adjoining two volumes respectively each having reduced atmospheric pressure and roller means for transferring said document from one belt to another.

9. A copying camera as set forth in claim 8 wherein said first object plane is spaced apart from the second object plane and wherein said moving means includes an adjustable extended path greater than the distance between the two object planes.

10. A copying camera as set forth in claim 8 wherein said adjustable extended path is varied by means of a transversely movable chamber which is adapted to move a conveyor belt into an extended path while maintaining a suction at the belt surface and maintaining the belt in tension for all values of document path.

11. A copying camera as set forth in claim 10 wherein said chamber is connected to a vacuum pump and portions of said belt move across two faces of said chamber, said chamber being adjustable by a manually operable rack and pinion.

References Cited in the file of this patent

UNITED STATES PATENTS

1,291,954	Losey	Jan. 21, 1919
1,409,628	Wescott	Mar. 14, 1922
1,614,619	Kaplan	Jan. 18, 1927
1,952,519	Transtrom	Mar. 27, 1934
2,198,115	John	Apr. 23, 1940
2,213,531	Oswald et al.	Sept. 3, 1940
2,391,044	Terry	Dec. 18, 1945
2,578,320	Schubert	Dec. 11, 1951
2,632,360	Eaton et al.	Mar. 24, 1953
2,930,284	Limberger	Mar. 29, 1960
2,939,371	Schutt et al.	June 7, 1960
2,940,358	Rosenthal	June 14, 1960

FOREIGN PATENTS

446,165	Great Britain	Apr. 27, 1936
981,433	France	Jan. 17, 1951