United States Patent [19]

Kistner et al.

[11] **3,726,590**

[45] **Apr. 10, 1973**

[54] FICHE-TO-FICHE COPIER

[75] Inventors: **Jerome L. Kistner**, Cincinnati; **Robert E. Gettle**, Hamilton, both of Ohio

[73] Assignee: **Mosler Safe Company**, Hamilton, Ohio

[22] Filed: **Aug. 6, 1971**

[21] Appl. No.: **169,650**

[52] **U.S. Cl.** **355/100**, 271/51, 355/102

[51] **Int. Cl.** **G03b 27/30**

[58] **Field of Search**.....355/100, 99, 91, 355/97, 102, 103, 12; 95/89 G; 271/51

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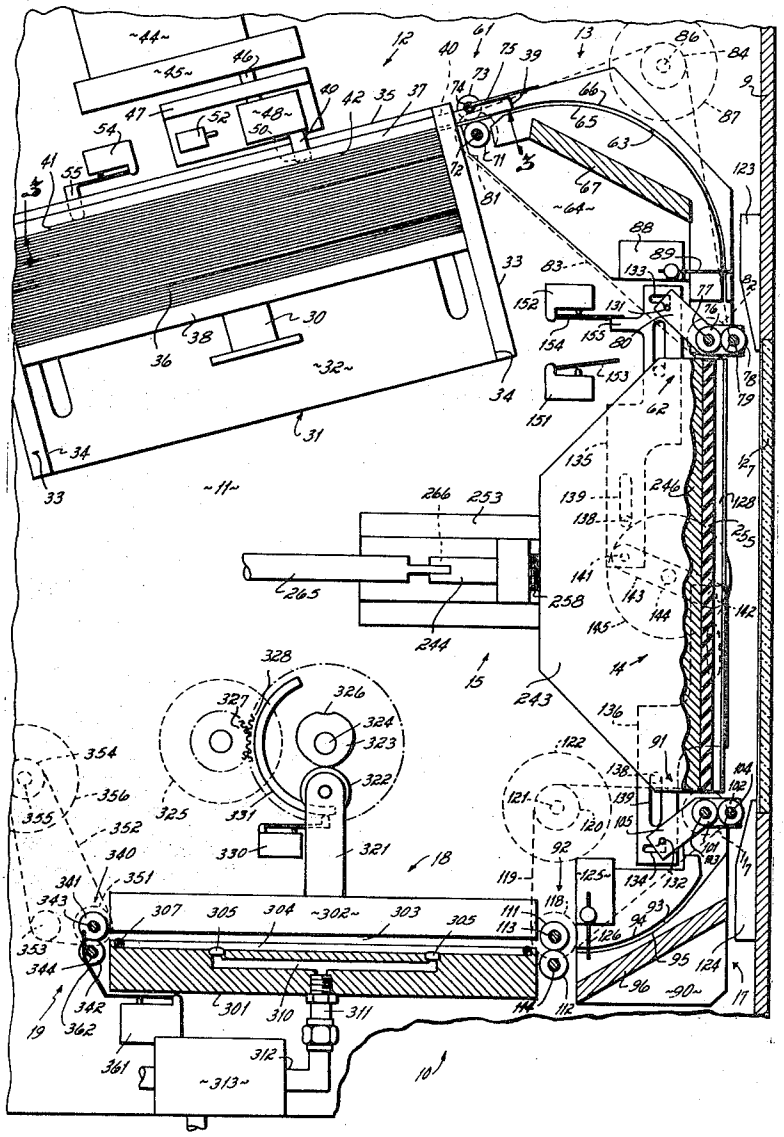
[57] **ABSTRACT**

A compact apparatus for making card-like photographic copies in which the copy cards proceed in a U-shaped path with one dimension of the card extending vertically throughout its travel from a stack feeder at one arm of the U, to an exposure station at the base of the U, and to a developing station at the other arm of the U. Retractable drive rollers are provided at the exposure station which, in drive position, provide continuous feed control of the card, and in retracted position, allow for complete exposure from edge to edge of fiche type copy cards.

23 Claims, 33 Drawing Figures



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SHEET 1 OF 8

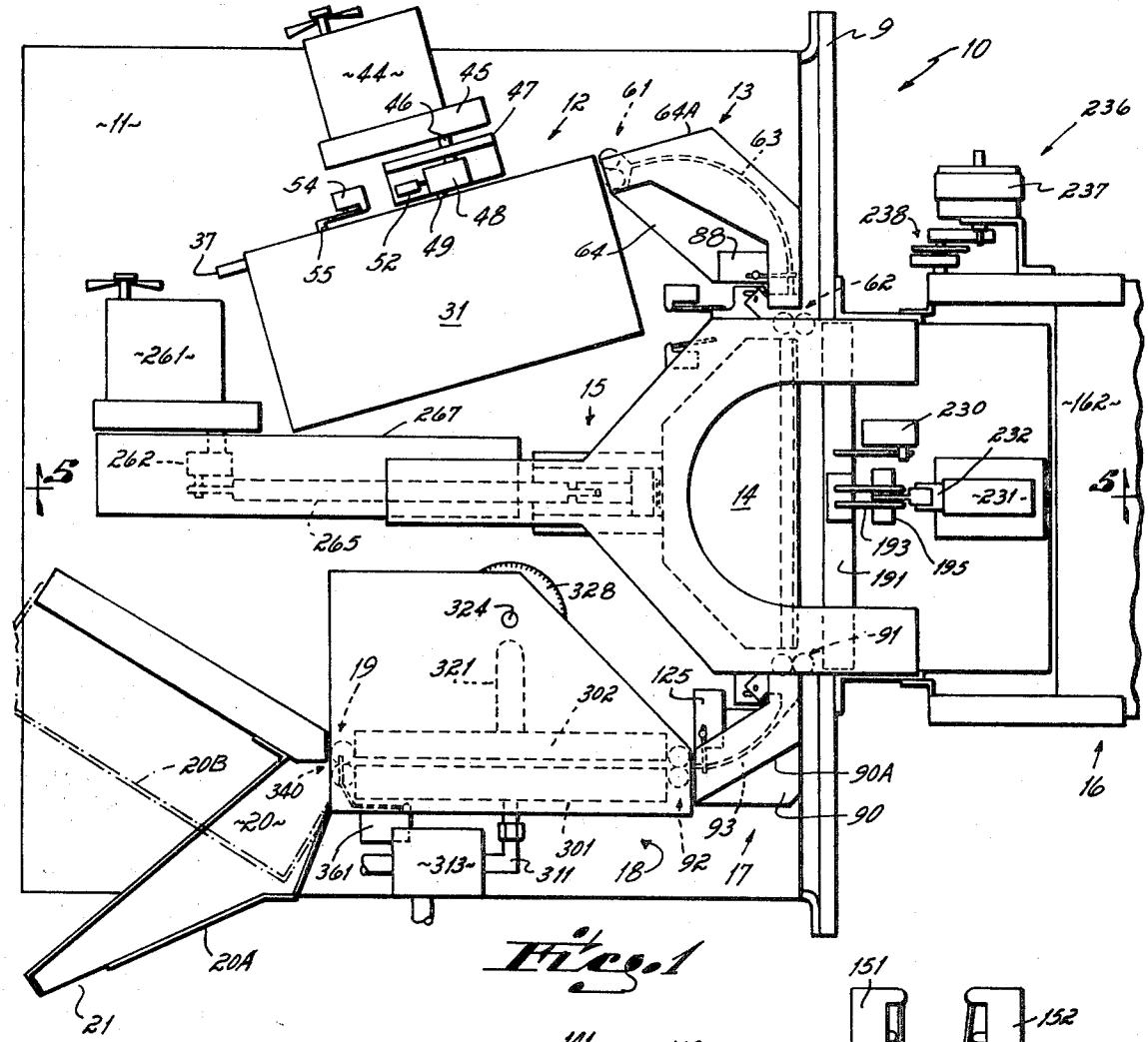

Fig. 1

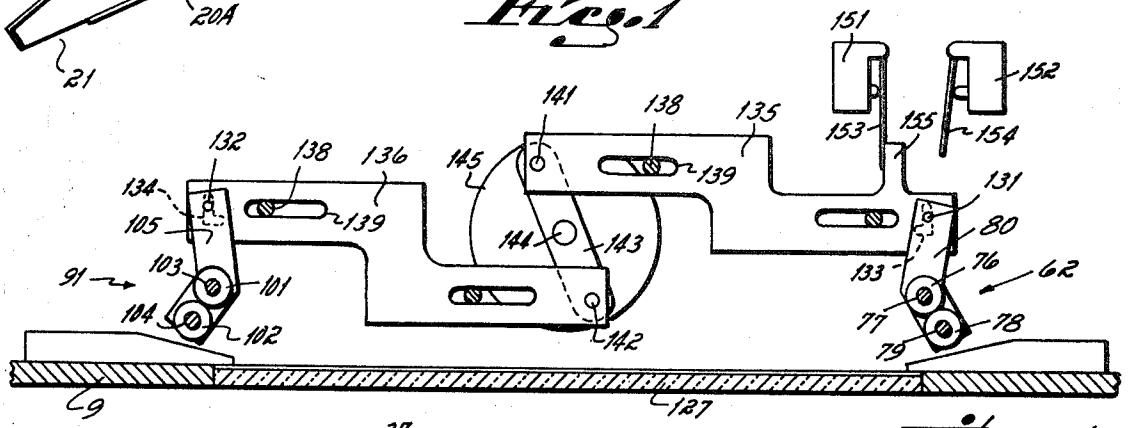

Fig. 4

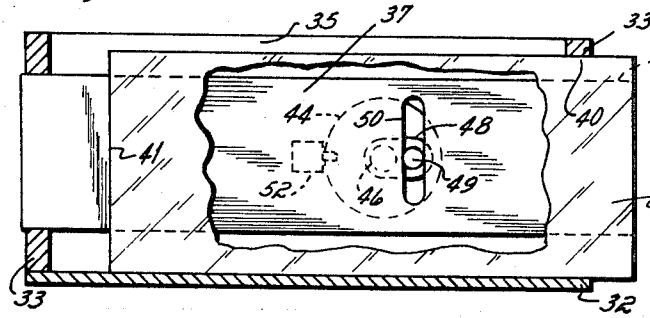

Fig. 3

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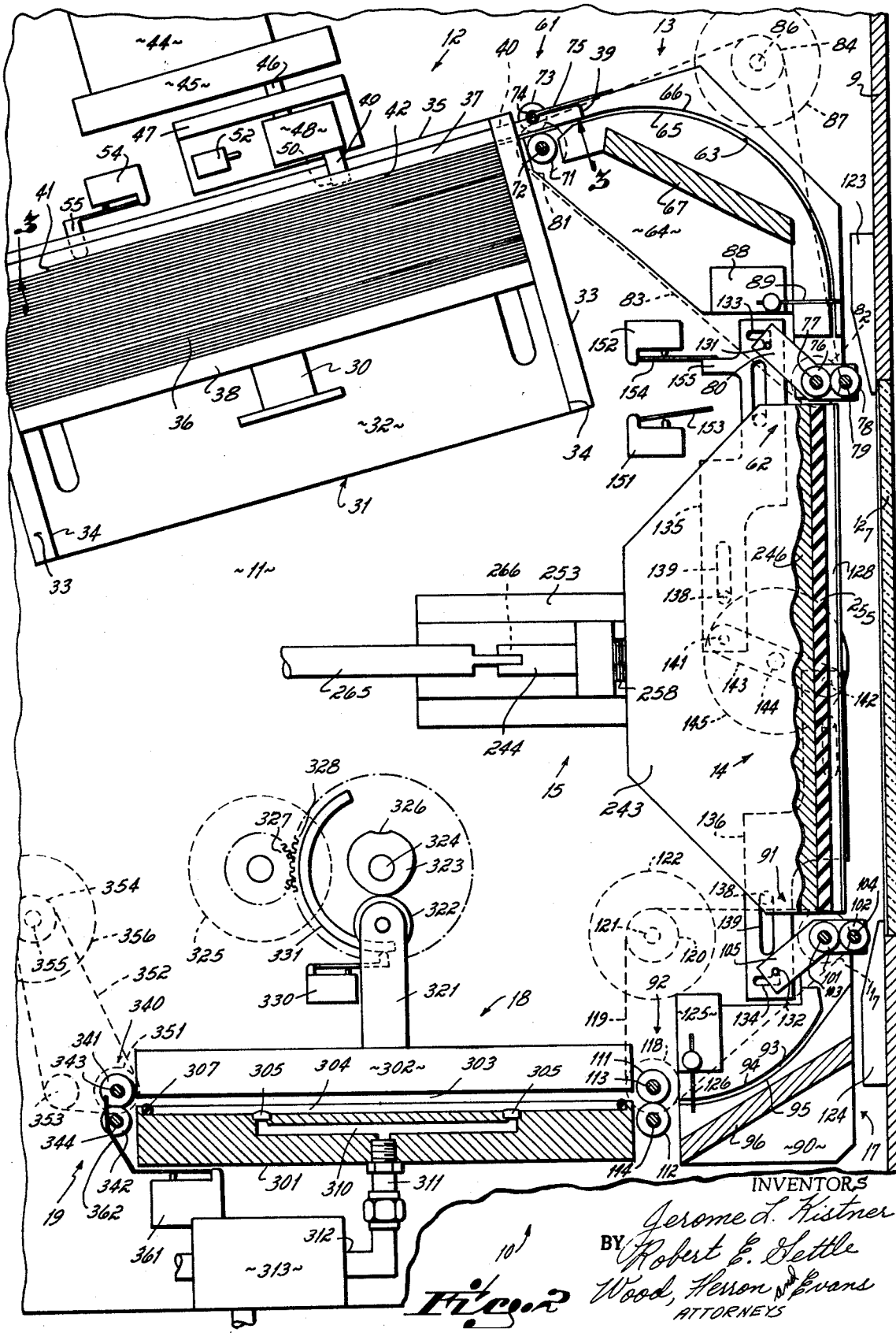

Fig. 2

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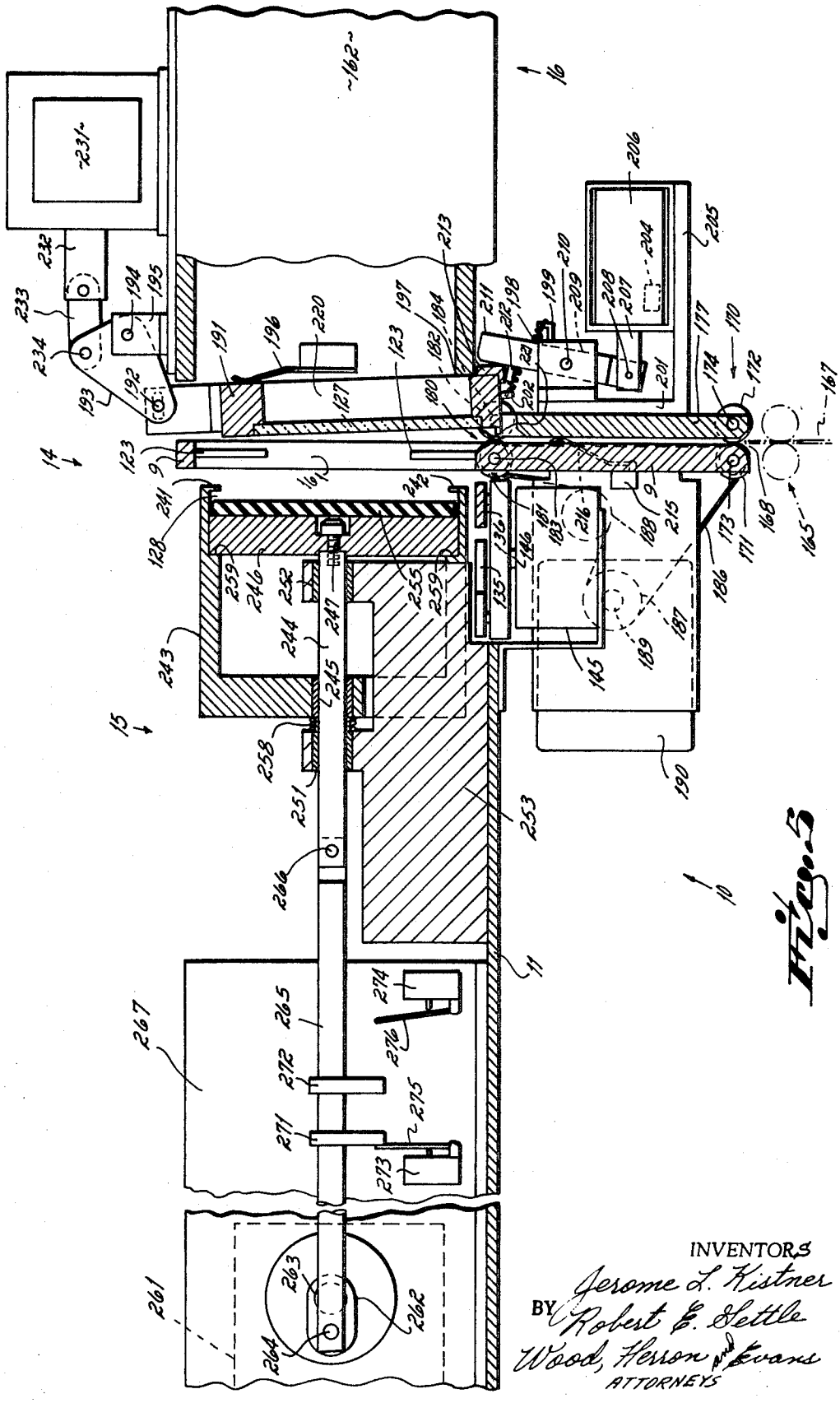

Fig. 3

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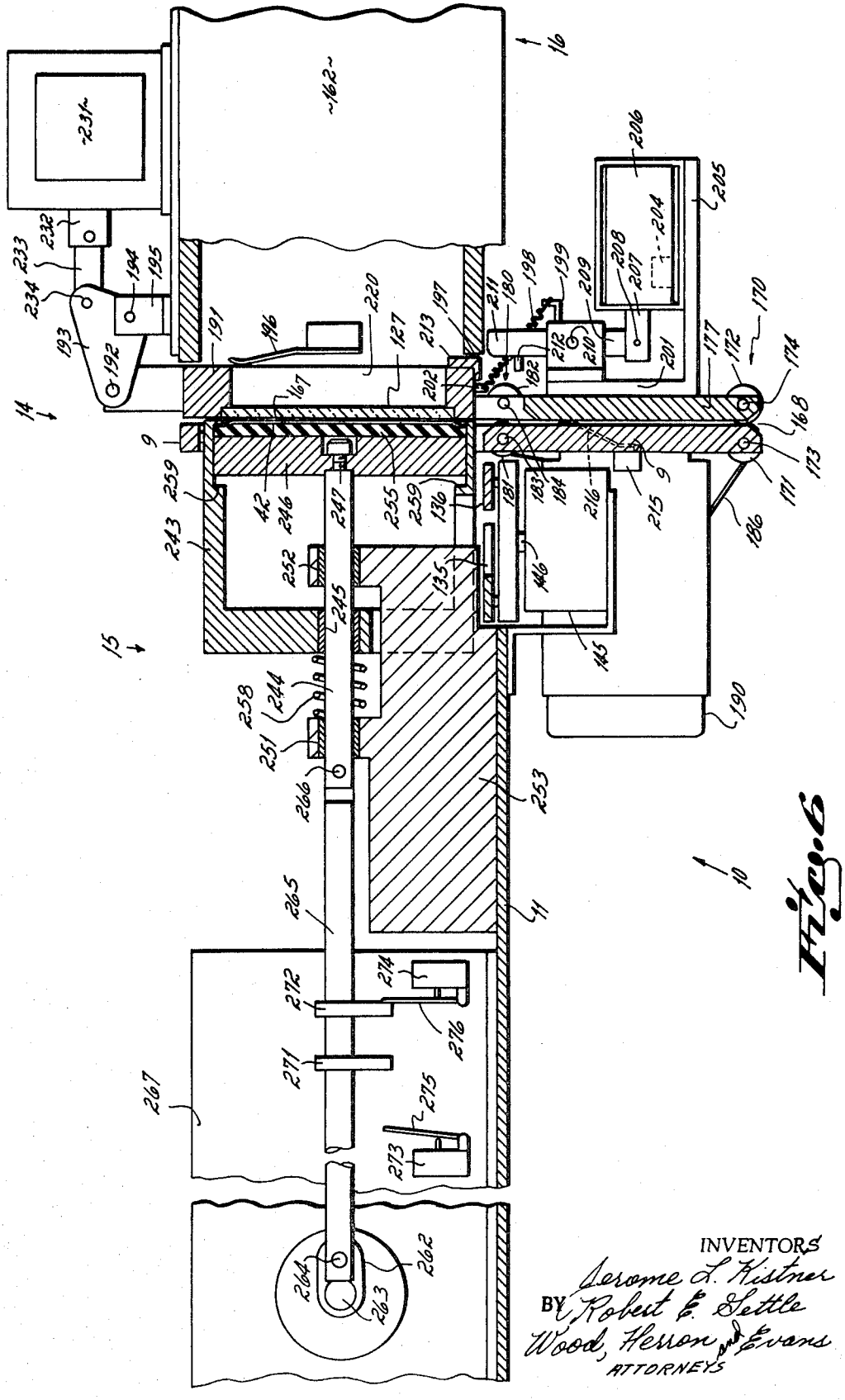

Fig. 6

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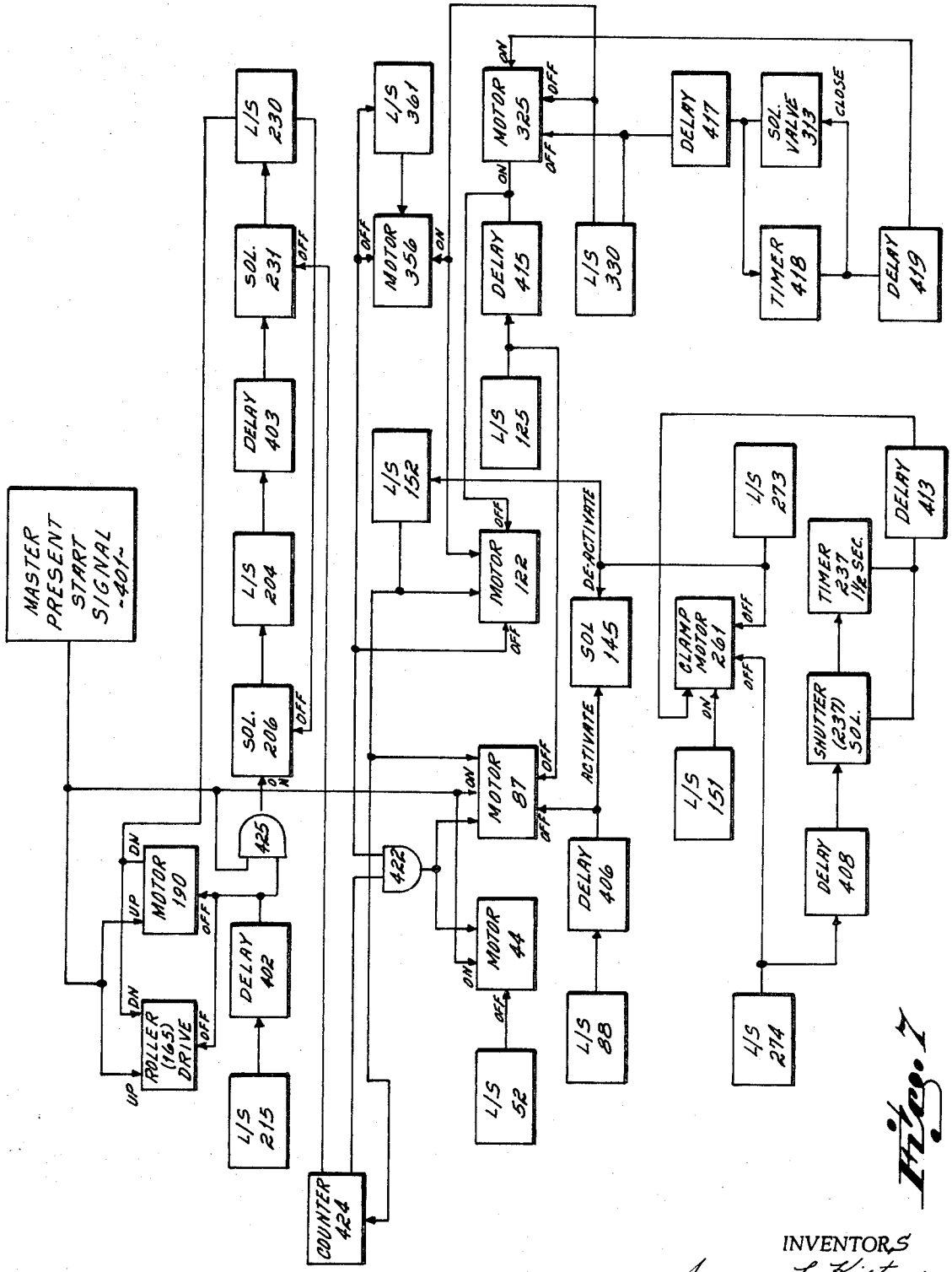

Fig. 1

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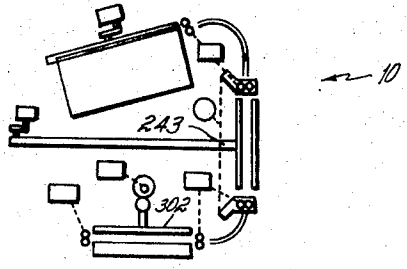

Fig. 8A

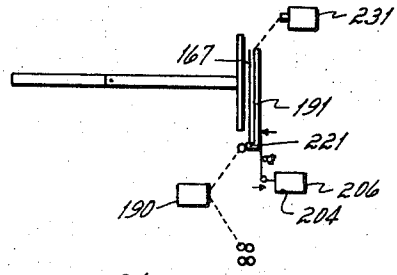

Fig. 8E

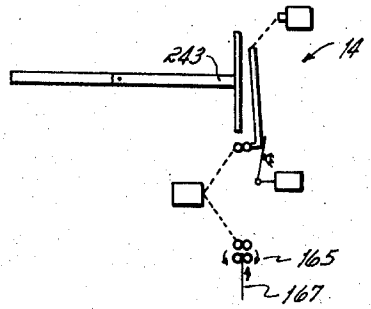

Fig. 8B

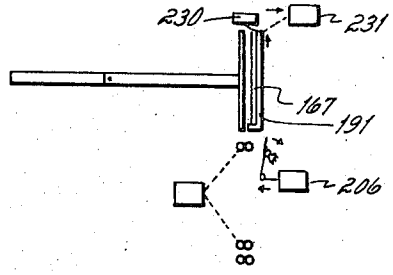

Fig. 8F

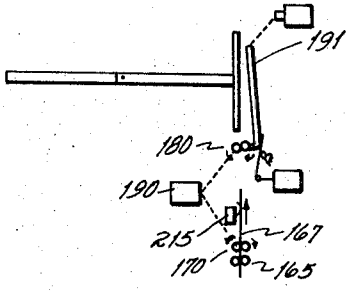

Fig. 8C

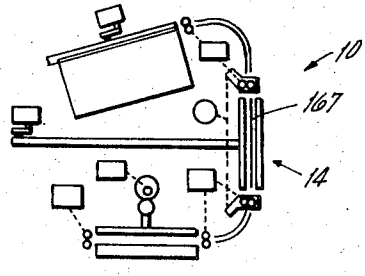

Fig. 8G

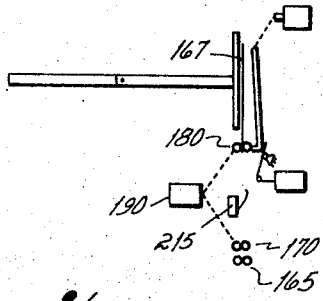

Fig. 8D

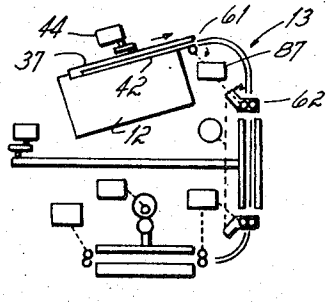

Fig. 8H

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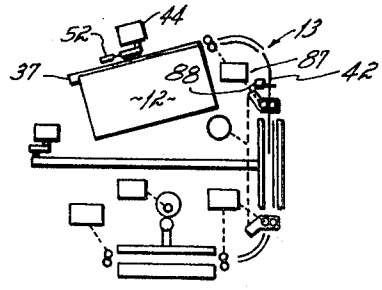


Fig. 8I

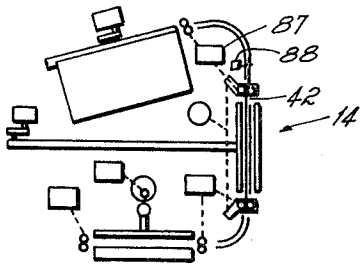


Fig. 8J

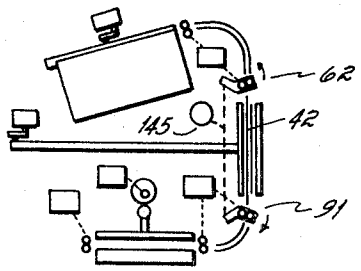


Fig. 8K

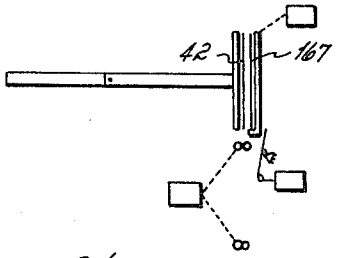
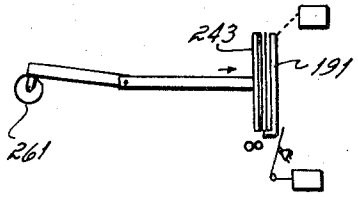


Fig. 8L



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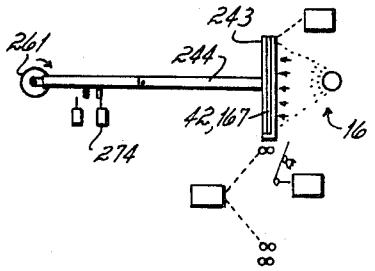

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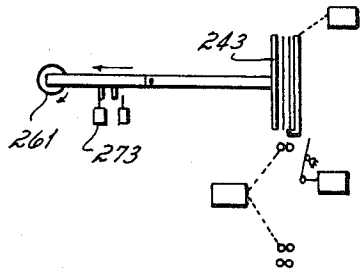
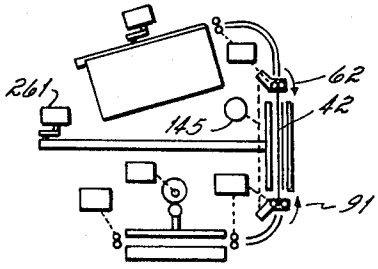


Fig. 8O



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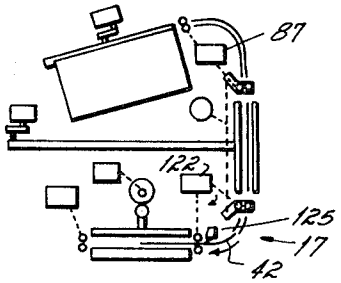

Fig. 8Q

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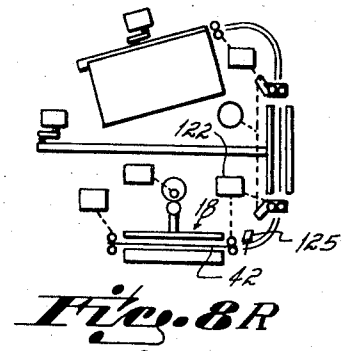

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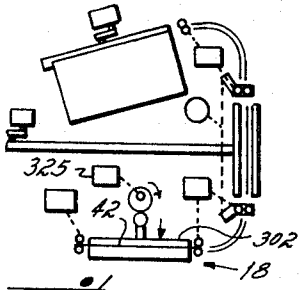

Fig. 8S

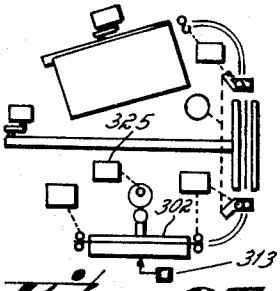

Fig. 8T

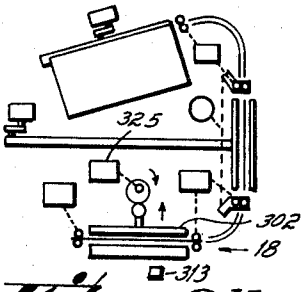

Fig. 8U

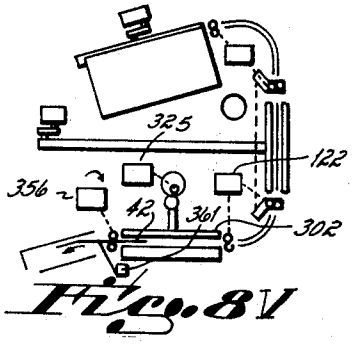

Fig. 8V

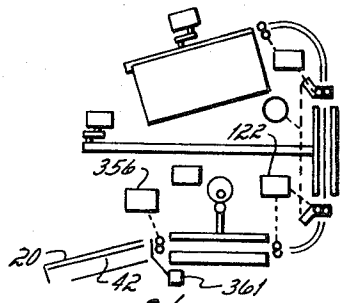

Fig. 8W

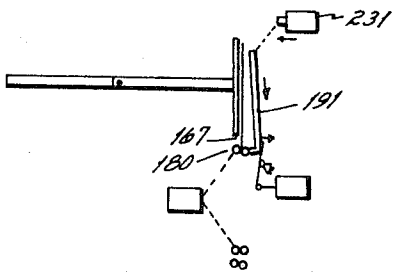

Fig. 8X

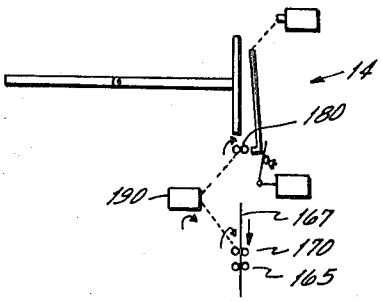

Fig. 8Y

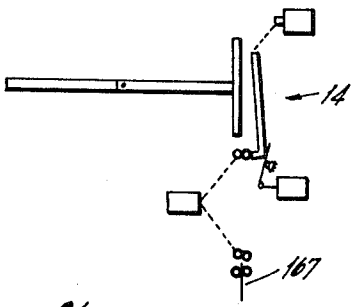

Fig. 8Z

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FICHE-TO-FICHE COPIER

The present invention relates to record copying devices and more particularly to apparatus for making card-like record copies of, for example, the fiche type.

The storage of information, particularly documentary information, in the form of microimages on photographic film is a common and wide-spread practice. This practice usually involves the provision for a film master file system in which master copies of the documents are stored. The present invention relates to apparatus, particularly for use with such systems, and in which copies of the master files are made on discrete card like forms. Typically, the card-like forms are rectangular file cards in which the information is usually recorded photographically on a transparent portion thereof. These cards are frequently of the type known as aperture cards in which a mounting material, usually opaque and of a paper type substance, defines the shape of the card, and which has at least one aperture formed therein in which is contained a transparent film insert. Another common type of card is that of the fiche type, in which the transparent film material defines the entirety of the card. The present invention is directed toward a copier which is applicable to making copies on various types of such cards, but includes features which are specifically useful in making copies of fiche type cards in which substantially the entire area of the card may be exposed to information from the master copy.

It is a primary objective of the present invention to provide a card copier wherein a complete copying process can be performed in a rapid and compact operation.

A more specific objective of the present invention is to provide a copying apparatus in which the supply of copying blanks, the exposure station at which the copy blank is exposed to information from the master file, and a developing station which renders the latent image formed at the exposure station permanent are related and positioned in such a way as to form a highly compact and efficient device. More specifically, it is an objective of the present invention to form an efficient and compact device in which photosensitized copy cards having for example a diazo coating, are fed to an exposure station whereat exposure is made by, for example, a contact printing process, and to a developing station whereat the exposed coating is developed by application of a developer such as pressurized anhydrous ammonia vapor subjected to the card while a sealed developing chamber.

It is one specific objective of the present invention to provide an apparatus in which the above objectives can be accomplished in making fiche copies of master files, and particularly from other fiche type masters, which allows exposure of substantially the entire area of the copy card.

The present invention is predicated on the concept of providing a compact copying device wherein the copy card storage magazine, the exposure station, the developing station, and the delivery or discharge means are positioned along a generally U-shaped path of travel through which the copy cards, when traveling, will be maintained in a generally vertical plane. More specifically, each of the stations is situated along a different straight portion of the path so that the copy cards at those stations are maintained in a substantially flat vertical plane. The stations are connected by conveyor devices through which are defined curved trackways or guides along which the cards are advanced from station to station. Means are provided for bringing the master files to the exposure station and clamping them into contact with the copy cards and exposing the copies to the source of radiation projected through the master copy.

The present invention is further predicated in part upon the concept of providing movable drive rollers which operate to carry the copy card into and out of the exposure station and which are maintained in a normal driving position such that the copy card is always engaged by at least one pair of such rollers, and which rollers are movable away from the copy card during the exposure process to prevent the shielding of the copy card from the exposing radiation and thereby allowing exposure from substantially edge-to-edge of fiche type copy cards.

The advantages of the present invention reside in the provision, in a copying device which provides a complete copy process, of an operation of exceptional compactness heretofore not provided by devices of the prior art. Furthermore, the device of the present invention provides for the full exposure of fiche type copy cards during the copying process.

These and other objectives of the present invention will be more readily apparent from the following detailed description of the drawings illustrating one preferred form of a record copying device of the fiche-to-fiche copier type which embodies principles of the present invention.

FIG. 1 is a plan view of a fiche-to-fiche copier embodying principles of the present invention.

FIG. 2 is a plan view, partially broken away and partially in cross section, of a portion of the copier of FIG. 1.

FIG. 3 is a cross sectional view partially broken away, of the card feed mechanism of the copier of FIG. 2 and taken generally along lines 3-3 of FIG. 2.

FIG. 4 is a detail plan view of the roller release mechanism of the copier of FIG. 2 illustrating the rollers at the exposure station in released condition.

FIG. 5 is a cross sectional view along line 5-5 of FIG. 1 illustrating the exposure station in an empty or standby condition.

FIG. 6 is a cross sectional view similar to FIG. 5 illustrating the exposure station in a loaded condition for the exposure of a copy.

FIG. 7 is a diagram of the controls of the copier of FIG. 1.

FIGS. 8A-Z are diagrams, presenting step by step illustration of the operation of the copier of FIG. 1.

FIG. 1 illustrates one specific embodiment of a copier which is of the fiche-to-fiche copier type according to principles of the present invention, that is, in which fiche copies are made from fiche masters. While the present invention is described in relation to this specific embodiment, certain principles of the invention are applicable to copiers in which card copies in general are made from masters of various forms. For example, the copies may be cards of the fiche type, or may be aperture cards in which one or more transparent inserts are carried by a paper mount, or may be other discrete

card-like copies. The masters from which the copies are made, on the other hand, may be in the form of cards such as the fiche or aperture cards, or may be in the form of webs such as rolled microfilm.

Referring to FIG. 1, the copier 10 includes a horizontal base mounting plate 11 to which is rigidly secured a vertical mounting plate 9. To the plate 11 is secured a card supply magazine assembly 12 which is adapted to separately feed discrete blank copy cards to a feed conveyor assembly 13, also rigidly mounted to the base plate 11. The feed conveyor assembly 13 advances the discrete cards from the magazine assembly 12 to an exposure station 14. The exposure station 14 includes a card handling assembly portion 15 mounted to the base plate 11, and an exposure and light housing assembly 16 mounted to the vertical mounting plate 9. An advancing conveyor assembly 17 is mounted to the base plate 11 and positioned opposite the exposure station 14 from the feed conveyor 13. The advancing conveyor 17 operates to advance exposed cards from the exposure station 14 to a developing station 18 which is mounted also to the base plate 11. A delivery conveyor 19 is mounted to the base plate 11 opposite the developing station 18 from the advancing conveyor 17. The delivery conveyor 19 operates to feed exposed and developed copies from the developing station 18 to a delivery tray 20. As shown in FIG. 1, the delivery tray 20 may take two forms. The form 20A illustrated in solid lines in FIG. 1 represents a delivery tray of the type which will present the individual finished copies to the operator for removal and for this purpose is provided with an accessible opening 21. The alternative form 20B is illustrated in phantom lines in FIG. 1 and represents a stacker type hopper which will accumulate finished copies in a stacked relationship for their later removal by the operator. The hopper 20 is also rigidly mounted to the base plate 11.

Referring to FIG. 2, the supply magazine 12, the feed conveyor 13, the exposure station 14, the advancing conveyor 17, the developing station 18, and the delivery conveyor 19 are more completely illustrated. These components operate to form fiche copies from fiche masters. The masters are retrieved from storage and transported to the exposure station 14. Then, one or more copy cards are sequentially fed to the exposure station 14 where they are exposed to the image of the master card, then fed to the development station 17 where they are developed to render the latent images of the master visible, and then they are discharged at the delivery hopper 20. After all desired copies have been made, the master is returned to its storage area.

Unexposed fiche copy cards are stored at the supply magazine 12. When a copy of a master which has been fed to the exposure station 14 is desired, a fiche copy card is fed from the magazine 12, advanced by way of the feed conveyor 13 to the exposure station 14, where it is urged into contact with the master by actuation of the copy card handling portion 15 of the exposure station 14. The copy card preferably carries a diazo coated photosensitive surface which will preferably face the master during exposure. At the exposure station 14, this surface is exposed to ultraviolet light from the light source portion 16 of the exposure station 14, and then the copy card released from the exposure station and fed by way of the advancing conveyor 17 to the developing station 18, where it is developed by contact with pressurized anhydrous ammonia vapor. Upon being developed, the completed copy is advanced by way of the delivery conveyor 19 to the discharge outlet 20.

The cards of copyable fiche material are maintained in the magazine 12 in a vertical orientation and, when advanced, proceed in a U-shaped path along the feed conveyor 13 and maintain their vertical orientation through the exposure station 14 along the advancing conveyor 17 and through the developing station 18. In this manner, copies can be made in an efficient and compact operation.

The unexposed copy supply magazine and feed mechanism 12 includes a U-shaped tray portion 31 having a base 32 rigidly secured to the machine base mounting plate 11 and having perpendicularly upstanding side walls 33 which terminate in inwardly projecting flanges 34 at the upper ends thereof. The tray 31 is adapted to surround and contain a stack of blank unexposed fiche cards 36. The stack of cards 36 is compressed between a feed plate 37 and a stacker plate 38. The stacker plate 38 is urged toward the feed plate 37 by springs 30 or any other suitable mechanism. The feed plate 37 is slideably supported to a fixed end plate 35 rigidly mounted on one end of the tray, and is adapted to move in a reciprocating motion horizontally through an opening 40 in one of the walls 33 and toward the feed conveyor assembly 13 (FIG. 3). In FIGS. 2 and 3, the plate 37 is shown in its extended position with its leading end 39 in engagement with the conveyor assembly 13. The plate 37 is provided with a step 41 in its face adjacent the stack 36 which presents a vertical edge engageable with the end card on the stack 36. The width of the face of the step 41 is slightly less than the thickness of one of the cards 36 so that, as the feed plate 37 reciprocates, engagement is made with one of the cards to push it toward the feed conveyor assembly 13, but so as to only feed one card and to separate it from the stack 36. The opening 40 in the end 33 of the tray 31 is slightly greater than the combined thickness of the feed plate end 39 and a single one 42 of the cards.

The plate 37 is reciprocatably driven by a motor 44 rigidly mounted through a gear housing 45 to the base plate 11. The gear housing 45 has an output shaft 46 which extends through a bracket 47, which is rigidly supported to the base plate 11, and terminates in an eccentric coupling element 48. The element 48 has an output shaft 49 which projects into a slot 50 in the plate 37. This will be better shown by reference to FIG. 3.

FIG. 3 shows a card blank 42 broken away to expose the feed plate 37 slideably mounted to the tray end portion 35. The slot 50 in the feed plate 37 is vertically oriented and is adapted to receive the shaft end 49 of the eccentric element 48. In this manner the rotary motion of the eccentric 48 is translated into reciprocating linear motion of the feed plate 37. As the eccentric element 48 was rotated to the position shown in FIG. 3, the card 42 was engaged by the notch or step 41 and advanced to the right as shown in the figure. Upon return motion of the eccentric 48, slide plate retracts to the left in the figure. Upon this return motion, the eccentric 48 actuates a limit switch 52, mounted on the bracket 47, to stop the motor 44 with the feed plate in its rest position.

Referring again to FIG. 2, a limit switch 54 is provided having a feeler actuator 55 positioned below the feed plate 37 to engage the stack 36. When the stack contains cards, the switch 54 is actuated, but when the stack is exhausted, the switch 54 de-actuates to provide means to signal that the supply of copy cards is exhausted.

The feed conveyor 13 includes two pairs of rollers 61 and 62 which are spaced from each other at opposite ends of an arcuate guide path 63 by a distance slightly less than the length of one of the cards 42. In this manner, a copy card 42 can be advanced through the feed conveyor 13 while always remaining in engagement with one of the pairs 61 or 62 of rollers. Control of the copy card 42 in its vertical attitude is maintained by upper rollers and path (not shown).

The guide path 63 is a slot formed in a block 64 rigidly mounted to the base plate 11. The slot 63 is defined by an inner convex guide surface 65, an outer concave surface 66, and a bottom. The bottom is located above the base plate 11 and is co-planar with the top of the tray base 32. The upper guide path's block 64A (FIG. 1) is mounted to a bracket 67 and is parallel to the block 64 so that its slot is overlying the slot 63.

The roller pair 61 includes a driven roller 71 rotatably mounted upon a shaft 72 next to the base plate 11, and an idler roll 73 rotatably mounted upon a shaft 74 carried by a pair of leaf springs 75 mounted at their ends to the block 64 to bias the idler roll 73 against the driven roll 71. The upper ends of the shafts 72, 74 are journalled in the upper block (not shown) and carry the upper rollers (not shown).

The roller pair 62 includes a driven roller 76 rotatably supported by a shaft 77 which is carried by the base plate 11, and an idler roll 78 rotatably mounted upon a shaft 79 which is carried by a bracket 80 pivotally mounted upon the shaft 77. An upper bracket (not shown) is similarly attached to the shafts 77, 79 at their upper ends and carry similar rollers.

The driven rollers 71 and 76 of the roller pairs 61 and 62, respectively, are provided with driven sprockets 81 and 82. About these sprockets 81 and 82 extends a driven chain 83 which also extends around a sprocket 84 driveably supported upon a shaft 86 of an electric motor 87. Energization of the motor 87 drives the rollers 71 and 76 through the chain 83 to feed a card 42 through the nip of the roller pair 61 as the card 42 is fed from the magazine 12 to advance the card through the nip of the roller pair 62 and into the exposure station 14.

A limit switch 88 is mounted to the base plate 11 and has a feeler arm 89 positioned along the path 63 to provide means to signal the feed of a card into the exposure station 14.

The advancing conveyor 17 is similar to the feed conveyor 13. The upper elements of this conveyor are not shown, but it is to be understood that they are identical with the lower elements which are described in detail. The conveyor 17 includes two pairs of rollers 91 and 92 spaced at opposite ends of a guide path 93 formed in a lower base block 90. The slot is defined by a convex guide wall 94, a mating concave guide wall 95, and a bottom co-planar with the bottom of slot 63. The upper guide block 90A (FIG. 1) is mounted upon a bracket 96. The roller pairs 91 and 92 are spaced apart by a distance less than the length of the card 42 so that the card passing through the advancing conveyor 17 will always be under the control of one of the roller pairs 91 or 92.

The roller pair 91 includes a driven roller 101 and an idler roller 102. The roller 101 is rotatably mounted upon the shaft 103 which is supported by the base plate 11. The idler roller 102 is mounted upon a shaft 104 which is supported by a pair of brackets 105 pivotally mounted to the shaft 103 and spaced at opposite ends of the roller 101.

The pair of rollers 92 includes a driven roller 111 and an idler roller 112. The roller 111 is rotatably mounted upon the shaft 113 which is supported by the base plate 11. The idler roller 112 is mounted upon the shaft 114 which is also supported by the base plate 11. The rollers 101 and 111 are provided with drive sprockets 117 and 118, respectively, each surrounded by a driven chain 119 which surrounds a drive sprocket 120 of the shaft 121 of an electric motor 122. Operation of the motor 122 drives the roller pairs to withdraw a copied card from the exposure station 14 and feed it along the path 93 through the rollers 92 and to the developing station 18.

A limit switch 125 mounted to the plate 94 is provided with a feeler arm 126 positioned along the path 93 to signal the advancing of a card through the advancing conveyor 17 to the develop station 18.

At the exposure station 14, a copy card 42 which is photosensitized with a diazo material is exposed by ultraviolet light to the image of a master card which is presented to the exposure station. The master card is retained in contact with a glass window 127 at the support wall 9 by a pair of guide members 123 and 124. The copy card, when initially presented to the exposure station 14, will be held in a slot 128 (co-planar with the bottoms of slots 63 and 93) in the copy card handling portion 15 of the exposure station 14, and will have its opposite ends gripped by the roller pairs 62 and 91. The portion 15, as will be explained in more detail in connection with FIGS. 5 and 6, urges the copy card 42 into direct contact with the master card against the glass window 127. In order to provide a more complete contact between the master card and the copy card, and thus a more complete exposure of the copy card, the roller pairs 62 and 90 are adapted to retract from engagement with the edges of the copy card through the pivotal action of the levers 80 and 105 respectively.

As discussed above, the levers 80 and 105 are pivotally mounted about the axes 77 and 103, respectively, of the driven rollers 76 and 101 respectively. When these levers are in the position illustrated in FIG. 2, the idler rollers 78 and 102 block the edge regions of the copy card from exposure to the ultraviolet light impinging through the master card and the window 127. During exposure, however, the levers 80 and 105 will take the positions illustrated in FIG. 4, in which the idler rolls have been pivoted away from each other and out of the path of the light impinging upon the edges of the card 42.

Referring to FIG. 4, the ends of the levers 80 and 105 opposite the idler rolls 78 and 102 are provided with pins 131 and 132, respectively. The pins are adapted to be received by L-shaped slots 133 and 134, respectively, in the ends of links 135 and 136, respectively. The

links are slideably supported to the base plate **11** by a set of four pins **138**, each mounted in a respective slot **139** in the links **135** and **136**. The opposite ends of the links **135** and **136** are pivotally mounted at points **141** and **142**, respectively, to an arm **143** attached to a shaft **144** of a rotary double-acting solenoid **145**. When the solenoid is in the position illustrated in FIG. **4**, the idler rollers are withdrawn from contact with the copy card, and when in the position of FIG. **2**, the idler rollers are in engagement with the copy card.

The respective positions are monitored by a pair of limit switches **151** and **152**, respectively, having actuators **153** and **154** positioned to engage a projection **155** on the lever **135**.

The details of the exposure station **14** are shown in the vertical cross section view of FIG. **5**. In this figure, the exposure station is illustrated in an unloaded condition. The copy card handling portion **15**, supported on the base plate **11**, is illustrated in position ready to receive an unexposed sensitized copy card. The vertical support plate **9** is illustrated having an aperture **161** therein ready to receive a master card to be copied. The light source **16** includes a housing **162** rigidly mounted with respect to the support **9** containing the ultraviolet light which directs ultraviolet radiation through the glass **127**, the master card, and the aperture **161** to expose the copy card supported by the copy support portion **15**.

The master card handling mechanism is adapted to receive a selected master card from a file. The selected master card is presented at a pair of rollers **165**, for example, which may be part of a conventional card selector device such as that disclosed in U. S. Pat. No. 3,536,194 of Warren D. Novak, entitled DOCUMENT RETRIEVAL AND HANDLING SYSTEM. The rollers **165** present a master card **167** with its upper edge in engagement with the nip **168** of a pair of rollers **170** which include a drive roller **171** and an idler roller **172**. The roller **171** is rotatably mounted upon a shaft **173** which is mounted in the vertical support plate **9**. The idler roll **172** is rotatably mounted upon a shaft **174** which is mounted upon a support plate **177** which is rigidly mounted with respect to the vertical support plate **9**. Similarly, a pair of upper rollers **180** is provided which also includes a drive roller **181** and an idler roller **182**, each respectively rotatably mounted upon a pair of shafts **183** and **184** to the plates **9** and **177**, respectively. These rollers are spaced above the set of rollers **170** a distance less than the height of the master card **167** so that control of the master card **167** is always attained by at least one of the pairs of rollers **170** or **180**. The drive rollers **171** and **181** are provided with a pair of pulleys around which is received a drive belt **186** which is directed around a drive pulley **187** and a tension pulley **188**. The pulley **187** is mounted upon a shaft **189** of an electric motor **190**. When the motor **190** is energized in one direction, the rollers **171** and **181** are driven to advance the master card **167** upwardly toward the aperture **161**. When the motor **190** is energized to run in the opposite direction, the master card **167** is driven downwardly from the area of the aperture **161** and into the set of rolls **165** to be returned to storage.

When a card **167** is advanced upwardly toward the aperture **161**, the card will rest with its lower edge at the nip of the rollers **180**. An aperture plate **191** is pivotally linked at point **192** to a linkage **193** which is in turn pivotally mounted at point **194** to a bracket **195** rigidly supported to the top of the housing **162** of the light source **16**. A leaf spring **196** is provided having a free end urged against the side of the plate **191** and its other end constrained rigidly to the housing **162** of the light source **16**. The lower end of the plate **191** is urged against an abutment surface **197** of the housing **162** by a spring **198** connected in tension between a hook **199** rigidly mounted to a bracket **201** supported rigidly upon the plate **177**, and a hook member **202** at the base of the aperture plate **191**.

A solenoid **206** is rigidly supported upon a horizontal leg **205** of the bracket **201** and has its output shaft **207** pivotally connected at point **208** to one end of a lever **209**. The lever **209** is pivotally connected at its center at shaft **210** to the bracket **201**. The free end **211** of the lever **209** is provided with a projection **212** which, in cooperation with the end **211** of the lever, is adapted to engage an abutment plate **213** mounted at the lower end of the aperture plate **191**. When the solenoid **206** is de-energized, the lever **209** and the aperture plate **191** are in the positions shown in FIG. **5** and a switch **204** within the solenoid **206** is tripped. A switch **216** having a feeler arm **216** is mounted to the plate **177** so that its arm detects a card's presence or absence from the feed channel between the plates **9** and **177**. The switch **215** functions through suitable timing (to be described) to energize and de-energize the motor **190** and solenoid **206**.

The aperture plate **191** has an aperture **220** therein over which is mounted the glass window **127**. At the lower end of the aperture plate **191** is a horizontal lip portion **221**. When the solenoid **206** is energized, its actuator **207** moves to the right in the figure, and the upper end **211** of the lever **209** moves to the left in the figure, causing the lip portion **221** to extend beneath a master card which will be positioned with its lower edge between the nip of the rollers **180**.

A solenoid **231** is rigidly supported to the top of the housing **162**. The actuator **232** of the solenoid **231** is connected through a pivotal linkage **233** to a point **234** on the link **193**. When the solenoid **231** is actuated, its actuator **232** will move to the right in the figure, causing the link **193** to pivot clockwise and to elevate the aperture plate **191**. This action will occur, during operation, after the actuation of the solenoid **206**, thus insuring that the lip **212** will be engaged with the lower edge of the master card **167** so that the aperture plate **191** will be lifted and thereby lift the master card **167** to a position centered with the opening **161** in the plate **12**. As the plate **191** moves upwardly, it is urged into the opening **161** of the plate **12** by pressure exerted by spring **196** to press the master card against the guides **123**, **124**. When properly positioned as illustrated in FIG. **6**, the plate **191** will close a switch **230** (FIG. **1**).

Returning to FIG. **5**, the copy card handling portion **15** includes the slot **128** defined on one side by opposing upper and lower portions **241** and **242**, respectively, of a card support housing **143**. The housing **243** is slideably supported upon a shaft **244** through a slide bearing **245** and is also slideably supported near the flange ends **241** and **242** upon a pressure plate **246** rigidly secured by a bolt **247** to the end of the rod **244**.

The rod 244 is in turn slideably supported on a pair of bearings 251 and 252 carried by a mounting support 253 rigidly supported upon the base plate 11. The pressure plate 246 is provided with a rubber facing cushion 255 which defines the other side of the slot 128. A spring 258 is compressed between the bracket for bearing 251 and the housing 243 to urge the housing 243 toward the pressure plate 246 such that upper and lower edge portions 259 of the housing 243 are in engagement with the pressure plate 246.

A motor 261 is provided having an eccentric plate 262 connected to its output shaft 263, and an eccentric pivot pin 264 mounted thereon for pivotal attachment of a link rod 265 which is pivotally attached at its other end by a pin 266 to the end of the rod 244. The motor 261 is mounted to a support bracket 267 fixed to the base 11. Rotation of the motor 261 reciprocatably drives the link 265 to reciprocate the shaft 244. This action moves the housing 243 and the pressure plate 246 from the position shown in FIG. 5 in unison to the right of the figure until the flange portions 241 and 242 of the housing 243 come into engagement with the support plate 9, at which time the pressure plate 246 continues its motion to the right while the housing 243 comes to rest against the plate 9 to compress the copy card against the glass plate 127 which is positioned in the aperture 161 of the plate 9. This position, with the master card 167 and the copy card 42 in place, is illustrated in FIG. 6.

A pair of plates 271 and 272 are attached to the rod 265 in such a position to actuate limit switches 273 and 274 by contacting their actuators 275 and 276 respectively, as the assembly 15 is in its retracted position of FIG. 5 and its actuated position of FIG. 6, respectively. A shutter control 236 including a timer 237 and suitable linkage 238 exposes the compressed copy card and master card to the ultraviolet light for the prescribed time duration.

Referring again to FIG. 2, the development section 18 is illustrated and includes a fixed platen 301 rigidly mounted to the base plate 11 and a movable platen 302 having a planar surface adjacent the surface of the fixed platen 301, and slideably supported on the base plate 11 to move into and out of pressure engagement with the fixed platen 301. The movable platen 302 is supported and biased by conventional means (not shown) away from the fixed platen 301. When in its normal position, as illustrated in FIG. 2, a space 303 is defined between the platens to receive an exposed but undeveloped copy card 42. When a copy card 42 is in position for developing between the platens 301 and 302, the movable platen 302 is driven into a sealed engagement against the fixed platen 301 to define a developer chamber 304 formed in the platen surface of the platen 301 and sealed by a ring seal of elastic material 307 which circumscribes the chamber 304. Anhydrous ammonia gas developer is injected under pressure into the chamber 304 through a set of nozzles 305 which are provided in the openings of a conduit 310 formed in the platen 301. The conduit 310 connects to a supply line 311 which is connected to the output 312 of a conventional valve 313 which controls the injection of ammonia developer into the chamber 304. The valve 313 is a two-way valve which has an exhaust port normally connecting the chamber 304 to a water trap when the valve solenoid is de-energized. Most of the gas in the chamber which is under pressure of about 75 psi, thus exhausts through the trap and little escapes to the atmosphere when the chamber 304 is opened.

The movement of the movable platen 302 is achieved through a link 321 rigidly secured to the back of the platen 302 and provided with a cam follower 322 rotatably mounted at its free end. Follower 322 is adapted to follow a cam 323 secured to a shaft 324. The cam 323 is provided with a slight depression 326 at the high lobe thereof to provide a stable position which would prevent movement of the movable platen 302 upon application of pressurized ammonia vapor to the chamber 304. The shaft 324 and cam 323 are driven in rotation by a motor 325 through gears 327, 328. The gear 327 carries a semi-circular actuating surface 331 which actuates a switch 330, the purpose of which will be described in conjunction with the description of FIG. 7.

Referring again to FIG. 2, the delivery conveyor 19 includes a pair of rollers 340 which include a driven roller 341 and an idler roller 342, each rotatably supported on the respective shafts 343 and 344 which are supported upon the base plate 11. The roller pair 340 is spaced at the exit end of the developing station 18 at a distance from the roller pair 92 which is less than the length of one of the copy cards 42 so that a copy card at the developer station will always be under the control of one of the roller pairs.

The driven roller 340 is provided with a drive pulley 351 which is driveably engaged by a belt 352 which surrounds an idler roll 353 and a drive pulley 354 rigidly mounted to a shaft 355 of a motor 356.

A limit switch 361 is rigidly supported by the base plate 11 and includes an actuator finger 362 which is positioned so as to be tripped by a card passing through the nip of the rolls 340.

The controls of the copier machine are illustrated in the diagram of FIG. 7. The controls of the machine are designed to function to initiate a copying cycle in response to a start signal. This signal will usually indicate the presence of a master card to be copied at the roller pair 165. This card has usually been presented to these rollers by a document retrieval device. The start signal is indicated diagrammatically as the output of a start signal generator 401 in FIG. 7. This signal is connected to circuitry which starts the drive for the rollers 165 and energizes the motor 190 to turn the rollers 170 and 180 to move a master card in the up direction into the copier. The passage of the card toward the copier is detected by the limit switch 215. The drop out of the limit switch 215 in response to the trailing edge of the master card energizes an electrical delay circuit 402 which generates a delayed electrical signal which is connected through circuitry which turns off the motor 190 and stops the drive to the rollers 165. This delay also energizes the solenoid 206 which trips the limit switch 204 which is connected to energize a delay circuit 403 which generates a delayed electrical signal which energizes the solenoid 231. The solenoid 231 lifts the platen assembly 191 into position which trips a limit switch 230. This signals that the master card is in position ready for copying. The turning on of the limit switch 230 is connected in a circuit to de-energize the solenoid 206.

The signal from the start generator **401** is also connected in a circuit to turn on the motors **44** and **87** to start feed of a copy card. The motor **44** operates until it trips the limit switch **52**, which turns off the motor **44**. The motor **87** operates to feed a card through the feed conveyor **13**. As the card is fed it trips the limit switch **88** which, upon a dropping out of the switch **88** in response to the trailing edge of the card being fed, energizes a delay circuit **406** which generates a delayed electrical signal which turns off the motor **87**. This delay is sufficiently long to allow the card to be completely fed into the slot **128** of the clamp assembly housing **243**. The delay signal also activates the solenoid **145**, which retracts the roller pairs **62** and **91**. This trips the limit switch **151**, which energizes the clamp motor **261**, which operates until turned off by the tripping of the limit switch **274**. The limit switch **274** is connected to the input of a delay circuit **408** which generates a delay signal which actuates the solenoid for the shutter timer mechanism **236**. This mechanism includes a timer **237** which generates a delayed signal which closes or de-energizes the shutter solenoid **236**. Typically, the time constant of the timer **237** is in the order of approximately 1½ seconds with a conventional ultraviolet source of the mercury vapor type. The output of the timer **237** also energizes a delay circuit **413** which generates a delayed signal which energizes the clamp motor **261** which opens the clamp and continues operating until the limit switch **273** is tripped, which turns off the motor **261** and also re-energizes the solenoid **145** to return the drive rollers to their positions in engagement with the edges of the copy card. This action energizes the limit switch **152**.

The signal from the limit switch **152** is used to initiate the mechanism to discharge the exposed copy card toward the developing station and also may be used to return the master card to storage, or, in the event that plural copies are to be made, to decrement a counter.

The output of the limit switch **152** is connected to turn on the motors **87** and **122**, which cause the card to be advanced out of the exposure station and through the conveyor **17**. This card will trip a limit switch **125** which will de-energize the motor **87**, and the trailing edge of the card will cause the switch **125** to drop out, initiating the delay circuit **415** which generates a delayed signal which turns off the motor **122** and turns on the motor **325**, which closes the developing chamber. The closure of the developing chamber is sensed by limit switch **330** which, upon actuation, turns off the motor **325** and energizes a delay circuit **417**, which generates a delayed signal which energizes the solenoid valve **313** and begins a timer **418** included in the valve **313**. The time constant of the timer for developing is approximately five seconds when developer pressures in the area of 75 psi are applied. The output of the timer **418** signals the closure of the valve **313** and energizes a delay circuit **419** which generates noise signal to again turn on the motor **325** to open the developing station. This causes the de-activation of the limit switch **330** upon completion and generates a signal to turn off the motor **325**. The signal from the limit switch **330** also signals the turning on of the motors **122** and **356** to remove the card from the developing station. The advancing developed card trips limit switch **361** which is connected in a circuit to turn off the motor **122**.

If multiple copies are to be made, the signal from the limit switch **361** passes through an AND-gate **422** and re-initiates the card feed cycle by turning on the motors **44** and **87**.

When a signal is generated either from the limit switch **152**, if only single copies are to be made, or from the zero output of a counter **424** which would be employed to determined the number of multiple copies to be made, a signal is generated which is connected to circuitry to the solenoid **231** to de-energize the solenoid **231** and to cause the platen **191** to drop to release the master card. The movement of the platen **191** will cause the opening of the limit switch **230** which will generate a signal through appropriate circuitry which will energize the roller **165** drive and the motor **190** to carry the master card downward and out of the copying device. The downward passage of the master card will trip limit switch **215** which will generate a signal to the delay circuit **402** which will again output a delay signal which will turn off the roller **165** drive and the motor **190**. This signal is prevented from re-activating the sequence beginning with solenoid **206** by virtue of the AND-gate **425** having an input connected to the start signal generator **401**.

The operation of the copier described above will be best understood by reference to the sequence of the diagrammatic illustrations represented in FIG. **8A-8Z**. Referring to FIG. **8A**, a top diagrammatic view of the copier is illustrated while in its normal standby condition. None of the motors nor any of the parts are moving at this time and the clamp assembly **243** and the developer platen **302** are in their retracted positions.

Some of the views of the sequence are top views similar to those of the FIG. **1** and **2**, while others are elevational views similar to those of FIGS. **5** and **6**.

FIG. **8B** is a diagram in elevation through the exposure station **14**, illustrating the condition of the apparatus as the start signal is received. At this time, a master card **167** is presented at the rollers **165**.

As FIG. **8C** shows, the motor **190** is energized to drive the rollers **170** and **180** to move the master card **167** upwardly toward the platen **191**. At this point, the master card trips the limit switch **215**.

Referring to FIG. **8D**, the card **167** has reached its uppermost position, passing a limit switch **215** and releasing it, which, after a time delay, has disengaged the motor **190** to stop the rollers **180** and **170**. At this point, the rolls **165** are also stopped.

Upon the stopping of the motor **190**, the solenoid **206** is energized to move the platen **191** to the position shown in FIG. **8E** to cause the lip **221** to engage the lower edge of the master card **167**. This action trips a limit switch **204** within the solenoid **206** to energize the lift solenoid **231**, which lifts the platen **191** and the master card **167** into the viewing aperture, tripping a limit switch **230** and de-energizing the solenoid **206** as shown in FIG. **8F**.

Simultaneous with the actions illustrated in the above FIGS. **8B-8F**, a copy card is fed to the exposure station by the procedure illustrated in FIGS. **8G–8K**, described as follows.

FIG. **8G** illustrates the copier **10** in top diagrammatic view with the master card **167** in the position that it will attain by the time the copy card has arrived at the exposure station **14**.

FIG. 8H illustrates the initiation of the feed of a copy card 42 through the actuation of the motor 44 which advances the feed plate 37 as shown. Also, the motor 87 operates to drive the rolls 61 and 62 to continue the feed of the card after it has been advanced by the feed plates 37 from the supply magazine 12.

Referring to FIG. 8I, the card 42 is advanced through the feed conveyor 13 to trip the limit switch 88. At this time, the motor 44 returns the feed plate 37 to the magazine 12 and is de-energized upon contact of the limit switch 52.

Referring to FIG. 8J, the card copy 42 is completely fed into position within the exposure station 14 and the limit switch 88 is released which, after a specified time delay, has de-energized the motor 87. At this time, and in FIG. 8K, the solenoid 145 is energized to withdraw the rolls 62 and 91 to release the card 42.

Referring to FIG. 8L which is again a cross sectional elevational diagram through the exposure station, the relative positions of the copy card 42 and the master card 167 are illustrated. Upon the occurrence of the condition illustrated in FIG. 8K above, the master card 167 being brought to the exposure station as was illustrated in FIG. 8F, and the copy card being brought to the exposure station as illustrated in FIG. 8K, the clamp drive motor 261, as illustrated in FIG. 8M, is actuated. This moves the clamp 243 toward the platen 191, and the abutment of the clamp 243 and the aperture wall stop the clamp at this point. However, the motion of the motor 261 and the shaft 244 of the ram force the rubber plate on the plunger within the clamp 243 to urge the copy card 42 and the master 167 into contact. At this point (FIG. 8N), the limit switch 274 is tripped and the shutter of the light source 16 is opened to expose the copy 42. Upon completion of the exposure time interval, the motor 261 is re-energized and the ram 243 is withdrawn to its initial position (FIG. 8O), at which point the limit switch 273 is actuated to de-energize the motor 261.

Referring again to the top elevational views of FIGS. 8P–8W, upon the stopping of the motor 261, the solenoid 145 is re-energized and the roller 62 and 91 are again dropped into the engaging position with the copy card 42 as shown specifically in FIG. 8P.

When this has occurred, as is shown in FIG. 8A, the motors 87 and 122 are energized and the copy card 42 is fed through the advancing conveyor 17 toward the develop station. Upon advancement of the card 42, the limit switch 125 is tripped. This action turns off the motor 87.

FIG. 8R illustrates the copy card 42 moved to the develop station 18, the limit switch 125 having been released and stopping the motor 122 after a specified time delay.

After this time delay, as is illustrated in FIG. 8S, the motor 325 is energized to drive the platen 302 into closing position for the developing station 18. The card 42 is at this point sealed within the develop station 18.

Referring to FIG. 8T, upon movement of the platen 302 to its fully closed position, the motor 325 is stopped, and the injection of high pressure ammonia developer into the development chamber is initiated by the opening of a valve 313.

As shown in FIG. 8U, at the specified time delay, the valve 313 is closed and the motor 325 is re-energized, moving the platen 302 away from the development station 18.

Referring to FIG. 8V, upon the flow outward motion of the platen 302, the motor 325 is stopped and the motors 122 356 are energized, forcing the card 42 from the development station, at which point the limit switch 361 is tripped.

Referring to FIG. 8W, the passage of the card 42 into the hopper 20 releases the limit switch 361 and stops the motors 356 and 122.

At any time after the position illustrated in FIG. 8P above is attained, provided no additional copies of the same master are to be made, the following operations illustrated in FIGS. 8X through 8Z may be executed to return the master card to its file.

Referring to FIG. 8X, the solenoid 231 is de-energized and the platen 191 is allowed to drop down and away to allow the master 167 to drop into engagement with the rollers 180.

As shown in FIG. 8Y, the motor 190 is then energized in a direction opposite that of FIG. 8C above so as to drive the rollers 180 and 170 to move the master card in a downward direction.

At this time, the rollers 165 are also driven at the same direction and the master card 167 is delivered from the exposure station 14 in the manner illustrated in FIG. 8Z.

From the foregoing description of the preferred embodiment of the copying machine according to principles of the present invention and of the detailed discussion of the operation thereof, it will be apparent that the inventive concepts set forth are applicable to devices which may take many forms as are encompassed by the following claims:

We claim:

1. An apparatus for making card-like copies of image bearing records comprising:

a supply station adapted to support a supply of blank copy cards in a vertically extending orientation;

an exposure station adapted to receive a blank copy card in a vertically extending orientation, and including master record moving means for moving a master record which is normally located remotely from said exposure station in a first vertical direction into parallel alignment with said blank copy card and means for exposing said copy card to an image from said master record, said master record moving means being operative to move said master record in a second vertical direction opposite said first vertical direction after exposing said copy card to return said master record to its normal location remote from said exposure station;

a developing station adapted to receive an exposed copy card in a vertically extending orientation, and including means for developing the exposed copy card;

said stations all being generally positioned in the same horizontal plane and being disposed along a generally U-shaped path with said exposure station intermediate said supply in developing stations; and

means for feeding a blank copy card from said supply station to said exposure station, and for advancing an exposed copy card from said exposure station to said developing station.

2. An apparatus according to claim 1 wherein:
the cards are maintained in a flat planar shape at said stations; and
said advancing means includes
a. a feed conveyor positioned between said supply and exposure stations for feeding a blank copy and therebetween,
b. an advancing conveyor positioned between said exposure and developing stations for feeding exposed cards therebetween, and
c. said conveyors having arcuate guideways therein for guiding said card in an orientation normal to the plane of said stations.

3. An apparatus according to claim 1 further comprising:
a delivery hopper; and
means for delivering a developed copy card from said developing station to said hopper.

4. An apparatus according to claim 1 further comprising:
means at said exposure station for urging said copy card and said master card into contact during said exposure of said copy card.

5. An apparatus according to claim 4 wherein:
said master record is of the image bearing type.

6. An apparatus according to claim 1 wherein:
said master has transparent film image bearing areas; and
said apparatus includes means for directing radiant energy through said master to expose said copy.

7. An apparatus according to claim 6 wherein:
said blank copy has a diazo photosensitized surface; and
said radiation includes radiation in the ultraviolet spectral region.

8. An apparatus according to claim 7 wherein:
said developing station includes means for subjecting said exposed card to anhydrous ammonia vapor.

9. An apparatus according to claim 8 wherein said developing station includes:
means for forming a sealed chamber about the exposed surface of said copy card; and
means for injecting said vapor under pressure into said chamber.

10. An apparatus according to claim 1 wherein said feeding and advancing means includes plural sets of rollers adapted to engage a copy card at said exposure station and movable away from said copy card during the exposure of said card.

11. An apparatus according to claim 10 wherein:
said card is of the fiche type.

12. An apparatus for making card-like copies of image bearing records comprising:
a plurality of stations being generally positioned in the same plane and being disposed along a generally U-shaped path, said stations including a supply station, a developing station, and an exposure station disposed along said path intermediate said supply and developing stations;
said supply station being adapted to support a supply of blank copy cards in an orientation perpendicular to said plane;
said exposure station being adapted to receive a blank copy card in an orientation perpendicular to said plane, and including means for moving a master record which is normally located remote from said exposure station in a first direction perpendicular to said plane into parallel alignment with said blank copy card and means for exposing said copy card to an image from said master record, said means for moving said master record being operative to move said master record in a second direction opposite said first perpendicular direction after exposing said copy card to return said master record to its normal location remote from said exposure station;
said developing station being adapted to receive an exposed copy in an orientation perpendicular to said plane, and including means for developing the exposed copy card; and
means for feeding a blank copy card from said supply station to said exposure station, and for advancing an exposed copy card from said exposure station to said developing station.

13. An apparatus according to claim 12 wherein:
the cards are maintained in a flat planar shape at said stations; and
said advancing means includes
a. a feed conveyor positioned between said supply and exposure stations for feeding a blank copy and therebetween,
b. an advancing conveyor positioned between said exposure and developing stations for feeding exposed cards therebetween, and
c. said conveyors having arcuate guideways therein for guiding said card in an orientation normal to the plane of said stations.

14. An apparatus according to claim 12 further comprising:
a delivery hopper; and
means for delivering a developed copy card from said developing station to said hopper.

15. An apparatus according to claim 13 further comprising:
means at said exposure station for urging said copy card and said master card into contact during said exposure of said copy card.

16. An apparatus according to claim 12 wherein said feeding and advancing means includes plural sets of rollers adapted to engage a copy card at said exposure station and movable away from said copy card during the exposure of said card.

17. An apparatus for making card-like copies of image bearing records comprising:
a supply station adapted to support a supply of blank copy cards;
an exposure station adapted to receive a blank copy card, and including means for exposing said copy card to an image from a master record;
a developing station adapted to receive an exposed copy card, and including means for developing the exposed copy card;
said stations being disposed along a path with said exposure station being disposed intermediate said supply and developing stations;
means for feeding a blank copy card from said supply station to said exposure station, and for advancing an exposed copy card from said exposure station to said developing station, and
said feeding advancing means including plural sets of rollers adapted to engage a copy card at said expo-

sure station and movable away from said copy card during the exposure of said card.

18. An apparatus for making card-like copies of image bearing records comprising:

means for feeding a blank copy card into an exposure station, and for delivering an exposed copy card out of said exposure station; and

feeding and delivering means including plural sets of rollers adapted to engage a copy card at said exposure station and movable away from said copy card during the exposure of said card.

19. An apparatus for making fiche copies of image bearing card-like masters comprising:

means for feeding a blank copy card supply into said exposure station, and for delivering an exposed copy card out of said exposure station; and

said feeding and delivering means including plural sets of rollers adapted to engage a copy card at said exposure station and movable away from said copy card during the exposure of said card.

20. An apparatus according to claim 19 further comprising:

means for supporting said master at said exposure station; and

means at said exposure station for urging said copy card and said master card into contact during said exposure of said copy card.

21. An apparatus according to claim 20 wherein:

said apparatus further comprises means for transporting said master card between said exposure station and a position remote said exposure station.

22. An apparatus according to claim 19 wherein:

said master has transparent film image bearing areas; and

said apparatus includes means for directing radiant energy through said master to expose said copy.

23. An apparatus to claim 22 wherein:

said blank copy has a diazo photosensitized surface; and

said radiation includes radiation in the ultraviolet spectral region.

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