United States Patent [19]

Hakanson

[11] **3,867,031**

[45] **Feb. 18, 1975**

[54] **METHOD AND APPARATUS FOR ASSURING CONTACT BETWEEN THIN SHEETS OF MATERIAL**

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[73] Assignee: **Scott Paper Company,** Delaware County, Pa.

[22] Filed: **Feb. 7, 1974**

[21] Appl. No.: **440,364**

[52] **U.S. Cl.** **355/78,** 100/178, 100/210, 355/99, 355/132

[51] **Int. Cl.** **G03b 27/02**

[58] **Field of Search** 355/97, 78, 75, 99, 91, 355/133, 100, 132; 100/210, 178

[56] **References Cited**

UNITED STATES PATENTS

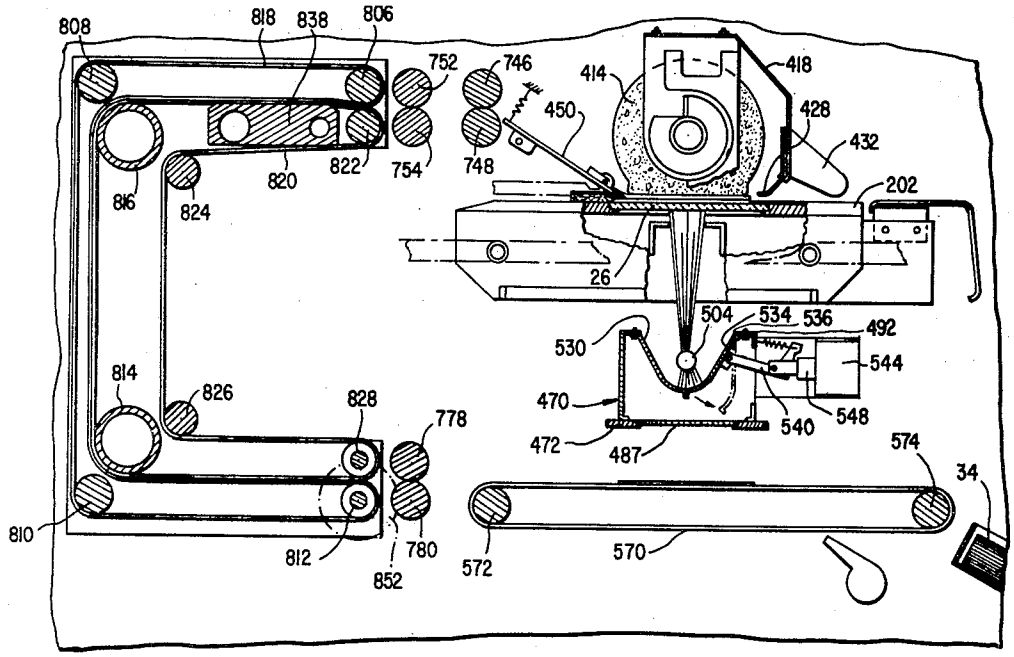
2,835,179	5/1958	Fairbank	355/100
2,919,636	1/1960	Kron	355/99
3,025,778	3/1962	Stuckens	355/75
3,031,941	5/1962	Moser	355/100
3,069,990	12/1962	Eisbein et al.	355/100
3,667,845	6/1972	Leavitt et al.	355/91
3,715,156	2/1973	Levy	355/99 X

Primary Examiner—Richard L. Moses
Attorney, Agent, or Firm—R. Duke Vickrey; William J. Foley

[57] **ABSTRACT**

Method and apparatus for assuring contact between superposed thin sheets of material transported on a movable carriage in which a freely rotatable, resilient roll is disposed above the carriage at a spacing less than the roll radius such that movement of the carriage past the roll causes engagement of the same such that the roll is flattened and pressed against the superposed sheets on the carriage and rotated thereby to assure positive contact between the sheets while precluding relative movement therebetween.

10 Claims, 16 Drawing Figures



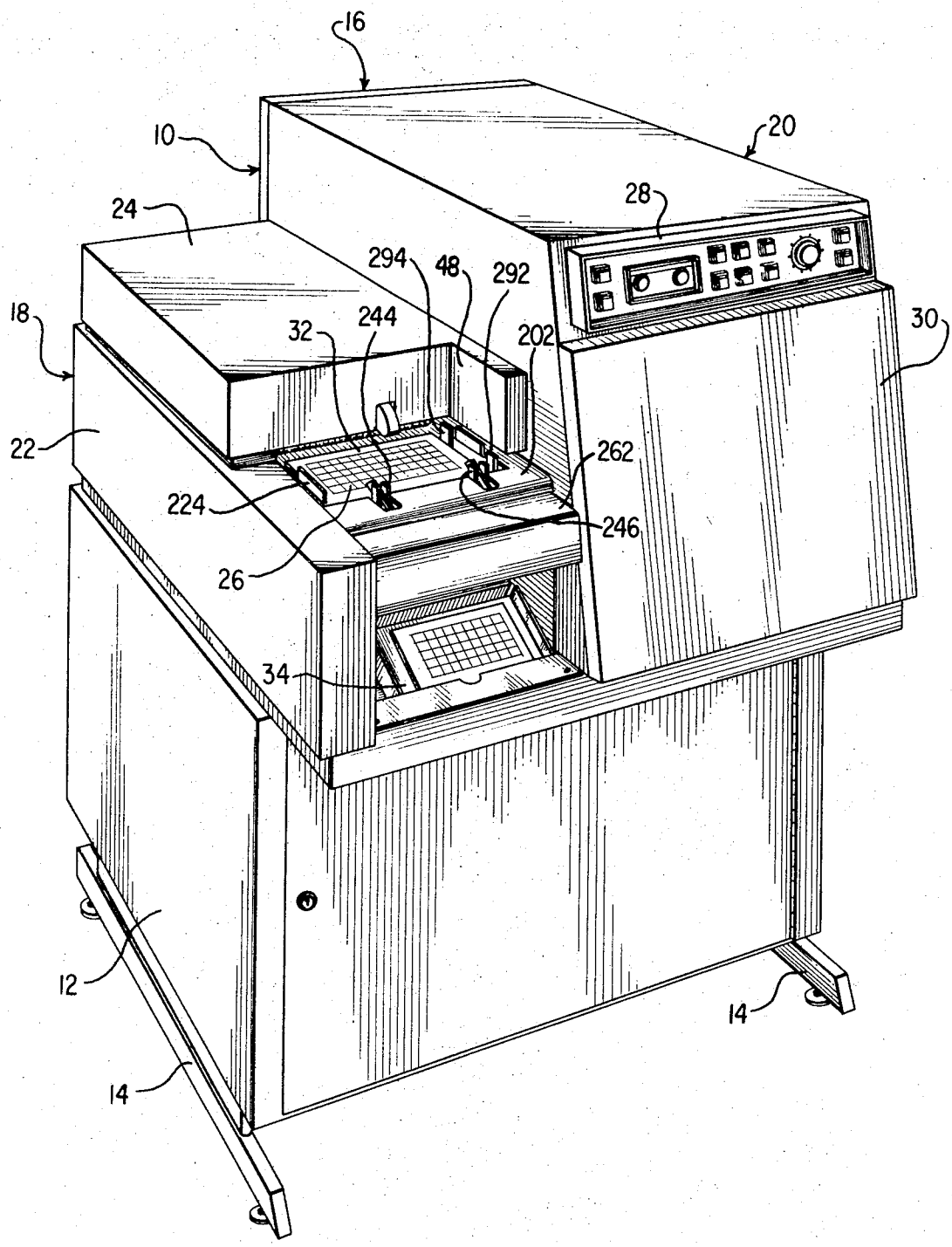

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FIG 1

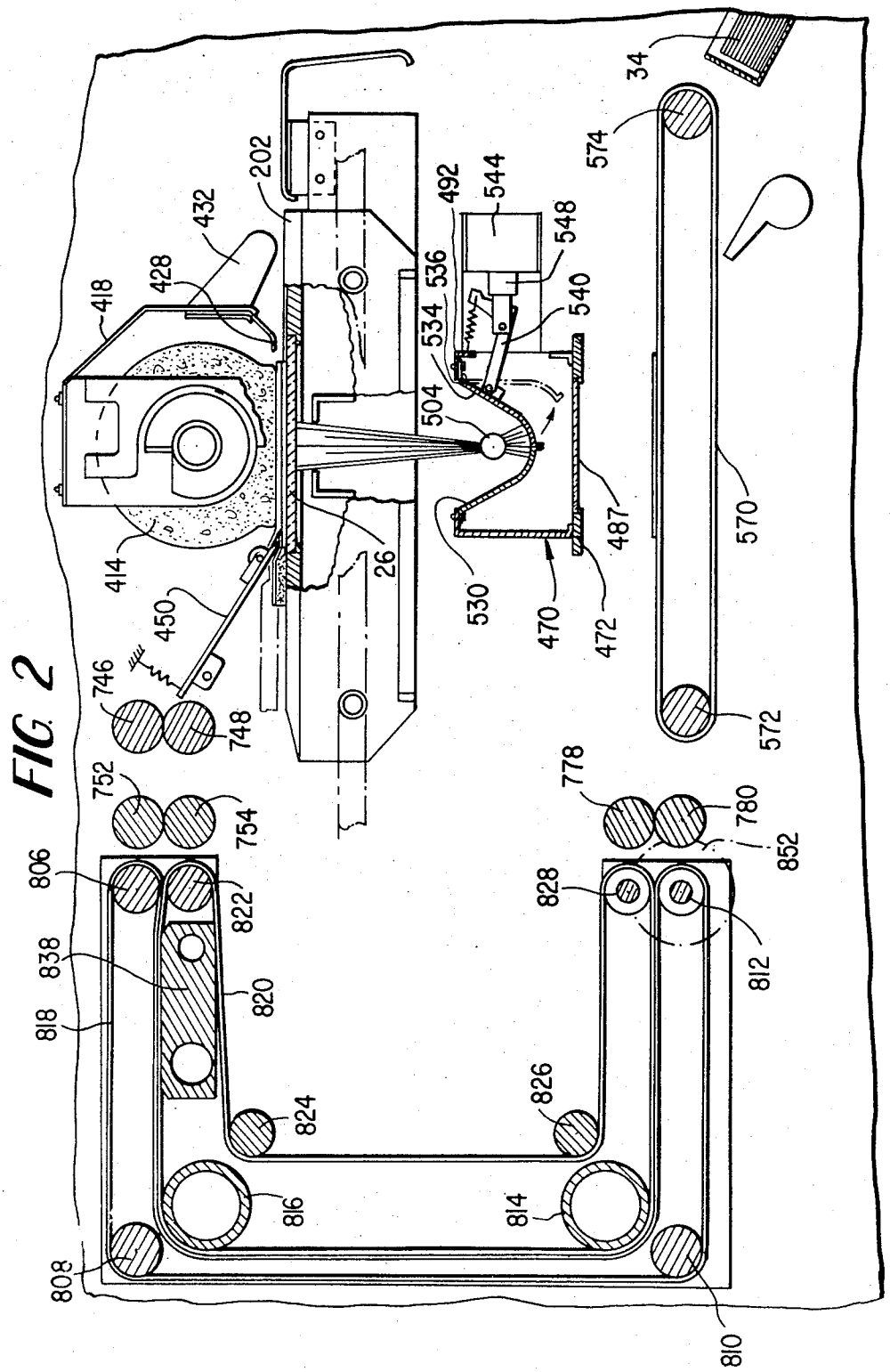
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FIG. 2

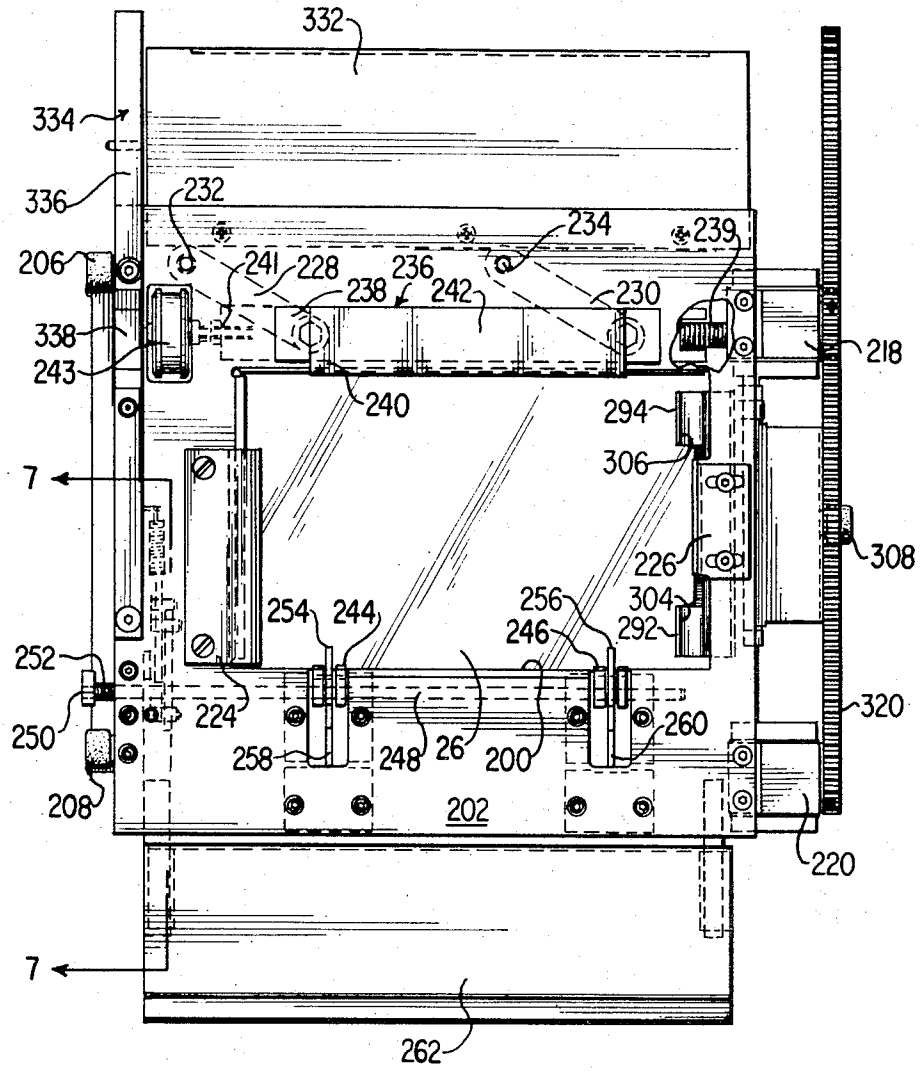
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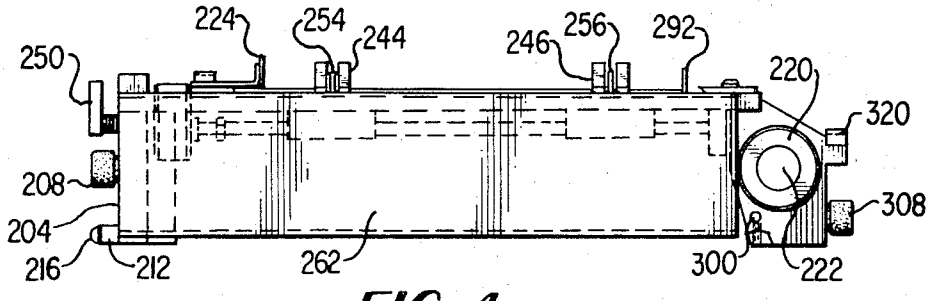
FIG. 3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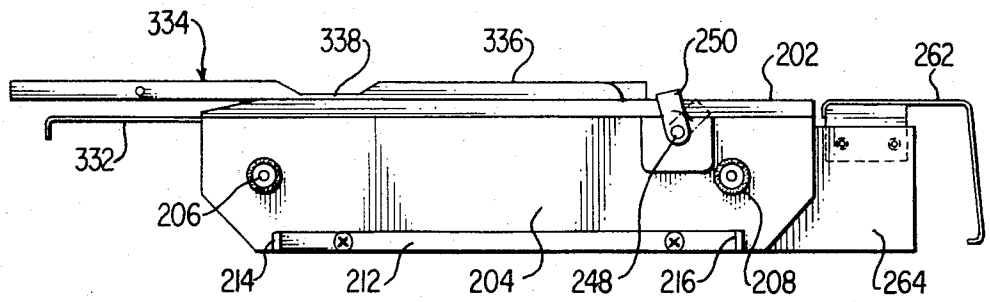


FIG. 5

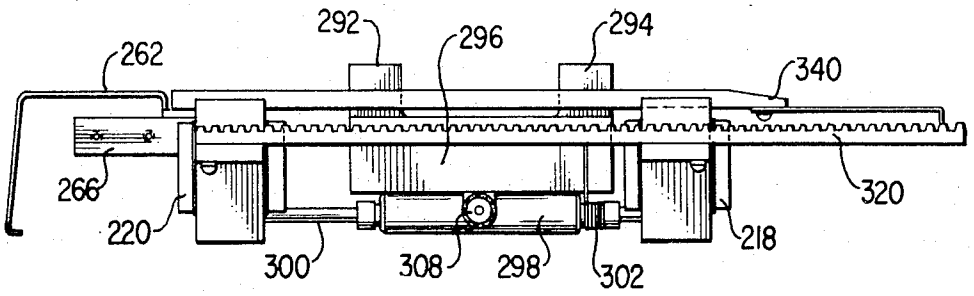
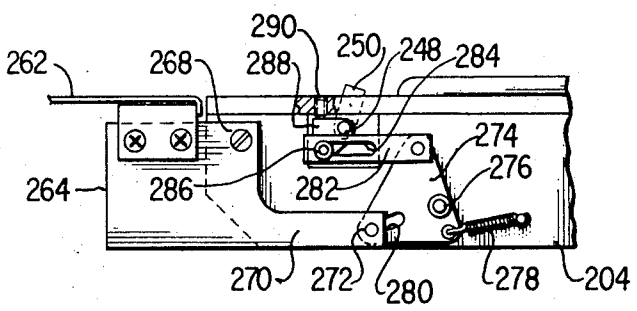


FIG. 6

FIG. 7



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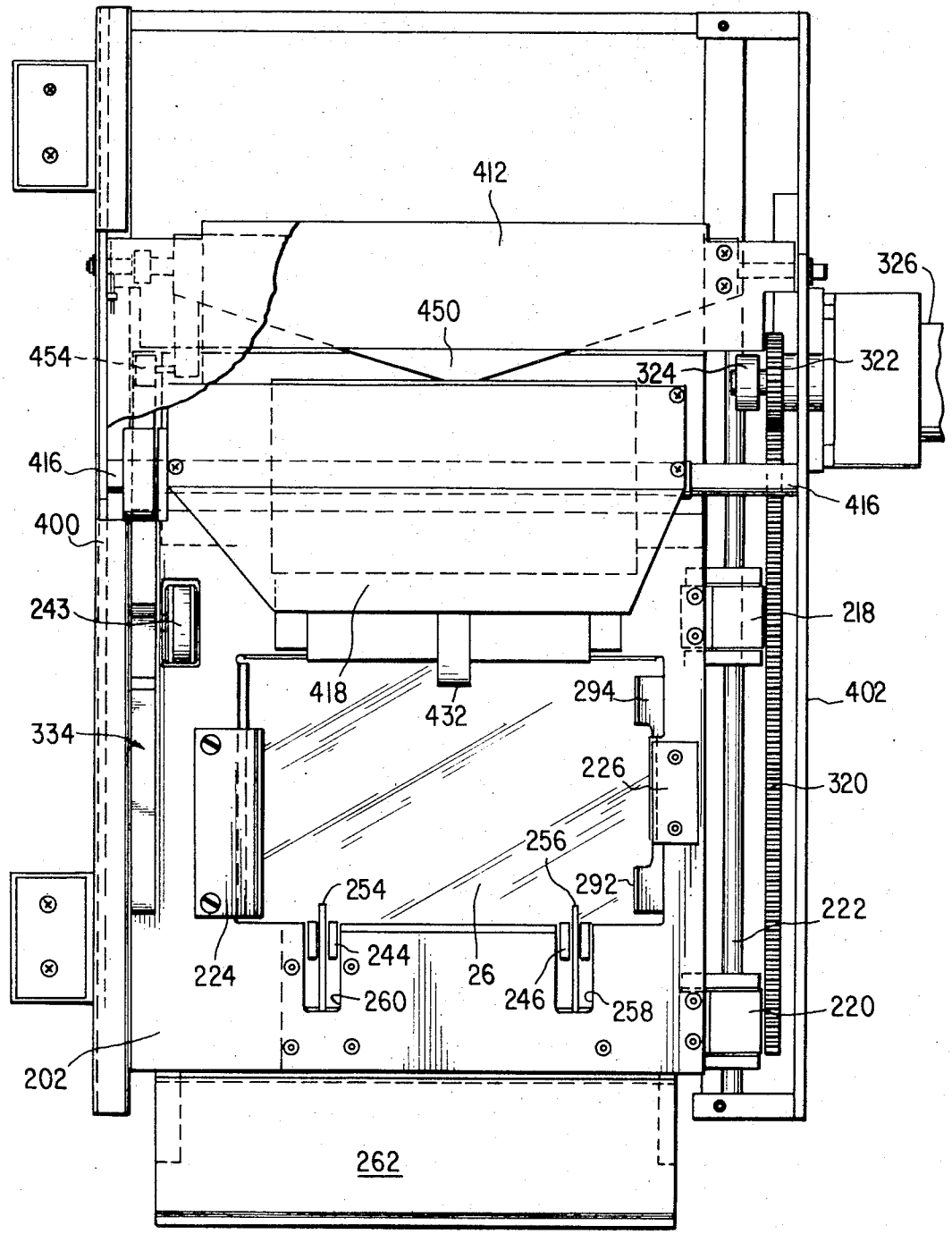
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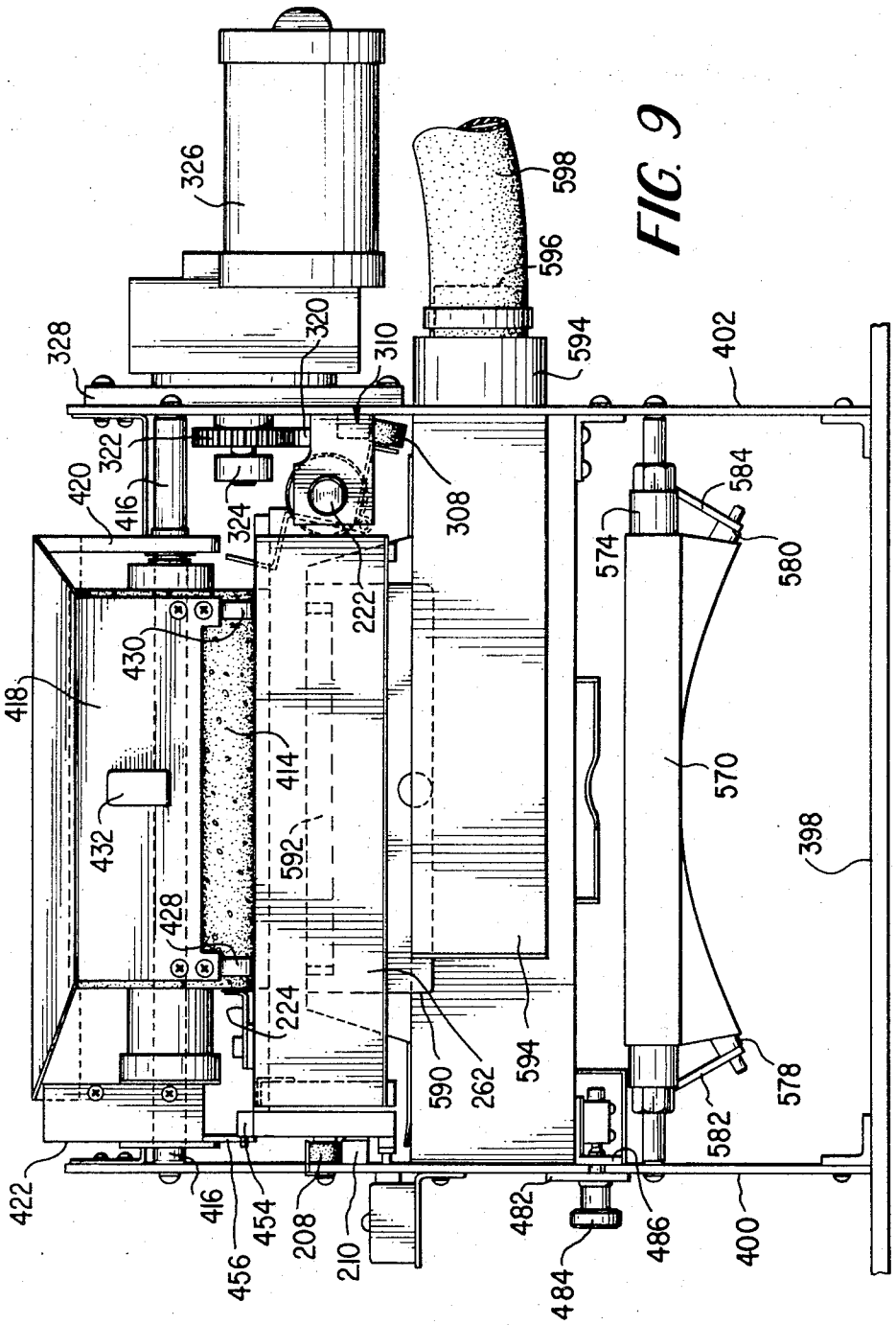
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FIG. 9

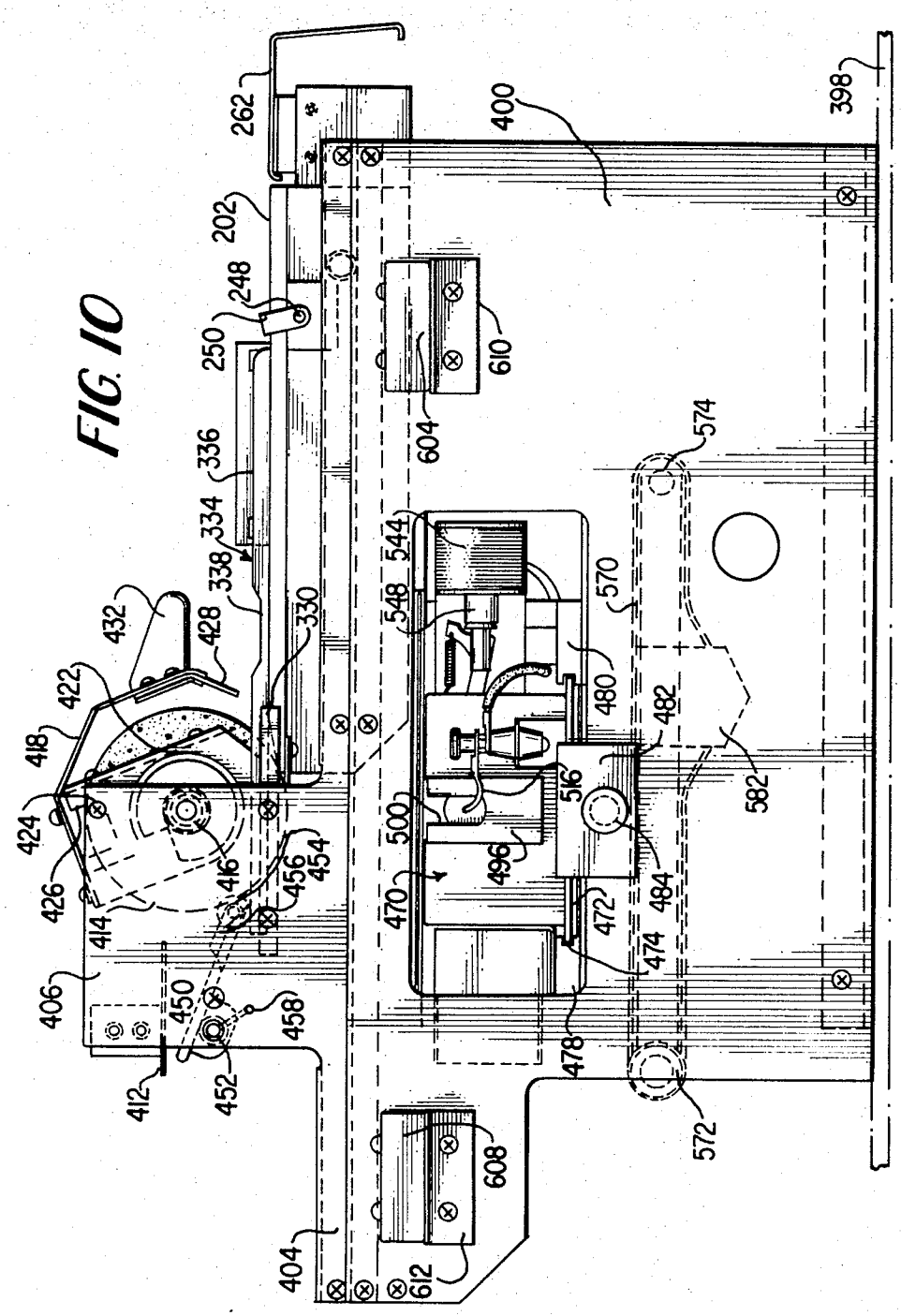
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FIG. 10

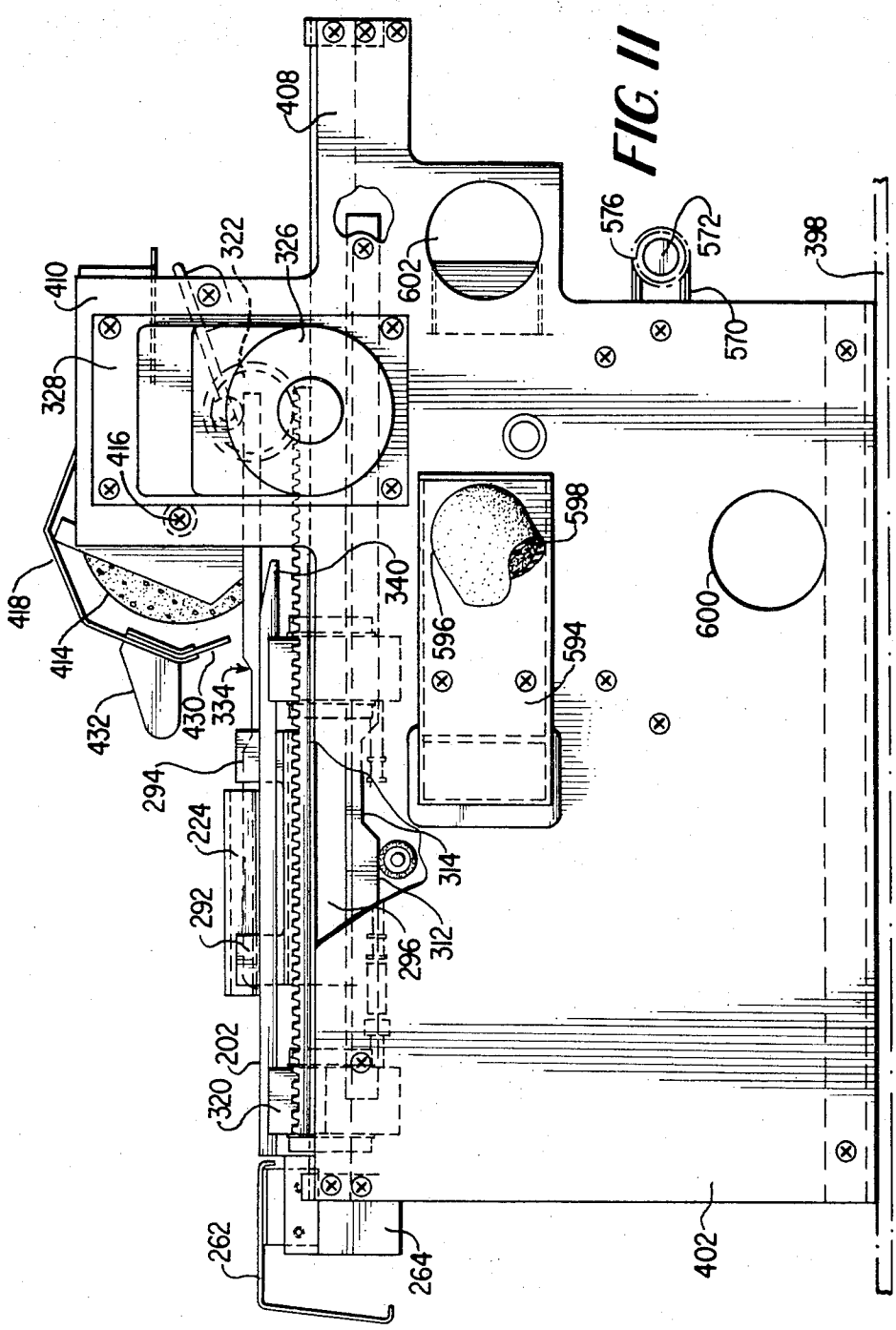
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FIG. 11

FIG. 12

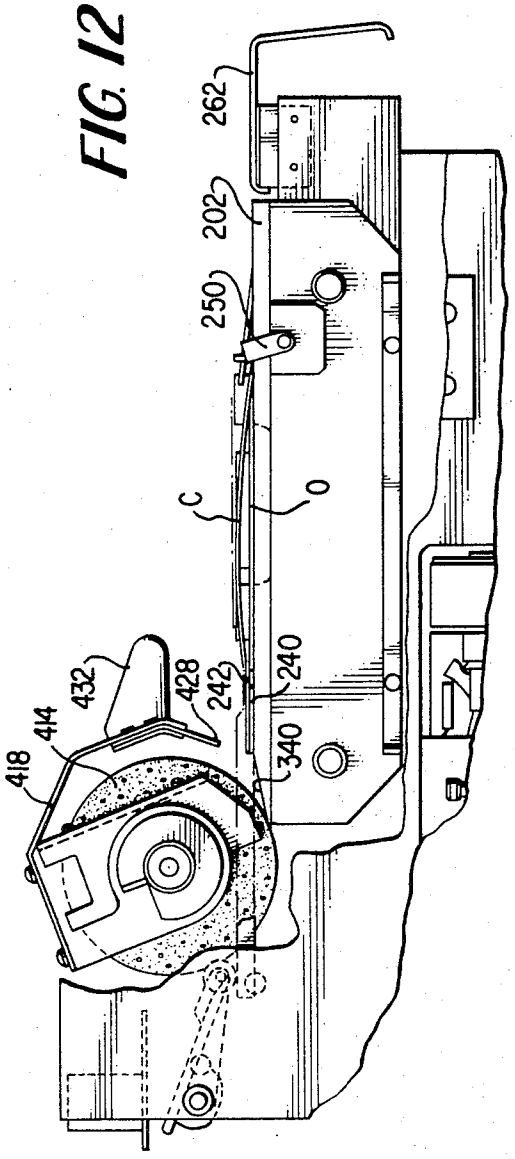
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FIG. 13

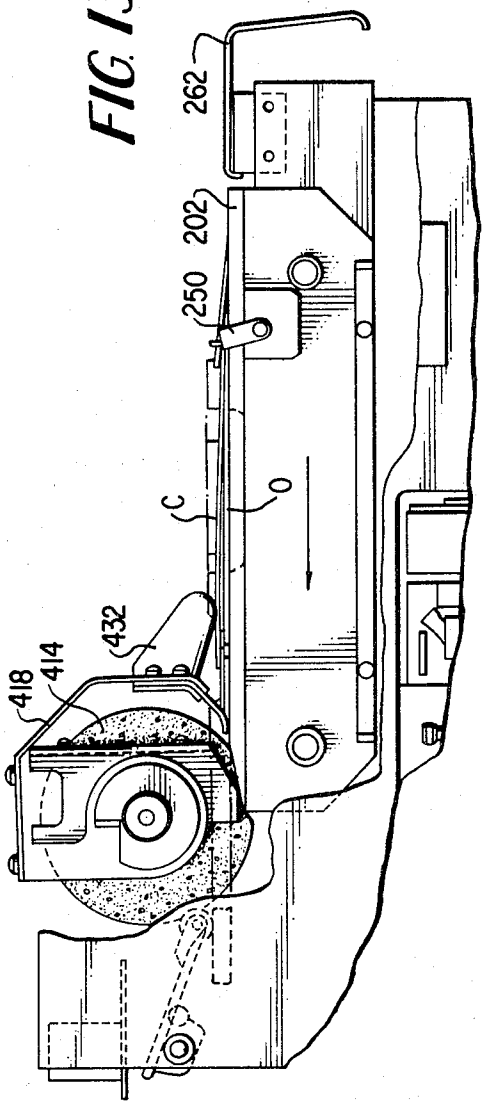
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FIG. 14

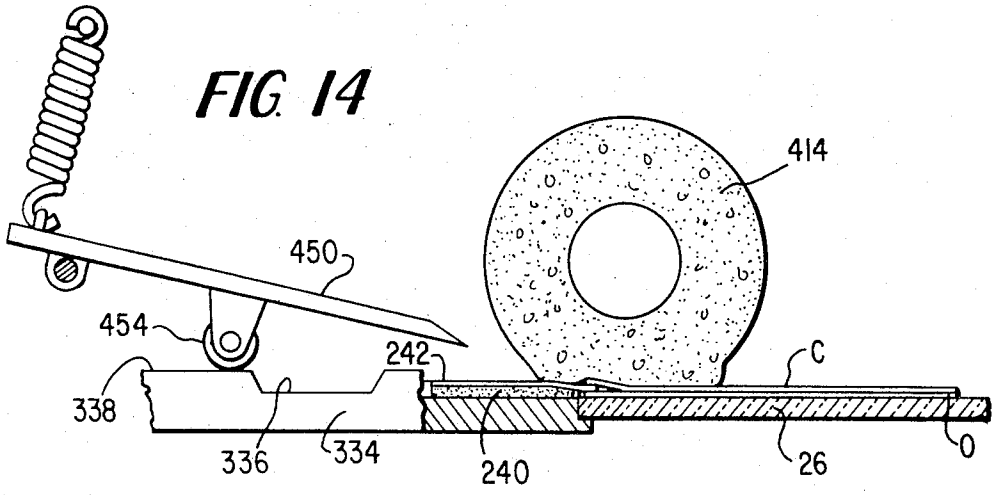


FIG. 15

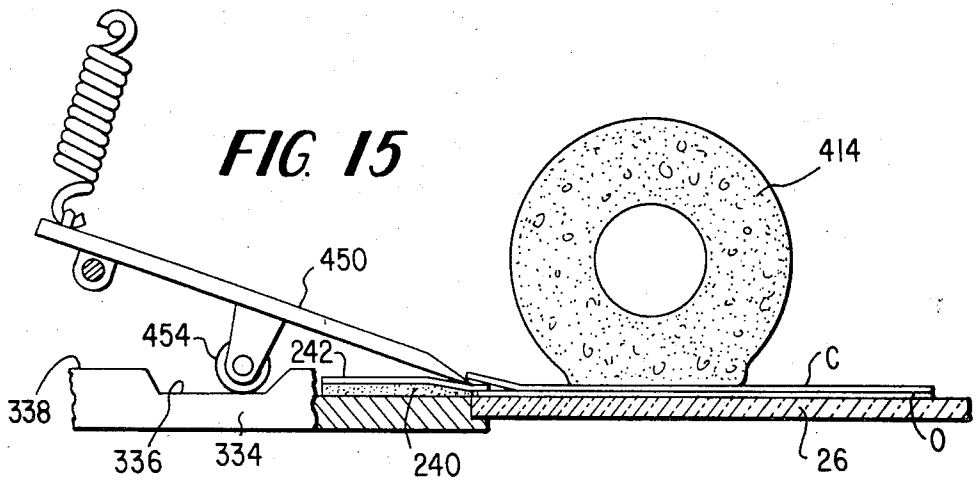
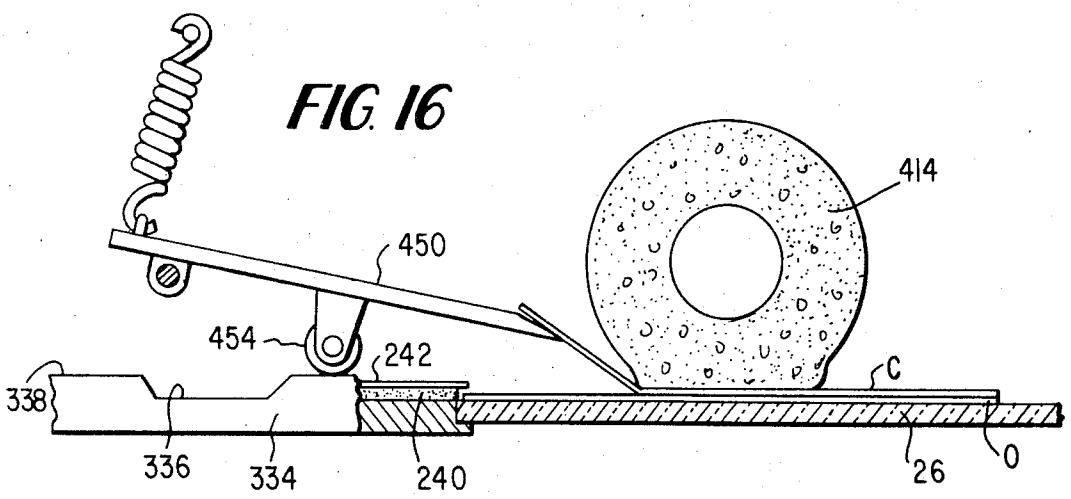


FIG. 16



METHOD AND APPARATUS FOR ASSURING CONTACT BETWEEN THIN SHEETS OF MATERIAL

RELATED APPLICATIONS

The present invention is described but not claimed in commonly assigned copending application U.S. Ser. No. 339,284 for MICROFICHE DUPLICATOR filed Mar. 8, 1973 in the names of joint inventors Albert Francis Touchette and Nils L. Hakanson, the latter being the sole inventor of the subject invention. The disclosure of the present invention in U.S. Ser. No. 339,284 was derived from the present applicant.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to apparatus for maintaining thin sheets in contact, and more particularly to method and apparatus for assuring contact between thin sheets of material while precluding relative movement therebetween.

2. Description of the Prior Art

As a result of the growing volume of documentary material being stored in microfiche form, the need has arisen for a versatile microfiche copier which is both simple in design and operation, requires minimal operator maintenance and has the capability of providing high quality single or multiple copies automatically. A number of approaches have been taken in the past in an effort to meet this need and generally have proven satisfactory for their intended purpose. However, conventional microcopiers exhibit various disadvantages which have limited their utility and widespread acceptance. In the contact printing type of microfiche duplicators, the original microfiche sheet must be maintained in intimate contact with the copy as the copy is being exposed through the original. Absent good contact between the original and copy sheets during exposure, the quality of the image formed in the copy sheet may deteriorate. Thus, there is a need in microcopiers to provide means for maintaining good contact between the original and copy sheets during exposure and of precluding relative movement therebetween.

The prior art suggests various alternatives to maintaining good contact in such apparatus. For example, U.S. Pat. No. 3,069,990 Eisbein et al. discloses a contact copying apparatus wherein an original sheet and a copy sheet are fed past an exposure device and separated therefrom by means of a translucent plate. Opposite the translucent plate is provided a feed and press roll which is journalled to turn about the axis ot its shaft, the roll being composed of a hard rubber core and an outer layer of sponge rubber which is covered by a cotton layer, or the like. The axis of the roll is located at a sufficiently small distance from the plate so that the part of the roll outer layer which engages the plate undergoes considerable flattening against the plate. The roll is driven to feed the superposed copy and original sheets past the exposure device and the flattening of the outer surface of the roll assures good contact between the original and copy sheet during exposure.

U.S. Pat. No. 2,835,179 Fairbank discloses a photographic apparatus wherein an original photosensitives sheet and a copy sheet are superposed upon one another and guided past an exposure station where they

are exposed to light through a slit provided in the exposure device. The original and copy sheets are maintained in good contact during exposure by a resilient roll which is resiliently urged toward the slit by a compression spring.

Further, U.S. Pat. No. 3,622,241 Dexter discloses a rotary photosensitive material printer having a pair of cooled ultraviolet light sources situated on opposite sides of a work piece and a pair of negatives which are passed therebetween. The sources are each positioned within a tubular roller having a rigid translucent inner wall and a pliable translucent pressure outer wall. Air is forced into the volume between the rigid and pliable walls so as to maintain firm, fixed contact between the work piece and the associated negatives.

U.S. Pat. No. 3,031,941 Moser discloses an automatic copying apparatus including a light source, a light-transmitting plate and a resilient roll. The latter is forcibly rotated to feed superposed original and copy sheets past the exposure station, the resilient roll maintaining good contact between the original and copy sheets as they pass the exposure station and also serving to feed the superimposed sheets past the exposure station.

Another related apparatus is disclosed in U.S. Pat. No. 3,150,262 Ulseth et al. which discloses a thermographic copying machine including a pressure roll comprising a thick cylindrical resilient sleeve bonded to a rod or shaft and adapted to feed a superimposed original and copy sheet past the exposure station of the device while maintaining the superimposed sheets in intimate contact with each other during exposure.

Of interest are the following U.S. Pat. Nos. which disclose somewhat related devices: 2,919,636; 3,320,867; 3,498,709; 3,560,089; 3,574,460; 3,715,156; and 3,715,159.

Despite the fact that the devices described in the prior art, including the above discussed patents, function for their intended purpose, there is a need in certain types of microfiche duplicators for means for maintaining good contact between the original and copy sheets during exposure of the copy sheet.

SUMMARY OF THE INVENTION

It is therefore a primary object of the present invention to maintain good contact and preclude relative movement between thin sheets of material.

It is a further object of the present invention to provide such means in a copier for duplicating an original microfiche sheet by a contact printing operation.

It is a further object of the present invention to provide means for maintaining intimate contact between superposed original microfiche and copy sheets as the superposed sheets are fed past an exposure device.

The improvement of the present invention is summarized in that superposed thin sheets of material as maintained in contact without relative movement by a freely rotatable, resilient roll disposed above a support carriage for the sheets at a spacing less than the roll radius such that the roll is flattened and pressed against the superposed sheets thereby assuring intimate contact therebetween as the carriage moves past the roll.

Other objects and advantages will become apparent from the following description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a microfiche duplicator incorporating a preferred embodiment of a contact apparatus in accordance with the present invention;

FIG. 2 is a diagrammatic view in section of the exposure and clearing assembly and developing assembly of the duplicator of FIG. 1 and illustrates the invention;

FIG. 3 is a plan view of the copyboard assembly of the duplicator of FIG. 1;

FIG. 4 is a front elevational view of the copyboard assembly of FIG. 3;

FIG. 5 is a left side elevational view of the copyboard assembly of FIG. 3;

FIG. 6 is a right side elevational view of the copyboard assembly of FIG. 3;

FIG. 7 is a sectional view in detail taken along line 7—7 of FIG. 3;

FIG. 8 is a plan view of the exposure and clearing assembly of the duplicator of FIG. 1;

FIG. 9 is a front elevational view of the exposure and clearing assembly of FIG. 8;

FIG. 10 is a left side elevational view of the exposure and clearing assembly of FIG. 8;

FIG. 11 is a right side elevational view of the exposure and clearing assembly of FIG. 8;

FIG. 12 is a diagrammatic view in elevation of the exposure and clearing assembly of FIG. 8 in a first position;

FIG. 13 is a diagrammatic view similar to FIG. 12 showing the exposure and clearing assembly in a second position;

FIG. 14 is a diagrammatic view of the sheet separation assembly of the duplicator of FIG. 1 in a first position and the present invention;

FIG. 15 is a diagrammatic view similar to FIG. 14 showing the sheet separation assembly in a second position and the present invention;

FIG. 16 is a diagrammatic view similar to FIG. 14 showing the sheet separation assembly in a third position and the present invention;

DESCRIPTION OF THE PREFERRED EMBODIMENT

The apparatus of the present invention has general utility in connection with any of various machines or processes in which it is necessary to maintain two or more sheets of material in firm contact with each other without permitting relative movement therebetween; e.g., aperture card correlators, contact printing machines, photographic copiers, and the like. The present invention finds particular utility when used in conjunction with the microfiche duplicator described below, and for purposes of illustration, the apparatus of the present invention will be described only in conjunction with such duplicator.

A microfiche duplicator embodying the present invention is illustrated in FIG. 1 and is housed in a cabinet structure indicated generally at **10** having a base **12** in the form of a hollow cabinet supported on legs **14.** Mounted atop the base cabinet **12** is a main housing **16** divided into a reproduction compartment **18** and a control and supply compartment **20.** The reproduction compartment **18** houses the main reproduction apparatus of the duplicating machine and may be provided with any number of suitable removable cover assemblies such as side and top covers **22** and **24.** Cover **24** is designed to expose the copyboard assembly **26** for the reproduction apparatus to be described below such that an original microfiche sheet may be conveniently placed atop the copyboard at the beginning of a copy sequence. The remaining reproduction apparatus is shielded from view to present an aesthetically pleasing appearance complementary to the office area where it is to be used. A main control panel **28** is disposed on the front of the control and supply compartment **20** and facilitates the operation and sequence selection of the machine.

Before proceeding with a detailed description of the invention, a brief general description of the operation of the duplicating machine will be presented for purposes of clarity.

The duplicator is turned on by depressing the appropriate switch on control panel **28** whereupon the apparatus readily assumes a stand-by or ready mode for the initiation of a reproduction sequence. The ready state is indicated by the ignition of a suitable lamp on control panel **28,** and thereafter an operator may conveniently insert an original microfiche sheet **32** atop the copyboard **26.** With the microfiche **32** manually placed approximately in the proper position on the copyboard **26** for reproduction, a sequence initiation switch on panel **28** is actuated causing a preselected length of copy film to be advanced from a bulk film roll located within the housing behind panel **30.** After the preselected length of film has been advanced from the film supply roll, the copy sheet is severed and falls atop the original sheet **32** on copyboard **26.**

With the above steps completed, the copyboard assembly **26** is automatically sequenced to begin movement toward the rear of the machine, which movement causes the original and copy microfiche sheets to be brought into precise registration. As the copyboard **26** advances rearwardly, the copy sheet is exposed through the original until the entire exposure has been made. With the copyboard continuing its rearward movement, the copy sheet is automatically separated from the original sheet, and it continues its rearward movement beyond the exposure station and into a development chamber in the reproduction compartment **18.** As the copy sheet advances through the development chamber, the original is brought back to the front of the duplicating machine by a rapid forward movement of the copyboard back to its original loading position.

The copy sheet continues its advancement through the developing chamber which is constructed in a generally U-shaped configuration such that the copy sheet exits from the developing chamber in a forward-going direction toward the front of the apparatus. The copy sheet then passes through a clearing station which is activated only when vesicular type copy films are used and is placed in a passive or stand-by mode for conveyance purposes only when diazo films are employed. The copy sheet is then received in a collection tray **34** located under the loading station or initial position of copyboard **26,** and the sequence is completed.

If it is desired to make multiple copies of an original microfiche sheet, the above process may be repeated by selection of the appropriate control on panel **28** with more than one copy sheet being fed through the equipment at any one time as the copyboard moves back and forth between loading and exposure stations. As will become clear as the description proceeds, the present invention has the capability of making not only single

or multiple copies but further may utilize diazo or vesicular film types developed in the case of diazo film with an aqueous or anhydrous developing agent supply.

A detailed description of the preferred embodiment of the invention is as follows. Referring to FIGS. 3 through 7, the copyboard assembly includes an ultraviolet transmissive plate 26 (FIG. 1) which may be made of any suitable material such as treated or coated glass designed to pass ultraviolet radiation from the exposure source of the duplicating system to the original and copy sheets resting atop the plate 26. It is also preferred that plate 26 be designed to filter as much as possible of the unwanted radiations emitted from the ultraviolet source as well as heat so as to prevent damage or deterioration of the film sheets during the duplicating process. Plate 26 is attached in an opening 200 defined by a generally rectangular copyboard housing 202 having a downwardly extending flange 204 along its left side supporting at spaced points a pair of roller bearings 206 and 208. Bearings 206 and 208 are adapted to ride along an elongated guide rail 210 (FIG. 9) mounted upon a frame member to be described below. Guide rail 210 may be of any suitable design and is preferably square in cross section as shown in FIG. 9. A microswitch trip bar 212 having a pair of protrusions 214 and 216 formed on the ends thereof is also affixed along the lower edge of side flange 204 as illustrated in FIG. 5.

A pair of linear bearings 218 and 220 are suitably attached to the right hand side of the copyboard 202 and ride along a shaft 222 fixedly secured to the frame of the duplicator housing in a longitudinal horizontal position as illustrated in FIG. 9. Attached to the top of copyboard housing 202 is a generally L-shaped fixed left side stop 224 and a suitable clamp plate 226. Also, a forward edge stop assembly, indicated generally at 236 and mounted on copyboard housing 202, includes a pair of parallel arms 228 and 230 pivotally mounted at one end to the copyboard at points 232 and 234 and similarly pivotally mounted at their other ends to an adjustable carriage plate 238. Plate 238 supports a compressible, rectangular sheet of material such as a foamed plastic or rubber composition 240 having disposed on its upper surface a thin semi-rigid sheet of plastic 242. The edge of plastic sheet 242 closest to the copyboard plate 26 overhangs the compressible element 240 by a slight amount, such as an eighth of an inch, so that the forward edge of an original microfiche sheet may be placed under the top sheet 242 and against the front side surface of element 240. The aforementioned structure is illustrated diagrammatically in FIGS. 14, 15 and 16. A spring 239 is held in compression between the copyboard housing 202 and the slotted right end of carriage plate 238 causing the same to be biased toward the end of a screw 241 adjustably positioned by the rotation of a knob 243. In this manner, the longitudinal position of assembly 236 with respect to copyboard plate 26 may be readily adjusted by rotating knob 243 thereby swinging the parallelogram formed by arms 228 and 230 and carriage plate 238 in the plane of the copyboard housing 202.

To facilitate the insertion of an original microfiche sheet atop the copyboard plate 26, a pair of front stop members 244 and 246, each having a pair of spaced, upright tangs, are attached to a rotatable shaft 248 journaled on the copyboard assembly under the copyboard housing 202. Shaft 248 extends through the side flange 204 and terminates in a rectangular arm 250 which cooperates with a spring 252 to bias the shaft 248 for rotating stop members 244 and 246 to an upright position shown in FIG. 1. Also disposed between the upright tangs of each of the stops 244 and 246 are angulated retaining members 254 and 256 which ride within grooves 258 and 260, respectively, in the copyboard housing 202. In this manner, engagement of the upper end of arm 250, as the copyboard housing 202 moves linearly toward the rear of the duplicating apparatus, causes the rotation of shaft 248 and the retraction of stop members 244 and 246 into a pair of accommodating recesses in the housing surface. At the same time, retaining members 254 and 256 are swung back and down to nest between the tangs of the stop members such that both front stop assemblies are withdrawn from their biased upwardly protruding positions as shown and brought flush with the surface of housing 202.

An elongated lever 262 of generally L-shaped cross section is connected to the front of the copyboard assembly housing 202 at each end by members 264 (FIG. 7) and 266 (FIG. 6) which are pivotally secured to the underside of the copyboard housing 202. Referring to FIG. 7, member 264, which is disposed on the left side of lever 262 as visualized in FIG. 3, is pivotally mounted at point 268 and is connected through an arm 270 and a pin 272 to a triangular link 274 rotatable about pivot 276. Link 274 is biased to the position illustrated in FIG. 7 by spring 278 and defines a slot 280 which accommodates pin 272 of arm 270. The apex of link 274 is pivotally secured to a rectangular link member 282 defining a slot 284 accommodating the pin 286 of a generally triangular eccentric arm 288 fixedly secured to the shaft 248 of stop members 244 and 246. Eccentric 288 assumes a rest position as illustrated in FIG. 7 which may be adjusted by the setting of a small screw 290 through the copyboard housing 202.

In operation, downward pressure exerted upon lever 262, as by the hand of an operator, causes the rotation of member 264 about point 268 in a counter-clockwise direction. The counter-clockwise movement of member 264 is transmitted to the triangular link 274 causing the same to rotate clockwise about point 276. Link member 282 is thus moved rearwardly to rotate the eccentric member 288 counter-clockwise thus rotating shaft 248 and causing the retraction of stop members 244 and 246 as previously described. In this manner, at the start of a reproduction sequence, an operator may merely depress lever 262 causing the aforedescribed linkages to rotate shaft 248 and retract stops 244 and 246 so as to facilitate the insertion of an original microfiche sheet with the leading edge thereof resting against the compressible member 240 under the overhanging front edge of plastic sheet 242. Thereafter, lever 262 may be released whereby stops 244 and 246 revert to their biased upright positions so as to properly orient the original microfiche sheet longitudinally of the copyboard housing 202. Further, as the original microfiche sheet is placed by an operator atop plate 26 adjacent left fixed stop 224, the duplicator will automatically thereafter provide positive lateral alignment of the original sheet by the operator of a pair of laterally movable right stops 292 and 294.

Referring to FIGS. 6 and 9, stops 292 and 294 protrude from the upper surface of a generally Z-shaped bent plate 296 which has secured centrally thereto an elongated collar 298 which is journaled for rotation

about a shaft 300 suitably affixed to the copyboard housing 202. Plate 206 is biased by a spring element 302 in a counter-clockwise direction as visualized in FIG. 9, thus tending to bring stop members 292 and 294 to an upright position against a pair of recesses 304 and 306 formed in the copyboard plate 26. A cam roller 308 is centrally disposed upon the lower distal arm of member 296 and cooperates with a linear cam 310 for rotating member 296 and thus causing the movement of stops 292 and 294 with respect to the fixed left stop member 224 as the copyboard assembly moves along its linear path of travel. As shown in FIG. 11, cam 310 has a generally flat surface 312 and a flat recessed surface 314 such that stop members 292 and 294 are normally held in a position away from left stop member 224 and move toward stop 224 as roller 308 rides along cam 310 and into recess 314.

A gear rack 320 is attached along the right side of copyboard housing 202 and cooperates with a circular gear 322 which is driven through a slip clutch 324 by a reversible DC motor 326. Motor 326 is attached at plate 328 to the frame member of the exposure assembly to be described below. Thus, as the DC motor 326 rotates gear 322, the copyboard assembly is moved linearly along a longitudinal path on roller bearings 206 and 208 and linear bearings 218 and 220.

In operation, after an original microfiche sheet has been inserted over the copyboard plate 26 as described above, a preselected length of copy film is supplied by the film feed and cutting assemblies within the housing behind panel 30 and falls atop the original sheet on the copyboard housing 202. Details of the film feed and cutting assemblies have been omitted for the sake of brevity as they form no part of the invention and any type of film feed and cutting apparatus known in the art could be employed. The copy film could even be hand cut and placed by hand upon the copyboard.

After placement of the copy film on the copyboard, actuation of DC motor 326 causes the copyboard assembly to move linearly toward the rear of the duplicator whereupon roller 308 rides along cam 310 into recess 314 causing the rotation of stops 292 and 294 toward the fixed left stop 224 to move both the original and copy sheets against the stop member 224 for precise lateral registration thereof. As will be more clearly appreciated as the description proceeds, after roller bearing 308 traverses the recessed groove 314 in cam 310 it will ride up onto surface 312 thereby retracting stops 292 and 224 from interference with the exposure roller (to be described below) as the copyboard assembly continues its rearward movement. Likewise, an elongated rectangular cam 330 affixed to the left side of the frame of the exposure assembly cooperates with arm 250 of shaft 248 such that the same engages cam 330 and is rotated thereby as the copyboard moves through the exposure station for retracting upright stops 224 and 246 to preclude damage to the exposure assembly as the copyboard completes its rearward movement.

Also carried on the copyboard housing 202 is a flat guide plate 332 and a linear cam 334 aligned longitudinally along the left edge of the housing 202 and similar in configuration to that of linear cam 310. Cam 334 thus defines a main, flat cam surface 336 having formed therein a notch-like recess 338 for cooperation with the roller bearing of a copy sheet pick-off assembly to be described below. In addition, the forward edge portion of copyboard housing 202 is tapered at surface 340 (FIG. 6) adjacent guide plate 332 for cooperative engagement with the soft pressure roller of the invention on the rearward pass of the copyboard assembly during a reproduction sequence.

The exposure station of the duplicating apparatus is illustrated in FIGS. 2 and 8 – 13 and includes a frame formed of a base plate 398 having a pair of side plates 400 and 402 affixed thereto in spaced parallel relationship. Each of the side plates 400 and 402 is generally rectangular in configuration and has a pair of extension ears 404–406 and 408–410, respectively, extending orthogonally from an upper rear corner thereof. Guide rail 210 of the copyboard assembly is horizontally secured to frame plate 400 as shown in FIG. 9 as is the support rod 222 for linear bearings 218 and 220. Further, motor 326 for driving the copyboard assembly is attached at plate 328 by suitable means such as screws to the side plate 402 as shown in FIGS. 9 and 11. A suitable flat, rectangular plate 412 extends between and is rigidly secured to ears 406 and 410 of side plates 400 and 402, respectively, to provide the necessary structural rigidity for the entire frame assembly.

A soft roller 414, constructed of any suitable material such as solid or foam rubber, is mounted for free rotation about a transverse shaft 416 connected between plates 400 and 402. Roller 414 is disposed for engagement with the upper surface of the copyboard assembly housing 202 as the same is moved rearwardly of the duplicating apparatus by motor 326 to maintain the original and copy microfiche sheets in firm contact against each other and against the surface of the copyboard plate 26 during movement of the same. Cooperating with the soft roller 414 is a copy film drag assembly which includes a generally curved support member 418 frictionally secured to the hub of roller 414 by a pair of spaced leg members 420 and 422. A stop member 424 protruding from the inside surface of flange 406 of frame side plate 400 cooperates with a recessed groove 426 in leg member 422 to define the limits of rotary movement of the drag cover 418. As shown in FIG. 9, a pair of thin, rectangular strips 428 and 430, of rubber or other resilient material, are secured to the lower front corners of member 418 and cooperate with the copyboard assembly and the soft roller 414 to engage the forward edge of a copy sheet and exert a drag force thereupon to shift the copy sheet against stop members 244 and 246 for precise longitudinal registration of original and copy sheets of microfiche as the copyboard assembly moves rearwardly of the duplicating apparatus. Also disposed on the front surface of member 418 is a centrally protruding nose 432 which gently engages the exposed surface of the copy sheet to correct for improper alignment caused by any film curl existing in the original or copy film sheets.

Thus, as the copyboard housing 202, containing both original and copy sheets, begins to move rearwardly of the duplicator, the inclined forward surface 340 of the copyboard housing will engage the perpheral surface of soft pressure roller 414 causing the same to be rotated as the copyboard continues its rearward advancement. Since cover member 418 is in frictional engagement with the hub of pressure roller 414, the initial rotation of the roller caused by the movement of the copyboard housing rotates the cover in a clockwise direction as visualized in FIG. 10 to bring the rubber drag members 428 and 430 downwardly into contact with the top sur-

face of the copyboard. At the same time, the protruding nose **432** of plate **418** swings down over the center of the advancing copy and original sheets flattening the curl thereof and gently urging the same against the surface of plate **26.**

Upon continued rearward movement of the copyboard assembly, stop **424** engages the rear edge of groove **426** precluding further rotation of plate **418** as the pressure roller **414** continues to be moved by the advancing copyboard housing **202.** The drag members **428** and **430** thereafter engage the forward edge of the copy sheet causing the same to be slid into engagement with stops **246** and **244** assuring precise registration of the copy sheet with the original microfiche carried by the copyboard. Further advancement of the copyboard assembly causes the registered copy and original microfiche sheets to be brought under the pressure roller **414** maintaining the microfiche sheets in firm contact with each other and with the top surface of the transmissive plate **26** for exposure of the copy sheet as will be described below.

A generally triangular flat copy sheet pick-off plate **450** is pivotally secured along its rear edge on a shaft **452** mounted between plates **400** and **402** of the exposure frame assembly. In this manner, the apex of the triangular plate **450** is centrally disposed with respect to the copyboard assembly and points to the front of the duplicating apparatus as illustrated in FIG. **8.** A roller bearing **454** is attached to the distal end of a linkage arm **456** having its proximal end rigidly secured to the triangular pickup plate **450** at its left side as viewed in FIG. **11.** Roller bearing **454** cooperates with linear cam **334** carried upon the copyboard housing **202** to lift the apex of the triangular pick-off plate **450** slightly away from the copyboard surface until the forward edge of the copy sheet has just passed the pressure roller **414.** Thereafter, roller bearing **454** will ride into recess **336** in cam **334** enabling the apex of the pick-off plate **450** to engage the top surface of the thin plastic sheet **242** covering the compressible sponge-like element **240.** Since the forward edge of the original microfiche sheet is inserted below the overhanging edge of plastic sheet **242,** and the copy microfiche sheet rests atop sheet **242,** the apex of the pick-off plate **450** will cause element **240** to be compressed allowing the pick-off plate to ride under and lift off the forward edge of the copy sheet as the same is further advanced by the continued movement of the copyboard assembly. Also, as the roller bearing **454** rides out of the recess **336** and onto the surface **338** of cam **334,** the apex of pick-off plate **450** is raised above the copyboard surface thereby lifting the copy sheet away from the original microfiche sheet to simply, effectively and positively separate the two as the copyboard housing **202** progresses to the rear of the duplicating apparatus.

As noted briefly above, after the copy sheet has been separated from the original, the exposed copy thereafter proceeds to a developing station while the original microfiche sheet is transported upon the copyboard back to the front of the duplicator. In order to preclude fouling of the original sheet upon the forward-going return of the copyboard assembly which, for example, may be caused by the presence of a fold or curl in the original microfiche sheet, an elongated rod-like retaining roller **458** is pivotally secured to the underside of the triangular pick-off plate **450** slightly below and parallel with shaft **452** to engage the original microfiche sheet and maintain the same in a generally flat posture upon the copyboard surface. Thereafter, as the copyboard carriage returns to its initial position, the roller **458** assures that the same will smoothly pass below the soft pressure roller **414** without becoming damaged.

An exposure lamp assembly indicated generally at **470** (FIGS. **2** and **10**) is disposed transversely of the duplicator apparatus between frame plates **400** and **402** and includes a base plate **472** of generally flat, rectangular configuration adapted to be slidably secured within grooves **474** and **476** formed in a pair of transverse mounting brackets **478** and **480,** respectively, attached between plates **400** and **402.** A generally L-shaped flange **482** is attached to base **472** and carries a threaded bolt **484** adapted to be cooperatively received within a mounting bracket **486** attached to plate **400.** The exposure lamp assembly **470** is thus selectively removable and may be secured in position directly underneath the soft pressure roller **414** by sliding base **472** along grooves **474** and **476** and thereafter engaging bolt **484** with bracket **486.** A rectangular opening is centrally defined by base plate **472** over which is disposed a light transmissive heat filter element **487** which may be constructed of any suitable material well known to those skilled in the art.

Mounted within the lamp assembly **470** is an elongated tubular ultraviolet lamp **504** which is preferably a **1000** watt ultraviolet mercury vapor lamp. Operating potential for lamp **504** may be supplied from a suitable conventional power source (not shown) through jacks (not shown) mounted upon the exposure and clearing assembly frame.

A generally parabolic elongated reflector assembly is disposed under lamp **504** and includes a first polished metal reflector element **530** secured, as by screws, at its upper end to a lip **532** formed along the top edge of flange **494.** A second polished metal reflector element **534** is secured through hinge **536** and suitable screws to a lip formed along the upper edge of flange **492.** Reflector element **534** is connected at its lower edge, as viewed in FIG. **2** through a pivot pin to a generally L-shaped connecting link **540** having the shorter arm thereof secured through tension spring to the flange **492.** A solenoid **544** is mounted to flange **492** and has its plunger **548** pivotally connected to the elbow of L-shaped link member **540** and receives a control signal at its winding through a pair of conventional plugs (not shown) which cooperate with complementary jacks (not shown) affixed to the exposure assembly frame. In this manner, actuation of solenoid **544** causes the retraction of plunger **548** which acts through link member **540** to swing the reflector element **544** away from lamp **504** to allow ultraviolet radiation to pass through heat filter **487** for illuminating the upper surface of an endless conveyor belt **570** for clearing vesicular type copy films.

Conveyor belt **570** is constrained between a pair of horizontally aligned spaced rollers **572** and **574** extending transversely between plates **400** and **402** and journaled for rotation thereupon. A gear **576** (FIG. **11**) is attached to the inner end of roller **572** for cooperative engagement with a conventional (not shown) motor which drives the conveyor belt **570** at the desired speed. Conveyor belt **570** may be constructed of any suitable material such as rubber impregnated fiberglass and is maintained in its desired lateral position by a pair of inclined rollers **578** and **580** which are pivotally dis-

posed upon angulated brackets 582 and 584, respectively, for engagement with the inner surface of belt 570 below rollers 572 and 574 as shown in FIG. 9.

An inverted generally U-shaped collimator support tray 590 (FIG. 9) is slidably disposed between frame members 400 and 402 above the exposure lamp assembly 470 for supporting a suitable honeycomb collimator between the ultraviolet lamp source 504 and the pressure roller 414. The honeycomb collimator 592 may be removed from its operative position between lamp 504 and roller 414 by longitudinal movement of tray 590, if desired.

An exhaust duct 594 of generally rectangular cross section extends laterally across the exposure and clearing assembly in front of the lamp assembly 470 and has suitable openings adjacent the lamp assembly for exhausting the heated air surrounding the lamp from the apparatus. Duct 594 communicates through a circular connector 596 to an exhaust hose 598 connected with a conventional exhaust blower (not shown).

A pair of microswitches 604 and 608 are mounted upon L-shaped brackets 610 and 612, respectively, secured to plate 400 of the exposure frame assembly such that the actuating arms of microswitches 604 and 608 protrude through openings in the plate wall for selective engagement and actuation by protrusions 214 and 216 carried on flange 204 of the copyboard assembly as shown in FIG. 5.

After separation of the copy sheet from the original sheet on the copyboard assembly by the pick-off plate 450, the copy sheet is advanced by roller sets 746–748 and 752–754, which are continuously driven by conventional means (not shown), into the developing chamber 800. The developing chamber can be provided by many conventional developing apparatus, and it will be only briefly described here because it forms no part of the invention. Within the developing chamber 800 are a plurality of rollers 806, 808, 810, 812, 814, and 816 supporting endless belts 818 and 820 which are continuously driven by conventional drive means (not shown) and transport the exposed copy sheet through the developing chamber 800.

Within the developing chamber 800 are heating elements provided by heating block 838, and others if desired, which provide the necessary heat to develop the vesicular film, when that film is used or heat the ammonia atmosphere within the chamber when diazo film is used. The heat can be provided by conventional electrical means and controlled by conventional thermoswitches. The ammonia atmosphere can be provided by conventional feeding means for feeding metered quantities of anhydrous ammonia and water into a receiving tray (not shown) in the bottom of the developing chamber 800.

After being transported through the developing chamber 800 by belts 818 and 820, the developed film is advanced by roller set 778 and 780, driven by conventional means (not shown), to conveyor 570. Conveyor 570 conveys the develops diazo film to receiving tray 34 without further processing. If the duplicator is set for vesicular film, the reflector element 534 will be swung to its retracted position, permitting light from lamp 504 to pass through heat filter 487 and shine on conveyor 570. In this mode, the film is cleared as it passes beneath the light assembly 470.

The duplicator described in connection with the present invention includes a control network housed within the cabinet and constructed with conventional switching assemblies, such as relays, to provide the desired control sequence for operating the system. The particular circuit details of that control system may be of any suitable design accomplishing the sequence to be described below. In view of the great number of variations in the details of the circuit control network, which are well known to those of ordinary skill in the art, no attempt will be made herein to describe any particular circuit in detail, for the sake of brevity. However, the desired control sequence will be fully presented in accordance with the preferred mode of operation of the present invention as the description proceeds.

Prior to the beginning of a particular reproduction sequence, a roll 38 of diazo or vesicular film is inserted within compartment 30 and threaded through the film feed and cutting assemblies within that compartment. The microfiche duplicator described in connection with the present invention is adapted to make copies using either of these film types, dependent upon the position of a first selector switch. Diazo and vesicular lamps on panel 28 apprise the operator of the position of the first selector switch when the duplicator is on. If a diazo film is used, and the switch is placed in its diazo selector position, the following sequence of events occurs as the "on" push button of panel 28 is depressed.

Initially, operating potential is fed to a cooling blower in the duplicator housing and to the heating elements of the developing assembly. In addition, the developer drive motor (not shown) is turned on causing the movement of the developer belts 818 and 820 as well as the clearing conveyor 570. As the temperature within the developing chamber reaches approximately 160°F., the heating elements are appropriately cycled by a thermoswitch to maintain this temperature. It is noted that the vesicular heating elements will be controlled to maintain the temperature of the thermally conductive block 838 at approximately 300°F when the machine is processing vesicular film.

At the same time, a metered amount of water and anhydrous ammonia is fed into the developer to develop the diazo film. The metering means are not shown as they can be provided by any number of conventional systems and form no part of the present invention.

The exposure lamp 504 is then supplied with operating potential, and the ready lamp on control panel 28 is turned on. The microfiche duplicator is thus placed in a stand-by mode ready to receive an original microfiche sheet for the making of a copy.

A second switch may be placed in either of two positions corresponding to the use of roll or cut sheet copy film in the duplicator. With the second switch in the sheet supply position, the sheet indicator lamp on control panel 28 is lit, and the film advance and cutting assemblies are disabled to preclude inadvertent advance of the film from the roll. With the second switch in the roll feed position, an operator may depress either the single or multiple selector push buttons, the number of multiple copies being preselectable by the setting of the counter of control panel 28. If the single copy push button is depressed, a motor in the film feed and cutting assemblies will become energized, causing a precisely measured length of copy film to be fed from the supply roll and thereafter severed by a blade in the cutting assembly so as to fall atop the original microfiche sheet

which has been previously inserted over the copyboard plate **26.**

DC drive motor **326** of the copyboard assembly will then be energized, whereupon the copyboard will be moved forward at a rate dependent upon the setting of the exposure dial on control panel **28.** The exposure dial controls the power to the motor **326,** by conventional means such as a rheostat, and thus the speed of the motor. The amount of exposure to the light is controlled by the speed of the copyboard through the exposure assembly. Microswitches **608** and **604** of the exposure and clearing assembly coact with protrusions **214** and **216** of the copyboard to detect the limits of movement thereof as the reproduction sequence progresses. Specifically, microswitch **608** detects the limit of forward movement of the copyboard, causing drive **326** to be reversed through conventional switching relays (not shown). As motor **326** rotates in the reverse direction, the copyboard is returned to the front of the duplicator at a faster speed than it moved to the rear of the duplicator. The copy sheet thereafter continues its advancement through the developing chamber and back toward the front of the duplicator where it is conveniently delivered to the receiving tray **34.** The original microfiche sheet is maintained on the copyboard and is returned therewith for the making of additional copies if so desired.

If the multiple copy selector button is depressed on control panel **28,** the above sequence is repeated for the desired number of copies, with the copyboard carrying the original sheet back and forth along its linear path of travel as each exposed copy sheet is cut and fed through the exposure and developing stations.

To further clarify the operation of the microfiche duplicator, reference will now be made to the diagrammatic views of FIGS. **12** through **16.** Referring to FIGS. **12** and **13,** at the start of a reproduction sequence, an original microfiche sheet **0** is placed atop the copyboard plate **26** between the fixed left stop **224** (FIG. **1**) and the retracted right hand stops **292** and **294.** As the operator inserts the original microfiche sheet on to the copyboard, lever **262** is depressed downwardly causing front stops **244** and **246** to be retracted flush with the copyboard surface. The leading edge of the original sheet is thereafter located underneath the thin plastic separator sheet **242** and against the front side of the compressible sponge-like element **240.** Release of lever **262** thereafter returns the front stops **244** and **246** to their upright positions shown in FIG. **1** thereby capturing the original sheet in its proper longitudinal position on the copyboard.

A measured and cut length of copy film C from supply roll is thereafter dropped onto the copyboard approximately three-eights of an inch forward of the stops **244** and **246** and between the left and right stop members. Thus, the copy sheet drops onto the copyboard with its leading edge above the plastic separator element **242** enabling positive separation of the copy and original sheets after exposure.

As the copyboard begins its forward travel, the cammed right hand stop members **292** and **294** move toward the fixed left stop **224,** as controlled by roller **308** and cam **310** (FIG. **9**). Stops **292** and **294** thus move both the original and copy sheets against stop **224** to provide positive lateral registration therebetween.

Further forward travel of the copyboard causes the inclined leading edge **340** thereof to engage the soft pressure roller **414** causing the same to rotate clockwise as visualized in FIGS. **12** and **13.** The frictional engagement of carrier plate **418** with pressure roller **414** causes the same to rotate clockwise so as to lower the rubber drag elements **428** and **430** against the copyboard surface as shown in FIG. **13.** Nose member **432** also moves downwardly against the copyboard so as to flatten the film and remove the curl in the copy sheet to provide accurate registration as the copyboard advances. Continued movement of the copyboard causes the rubber drag elements **428** and **430** to engage the copy sheet C to slide the same against stops **244** and **246,** completing the registration sequence.

Both the cammed right hand stops **292** and **294** and stops **244** and **246** maintain their upright positions until the copy and original sheets are captured by the pressure roller **414.** Thereafter, and in response to continued forward movement of the copyboard assembly, the cammed right hand stops **292** and **294** are retracted to their rest positions to assure clearance with the end of the pressure roller **414.** Similarly, the forward movement of the copyboard causes the engagement of arm **250** with stationary cam **330** for retracting stops **244** and **246** to their flush or nested positions within the top surface of the copyboard so that they will pass underneath roller **414** without damaging the same.

As the registered original and copy sheets pass under pressure roller **414,** a compressive force is exerted thereagainst causing both sheets to be maintained in firm contact with each other and with the copyboard plate **26** for accurate exposure. As shown in FIG. **2,** the ultraviolet radiation from lamp **504** is directed through a suitable slit aperture having a width somewhat less than the flat section of the pressure roller **414** compressed against the glass. In this manner, the copy sheet C is securely held over original sheet **0** for assuring distortion-free exposure of the copy as the copyboard continues its forward travel.

As the copy sheet C is exposed, and passes beyond roller **414,** it is separated from the original sheet **0** by the pick-off plate **450** shown diagrammatically in FIGS. **14** through **16.** As described above, the original sheet **0** is placed in position on the copyboard so that the leading edge thereof is below the plastic separator sheet **242.** Also, the copy sheet C is aligned with the original such that its leading edge is above the separator sheet **242** as shown. When the copyboard moves forward beneath the pressure roller **414,** the soft foam material **240** supporting the separator sheet **242** is compressed so that good contact between the master or original and copy sheets is attained. As the separator **242** exits from the pressure roller **414,** the foam sheet **240** returns to its original shape causing the leading edges of the original and copy sheets to be slightly separated. Further forward travel causes the roller bearing **454** of the pick-off plate **450** to ride into recess **336** of cam **334** enabling the pick-off plate to be pivoted against the separator sheet **242.** As plate **450** moves downwardly, the tapered leading edge thereof compresses the foam support sheet **240** enabling the apex of the pick-off plate to ride under the leading edge of the copy sheet C. As the copyboard continues its forward travel, the copy sheet is caused to ride up on the pick-off plate **450** with cam **334** acting through roller **454** to raise the pick-off plate away from the copyboard

surface to preclude damaging the original sheet as it moves thereunder. The original sheet remains under the separator sheet **242** while the copyboard finishes its forward travel and thereafter returns to its start or loading position shown in FIG. **1.**

Referring again to FIG. **2,** the separated copy sheet C is passed above pick-off plate **450** and is thereafter guided between driven roller sets **746–748** and **752–754** into the developing chamber. The advancing copy sheet is thereafter captured between belts **818** and **820** within the chamber for transporting the copy sheet and developing the exposed image therein. As noted above, if the copy sheet is a diazo film the copyboard will be exposed to ammonia, water vapor and an elevated temperature of approximately 160°F., causing the development of the exposed image. If the copy sheet, on the other hand, is a vesicular film, the same will be developed by 300° temperature of block **838** in the upper leg of the developing chamber. Of course, in the vesicular mode, the anhydrous ammonia solenoid valve will be deenergized, as will be the liquid metering assembly, such that the copy sheet is merely exposed to heat for affecting development thereof. The developed copy sheet is passed from the lower leg of the development chamber through driven rollers **778** and **780** onto conveyor belt **570.**

Conveyor belt **570** transports a developed diazo copy to the receiving tray **34** and also acts as a clearing station for a developed vesicular copy. In the vesicular mode, preselected by switch **31,** solenoid **544** is energized to rotate reflector element **534** to the position shown in dashed lines in FIG. **2.** With reflector element **534** swung to its retracted position, light from lamp **504** passes through heat filter **487** and shines on the upper surface of conveyor **570.** As the developed vesicular copy sheet passes under the lamp assembly **470,** the light from lamp **504** causes the same to be cleared, thus fixing the exposed and developed image of the original microfiche.

Thus, it can be appreciated that the present invention, as disclosed above and illustrated primarily in FIGS. **20–25,** enables the simple and inexpensive construction of apparatus for positively assuring intimate physical contact between thin sheets of material while at the same time precluding the generation of opposing forces on various individual sheets, which forces might otherwise cause relative movement therebetween. The present invention is, therefore, exceptionally well suited for direct contact photographic duplication applications, and particularly, the reproduction of microfilm or microfiche.

Inasmuch as the present invention is subject to many variations, modifications and changes in detail, it is intended that the foregoing description be interpreted as illustrative of a preferred mode and not in a limiting sense.

What is claimed is:

1. Apparatus for establishing firm contact between superposed thin sheets of material, comprising:

a frame;

a support carriage mounted on said frame for carrying said superposed thin sheets of material; and

a freely rotatable, resilient roll disposed above said carriage at a spacing therefrom less than the roll radius, said roll being engaged by said carriage as the same transports said superposed sheets past said roll such that the roll is flattened and pressed against said superposed sheets on the carriage, said roll being journalled for free rotation on said frame whereby said roll is rotated by said carriage in synchronism therewith to preclude relative movement between said sheets.

2. The apparatus of claim **1** wherein said carriage is linearly moveable on said frame under said roll, and said apparatus is part of a microfiche duplicator and establishes firm contact between an original and copy sheet of microfiche.

3. The apparatus of claim **2** wherein said roll is generally cylindrical.

4. The apparatus of claim **2** wherein said roll has a rigid central core surrounded by a cylinder of resilient foamed material.

5. The apparatus of claim **2** wherein said carriage has an upper surface formed of a substantially flat main portion and a downwardly offset front portion contiguous with said main portion to facilitate engagement of said roll.

6. The apparatus of claim **2** wherein said carriage includes a flat, light-transmissive plate.

7. The apparatus of claim **6** wherein said resilient roll is substantially opaque such that the same provides a substantially uniform background for exposure of one thin sheet of film through the other as said carriage moves under said roll.

8. A method for maintaining contact between thin sheets of material, comprising the steps of:

placing a plurality of thin sheets on a carriage mounted for linear movement on a frame and spaced from a freely rotatable resilient roll at a distance less than the roll radius; and

moving said carriage along said frame under said roll such that said roll is engaged and rotated thereby, said movement of said carriage flattening said roll against the upper surface of said carriage to place said sheets in positive contact without permitting relative movement therebetween.

9. The method of claim **8** wherein said sheet placing step includes placing an original and copy sheet of microfiche in superposition on said carriage.

10. The method of claim **9** further including exposing the original and copy sheet of microfiche to an exposure light while said sheets are held in positive contact without permitting relative movement therebetween.

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