United States Patent [19]

Freeman et al.

[11] **3,922,083**

[45] **Nov. 25, 1975**

[54] **ELECTROSTATIC COPYING DEVICE WITH PAPER CUTTER MECHANISM**

[76] Inventors: **Lawrence M. Freeman,** 599 Ansley Court, NE., Atlanta, Ga. 30324; **Francis T. Arnold,** 2379 Tristan Circle, NE., Atlanta, Ga. 30345

[22] Filed: **June 17, 1974**

[21] Appl. No.: **479,657**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 304,519, Nov. 7, 1972, abandoned, which is a continuation-in-part of Ser. No. 146,114, May 24, 1971, Pat. No. 3,730,622.

[52] **U.S. Cl.** **355/13;** 83/208; 83/222; 355/3; 355/10; 355/11; 355/12; 355/14; 355/27; 355/28; 355/29; 355/45

[51] **Int. Cl.** **G03b 21/00**

[58] **Field of Search** 355/3, 10–14, 355/27–29, 45; 83/208, 222

[56] **References Cited**

UNITED STATES PATENTS

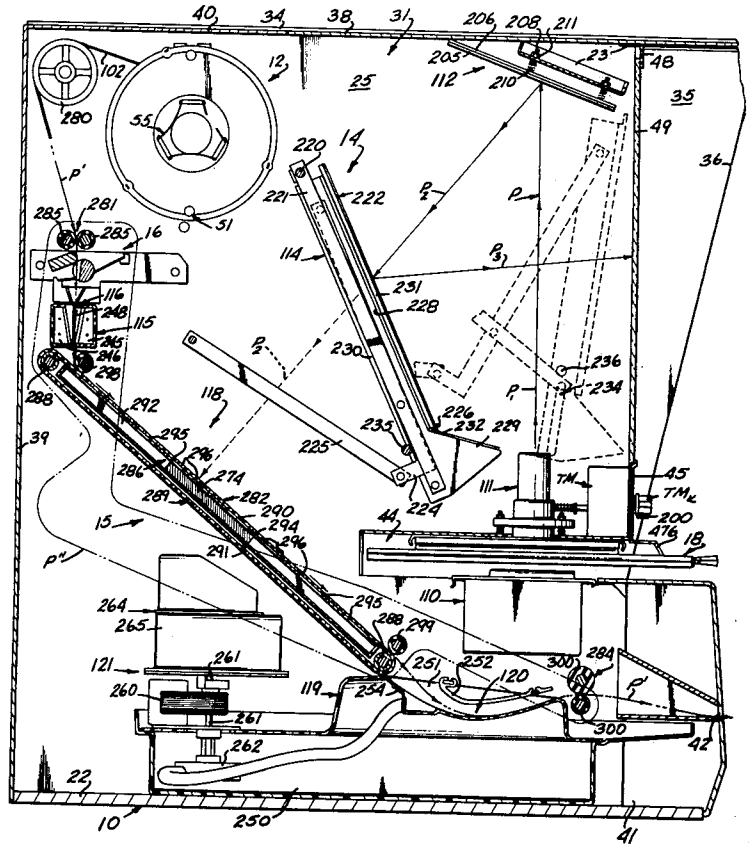
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Primary Examiner—Richard M. Sheer
Attorney, Agent, or Firm—B. J. Powell

[57] **ABSTRACT**

An electrostatic photocopying microfilm reader-printer for copying images from an original document medium onto copy paper including a cassette for holding a supply of copy paper, an image forming mechanism for electrostatically forming an image on the copy paper, a vacuum conveyor for moving the copy paper through the image forming mechanism, a paper cutter mechanism for cutting indeterminate lengths of copy paper into shorter determinate lengths, and a flexible endless driving element for operating the imaging forming mechanism, the vacuum conveyor and the paper cutter mechanism. The paper cutter mechanism further including a pair of cutting members having a cocked position and a released position so that the cutting members cut the sheet material as they move from the cocked position to the released position, resilient means for urging the cutting members toward the released position, latch means for selectively holding the cutting members in the cocked position, and release means for causing the latch means to release the cutting members for movement to the released position to cut the sheet material.

28 Claims, 38 Drawing Figures



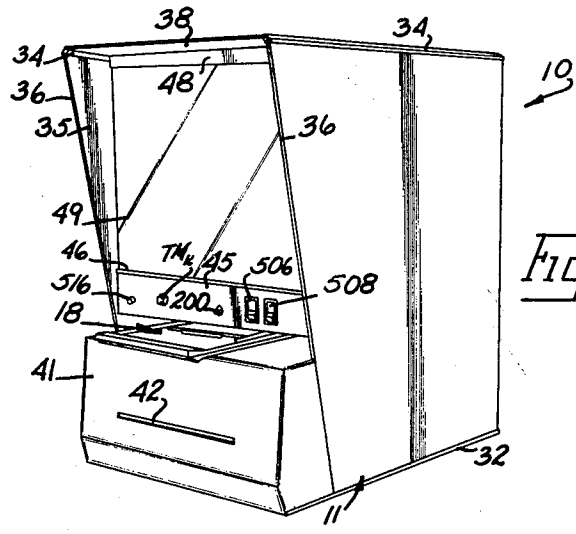

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Fig 1

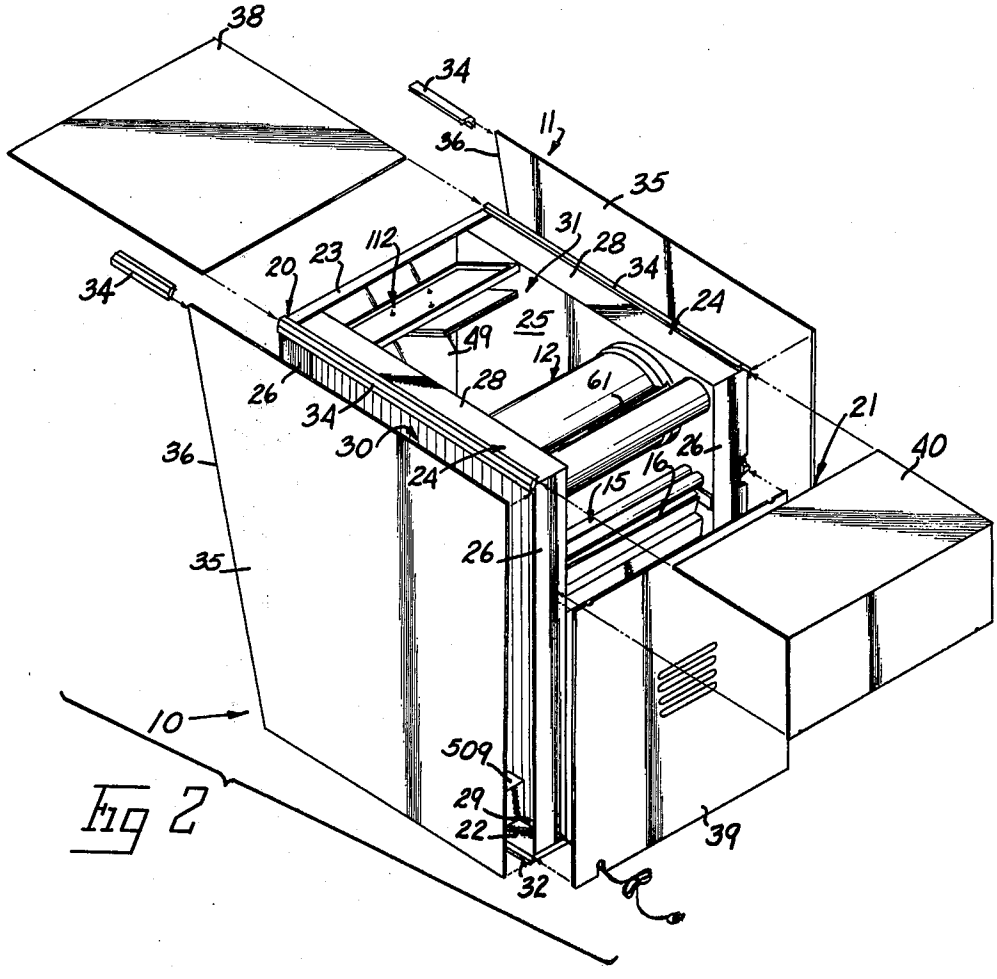

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Fig 2

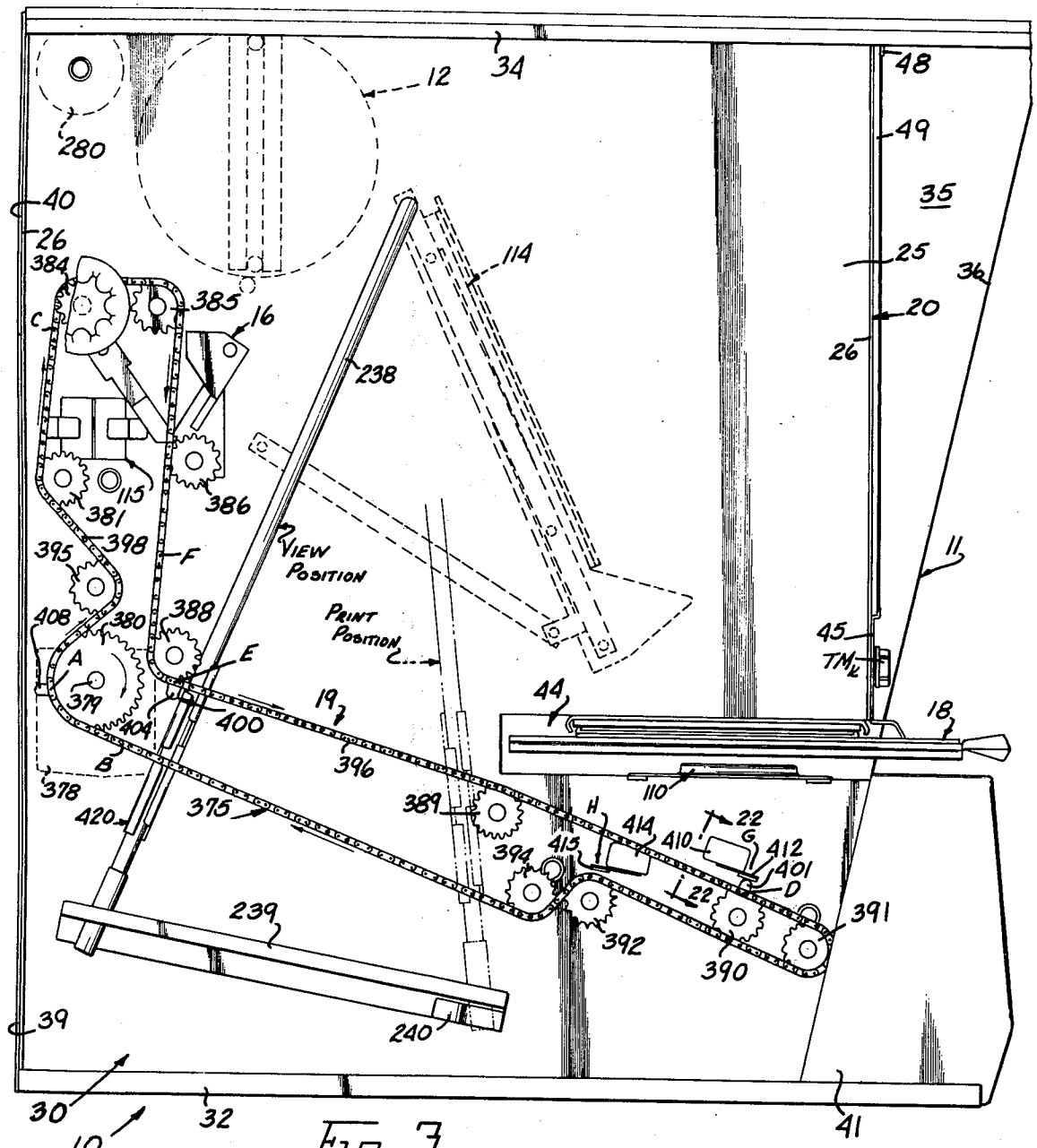

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Fig 3

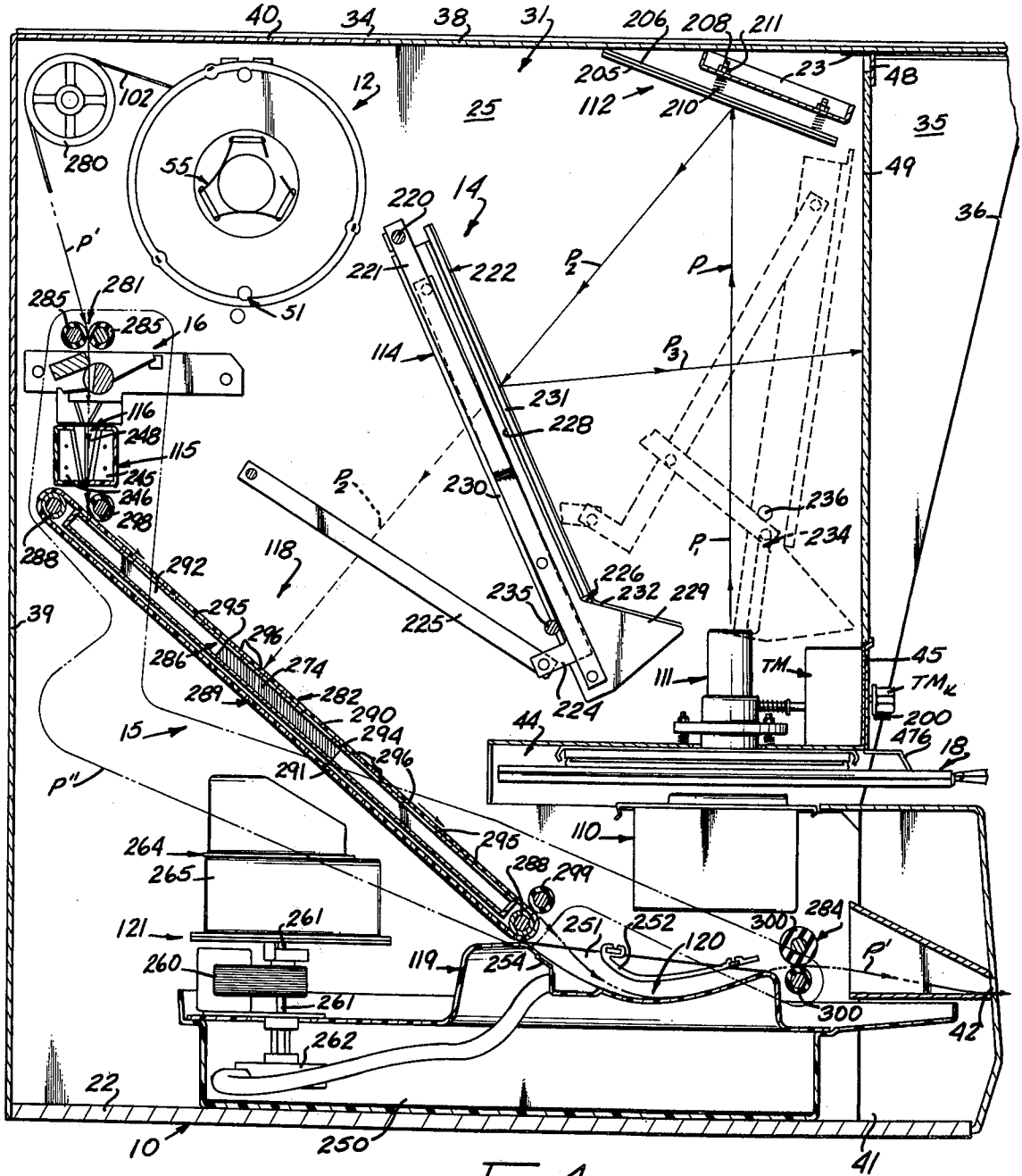

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Fig 4

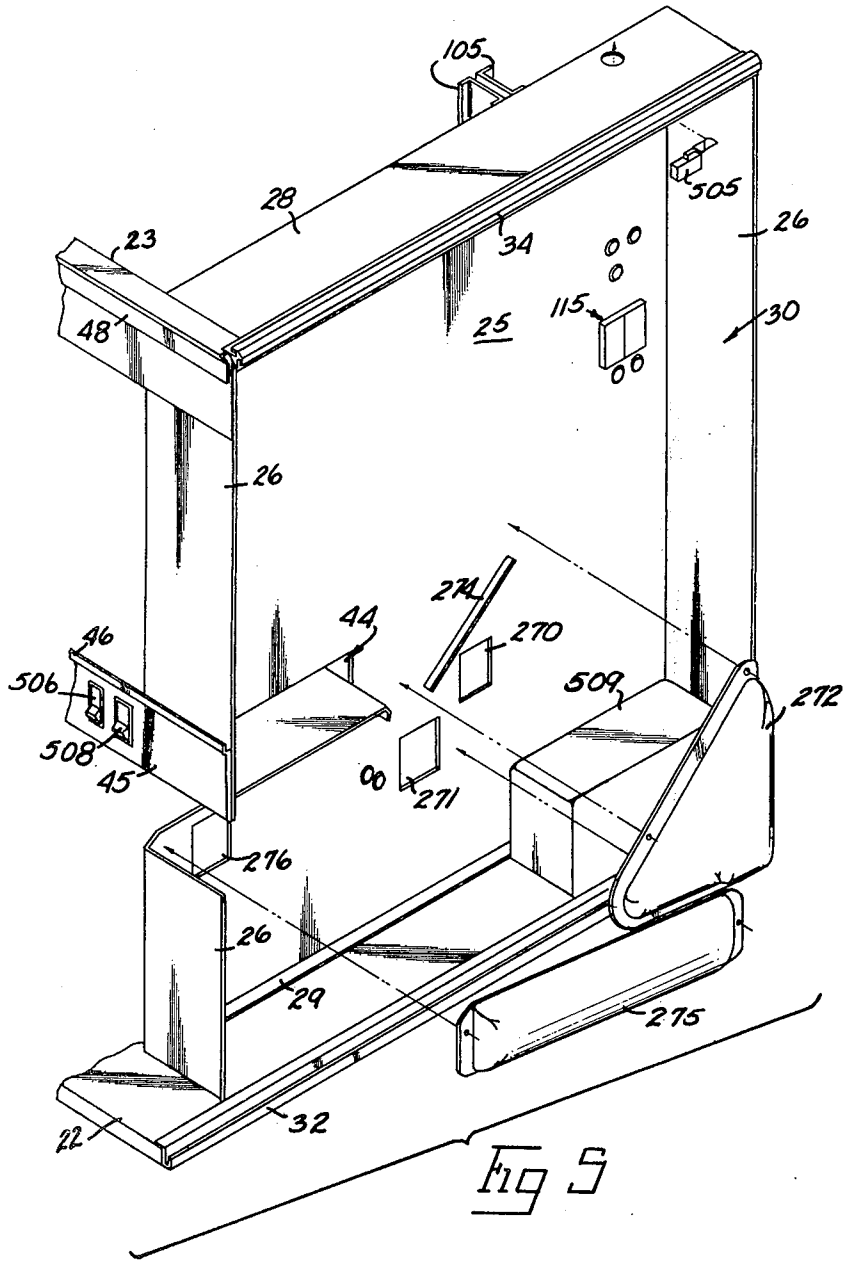

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Fig 5

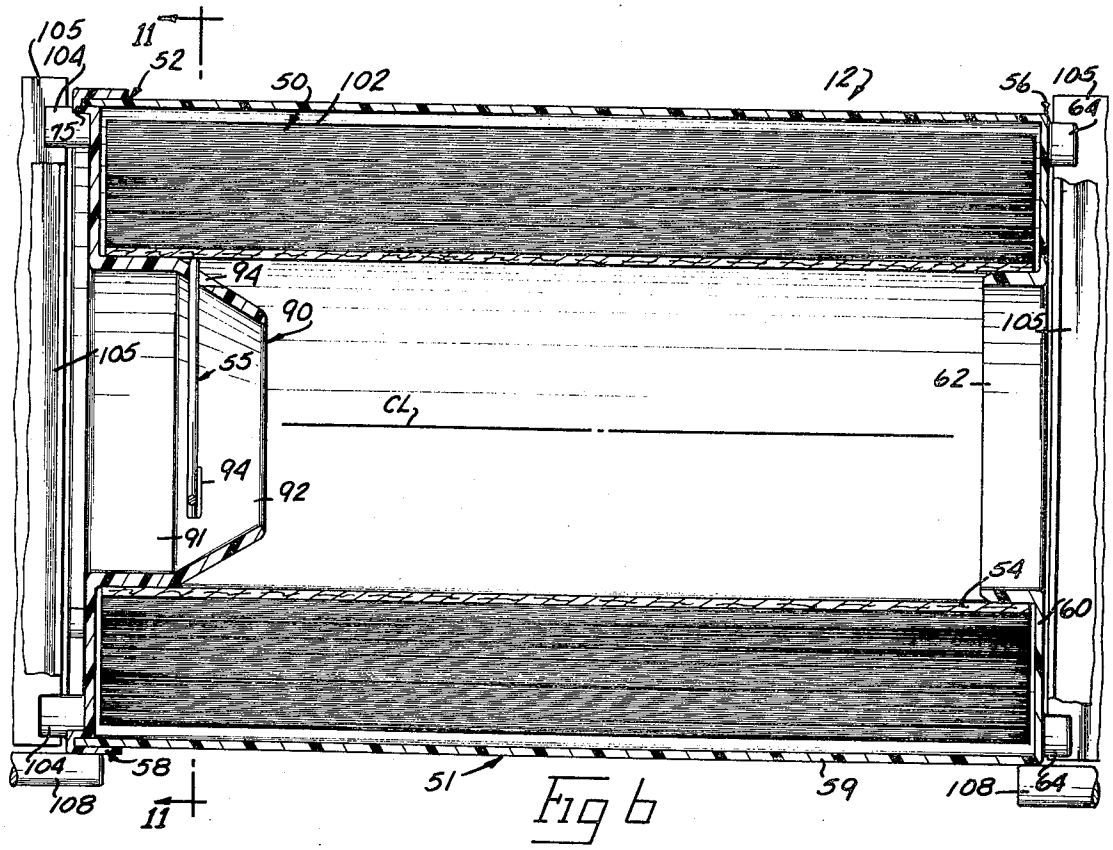


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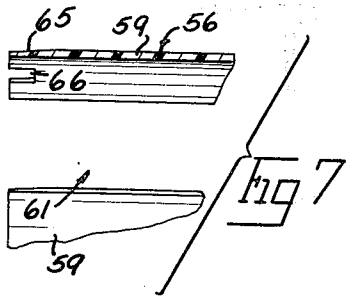


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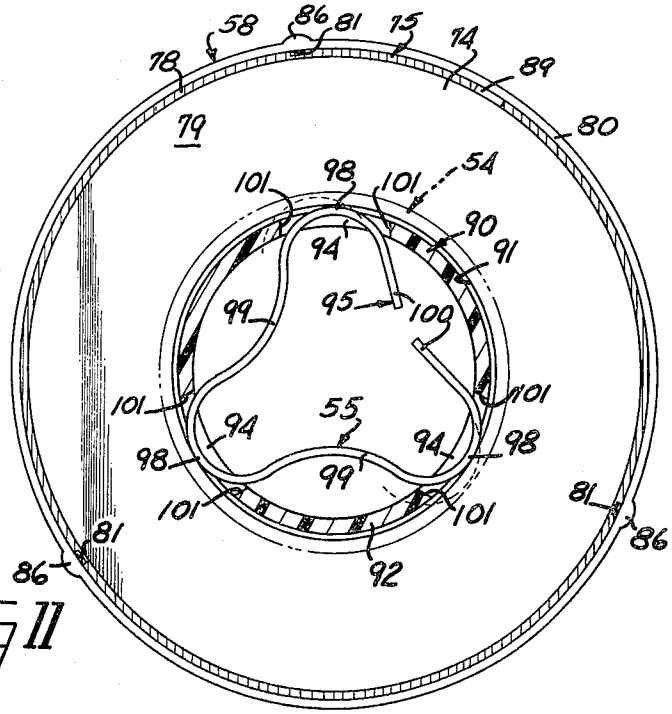


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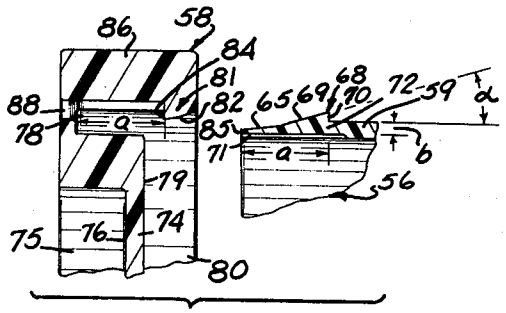


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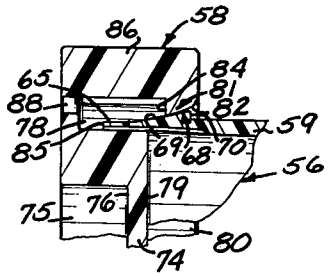


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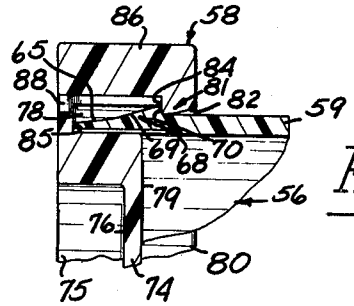


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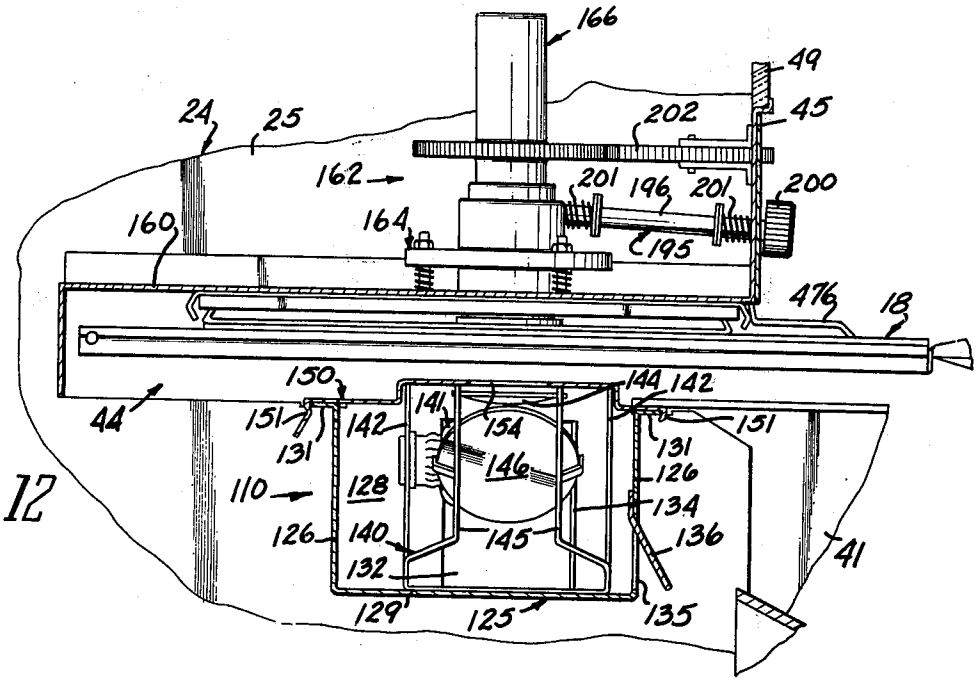


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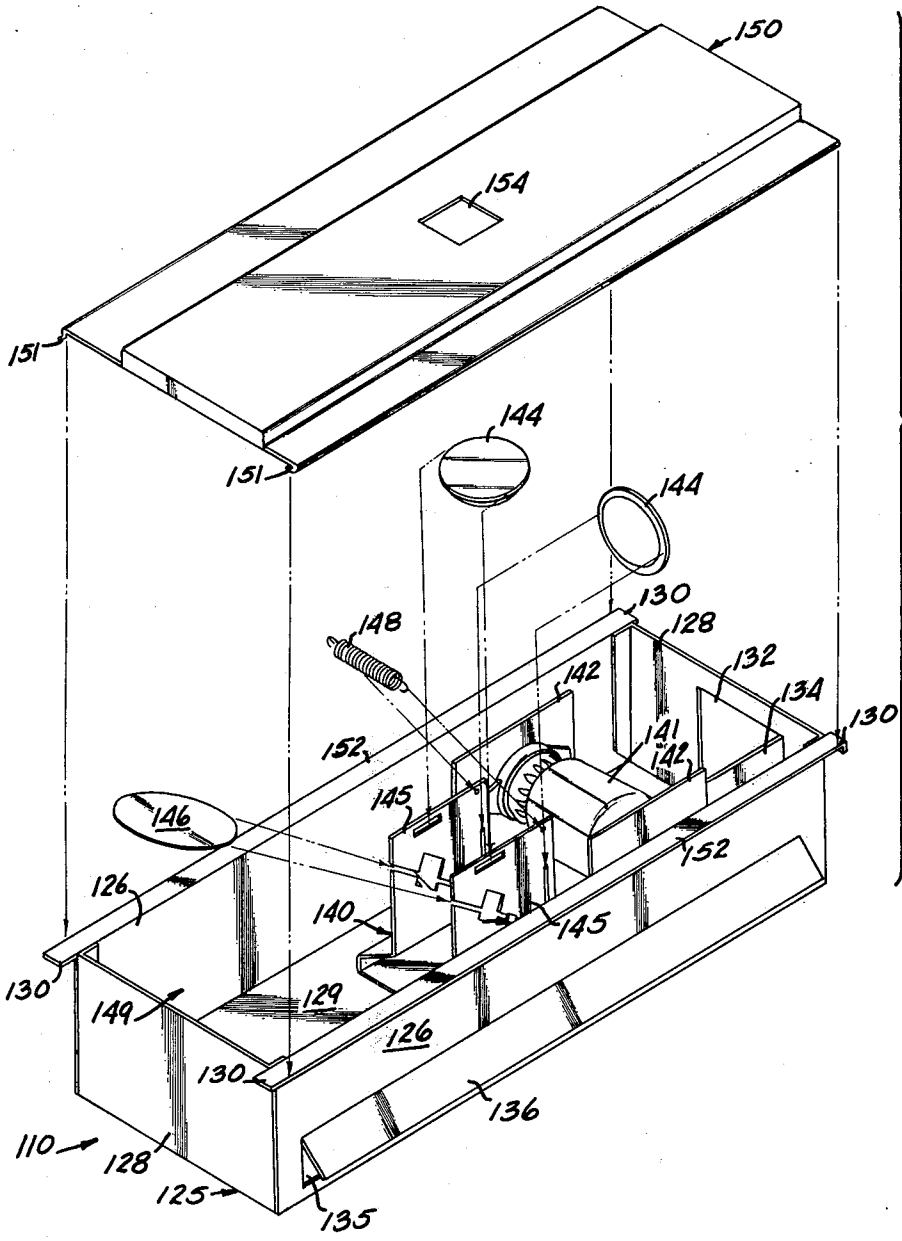

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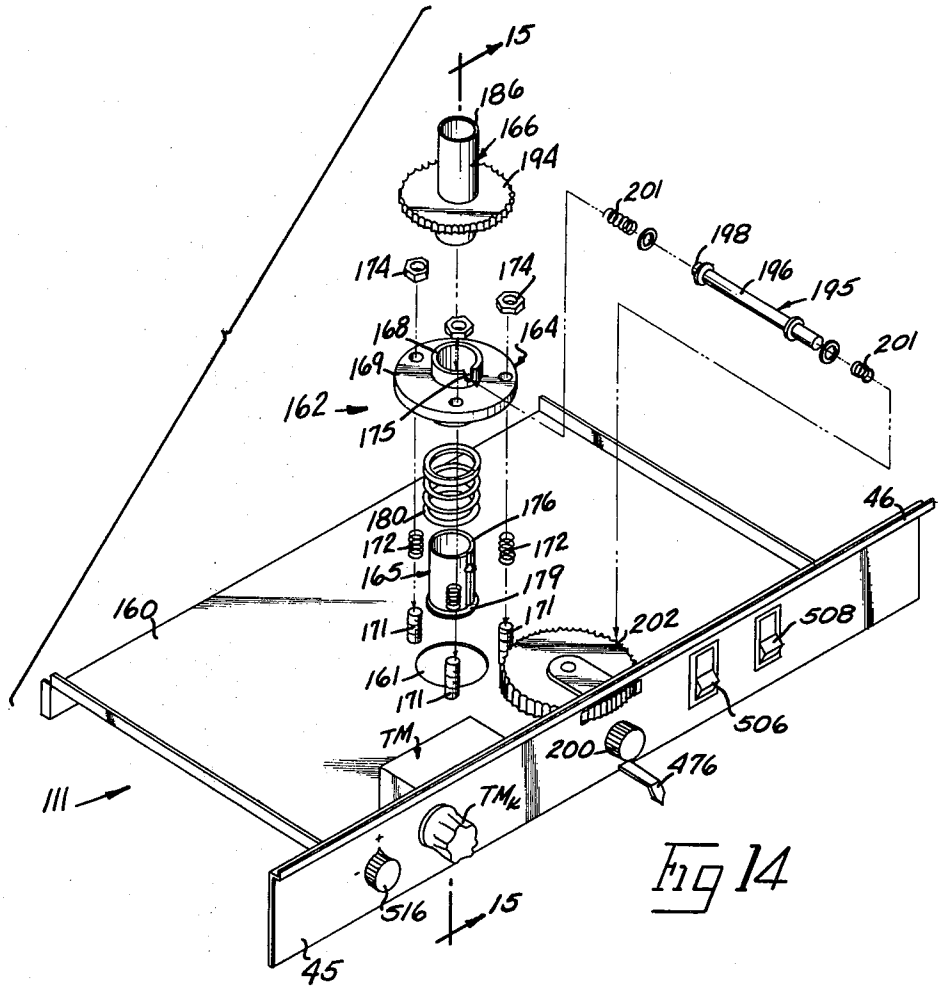

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Fig 14

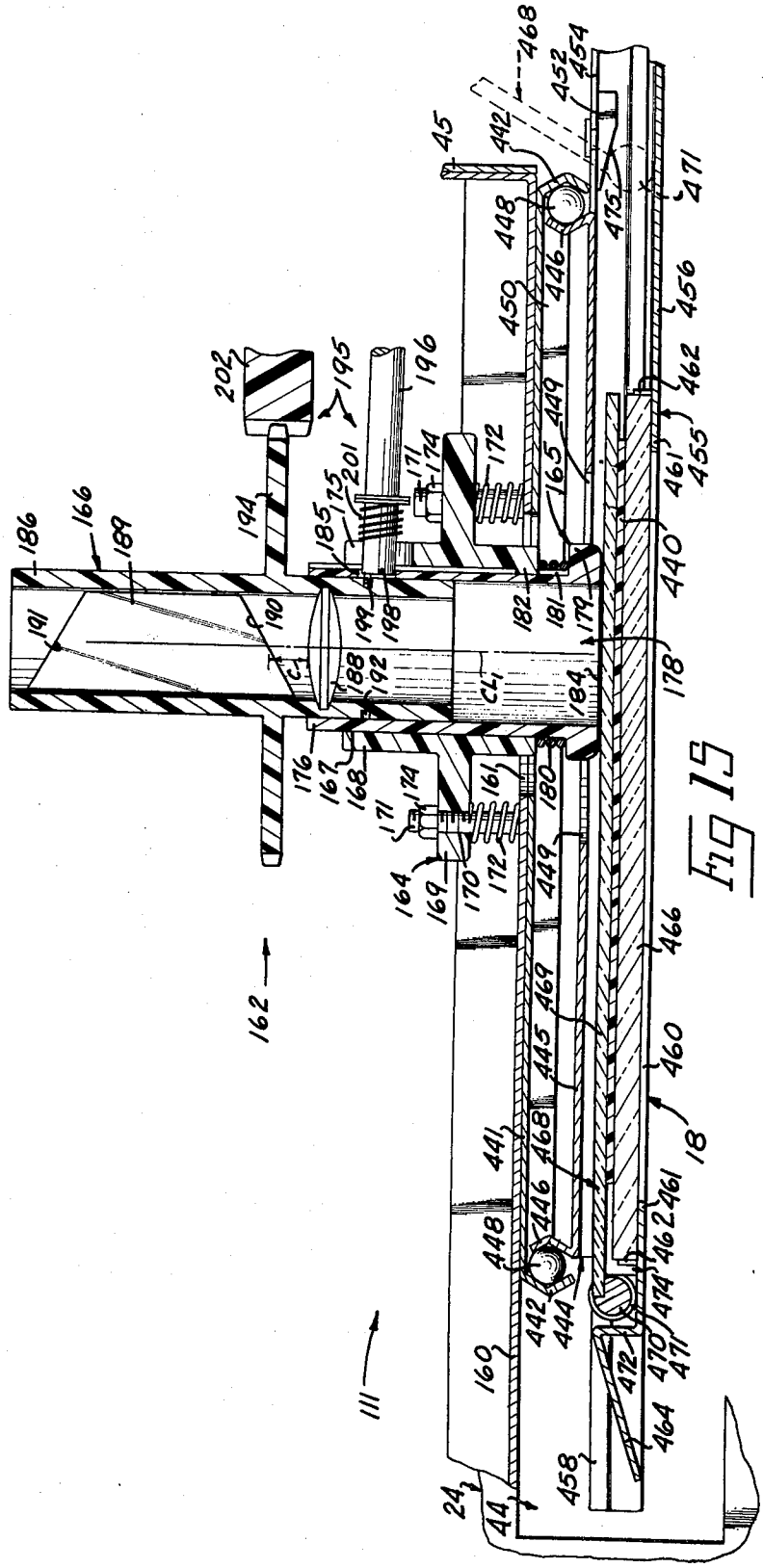

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Fig 15

Fig 1b

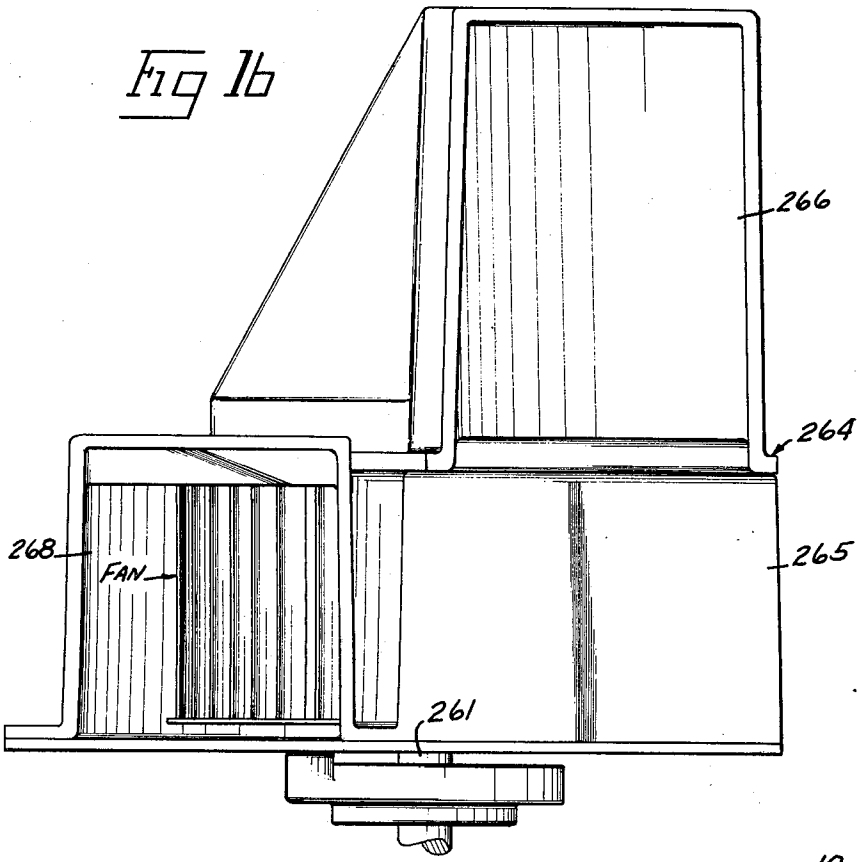
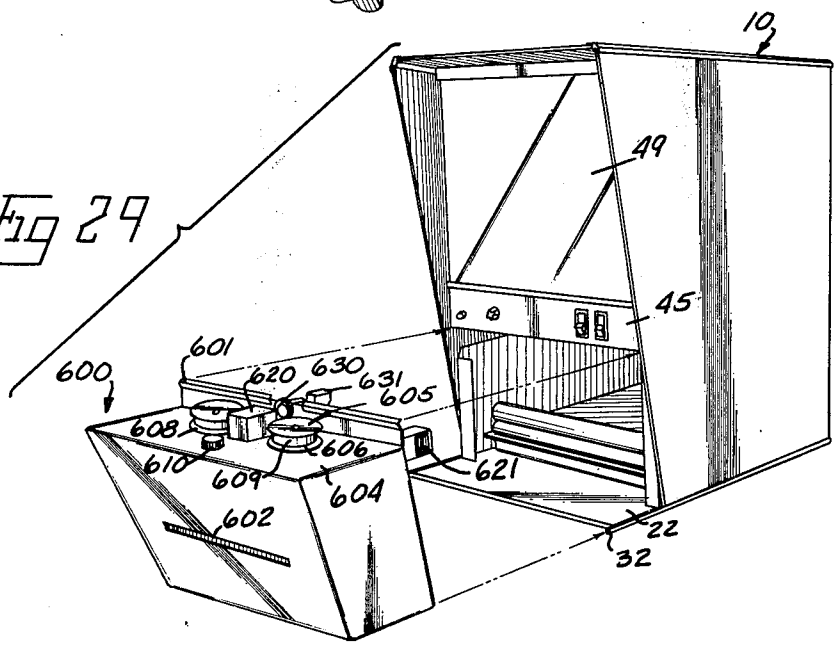

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Fig 29


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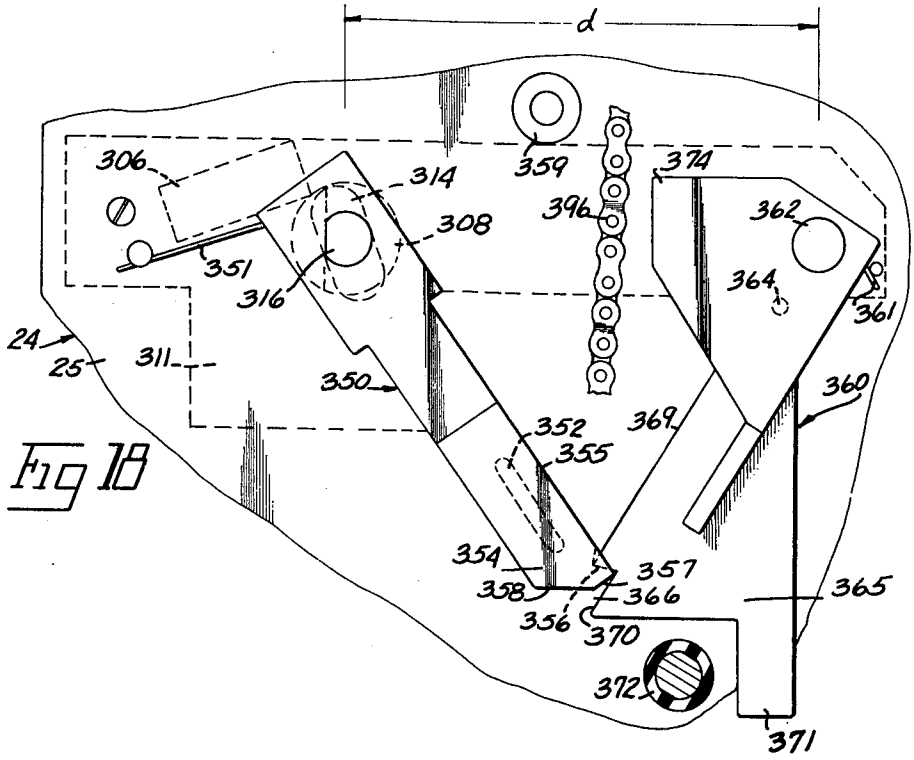

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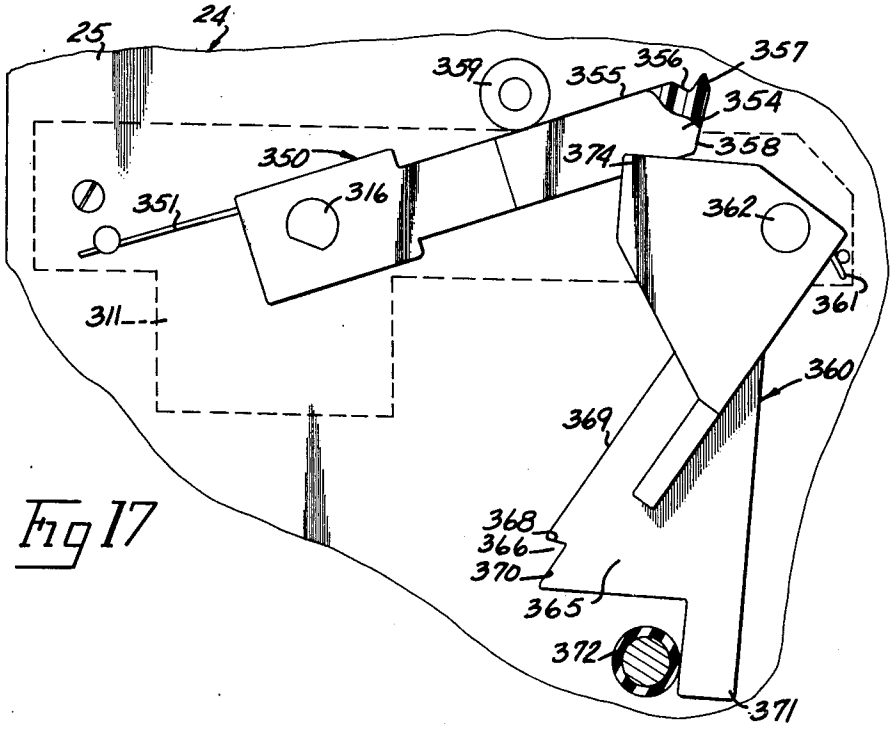

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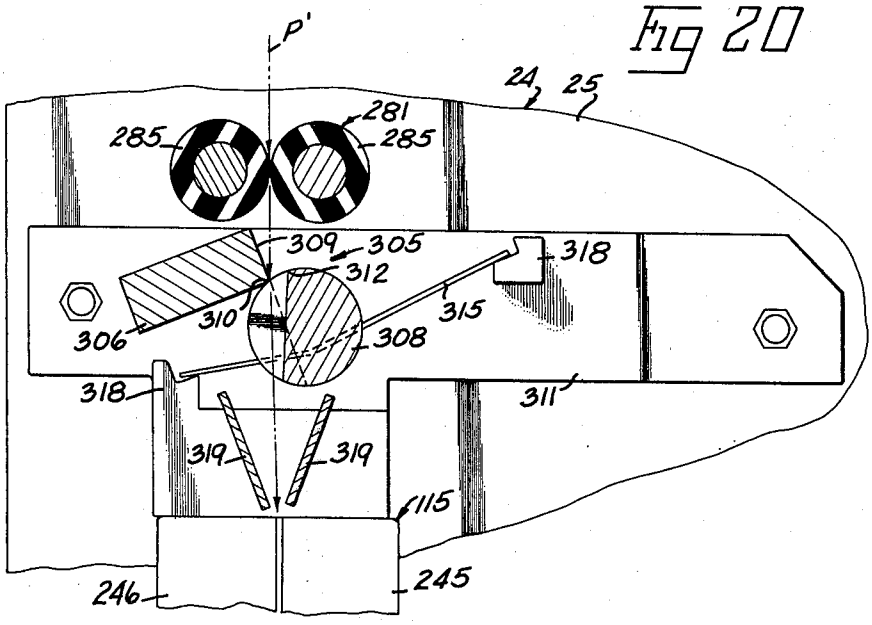

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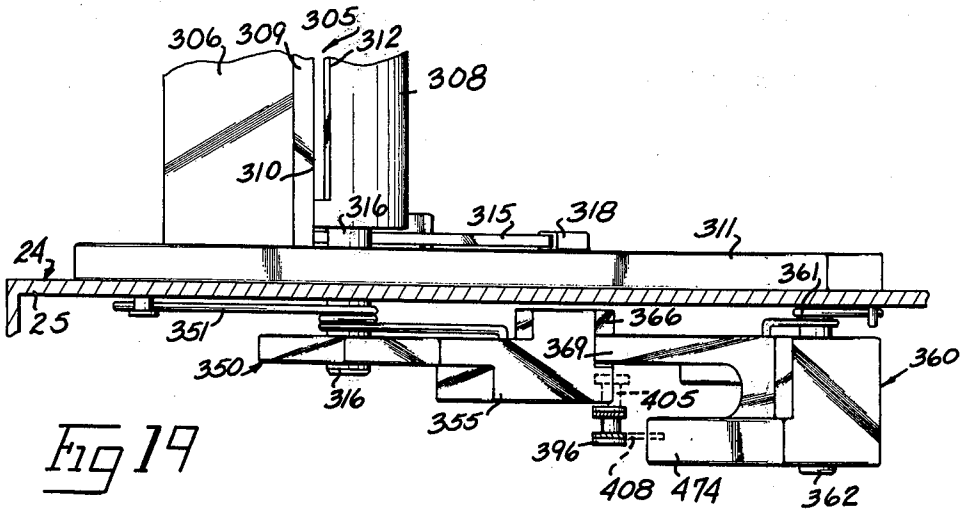

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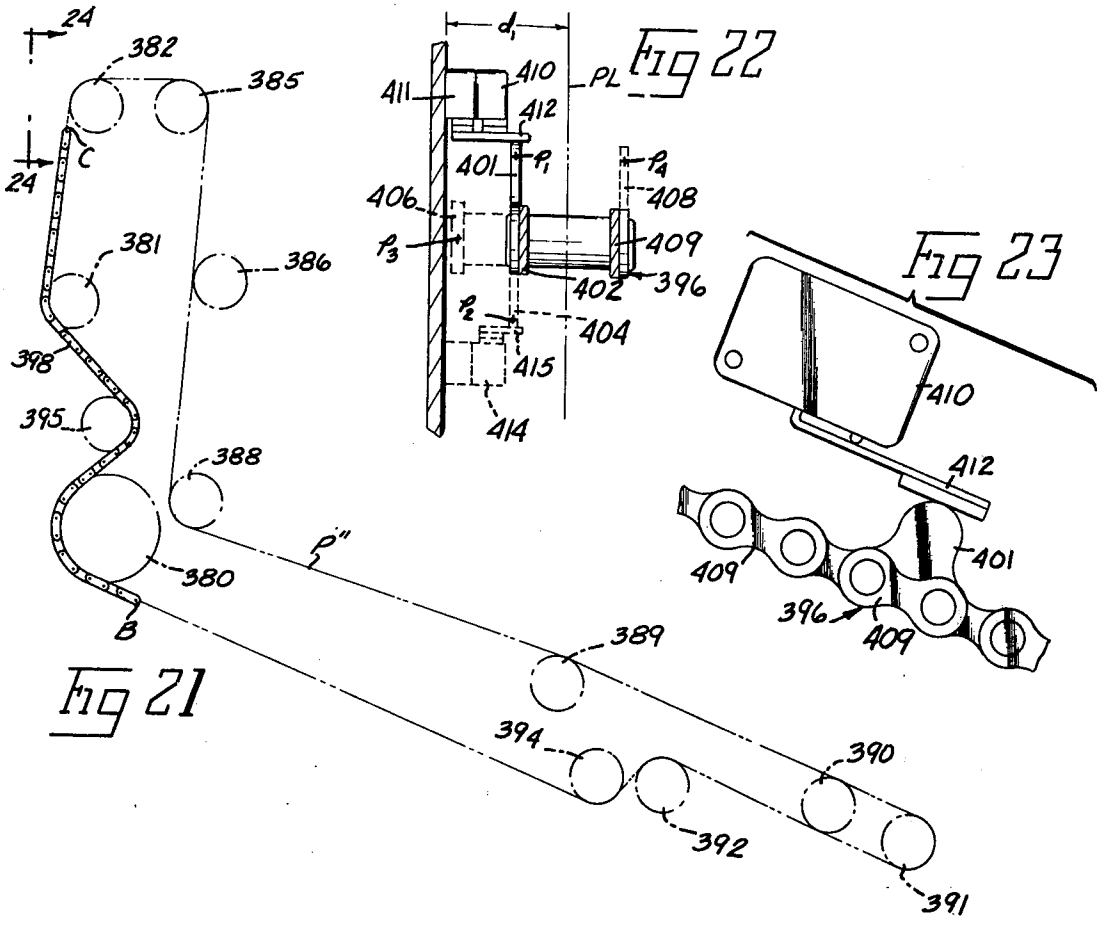


Fig 21

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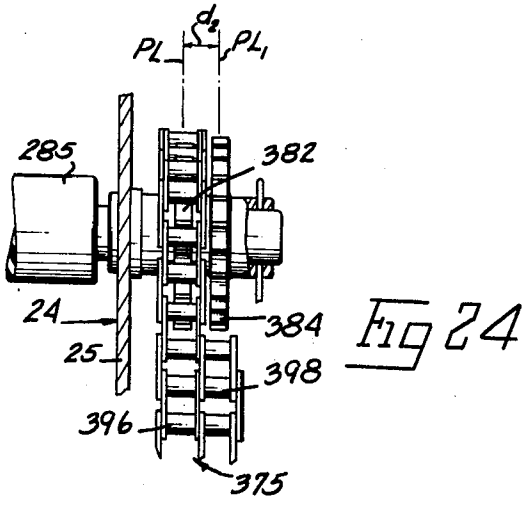


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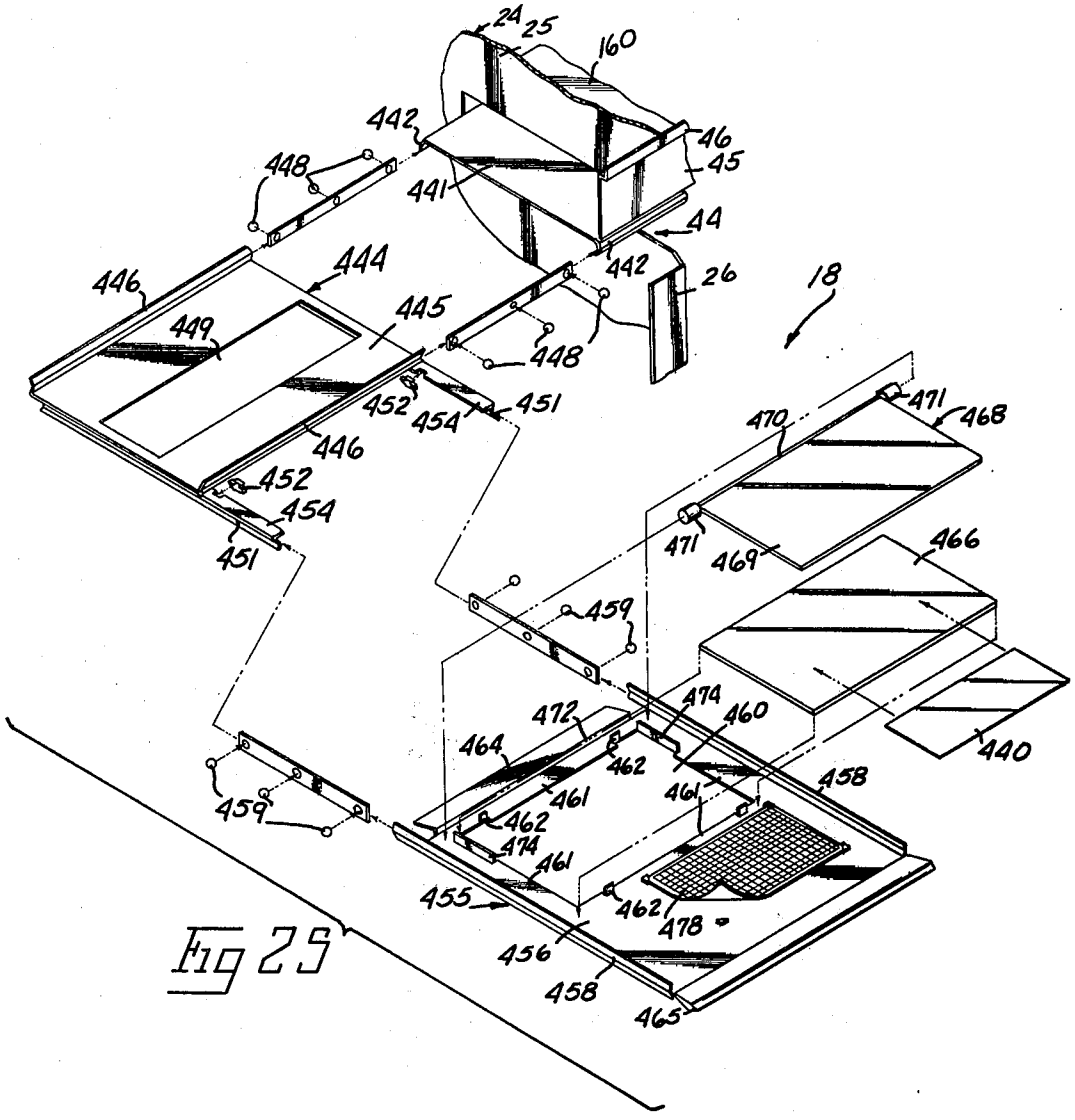

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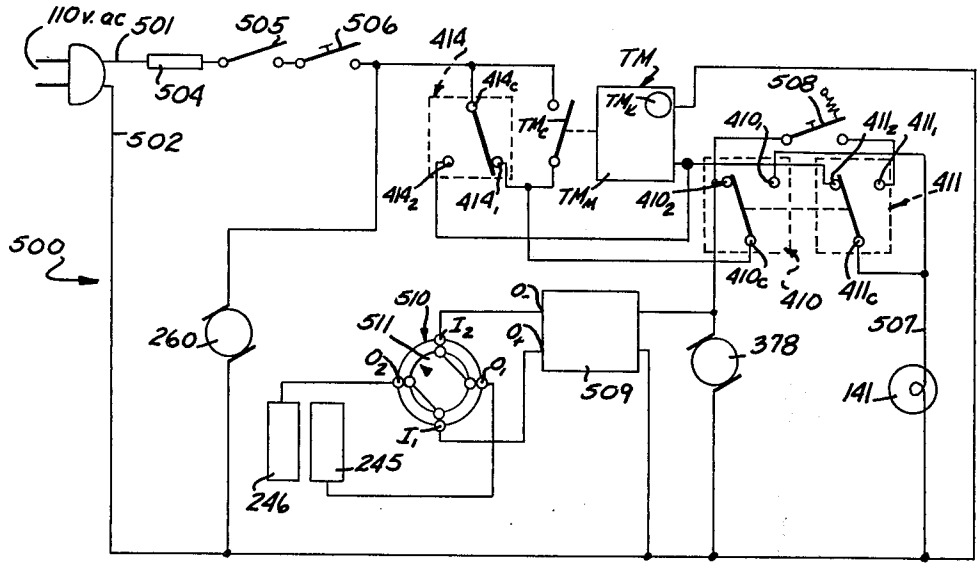


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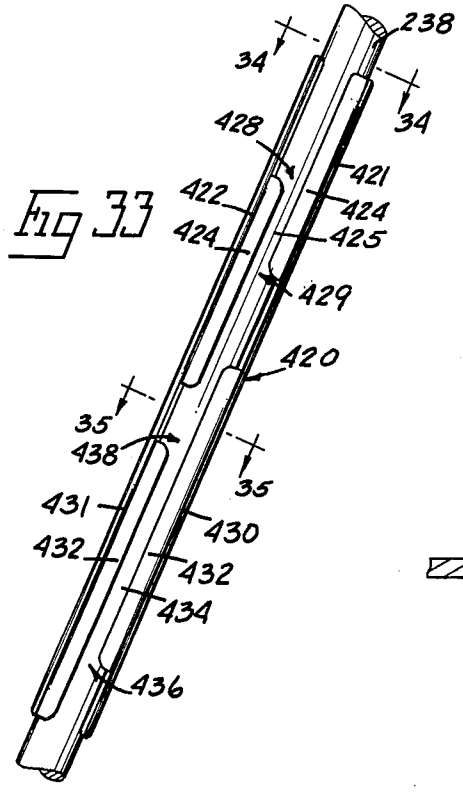


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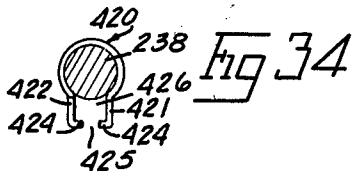


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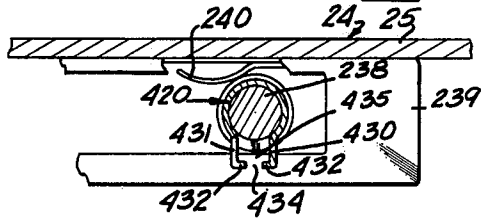
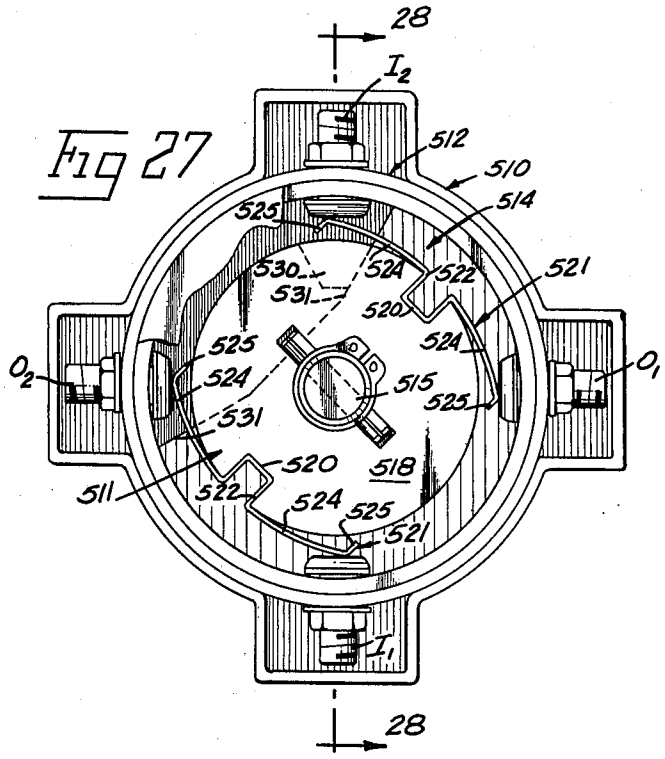


Fig 35

Fig 27


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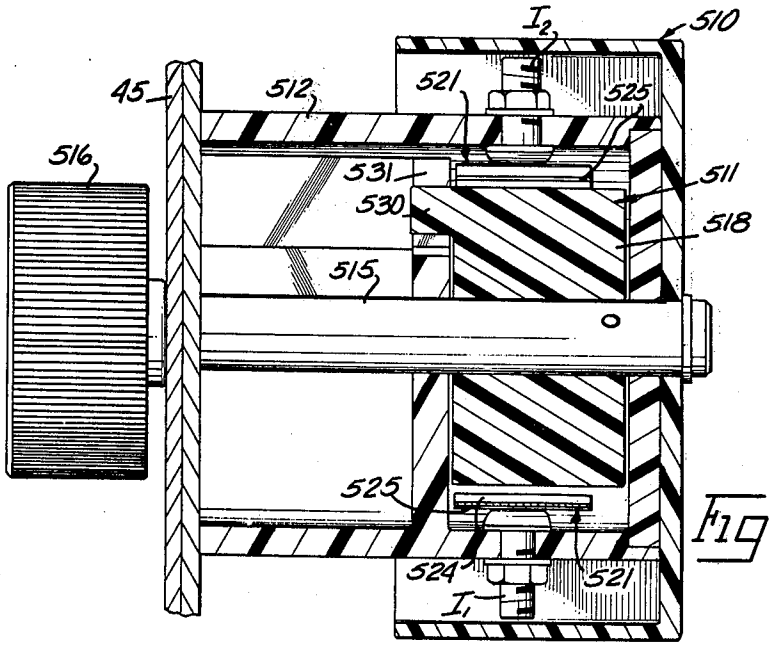

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Fig 28

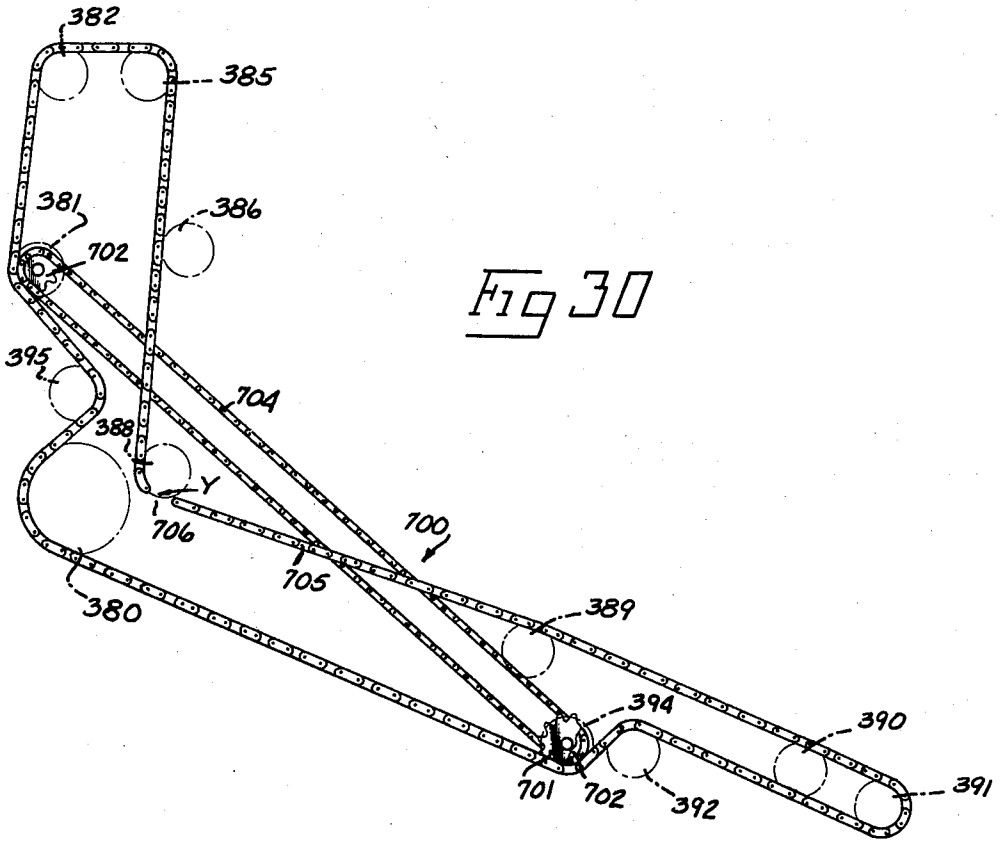

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Fig 30

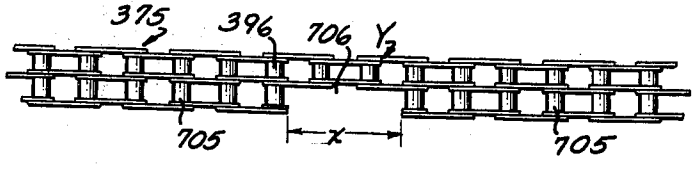

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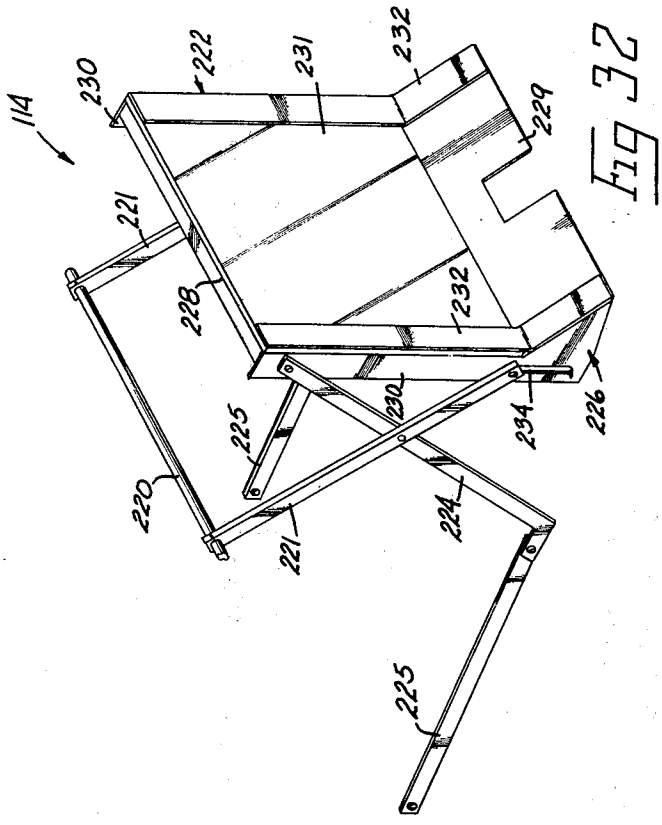

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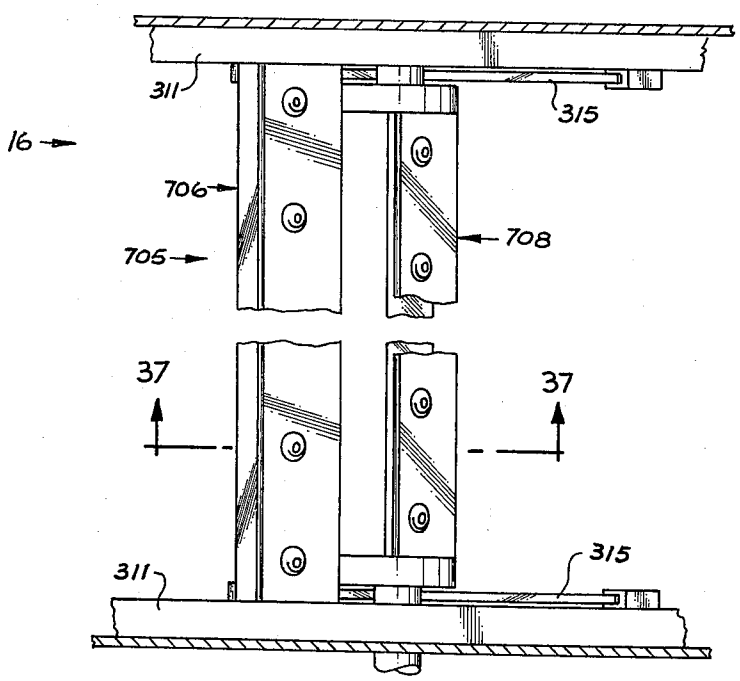


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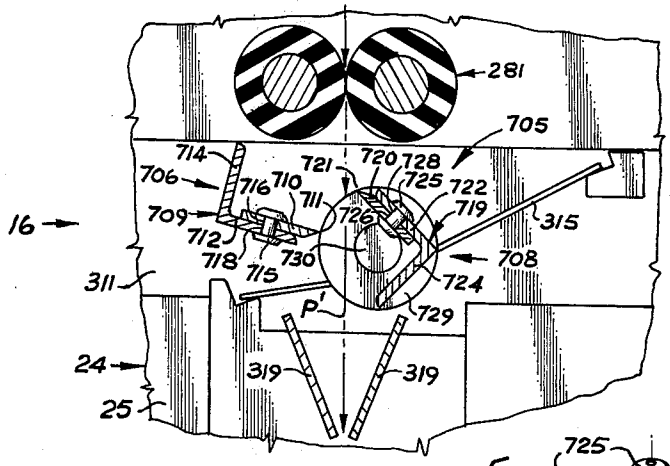


Fig 37

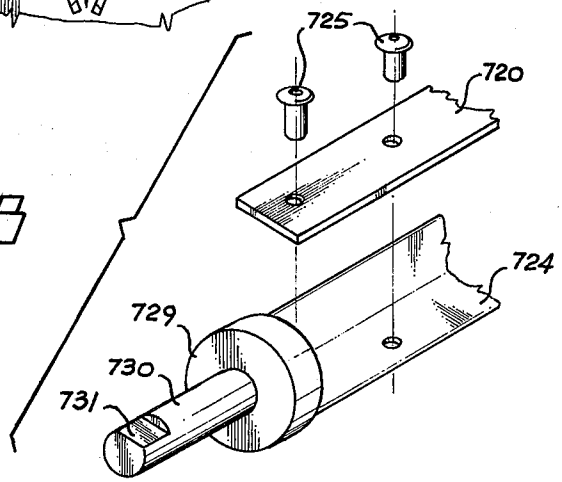


Fig 38

ELECTROSTATIC COPYING DEVICE WITH PAPER CUTTER MECHANISM

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of our copending application Ser. No. 304,519, filed Nov. 7,1972 for "Reader-Printer Apparatus" now abandoned which is a continuation-in-part of our still earlier filed application Ser. No. 146,114 for "Microfilm Viewer-Printer", now U.S. Pat. No. 3,730,622, but pending on Nov. 7,1972.

BACKGROUND OF THE INVENTION

Various machines are available on the market today for electrostatically copying the visual image on an original document medium onto copy paper. Usually, the various components of these machines are independently driven with the operation controlled by the use of switch elements operated by the leading edge of the copy paper. Because of the sensitivity required for paper actuated switches, these prior art machines have been difficult to properly adjust and to maintain. Moreover, because a relatively large number of components required for these prior art machines, the manufacture thereof has been expensive. Because of the synchronization required to successfully copy, these prior art machines have frequently become out of adjustment resulting in excessive loss of production and in the necessity of having technically trained personnel available to repair same. These prior art machines have used a solenoid operated paper cutter mechanism which has caused difficulty in maintaining adjustment, in keeping the operating noise to a satisfactory level, in keeping the cost of manufacture to an economical level, and in keeping replacement to a satisfactory level.

SUMMARY OF THE INVENTION

These and other problems and disadvantages associated with the prior art are overcome by the invention disclosed herein by providing a machine which has a minimum number of components, operates with a minimum required amount of adjustment, and is effecient in operation. Thus, not only is the manufacturing cost minimized, but also the operating and maintenance cost. The machine provides a single endless member which both drives the various components of the machine and carries the control elements for controlling the operation of the machine independently of the position of the copy paper.

Generally, the apparatus of the invention includes a supply of copy paper, an image forming means, a conveyor means for moving the copy paper through the image forming means, and a combination driving and control means for operating the image forming means and conveyor means. The image forming means includes charging means for imposing an electrostatic charge on the copy paper, projection means for projecting the image from the original document medium onto the copy paper to expose same at an exposure station, and developing means for applying toner particles to the exposed copy paper at a developing station to develop the latent electrostatic image on the copy paper into a visual image. In the microfilm reader-printer embodiment of the invention, a shutter-mirror assembly is provided for selectively projecting the visual image from the original document medium onto a viewing screen while at the same time preventing the image from being projected to the exposure station.

The conveyor means includes a paper feed means for feeding the copy paper from the supply of copy paper in single sheet fashion toward the image forming means, exposure conveyor means for receiving the copy paper from the paper feed means and positioning same at the exposure station, and discharge means for receiving the exposed and developed copy paper after passage through the developing station.

A paper cutter mechanism is provided for cutting the copy paper to length after a prescribed amount of the paper has been fed by the paper feed means. The mechanism has a cocked position in which it is spring urged toward a cutting position through which the cutter moves upon release from the cocked position to cut the paper.

The endless member is flexible and drivingly connects a main drive motor to the exposure conveyor means and discharge means to drive same when the main drive motor is operated. A secondary flexible engaging member of a prescribed length is carried by the endless member at a prescribed location thereon to selectively drivingly engage the paper feed means for a prescribed period of time during each print cycle to feed a prescribed length of paper toward the image forming means. The control means includes a plurality of control switches spaced along the prescribed path of the endless member and a plurality of switch actuating members carried by the endless member at prescribed locations thereon to operatively engage only a corresponding one of the control switches to operate same. An additional operating member is also carried by the endless member for moving the paper cutter mechanism to its cocked position, and a release operating member is carried by the endless member for releasing the cutter mechanism to cut the copy paper to length. In the microfilm reader-printer, the operating member used to cock the cutter mechanism is also used to transfer the shutter-mirror assembly from its viewing position to its printing position and then back to its viewing position during a printing cycle.

The supply of copy paper is in the form of a roll which is carried in a paper cassette. The roll of copy paper is carried on a support tube rotatably mounted in a housing. A braking means is carried by the housing for internally braking the support tube. The housing is designed for a single use which lends itself to assembly with the roll of copy paper therein but is destroyed upon disassembly to prevent reloading same.

These and other features and advantages of the invention will become more clearly understood upon consideration of the following detailed description and accompanying drawings wherein like characters of reference designate corresponding parts throughout the several views and in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front perspective view illustrating the invention embodied in a microfilm reader-printer for use with microfiche;

FIG. 2 is an exploded perspective view of the machine of FIG. 1 taken from the rear of the maching to show the cabinet construction;

FIG. 3 is a side elevational view of the drive side of the machine of FIG. 1 with the side panel removed to show the combination driving and control means;

FIG. 4 is a longitudinal cross-sectional view of the machine of FIG. 1 showing the internal construction thereof;

FIG. 5 is a partial exploded perspective view of the duct side of the machine with the side panel ommitted for clarity;

FIG. 6 is a longitudinal cross-sectional view of the paper cassette of the invention;

FIG. 7 is a partial longitudinal cross-sectional view of the main cylinder of the paper cassette;

FIG. 8 is an enlarged partial cross-sectional view showing the end cap and main cylinder of the paper cassette ready for assembly;

FIG. 9 is a view similar to FIG. 8 showing the end cap and main cylinder during assembly;

FIG 10 is a view similar to FIG. 8 showing the end cap and main cylinder assembled;

FIG. 11 is an enlarged cross-sectional view of the end cap taken along line 11–11 in FIG. 6 showing the brake;

FIG. 12 is an enlarged portion of the cross-sectional view of FIG. 4 showing the construction of the light source assembly and the projection unit;

FIG. 13 is an exploded perspective view of the light source assembly;

FIG. 14 is an exploded perspective view of the projection unit;

FIG. 15 is an enlarged cross-sectional view of the lens unit taken along line 15–15 in FIG. 14;

FIG. 16 is an enlarged elevational view of the fan unit showing the inlet and outlet thereof;

FIG. 17 is an enlarged elevational view of the cutter drive means in the released position;

FIG. 18 is an enlarged elevational view of the cutter drive means in the cocked position;

FIG. 19 is a top view of the cutter drive means in the cocked position;

FIG. 20 is a cross-sectional view through knife assembly of the cutter means taken longitudinally of the machine;

FIG. 21 is an elevational view showing the secondary chain of the drive and control means;

FIG. 22 is a view taken along line 22–22 in FIG. 3 with the various cam and switch members supperimposed thereon;

FIG. 23 is an enlarged elevational view of a portion of the main drive chain;

FIG. 24 is an enlarged view taken along line 24–24 in FIG. 21;

FIG. 25 is an exploded perspective view of the fiche carrier assembly;

FIG. 26 is an electrical schematic diagram for the machine;

FIG. 27 is an elevational view of the polarity switch with portions thereof removed to show the interior construction thereof;

FIG. 28 is a cross-sectional view taken along line 28–28 in FIG. 27;

FIG. 29 is an exploded perspective view of the machine showing its use with roll microfilm;

FIG. 30 is a schematic view of the main drive chain showing a time delay mechanism;

FIG. 31 is a view taken along line 31–31 in FIG. 30;

FIG. 32 is a perspective view of the shutter-mirror assembly;

FIG. 33 is an enlarged view of the drive arm of the shutter-mirror assembly;

FIG. 34 is a cross-sectional view taken along line 34–34 in FIG. 33;

FIG. 35 is a cross-sectional view taken along line 35–35 in FIG. 33;

FIG. 36 is a top plan view of an alternate paper knife assembly;

FIG. 37 is a cross-sectional view taken along line 37–37 in FIG. 36; and

FIG. 38 is an exploded partial perspective view of one of the knife assemblys of FIGS. 36 and 37 showing the manufacture thereof.

These figures and the following detailed description disclose specific embodiments of the invention, however, the inventive concept is not limited thereto since it may be embodied in other forms.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Reffering to the figures, expecially FIG. 1, it will be seen that the invention is disclosed herein as a microfilm reader-printer, however, it is to be understood that the inventive concept may be embodied in other machines such as a copying machine. The machine 10 disclosed in FIG. 1 is designed for use in copying the visual image from a microfiche. As best seen in FIGS. 2, 3 and 4, the machine 10 includes generally a cabinet 11, a supply of copy paper 12, an image forming means 14, a conveyor means 15, a cutter means 16, a carrier assembly 18 and a drive and control means 19. Generally, the machine is operated by placing a piece of microfiche in the carriage assembly 18, the controls of the image forming means operated to project the visual image from the microfiche to a viewing position for viewing a selected portion of the microfiche and then to an exposure position to print the selected portion of the microfiche shown in the viewing position onto a piece of copy paper from the supply of copy paper 12.

CABINET

The cabinet 11 includes generally a frame 20 with a cover assembly 21 enclosing same as best seen in FIG. 1 and 2. The frame 20 includes a rectangular base 22 and a pair of upstanding, spaced apart side frame 24 attached to and extending upwardly from opposite sides of base 22 and connected by cross braces 23. Each of the side frames 24 includes central upstanding rectangular support plate 25 having outwardly directed front and rear flanges 26 and a top flange 28, all of which are flush with a vertical plane at the side edges of the base 22 at their outer ends. An outwardly extending mounting flange 29 is provided along the lower edge of plate 25 to be used in attaching the side frame to the base. Thus, an outwardly opening recess 30 is provided by each side frame 24 with a space 31 between the side frame 24. The near side of the machine as seen in FIG. 1 is the duct side and the far side is the drive side.

The cover 21 includes aa bottom channel 32 on opposite sides of base 22 with top channels 34 along the outer edges of each top flange 28 above channels 32. A side panel 35 is slidably carried between each of the opposed botom and top channels 32 and 34 which has a forwardly projecting front edge 36 toward its upper end to close the recesses 30 in the sides of the machine. A top panel 38 is carried between the top channels 34 to close the upper forward portion of space 31. A back panel 39 is mounted on the rear flanges 26 to close the lower back portion of the space 31. A cassette cover 40 which has an inverted L-shape is carried between the

top channels 34 to close both the upper rear portion of space 31 and upper back portion of space 31 as will become more apparent. A paper exit cover 41 as best seen in FIG. 1 is carried by the bottom channels 32 to cover the lower front portion of space 31 and is provided with a paper exit opening 42 as will become apparent. The side frames 24 are provided with aligned, forwardly opening cutouts 44 best seen in FIG. 3 as will become more apparent.

A control panel 45 is carried between the front flanges 26 of side frames 24 to close part of the front portion of space 31 immediately above cutouts 44 as best seen in FIGS. 1, 4. The upper edge of panel 45 is provided with an upwardly opening support channel 46, which, in combination with a downwardly opening channel 48 carried by the upper ends of front flanges 26, removably mount a substantially square viewing screen 49. The viewing screen 49 is of known construction as will become more apparent.

SUPPLY OF COPY PAPER

The supply of copy paper 12, as seen generally in FIGS. 2 and 4 and more specifically in FIGS. 6–11, includes generally a roll 50 of copy paper mounted in a cassette 51. The cassette 51 includes a housing 52, a support tube 54 rotatably mounted in the housing 52 and on which is carried the roll 50 of copy paper, and a brake 55 carried by housing 52 and operatively engaging the support tube 54 to retard its movement.

The housing 52 is made in two pieces, a main cylinder 56 and an end cap 58. The housing 52 is assembled with the roll 50 and support tube 54 therein and is designed so that the housing 52 will be destroyed if disassembly is attempted to reload same. This makes the cassette 51 a single use item. The main cylinder 56 includes a tubular side wall 59 integral with a circular end wall 60 closing one end thereof. A paper exit slot 61 as seen in FIGS. 2 and 7 is defined along the length of the wall 59 parallel to its centerline CL as will become more apparent. A centrally located annular bearing flange 62 is carried on the inside of end wall 60 and projects into the paper cavity defined by walls 59 and 60 with a beveled inner end (FIG. 6) as will become more apparent. One end of the support tube 54 is received over bearing flange 62 to be rotatably carried thereon. Support lugs 64 are provided on diametrically opposed sides of the outside of end wall 60 for mounting the cassette 51 as will become more apparent.

The opposite end of side wall 59 is beveled along its outside edge as indicated at 65 in FIGS. 7–10 for a prescribed distance and down the length of wall 59. A notch 66 is also provided in the end of side wall 59 as best seen in FIG. 7 to locate the end cap 58 as will be explained. A plurality of locks 68 project out from the beveled surface 65 on side wall 59, one of which is shown in detail in FIGS. 8–10. While three such locks 68 are provided for the embodiment illustrated, the number may be varied without departing from the scope of the invention. Each lock 68 is formed integral with the side wall 59 and defines an outwardly tapering surface 69 and a radially extending locking surface 70. the surface 69 defines an angle α (FIG. 8) with the centerline CL of main cyllinder 56 and tapers inwardly toward the free end of side wall 59. The locking surface 70 is spaced from the end of wall 59 the distance a and is perpendicular to centerline CL. The inside of the free end of wall 59 directly under each of the locks 68 is under cut as indicated at 71 to provide a thinned portion 72 under each lock 68 of a prescribed thickness b at the point directly under the locking surface 70. This allows the locks 68 to deflect inwardly while the housing 52 is being assembled but fractures if disassembly is attempted as will become more apparent.

The end cap 58 closes the open end of the main cylinder 56. It includes a circular central plate 74 of approximately the same diameter as the end wall 60. An annular abuttment 75 is provided around the circumference of plate 74 and projects over the outside surface 76 of the plate 74. The abuttment 75 defines an annular groove 78 therein which opens on the inside surface 79 of plate 74. the groove 78 has a mean diameter equal to that of the side wall 59 of main cylinder 56 and has a width substantially equal to the thickness of side wall 59 so that the beveled end 65 of side wall 59 can be slidably received in groove 78 as will become more apparent. An annular support lip 80 integral with abuttment 74 projects over the inside surface 79 of plate 74 with its inside surface forming a continuation of the outside edge of groove 78.

A plurality of retainers 81 (FIGS. 8–11) are provided on the inside surface of lip 80 which correspond in number and location to locks 68 on the main cylinder 56 and co-operate therewith to hold the cap 58 onto cylinder 56. Each retainer 81 includes an inwardly beveled leading surface 82 and a radially extending trailing surface 84 perpendicular to the centerline CL of cap 58 and cylinder 56. The surface 84 is spaced from the bottom of the groove 78 the distance a (FIG. 8) so that when the end of side wall 59 is fully seated in the groove 78, the surface 84 of retainer 81 engages the locking surface 70 of lock 68 to hold the cylinder 56 and cap 58 together as seen in FIG. 10. It will also be noted that the locks 68 and retainers 81 are located so that the projecting end 85 of side wall 59 has just entered the groove 78 when the tapering surface 69 of lock 68 first engages the beveled leading surface 82 of retainer 81 as best seen in FIG. 9. A reinforcing boss 86 is provided at each retainer 81 to strengthen the lip 80 thereat. A slot 88 is formed through boss 86, abuttment 75, and partly through lip 80 as an incident to the molding operation when retainers 81 are formed. A locator 89 is formed across groove 78 which cooperates with the notch 66 to locate the retainers 81 in alignment with locks 68.

As the main cylinder 56 and end cap 58 are forced together, the tapering surface 69 of locks 68 and beveled surface 82 of retainers 81 create radially inwardly directed forces on the thinned portion 72 of side wall 59 causing the locks 68 to be deflected inwardly and allow the projecting end 85 of side wall 59 to fully seat in groove 78 whereupon the resilience of side wall 59 causes the locks 68 to spring back into their initial position. At this point the locking surface 70 of lock 68 is engaged by the trailing surface 84 of retainer 81 to hold the end cap 58 in position. If disassembly is attempted, the surfaces 70 and 84 exert substantially longitudinally directed forces on side wall 59 causing the thinned portions 72 to break away with locks 68. This prevents reuse of main cylinder 56.

A centrally located bearing flange 90 is provided on the inside surface of plate 74 of cap 58 which has a cylindrical portion 91 corresponding in diameter to that of bearing flange 62 to rotatably mount the support tube 54 within housing 52 in conjunction with flange 62. The flange 90 also includes an inwardly tapering brake mounting wall 92 on the leading end of cylindri-

cal portion **91**. The wall **92** mounts the brake **55** therein through three cutouts **94** equally spaced about the wall **92** at its juncture with the cylindrical portion **91**.

The brake **55** is a resilient member **95** formed from wire stock which has a convex arcuate central bearing portion **96** and a pair of convex arcuate side bearing portions **98** with each of the side bearing portions **98** being connected to the central bearing portion **96** through a concave arcuate camming portion **99** as best seen in FIG. **11**. Camming prongs **100** are provided on those ends of the side bearing portions **98** opposite those ends connected to the central bearing portion **96** which face each other but are not connected. The side portions **98** can be forced toward each other through the spring action of the central portion **96** which urges the side portions **98** apart toward their normal positions as shown by dashed lines in FIG. **11**. Thus, to insert the member **95** through the cutouts **94**, the side portions **98** are forced toward each other, the central portion **96** inserted through one of the cutouts, and then the side portions **98** released so that they project through the other cutouts when the member **95** springs back. When the tube **54** is on the cylindrical portion **91** of flange **62**, the outer tips of the portions **96** and **98** engage the inside thereof under the spring action of member **95**. The sides **101** of the cutouts **94** prevents the member **95** from rotating as the tube **54** is rotated. This exerts a retarding force of tube **54** as it is rotated.

The tube **54** is illustrated as made of fiberboard, however, other materials may be used. The tube **54** is as long as the cavity in the housing **52** and is rotatably supported between the cylindrical portion of flange **90** and flange **62** concentrically within the side wall **59**. the roll **50** is made up of layers of a single web **102** of copy paper wound around the tube **54** so that as the web **102** is unwound therefrom, the tube **54** is rotated therewith with a constant braking force exerted thereon by member **95**.

The cap **58** also includes a pair of mounting lugs **104** similar to lugs **64** on end wall **60** which are aligned with lugs **64**. Mounting brackets **105** are provided on the inside of each support plate **25** of side frames **24**. Brackets **105** as best seen in FIGS. **5** and **6** are provided with upwardly oriented channels **106** which are horizontally aligned across space **31** at the upper rear portion thereof. The lugs **64** and **104** are slidably received in channels **106** with the downward movement being arrested by abuttments **108**. This locates the paper exit slot **61** in an upward rearwardly extending position as seen in FIG. **2**.

While various materials may be used for making the main cylinder **56** and end cap **58** one satisfactory material is a medium impact polystyrene. This material is injection molded and has sufficient strength and elasticity to be assembled without being damaged, but insufficient strength and elasticity to be disassembled without fracture at the thinned portions **72** of side wall **59**.

IMAGE FORMING MEANS

The image forming means **14** is mounted between the side frames **24** in space **31** as best seen in FIG. **4** and includes a light source assembly **110**, a projection unit **111**, a fixed mirror assembly **112**, a movable mirror-shutter assembly **114**, a charging unit **115** with a charging station **116**, an exposure station **118**, a developing unit **119** with a developing station **120**, and a fan-pump assembly **121**.

The light source assembly **110** is mounted in space **31** below the cutouts **44** in side frames **24** and is best seen in FIGS. **12** and **13**. The assembly **110** includes an open top carriage box **125** having side walls **126**, end walls **128** and a bottom wall **129**. Mounting tabs **130** are provided on side walls **126** which project out over end walls **128** to engage notches **131** in the lower edge of each of the cutouts **44** to suspend the box **125** therebetween as seen in FIG. **4**. An air inlet opening **132** is provided through one end wall **128** with an air directing vane **134** along one edge of opening **132** and projecting into the interior of box **125** as seen in FIG. **13**. An exhaust opening **135** is defined through the front side wall **126** across the lower portion thereof and a downwardly inclined vane **136** is provided along the upper edge thereof and projects forwardly of box **125** to deflect the air flow exhausting from the box **125** downwardly as will be explained.

A light source undercarriage **140** is mounted on the bottom wall **128** of box **125** in the interior thereof. A lamp **141** is mounted between a pair of upstanding flanges **142** of undercarriage **140** in alignment with the air flow through inlet opening **132** as will be explained. A pair of condenser lens **144** are carried between upstanding resilient plates **145** of undercarriage **140** and, in conjunction with a reflector **146** also held between plates **145**, direct the light from lamp **141** from a horizontal direction into a vertical direction. The lens **144** and reflector **146** are removably held between plates **145** by a spring **148** connecting the plates as best seen in FIG. **13**.

The open top **149** of the box **125** is closed by a cover **150** as seen in FIGS. **12** and **13** which is held in place by catches **151** engaging flanges **152** along the upper edges of the side walls **126**. A light exit opening **154** is provided through cover **150** to allow the light to pass from the assembly **110** after it passes through the condenser lens **144**. The light thus exits the opening **154** along the upwardly directed leg P_1 of the light path P in the machine as best seen in FIG. **4**.

The projection unit **111** as best seen in FIGS. **4**, **14**, **15** includes a support platform **160** connected to the back of control panel **45** and flush with the upper edge of cutouts **44**. A centrally located aperture **161** is provided through platform **160** and is located in vertical alignment with the opening **154** in the cover **150** of light source assembly **110** so that the light through opening **154** passes through the center of aperture **161**. a focusing lens assembly **162** is provided at aperture **161** to focus the image transmitted in the light from assembly **110** as will be explained. The lens assembly **162** includes a lens holder **164** adjustably mounted on platform **160** about aperture **161**, a lens adjustment tube **165** slidably mounted in the holder **164**, and a lens unit **166** slidably and rotatably mounted in the tube **165**.

The lens tube holder **164** includes a central cylinder **168** defining a central passage **167** therethrough with a mounting flange **169** intermediate the ends of cylinder **168**. The centerline CL_1 of cylinder **168** is centered with respect to the aperture **161**. The flange **169** has three equally spaced holes **170** therethrough which slidably receive a like number of threaded studs **171** therethrough. The studs **171** are carried by platform **160** about aperture **161** so as to locate the centerline CL_1 of cylinder **168** in alignment with the centerline of aperture **161**. A compression coil spring **172** is received around each stud **171** between platform **160** and flange **169** and nuts **174** are threadedly received on

studs **171** above flange **169.** Thus, by tightening or loosening nuts **174,** the angular position of centerline CL_1 can be varied with respect to the centerline of aperture **161** as will become more apparent. An upwardly opening slot **175** is provided in the upper portion of cylinder **168** that faces the front of the machine as will become apparent.

The lens adjustment tube **165** is slidably received in the central passage **167** of the cylinder **168** from the lower end thereof. The tube **165** includes a main cylindrical body **176** with a central passage **178.** An abuttment flange **179** extends outwardly from the bottom end of tube **165.** The body **176** is slidably received in passage **167** in cylinder **168** and a compression coil spring **180** is received around body **176** between the lower end of cylinder **168** and flange **179** on tube **165** downwardly as will become more apparent. A longitudinally extending slot **181** is provided along the outside of body **176** which co-operates with a locator **182** inside cylinder **168** of holder **164** to fix the rotational position of tube **165** with respect to holder **164** while allowing tube **165** to slide in holder **164.** The lower face **184** of tube **165** rests on the carrier assembly **18** as will be explained. A hole **185** provided through the body **176** that lies in alignment with the slot **175** when the tube **165** is in position as will be explained.

The lens unit **166** is slidably and rotatably received in the upper end of adjustment tube **165.** Unit **166** includes an elongate hollow cylinder **186** having an outside diameter just sufficient to be slidably and rotatably received in passage **178** through tube **165.** A convex focusing lens **188** is mounted in the lower portion of cylinder **186** to focus the image transmitted by the light source assembly **110** as will become more apparent. A dove prism **189** is mounted in cylinder **186** above lens **188** with its longitudinal centerline aligned with the centerline of lens **188.** The light entry face **190** of prism **189** is located from the lens **188** a mean distance c as best seen in FIG. **15.** The distance c is such that the image from lens **188** just fits within the confines of the face **190.** Because it was found that the image does ot expand while it passes through prism **189,** it is only necessary that the entry face **190** and exit face **191** be as large as the image received rather that several times larger as was previously thought.

A circumferentially extending groove **192** is provided around the outside of cylinder **186** which lies behind the hole **185** in tube **165** and slot **175** in holder **164** when the unit **166** is in position as will become more apparent. A toothed gear **194** is also provided around cylinder **186** for use in rotating the image as is known in the art by rotating the cylinder **186** along with prism **189.**

A focusing drive mechanism **195** is provided to allow adjustment of the lens unit **166** from the control panel **45.** The mechanism **195** includes a drive shaft **196** with its driving end rotatably carried in the hole **185** in adjustment tube **165** and its driven end rotatably carried through an appropriate aperture in the control panel **45.** The driving end **198** of shaft **196** rests against the outside of cylinder **186** and a drive pin **199** carried by shaft **196** at the outside edge of end **198** is slidably recieved in groove **192** so that the unit **166** will be raised and lowered as the shaft **196** is rotated to focus the image. A focusing knob **200** is affixed to the driven end of shaft **196** protruding through the control panel **45** for the operator to selectively rotate shaft **196.** Springs **201** maintain shaft **196** in position. A driving gear **202** rotatably mounted on the back of panel **45,** meshes with the gear **194** and protrudes through panel **45** so that the unit **166** can be rotated by the operator from the front of control panel **45.**

The fixed mirror assembly **112** is mounted in the upper forward portion of space **31** on cross brace **23** as seen in FIGS. **2** and **4.** The assembly **112** intersects the path P at the upper end of leg P_1 thereof and reflects the image from the projection unit **111** downwardly and rearwardly along the leg P_2 of path P. Assembly **112** includes a mirror **205** mounted on backing **206.** The backing **206** has three studs **208** thereon which extend from the back thereof in spaced apart positions through holes in cross brace **23.** A coil spring **210** is placed around each stud **208** between cross brace **23** and backing **206** and nuts **211** engage the ends of studs **206** protruding through cross brace **23** to locate the reflecting plane of the mirror **205.** Thus, the mirror can be adjusted through nuts **211** to reflect the image along the legs P_1 of path P at a desired angle.

The movable mirror-shutter assembly **114** is pivotally mounted centrally within space **31** between side frames **24** as seen in FIGS. **4** and **33.** Assembly **114** serves to selectively reflect the image as it is directed along the leg P_2 of path P along the viewing leg P_3 of path P and onto the viewing screen **49** for viewing or to allow th image to continue along leg P_2 to the exposure station **118** as seen in the dashed line in FIG. **4** as will become apparent.

The assembly **114** includes a pivot shaft **220** pivotally mounted between the support plates **25** of side frames **24.** a pair of spaced apart driving links **221** are attached to opposite ends of shaft **220** between side frame **24** and extend forwardly and downwardly therefrom for rotation with shaft **220.** A reflector assembly **222** is mounted between the projecting ends of links **221** at the lower portion thereof. A positioning link **224** is pivoted intermediate its ends to each link **221** intermediate its ends. One of the ends of each of links **224** is pivoted to the upper end of reflector assembly **222** and the other of the ends of each link **224** pivoted to one end of a secondary arm **225.** The arms **225** are directed generally rearwardly and are pivoted to the side frames **24** on opposite sides of space **31.**

The reflector assembly **222** includes a support **226** with a forwardly facing bed **228,** a downwardly and forwardly facing shutter flange **229** along the bottom edge of bed **228,** and a pair of rearwardly facing side angles **230** along opposite side edges of bed **228.** A reflector **231** of known construction is mounted on the forward surface of bed **228** to reflect the image along the leg P_3 of path P onto the back of the viewing screen **49** when assembly **114** is in viewing position as shown by solid lines in FIG. **4.** Also, sealing strips **232** may be provided along the forward edges of the assembly **222** to block the light through screen **49** when the assembly **114** is in its print position as shown by dashed lines in FIG. **4.** The links **224** are pivoted to angles **230** at their upper end while the driving links are slidably and pivotally connected to the lower ends of angles **230** through slip joints **234.**

Viewing abuttments **235** are provided on the support plates **25** of the frames **24** that engage the underside of the ends of positioning links **224** adjacent their connection with arms **225** to locate the assembly **114** in the viewing position. Print abuttments **236** are provided on plates **25** of the side frames **24** to engage the top of the projecting ends of driving links **221** and locate the as-

sembly **114** in its printing position.

A driving arm **238** is provided on one end of pivot shaft **220** protruding through the plate **25** and extends generally downward therefrom within the drive recess **30** in side frame **24** as best seen in FIG. **3.** The arms **238** is shown in its viewing position in FIG. **3** in solid lines and in its printing position in phantom lines. Thus, as the lower end of arm **238** is pivoted forwardly in a counterclockwise direction in FIG. **3,** the reflector assembly **222** will be moved forwardly and upwardly while its top is pivoted forwardly to its printing position and, as the arm **238** is pivoted rearwardly or clockwise in FIG. **3,** the assembly **222** will be moved rearwardly and downwardly while its top is pivoted rearwardly to its viewing position. It will also be noted that since the center of gravity of assembly **222** is always forward of the pivot axis of shaft **220,** the weight of the assembly **222** urges the assembly **114** toward its viewing position.

The lower end of arm **238** is received in a guide **239** mounted on the outside of plate **25** within recess **30** as seen in FIGS. **3** and **35.** A resilient detent **240** is provided at the forward end of guide **239** to maintain the arm **238** and assembly **222** in their viewing position as will become more apparent.

The charging means **115** is positioned at the rear of the space **31** across the path P' of travel of the web **102** of copy paper as it moves from cassette **51** to the exposure station **118** as seen in FIGS. **3** and **4.** The unit **115** includes a pair of corona units **245** and **246** mounted between plates **25** of side frames **24** with an opening **248** therebetween through which the web **102** of copy paper passes to be electrostatically charged. The units **245** and **246** are wire type coronas of known construction as will become apparent.

The developing unit **119** is positioned in the lower forward portion of space **31** and is slidably supported by the base **22** of cabinet **11** as seen in FIG. **4.** The unit **119** applies toner particles to the copy paper after the electrostatic latent image has been formed to develop the image into a visual image. Unit **119** includes a liquid toner reservoir **250,** a paper submerging tray **251** which is filled with toner from reservoir **250** and through which the exposed copy paper passes to be submerged in the liquid toner for development, and an intensifier plate **252** which guides the paper through the toner and enhances the quality of the reproduced image as is known in the art.

The fan-pump assembly **121** is mounted on the developing unit **119** and drives the developing unit as well as creates a partial vacuum at the exposure station **118** while supplying cooling air to the light source assembly **110** and heated air to the developed copy paper. The assembly **121** includes a secondary drive motor **260** mounted on top of reservoir **250** with a drive shaft **261** extending both into the reservoir **250** and above motor **260.** A toner pump **262** of known construction is suspended in reservoir **250** and drivingly connected to that end of shaft **261** extending into the reservoir to pump the toner from reservoir **250** into tray **251.** Overflow holes **254** are provided in tray **251** to allow the excess toner to flow back into the reservoir **250.**

A fan unit **264** is mounted on reservoir **250** over motor **260** and operatively connected to the upper end of shaft **261.** The unit **264** of the centrifugal fan type with a housing **265** having an inlet **266** and an outlet **268** as seen in FIG. **16.** Both the inlet **266** and outlet **268** face the central plate **25** of the duct side frame **24** and are in a sealing relationship therewith when unit **119** is in position as seen in FIG. **4.**

An inlet port **270** (FIG. **5**) is provided through plate **25** in alignment with the inlet **266** of fan unit **264** and an outlet port **271** (FIG. **5**) is provided through plate **25** in alignemnt with outlet **268** of fan unit **264.**

An intake duct **272** (FIG. **5**) on the outside of plate **25** within duct recess **30** connects inlet port **270** to a vacuum port **274** through plate **25** at the exposure station **118** as will be explained. An exhaust duct **275** (FIG. **5**) on the outside of plate **25** in recess **30** connects the outlet port **271** to a cooling port **276** through plate **25** at the forward portion thereof. Cooling port **276** is aligned with the opening **132** in the end wall of light source assembly **110** (FIG. **13**) so that the cool air exhausted from the fan unit **264** passes over the lamp **141,** lens **144,** and reflector **146** to cool same while the air is heated. The heated air then passes through exhaust opening **135** and is deflected downwardly by vane **136** across the exit path P' of the developed copy paper as will become apparent to dry same.

CONVEYOR MEANS

The conveyor means **15** includes a guide roll **280,** a paper feed roll assembly **281,** a vacuum exposure assembly **282,** and a squeegee discharge roll assembly **284** that move the web **102** of copy paper from the cassette **51** along the path P' down through the charging station **116,** exposure station **118,** developing station **120** and out of the paper exit slot **42** in the front of the machine **10** as best seen in FIG. **4.**

The guide roll **280** is freely rotatably mounted between the upper rear corners of plates **25** of side frames **24** behind the paper cassette **51.** The web **102** of copy paper passes over the roll **280** and then downwardly to be drivingly engaged by the paper feed roll assembly **281.** The assembly **281** is located above the charging unit **115** at the rear end of the machine and includes a pair of rolls **285** of known construction spring biased together and rotatably mounted between the plates **25** of side frames **24.** The rolls **285** are driven as will be explained so as to drive the web **102** downwardly through the cutter means **16** as will be explained while unrolling the web **102** from roll **50** against the braking action of brake **55.** After the web **102** passes through cutter means **16,** it passes through the opening **248** between corona units **245** and **246** and then onto the exposure assembly **284.**

Assembly **284** includes a support pan **286** mounted between plates **25** of side frames **24** and extends from a position just below the charging unit **115** forwardly and downwardly to a position just rearwardly of the paper submerging tray **251.** Driving rolls **288** are positioned across the upper and lower ends of pan **286** to mount a vacuum exposure belt **289** therearound with an upper flight **290** passing over and supported by pan **286** and a lower flight **291** passing under pan **286.** As the rolls **288** are synchronously rotated, the upper flight **290** of belt **289** will be moved downwardly across pan **286.**

The pan **286** is hollow with a vacuum chamber **292** therein which communicates with the vacuum port **274** through plate **25** of side frame **24** so that a partial vacuum will be drawn in pan **286** when the fan unit **264** is operating. The top wall **294** of pan **286** is slotted at **295** to allow air to be drawn therethrough as is known in the art and apertures **296** are provided through belt **289** in known manner. This causes the partial vacuum to hold

the copy paper deposited on belt **289** thereon as the upper flight **290** of belt **289** moves the paper through the exposure station **118** so that it is oriented perpendicular to the image path P.

A backup roll **298** is rotatably mounted between side frames **24** in driving contact across the upper end of upper flight **290** of belt **289** so as to insure positive placement of the copy paper on the belt **289.** A separator roll **299** is rotatably mounted between side frames **24** in driving contact with the lower end of upper flight **290** of belt **289** to insure separation of the exposed copy paper from belt **289** and to drive the paper through the submerging tray **251** into contact with squeegee discharge roll assembly **284.**

The assembly **284** includes a pair of squeegee rolls **300** of known construction which squeeze the excess toner from the developed copy paper and discharge the paper through slot **42** as the rolls are driven as will be explained.

CUTTER MEANS

As noted above, the cutter means **16** is positioned across the path P' of paper travel between the feed roll assembly **281** and charging unit **115** to cut the web **102** when a prescribed length of the web has been fed by the rolls **285** as best illustrated in FIGS. **3, 4,** and **17-20.** The cutter means includes a knife assembly **305** having a stationary blade **306** and a rotary blade **308.** Blade **306** has a rectangular cross section with a forward face **309** and a cutting edge **310** at the lower forward corner thereof. The blade **306** is angled upwardly at its forward end as seen in FIG. **20** generally horizontally extending between mounting brackets **311** attached to the plates **25** of side frames **24.** The rotary blade **308** is rotatably mounted in brackets **311** in an operative relationship with stationary blade **306.** The blade **308** is a cylinder with a portion thereof removed to form a cutting edge **312** as is known in the art with circular abuttments at opposite ends thereof. The blade **308** is rotatably journalled in slots **314** through brackets **311** and a leaf spring **315** is positioned under the stub shafts **316** of knife **308** and held by detents **318** on brackets **311** to constantly urge the abuttments on blade **308** against the edge **310** on blade **306.** Thus, it will be seen that when the cutting edge **312** of rotary blade **308** is rotated past the cutting edge **310** of stationary blade **306,** the web **102** of paper passing between blades **306** and **308** will be cut as is known in the art. Guides **319** are carried between brackets **311** below blades **306** and **308** to guide the paper into the opening **248** between corona units **245** and **246.**

A driving arm **350** is affixed to the end of the stub shaft **316** extending through an opening in that plate **25** of drive side frame **24** as seen in FIGS. **17** and **18.** The arm **350** is located adjacent the outside of plate **25** and within recess **30.** The arm **350** is used to rotate the rotary blade **308** to cut the web **102** of copy paper. The arm **350** is urged in a counterclockwise direction as seen in FIGS. **2** and **17** by a torsion spring **351** positioned around stub shaft **316** with one end held by the plate **25** of side frame **24** and the other end connected to arm **350** through a slot **352.** The projecting end **354** of arm **350** is provided with a camming surface **355** on the outside thereof that is used to rotate the arm **350** clockwise as will be explained. The inside of the end **354** of arm **350** defines a check notch **356** that opens upwardly for use in holding the arm **350** in a cocked position as shown in FIG. **18** and described below. The lower portion of end **354** is beveled to provide a driving surface **358** as will become apparent. The counterclockwise movement of arm **350** is limited by a bumper **359** as seen in FIG. **17** as will become more apparent.

A latch **360** is pivoted on plate **25** of side frame **24** a prescribed distance d forwardly of drive arm **350** and co-operates therewith to control the position of arm **350.** The latch **360** is urged in a clockwise direction by a torsion spring **361** as best seen in FIG. **19** which is carried around the pivot shaft **362** of latch **360** with one of its ends connected to plate **25** and its other connected to latch **360** through hole **364.** The projecting end **365** of latch **360** is provided with a cutout **366** to provide a check shoulder **368** registerable with notch **356** to maintain the arm **350** in its cocked position as shown in FIG. **18.** The rearwardly facing edge **369** of latch **360** provides a camming surface lying in the plane of the projecting end **354** and notch **356** of arm **350** so that as the arm **350** is rotated in a clockwise direction as seen in FIG. **17** and further explained below, the beveled surface **358** of arm **350** will engage the edge **369** of latch **360** and rotate it in a counterclockwise direction sufficiently to allow the shoulder **368** to engage notch **356** in arm **350** to maintain the arm **350** in its cocked position. The cutout **366** also provides a limiting surface **370** which engages the tip **357** of arm **350** as the tip **357** passes over shoulder **368** to maintain the shoulder in alignment with notch **356.** Thus, when the arm **350** is released to be rotated in its counterclockwise direction, the shoulder **368** of latch **360** will engage the notch **356** of arm **350** to hold the arm **350** in its cocked position as shown in FIG. **18.**

A striker **371** is provided on the lower forward portion of the projecting end **365** of latch **360** to engage an abuttment **372** as will be explained to limit the clockwise movement of latch **360** under the influence of spring **361** so that when the latch is released, the edge **369** is in alignment with the beveled surface **358** of arm **350** so that the arm can be recocked.

For releasing the shoulder **368** from notch **356,** a trip **374** is provided on the upper end of latch **360** and displaced forwardly of the end **365** of latch **360.** When the trip **374** is moved downwardly as will be explained, the latch **360** will be rotated counterclockwise against the force of spring **361** to release arm **350.**

The cutting edge **312** of rotary blade **308** is oriented with respect to arm **350** so that when the arm **350** is in its cocked position shown in FIG. **18,** the blade **308** is oriented as shown by solid lines in FIG. **20** so that sufficient clearance is provided between cutting edges **310** and **312** for the web **102** of copy paper to pass therebetween. When the arm **350** is released from its cocked position (FIG. **18**) and is moved toward the bumper **359** (FIG. **19**), the cutting edge **312** of rotary blade **308** is moved past the cutting edge **310** of stationary blade **306** as seen by dashed lines in FIG. **20** as the arm **350** is rotated counterclockwise as seen in FIGS. **18** and **19** by spring **351** so that the web **102** will be cut as will become more apparent.

DRIVE AND CONTROL MEANS

The drive and control means **19** is mounted in recess **30** of side frame **24** on the drive side of the machine as best seen in FIGS. **3** and **21–25.** The means **19** includes a flexible endless transfer member **375** mounted about and engaging a series of sprockets for movement along a prescribed path P'' shown in FIGS. **4** and **21** and lying in a vertical plane PL within recess **30** shown in FIG. **22**

and spaced a predetermined distance d_1 from plate **25** of side frame **24** as will become more apparent. A main drive motor **378** is mounted on plate **25** within space **31** below the upper rear portion of the exposure assembly **284** with its drive shaft **379** protruding outwardly through plate **25** into drive recess **30.** A main drive sprocket **380** is pinned to the end of drive shaft **379** with its teeth lying within the plane PL. An upper driven sprocket **381** is pinned to the end of the support shaft of the drive roll **288** at the upper rear end of assembly **282** with its teeth also lying in plane PL. An idler sprocket **382** is rotatably journalled on the support shaft of the rearmost paper feed roll **285** with its teeth lying within the plane PL so that sprocket **382** rotates independently of roll **285** as seen in FIG. **24.** A driven sprocket **384** is also mounted on the end of the support shaft of roll **285** outboard of sprocket **382** but is pinned thereto so as to cause rolls **284** to rotate as it is rotated. The teeth of sprocket **384** lie in a plane PL_1 outboard of plane PL by a distance d_2 as best seen in FIG. **24.** An upper idler sprocket **385** is rotatably mounted on plate **25** forwardly of sprocket **382** with its teeth lying in plane PL as seen in FIG. **3.** A backup sprocket **386** is rotatably mounted on plate **25** through abuttment **372** below sprocket **385** with its teeth lying in plane PL. A corner sprocket **388** is rotatably mounted on plate **25** below sprocket **386** and adjacent the main drive sprocket **380** with its teeth lying in plane PL. A backup sprocket **389** is rotatably mounted on plate **25** just below the rear edge of the cutout **44** in plate **25** with its teeth in plane PL. A dual backup sprocket **390** is rotatably mounted on plate **25** below cutout **44** and just rearwardly of the discharge roll assembly **284.** The lower squeegee roll **300** has its support shaft pinned to a driven sprocket **391** with its teeth in plane PL. A backup sprocket **392** is rotatably mounted on plate **25** below cutout **44** and sprockets **389** and **390** and just forward of the lower front end of exposure assembly **282.** A driven sprocket **394** is pinned to the support shaft of the lower belt drive roll **288** of assembly **282** with its teeth lying in the plane PL. A takeup sprocket **395** is rotatably mounted on plate **25** between the main drive sprocket **380** and the driven sprocket **381** with its teeth in plane PL.

The flexible transfer member **375** includes a main drive endless link chain **396** which passes around the sprockets lying in plane PL. Starting at point A at the main drive sprocket **380,** it will be seen that chain **396** passes partly around the lower back portion of sprocket **380;** then upwardly around the front of sprocket **395,** then upwardly around the back of sprocket **381** and the upper back of sprocket **382;** then forwardly around the upper front of sprocket **385;** then downwardly along the back of sprocket **386** and around the lower back of sprocket **388,** then forwardly and slightly downwardly over the tops of sprockets **389** and **390;** then around the front of sprockets **391;** then rearwardly and upwardly under the bottom of sprocket **390** and over the top of sprocket **392;** then downwardly under sprocket **394;** and finally upwardly and rearwardly back to point A at main drive sprocket **380.**

As the motor **378** rotates its drive shaft **379** in a clockwise direction, the main drive chain **396** will be moved in the direction of the arrows in FIG. **3** thereby rotating the sprockets **381, 382, 385, 386, 388–392, 394** and **395.** This causes the upper flight **290** of exposure belt **289** to be moved in the direction indicated in FIG. **4** and the squeegee rolls **300** to be rotated to drive copy paper out of slot **42.**

For driving sprocket **384** and paper feed rolls **285,** transfer member **375** includes a secondary link chain **398** mounted on and movable with the main drive chain **396.** The secondary chain has a length considerably shorter than chain **396** as seen in FIG. **21** and is mounted on the outside thereof so that chain **398** moves along a path parallel to the path of the main chain **396** lying in the plane PL_1 of the teeth of sprocket **384** as seen in FIG. **24.** The chain **398** extends between points B and C on main drive chain **396** so that when that portion of main drive chain **396** between points B and C passes over idler sprocket **382,** the secondary chain **398** will drivingly engage the sprocket **384** to rotate it and paper feed rolls **285** to feed the web **102** of copy papar as will be more fully explained.

A control system **400** is also carried by main drive chain **396** as best seen in FIGS. **3** and **22** for controlling the electrical operation of the machine, the operation of cutter means **16,** and the position of the shutter-mirror assembly **114.** System **400** includes a cycle stop cam **401** mounted on the back links **402** of chain **396** as seen in FIG. **22** which extends on the outside of the chain at point D to move along with chain **396** on a path p_1 behind the plane PL and parallel thereto. System **400** also includes a registration cam **404** mounted on the back links **402** of chain **396** which extends inside the chain at point E to move along with chain **396** on a path p_2 behind the plane PL and parallel thereto.

System **400** further includes a cocking and drive pin **405** mounted on chain **396** at point F. It is carried by the back links **402** and extends behind chain **396** to be moved therewith along path p_3 behind and parallel to plane PL. The pin **405** serves both to cock the cutter means **16** and to drive the shutter-mirror assembly **114** from its viewing to printing position and back again during each printing cycle as will be explained. The pin **405** includes a disk shaped retainer **406** as seen in FIG. **22** which maintains contact with the driving arm **238** of the mirror-shutter assembly **114** as will be further explained.

Also included in system **400** is a trip cam **408** mounted on chain **396** at point A. Cam **408** is carried by the front links **409** of chain **396** as seen in FIG. **22** and extends outwardly of chain **396** to be moved therewith along path p_4 parallel to and in front of plane PL. Trip cam **408** engages the trip **374** of latch **360** to release the driving arm **350** and allow same to rotate blade **308** and cut web **102** as will be explained.

From the foregoing, it will be seen that paths p_1-p_4 never intersect so that each of the cams **401, 404** and **408** as well as pin **405** can be used to operate different components independently of each other.

System **400** further includes a cycle stop switch **410** in tandem with a light switch **411** positioned adjacent chain **396** at point G on side frame **24.** Switches **410** and **411** have a common actuator arm **412** which overlies only path p_1 as seen in FIG. **22** so that cam **401** transfers both switch **410** and switch **411** when point D on chain **396** reaches point G on side frame **24.** This causes the cycle to stop while at the same time causing lamp **141** to be illuminated as will be further explained. Thus, the chain **396** is always stopped at the same position at the completion of each cycle. A registration switch **414** is mounted adjacent chain **396** at point H on side frame **24.** The actuator arm **415** of switch **414** overlies path p_2 as seen in FIG. **22** so that cam **404** on

chain 396 transfers arm 415 when point E on chain 396 reaches point H. This energizes the exposure timing circuit as will be explained.

A drive bracket 420 is provided on the lower portion of driving arm 238 of assembly 114 lying behind the chain 396 between sprockets 388 and 389 and between sprockets 380 and 394 as seen in FIGS. 3 and 33. Bracket 420 includes a pair of upper flanges 421 and 422 facing chain 396 with flange 421 being the front flange and flange 422 being the rear flange. Each of flanges 421 and 422 include an inwardly facing lip 424 as seen in FIG. 34 so that a reduced width slot 425 is provided therebetween with a larger width channel 426 behind lips 424 and between flanges 421 and 422. The flange 421 is shifted upwardly along arm 238 with respect to flange 422 so that rearwardly facing entrance space 428 is provided above the upper end of flange 422 and a forwardly facing exit space 429 is provided below the lower end of flange 421. When arm 238 is pivoted to its rearmost position with the reflector assembly 222 at its viewing position, the entrance space 428 is aligned with path p_3 of drive pin 405 so that as point F on chain 396 moves past arm 238, the pin 405 will pass over flange 422 and into channel 426 to engage the lip 424 of flange 421 to drive the arm 238 forwardly therewith. Because the chain 396 is moving forwardly and downwardly carrying pin 405 therewith and because the bracket 420 moves along an arcuate path as arm 238 is pivoted, the relative movement between pin 405 and bracket 420 causes the pin 405 to pass down through slot 425 as arm 238 is driven forwardly to the print position while the retainer moves down through channel 426. Thus, lips 424 keep the pin 405 in engagement with flanges 421 and 422 to insure the pivoting of the arm 238 and reflector assembly 222 forwardly to the print position. As arm 238 reaches its print position, its lower end passes detent 240 which holds it in print position. At this time, the exit space 429 has become aligned with path p_3 so that pin 405 can pass out from between flanges 421 and 422 leaving arm 238 in print position. If the forwardmost position of arm 238 is reached before exit space 429 has become fully aligned with path p_3, it will be seen in FIG. 3 that chain 396 can flex downwardly since slot 425 is angled in a forward direction to allow pin 405 to move down slot 425 and out space 429. The amount chain 396 is allowed to flex downwardly is controlled by the position of backup sprocket 389 which is adjustable in known manner. This insures positive positioning of arm 238 forwardly of detent 240.

Bracket 420 also includes a pair of lower flanges 430 and 431 spaced below flanges 421 and 422 and facing chain 396 as seen in FIGS. 33 and 35. Flange 430 is the front flange and flange 431 is the back flange. Each of flanges 430 and 431 include an inwardly facing lip 432 which together define a slot 434 and channel 435 similar to that of flanges 421 and 422. The flange 430 is shifted upwardly along arm 238 with respect to flange 431 to provide a forwardly opening entrance space 436 below flange 430 and a rearwardly opening exit space 438 above flange 431. As point F on chain 396 passes rearwardly along the lower flight thereof between sprockets 394 and 380, the pin 405 enters channel 435 and passes upwardly along slot 434 to drive the arm 238 rearwardly out of engagement with detent 240 and back to its viewing position where pin 405 passes out through exit space 438.

The drive arm 350 of cutter means 16 is also positioned behind chain 396 so that the camming surface 355 overlies path p_3 when arm 350 is in its released position as seen in FIG. 17. When point F on chain 396 reaches the arm 350 in its released position, drive pin 405 engages the camming surface 355 and drives arm 350 down and clockwise as seen in FIG. 17. This causes the driving surface 358 on arm 350 to engage edge 369 of latch 360 and drive latch 360 counterclockwise to allow tip 357 to pass over shoulder 368 and engage surface 370 to locate shoulder 368 over notch 356. Camming surface 355 is dimensioned so that pin 405 releases it after tip 357 of arm 350 engages limiting surface 370 of latch 360. This leaves the shoulder 368 of latch 360 engaging notch 356 in arm 350 to hold arm 350 in its cocked position against spring 351 as seen in FIG. 18.

Trip 374 of latch 360 is located over the path p_4 of trip cam 408 when latch 360 is in its latching position holding arm 350 in its cocked position. When point A on chain 396 passes trip 374, the trip cam 408 engages trip 374 driving it downwardly and rotating latch 360 counterclockwise. This releases arm 350 to allow spring 351 to drive arm 350 upwardly in a counterclockwise direction to cause cutting edge 312 of rotary blade 308 to pass in a cutting relationship with cutting edge 310 on stationary blade 306 as shown by dashed lines in FIG. 20.

CARRIER ASSEMBLY

The carrier assembly 18 is mounted within cutouts 44 of side frames 24 as seen in FIGS. 1, 3, 4, 15 and 25 and is designed to position a microfiche 440 across the light path P between the light source assembly 110 and projection assembly 111 so that the visual image on the microfiche will be projected on the viewing screen 49 or the copy paper at exposure station 118. Assembly 18 is mounted under platform 160 of the projection unit 111 on a transversely extending race 441 attached to the underside of platform 160. Race 441 includes a pair of spaced apart depending race flanges 442 extending across space 31 transversely of the machine. A central opening is provided through race 441 in alignment with opening 161 in platform 160 to allow the light to pass therethrough.

Assembly 18 includes an undercarriage 444 mounted between race flanges 442 for movement back and forth transversely of the machine. Undercarriage 444 includes a central web 445 generally rectangular in shape with upstanding race flanges 446 along the front and rear edges thereof which cooperate with depending race flanges 442 to movably mount undercarriage 444 on ball bearings 448 between flanges 442 and 446. Thus, undercarriage 444 is easily movable transversely of the machine. A generally rectangular opening 449 is provided through web 445 to allow light to pass therethrough as will become more apparent. The sidewise movement of undercarriage 444 is limited by stops 450 attached to opposite ends of race 441 as best seen in FIG. 15.

A pair of outwardly facing race flanges 451 depend from opposite sides of web 445 starting at the back of the web and extending forwardly of the front of the web longitudinally of the machine. A pair of pivot cams 452 are carried by inwardly turned ledges 454 on flanges 451 in the vicinity of the front of web 445 as will be explained.

A fiche carrier **455** is mounted on undercarriage **444** for lateral movement therewith and longitudinal movement with respect thereto and to the machine as seen in FIG. **25.** Carrier **455** includes a generally rectangular web **456** having inwardly facing upstanding race flanges **458** which co-operate with flanges **451** to movably mount carrier **455** on undercarriage **444** through ball bearings **459** between flanges **451** and **458.** An opening **460** is provided across the rear portion of web **456** selectively alignable with opening **449** in undercarriage **444** to allow light to pass therethrough. Inwardly extending support lips **461** are provided around opening **460** as well as upstanding locating tabs **462** also as will become apparent.

A camming flange **464** is provided along the rear edge of web **456** which engages the face **184** of adjustment tube **165** of the projection assembly **111** as will become apparent to raise the face **184** onto the carrier **455** when the carrier **455** is moved rearwardly in the machine. A handle **465** is provided across the front edge of web **456** for use in positioning carrier **455** and undercarriage **444.**

A lower platen **466** is positioned over opening **460** where it is supported on flanges **461** and located by tabs **462** and side angles **474.** The platen **466** is a generally rectangular sheet of clear glass. An upper platen **468** is pivotally positioned over lower platen **466** so that the microfiche **440** can be positioned between the two platens. Platen **468** includes a generally rectangular sheet **469** of clear glass mounted on a pivot rod **470** along its rear edge. Rubber treads **471** are mounted on opposite ends of rod **470** which rest on the top of web **456** between an abuttment **472** at the juncture of flange **464** with web **456** and the rear ends of side angles **474** along opposite sides of opening **460.** The rod **470** is located on sheet **469** so that sheet **469** will be parallel with platen **466** when it overlies same as seen by solid lines in FIG. **15.** The pivot cams **452** on undercarriage **444** are provided with rearwardly facing inclined surfaces **475** which engage the upper portion of treads **471** to roll the treads **471** on the web **456** and rotate the upper platen upwardly in a counterclockwise direction as seen in FIG. **15** when the carrier **455** has been pulled to its forwardmost position. This allows the microfiche to be placed between platens **466** and **468** to load same. As the carrier **455** is pushed rearwardly, the cams **452** allow the upper platen to pivot down onto the microfiche. The camming flange **464** also lifts the tube **165** as the carrier **455** is moved rearwardly so that its face **184** rests on the upper surface of the sheet **469** of the upper platen **466.**

A pointer **476** is mounted on control panel **45** and is used with an interchangeable grid **478** carried on web **456** to locate the particular image on the microfiche **440** to be viewed and/or printed.

ELECTRICAL CIRCUIT

The electrical circuit **500** of the invention is best seen in FIG. **26** and is connected to a conventional **110-120** volt A-C volt source. The circuit **500** includes a common hot wire **501** and a common ground wire **502** and is operatively associated with the drive and control means through the cycle stop switch **410,** the light switch **411,** and the registration switch **414** seen in FIGS. **3** and **22.** The hot wire **501** includes a fuse **504,** a safety switch **505** (FIG. **5**), an an on-off switch **506** also shown in FIGS. **1** and **26** that connects the various components of the electrical circuitry to the power source. The safety switch **505** is closed when the cassette cover **40** is in position. The pump mootor **260** that operates the fan-pump assembly **121** is connected between the hot wire **501** and ground wire **502** so that when the on-off switch **506** is closed, the pump motor will be driven to pump the toner in the developing tray **251,** create a partial vacuum in pan **289** and to force cooling air over lamp **141** where it is heated and discharged through the opening **135** in light source assembly **110** across the discharge path of the developed copy paper.

The common contact 414_c of the registration switch **414** is connected to hot wire **501.** The normally open contact 414_2 of switch **414** is connected to timer motor TM_m of timer TM and to normally closed contact 411_2 of light switch **411** in parallel with each other. The normally closed contact 414_1 of switch **414** is connected to the common contact 410_c of the cycle stop switch **410.** The normally open contacts TM_c of timer TM are connected in parallel across the contacts 414_c and 414_1 of switch **414.** The other side of timer motor TM_m is connected to ground wire **502.** The timer TM is conventional and adjustable through knob TM_k on panel **45** in FIGS. **1** and **3** to vary its timing cycle. When the timer TM times out, contacts TM_c close until power is removed from its motor TM_m.

The normally open contact 411_1 of light switch **411** is connected to normally closed contact 410_2 of cycle stop switch **410** through normally open, momentary push button print switch **508.** The contact 410_2 is also connected to one side of main drive motor **378** with its other side connected to ground wire **502.** The normally open contact 410_1 is connected to one side of lamp **141** through wire **507.** Wire **507** is also connected to the common contact 411_c of light switch **411.** The other side of lamp **141** is connected to ground wire **502.**

The corona power supply **509** is also connected to contact 410_2 in parallel with motor **378** so that when power is supplied to motor **378,** the power supply **509** will also be powered. The power supply **509** is conventional with direct current outputs O+ and O− which are selectively connected to the corona units **245** and **246** through the charge selector switch **510.**

The charge selector switch **510** as best seen in FIGS. **27** and **28** serves to selectively reverse the polarity of the electrostatic field imposed on the copy paper by the corona units **245** and **246.** It is known that the polarity of the charge on the surface of the copy paper to be exposed will have the same polarity as the polarity of the corona unit facing that surface of the paper. Reference to FIG. **4** will show that the surface of the copy paper which is to be exposed is the forwardly facing surface as it passes between the corona units **245** and **246** and thus will have a charge thereon of the same polarity as the front corona unit **245.** When the unit **245** is connected to the output O−, the resulting electrostatic charge on the exposure surface of the copy paper will be negative and when the corona unit **245** is connected to the output O+, the resulting charge on the copy paper will be positive. This feature of the invention is necessary since some pieces of microfiche **440** have positive images thereon, while others have negative images thereon. Switch **510** includes a pair of input contacts I_1 and I_2 with contact I_1 being connected to the positive output O+ of the corona power supply **509** and the input I_2 being connected to the negative output O− of the corona power supply **509.** The switch **510** also includes a pair of output contacts O_1 and O_2 which can

be selectively connected to either of the inputs I_1 or I_2 through an actuator **511**.

The contacts I_1, I_2 and O_1, O_2 are mounted by a housing **512** that is cylindrical and defining an actuator receiving cavity **514** therein which receives the actuator **511** therein. The input contacts I_1 and I_2 are located on housing **512** so that they are diametrically opposed and output contacts O_1 and O_2 are also located by housing **512** so that they are diametrically opposed but shifted 90° with respect to the input contacts I_1 and I_2. This is best seen in FIGS. **27** and **28.** The actuator **511** is rotatably mounted within the chamber **514** and housing **512** on a pivot shaft **515** which is rotatably mounted within housing **512.** The shaft **515** extends through the control panel **45** of the machine and is equipped with a knob **516** as seen in FIG. **1** forwardly of control panel **45** so that the switch can be selectively operated. The actuator **511** includes a rotor **518** mounted on shaft **515** within the chamber **514** and connected to shaft **515** through a drive pin **519.** The rotor **518** is cylindrical and defines a pair of diametrically opposed outwardly facing slots **520** along the outer surface of the rotor **518** and extending generally parallel to the rotational axis of the rotor **518.**

A switch contact **521** is carried in each of the slots **520** for selectively connecting contacts I_1 and I_2 with contacts O_1 and O_2. Each contact **521** includes an inwardly extending protrusion **522** which fits within slot **520** to hold contact **521** in place and a pair of contact arms **524** which extend from protrusion **522** outwardly along the circumference of rotor **518.** Each of the arms **524** is urged outwardly toward housing **512** by the natural resiliency in the contact **521** so that the outermost ends **525** of the arms **524** will be urged into contact with the contacts I_1, I_2, O_1 or O_2. The arms **524** extend outwardly so that the total length of each contact **521** extends for approximately 90° about the periphery of rotor **518** on either sides of slot **520.** The natural resiliency of the protrusion **522** is also sufficient to maintain each contact within the slot **520.** Thus, it will be seen that when the contact end **525** of the contact member **521** is contacting the input contact I_1, the opposite end **525** will be contacting either the output contact O_1 or O_2. Likewise when the contact end **525** of the other contact member **521** is contacting the input contact I_2, the other end will be contacting either the output contact O_1 or O_2.

The output contact O_1 is connected to the front corona unit **245** while the output contact O_2 is connected to the corona unit **246.** Thus, it will be seen that when the rotor **518** is in the position shown in FIG. **27,** the input contact I_2 will be connected to the output contact O_1 so that the front corona unit **245** has a negative charge imposed thereon thus creating a negative electrostatic charge on the copy paper. When the rotor **518** is rotated counterclockwise as seen in FIG. **27,** it will be seen that the output contact O_2 will be connected to the input contact I_2 so that a negative charge will be imposed on the rear corona unit **246** and the electrostatic charge on the copy paper will be of a positive polarity.

A stop **530** on the back of rotor **518** co-operates with an abuttment **531** on housing **512** to limit the movement of rotor **518** between the position in which contact **521** connects the input contact I_1 with output contact O_1, and the position in which contact **521** connects the input contact I_2 with output O_2. Thus, the proper contact is insured.

This particular switch arrangement allows both positive and negative image microfiche to be copied without the necessity of changing the toner used to always produce a positive image on the copy.

OPERATION

In operation, it will be seen that the operator turns the machine "on" by closing the on-off switch **506.** The microfiche **440** is placed in the machine by the operator pulling the fiche carrier **455** forwardly with handle **465** so that the upper platen **468** is pivoted upwardly by the cams **452** to open the platens **466** and **468.** The microfiche **440** is then placed onto the lower platen **466** and the fiche carrier **455** pushed into the machine to close the upper platen **468** onto the lower platen **466** with the microfiche **440** therebetween. Because the cycle stop cam **401** is in the position seen in FIG. **3,** the switches **410** and **411** are both transferred so that the normally open contacts 410_1 are closed and the normally open contacts 411_1 are also closed. Thus, when the on-off switch **506** was closed to turn the machine "on", the lamp **141** is illuminated through the normally closed contact 414_1 of registration switch **414,** the closed contact 410_1 of the cycle stop switch **410** and ground wire **502** so that the light directed through the microfiche and the image is projected onto the viewing screen **49.**

To locate the correct portion of the microfiche **440** to be projected onto screen **49,** the operator then moves the carrier **455** into or out of the machine and laterally of the machine so as to align the pointer **476** over the desired section of the grid **478.** This generally locates the indicated portion of the visual image on the microfiche in alignment with the light path P from lamp **141** so that the visual image will be projected on the viewing screen as it passes upwardly to the fixed mirror assembly **112** along the portion P_1 where it is reflected downwardly and rearwardly along the portion P_2 of the path P and then reflected forwardly onto the screen **49** by the reflector assembly **222** which is now in its viewing position. The operator then focuses the image on the viewing screen **49** by turning the focusing knob **200** to focusing drive mechanism **195** which selectively moves the lens unit **166.** The operator may then rotate the driving gear **202** to selectively rotate the lens unit **166** and orient the image properly on the screen. The operator manipulates the charge selector switch **510** so that the contacts **521** properly connect the power supply **509** with the corona units **245** and **246** for a positive image to be formed on the copy paper regardless of whether the image on the microfiche is positive or negative.

It will also be noted that when the on-off switch **506** is closed, the motor **260** in the pump-fan assembly **121** is energized and remains energized as long as the machine is in its "on" position. This serves to continuously pump toner from the reservoir **250** into the paper submerging tray **251** to keep the toner both well mixed and a sufficient supply in tray **251** to develop the image on the copy paper. Simultaneously, it also causes the fan unit **264** to be continuously driven to create a partial vacuum through the upper flight of exposure belt **289** to hold the copy paper thereon. Also, the relatively cool air exhausting from the fan unit **264** is directed along duct **275** over the lamp **141.** This cools the lamp **141** while heating the air. The thusly heated air is then exhausted from light source assemebly **110** through

opening **135** to dry the developed copy paper as it passes from the machine.

When the image has been properly focused on and aligned with the screen **49**, the operator then depresses the momentary print switch **508** which is spring biased toward its open position. This action momentarily energizes the main drive motor **378** and the corona power supply **509**. Energizing the motor **378** drives the main drive chain **396** so that the stop cam **401** moves out of contact with the actuator arm **412** of switches **410** and **411** allowing them to return to their normal position. This causes contacts 410_2 and 411_2 to be closed so that power is maintained to motor **378** and corona power supply **509** through the normally closed contacts 414_1 of switch **414** and the normally closed contacts 410_2 of the switch **410**. It will also be noted that the lamp **141** is de-energized when the switch **410** returns to its normal position to prevent premature exposure of the copy paper.

When the main drive chain **396** is at its initial position shown in FIG. **3**, the cutter drive arm **350** is held in its cocked position with latch **360** engaging the notch **356** in arm **350**. As the chain **396** is moved around the sprockets by the motor **378**, the secondary chain **398** drivingly engages the sprocket **384** to rotate the paper feed rolls **285** together so as to drive the web **102** of copy paper downwardly between the stationary blade **306** and the rotary blade **308** of the cutter means **16**. This also drives the web **102** downwardly through the opening **248** between the corona units **245** and **246** so that the electrostatic charge is imposed thereon as the paper is fed downwardly. The leading edge of the paper engages the upper flight **290** of the exposure belt **289** as it moves downwardly and moves along with the upper flight **290** under the roll **298** so that the web **102** is held onto the upper flight **290** of the exposure belt **289**. The partial vacuum exerted through the belt **290** by the fan-pump assembly **121** holds the web **102** onto the exposure belt. As the chain **396** continues to move, the secondary chain **398** clears the sprocket **384** so that the paper feed rolls **285** cease to rotate. At the instant the secondary chain **398** releases the sprocket **384**, the trip cam **408** on chain **396** engages the trip **371** of latch **360** to pivot the latch **360** forwardly and cause the driving arm **350** to be released. This allows the spring **351** to pivot the driving arm **350** upwardly and rotate the blade **308** so that the web **102** is cut by the cutting edges **310** and **312**. This cuts a sheet of copy paper of a prescribed length from the web **102** and allows it to pass down onto the upper flight **290** of the belt **289**.

While the copy paper is being fed onto the upper flight of belt **289**, the drive pin **405** on chain **396** has moved into engagement with the upper flanges **421** and **422** of bracket **420** to shift the driving arm **238** of the assembly **114** forwardly with chain **396**. This transfers the shutter-mirror assembly **114** from its rearmost viewing position to its forwardmost printing position so that the reflector assembly **222** now covers the back side of the viewing screen **49** to block any light from entering the space **31** through screen **49**. The pin **405** leaves the arm **238** in its forwardmost printing position and continues to move with the chain **396**.

When the copy paper on the upper flight **290** of the exposure blet **289** reaches an exposure position so that the projected image from the microfiche **440** will be positioned within the confines of the sheet of copy paper, the registration cam **404** engages the actuating arm **415** of the registration switch **414** and transfers same. This causes the normally open contact 414_2 of switch **414** to be closed to disconnect the main drive motor **378** and the corona power supply **509** from the power source and to connect the timer motor TM_m of timer TM to the power source. At the same time, the closure of contact 414_2 also connects the lamp **141** to the power source through the normally closed contacts 411_2 of the light switch **411**. This projects the image from the microfiche **440** onto the electrostatically charged sheet of copy paper on the upper flight **290** of the exposure belt **289** since the projected image now passes behind the reflector assembly **222** and onto the upper charged surface of the copy paper. It will also be noted that because it may be necessary to vary the exposure time during which the charged copy paper is exposed, the timer TM is of the variable type with knob TM_k on the control panel **45** for selectively controlling same.

After a prescribed period of time which is determined by the setting of the knob TM_k, the timer motor TM_m times out and the normally open contact TM_2 is closed so that the main drive motor **378** is again energized through the normally closed contacts 410_2 of the cycle stop switch **410** while at the same time powering the corona power supply **509**. This moves the chain **396** so that the registration cam **404** is moved out of engagement with the registration switch **414** to allow the switch to return to its normal position. Thus, it will be seen that during the exposure of the copy paper on the exposure belt **289**, the chain **396** is not moving and the exposure belt **289** is held in a stationary position with the copy paper in registration with the projected image from the microfiche. Also, since the timer TM times out, the lamp **141** is de-energized so as to prevent over exposure of the copy paper.

As the chain **396** continues to move, the exposure belt **289** is again moved to cause the exposed copy paper to be fed through the toner in the tray **251** of the developing unit **119** and into engagement with the squeegee rolls **300** of the discharge roll assembly **284** to develop the latent image on the copy paper. It will also be noted that the drive chain **396** is rotating the rolls **300** together so as to force the copy paper out of the machine through the discharge slot **42** and cover **41**. The squeegee rolls **300** are of such construction that the excess toner will be squeezed from the developed copy. Also, the heated air discharged from the box **125** of the light source assembly **110** is directed onto the paper to heat and dry same. When the developed copy has been discharged, the chain **396** has again reached the position shown in FIG. **3** where the stop cam **401** again engages the actuator arm **412** of the switches **410** and **411** to transfer them back to their initial position. This completes the cycle of the machine.

While the chain **396** is moving the copy through the developing unit **119** and out between the rolls **300**, the drive pin **405** engages the lower flanges **430** and **431** on the driving arm **238** and moves the reflector assembly **222** back to its viewing position. Also, the pin **405** has moved past the drive arm **350** of the knife assembly **305** to move the arm **350** down to its cocked position as seen in FIG. **3** ready for the next printing operation.

MICROFILM CONVERSION

For using the machine **10** with roll type microfilm, a microfilm conversion unit **600** is provided as seen in FIG. **29**. The conversion unit **600** replaces the paper exit cover **41** of the machine cover **41** of the machine

cover **21**, the light source assembly **110** and the focusing lens assembly **162** of the projection unit **111**. The above enumerated units are removed from the machine prior to the installation of the conversion unit **600**. Also, the carrier assembly **18** is removed prior to the mounting of the conversion unit **600**.

It will be seen that the conversion unit **600** conforms in external appearance generally to the configuration of the paper exit cover **41** and is provided with a paper exit slot **602** corresponding to the paper exit slot **42** in the cover **41**. The upper rear edge of the unit **600** is provided with an upstanding bracket **601** adapted to conform with and engage the front race flange **442** of the race **441** mounted in the slot **44** of the machine frame **20**. The lower edges of the conversion unit **600** are adapted to sit within the bottom channel **32** on opposite sides of the machine frame **20** similarly to the paper exit cover **41**. Thus it will be seen that the conversion unit **600** is mounted on the machine by placing the upstanding mounting bracket **602** behind the race **442** and placing the lower outside edges of the unit **600** within the botton channels **32**. The unit **600** defines a substantially horizontally oriented working surface **604** on which the microfilm drive mechanism **605** is mounted.

The microfilm drive mechanism is of the reversing and variable speed type as is conventional in the microfilm reader-printer art with take-up and play-out reels **606** and **608** between which the rolls of microfilm **609** is mounted. An appropriate control **610** is provided which allows the direction of movement of the microfilm between the reels **606** and **608** to be selectively changed as well as the rate at which the transfer is taking place to be changed. The microfilm **609** passes through a guide assembly (not shown) as is known in the art for selectively positioning the roll of microfilm **609** for projection of the visual image thereon onto the screen **49** of the machine.

A light source assembly **620** is mounted forwardly of the film guide of the machine and has a construction similar to the construction of the light source assembly **110**. A duct **621** is associated to the light source assembly **620** to connect the cooling air from the duct **235** into the light source assembly **620** to cool same. The heated air exiting from the light source assembly **620** may be directed downwardly onto the developed copy paper to dry same in a manner similar to that previously disclosed for the light source assembly **110**.

A projection assembly **630** is mounted behind the film guide for focusing and orienting the projected image from the roll of microfilm similarly to the projection unit **111**. An appropriate prism **631** is provided behind and aligned with both the projection unit **630** and the aperture **161** in the platform **160** in the machine so that the projected image is deflected from a rearwardly oriented path upwardly through the aperture **161** along the path P as set forth previously. Thus, because the paper exit cover **41**, the light source assembly **110**, the lens assembly **162** and the carriage assembly **18** can be easily removed from the machine **10** and the conversion unit **600** substituted therefor, the machine **10** can be easily converted from a machine for reading and printing microfiche to a machine for reading and printed roll microfilm.

ALTERNATE EMBODIMENT OF TIME DELAY MEANS

Referring now to FIGS. **30** and **31**, an alternate form of the exposure time delay means for the machine is illustrated. The time delay means **700** is mechanical rather than electrical as disclosed in the first embodiment of the invention. The means **700** includes the main drive chain **396** which passes around the sprockets as enumerated in the first embodiment of the invention. It will be noted, however, that the sprockets **381** and **394** over which the endless chain **396** passes are idler sprockets rotatably mounted on the support shafts of the upper and lower belt drive rolls **288** of the assembly **282** so as to be moved independently of the rolls **288**. Mounted outboard of and immediately adjacent the lower sprocket **394** is a drive sprocket **701** which is pinned to the support shaft of the lower belt drive roll **288** for rotating same. Transfer sprockets **702** are pinned to the support shafts of the upper and lower belt drive rolls **288** behind sprocket **381** and **394** and a transfer chain **704** connects these sprockets so that when the lower drive roll **288** is rotated, the upper drive roll **288** will be correspondingly rotated.

Mounted on the main drive chain **396** on the outside thereof is a conveyor belt drive chain **705** which has a finite length slightly shorter than the length of the main drive chain **396** as seen in FIG. **31**. The chain **705** is mounted on the chain **396** in such a manner that they move as a single unit. The chain **705** is positioned on the chain **396** so as to leave a space **706** between the ends thereof at point Y on the main drive chain **396**. The space **706** has a length x such that when point Y on the main drive chain reaches the position corresponding to that position at which point E on the original drive chain **396** reaches the registration switch **414**, the chain **705** will disengage the drive sprocket **701** mounted on the support shaft of the lower belt drive roll **288** to stop the movement of the conveyor belt **289** for exposure. The space **706** is selected so that the conveyor belt **289** will be stopped for an average exposure time for the copy paper on the upper flight of the belt **289**. An appropriate control (not shown) may be provided which is connected to the lamp **141** to vary the intensity of the light from lamp **141** to provide a fine adjustment for the correct exposure of the copy paper. Thus, the belt **289** will be stopped for a prescribed period of time and will then be re-engaged by the chain **705** to continue the movement of the copy paper through the machine.

The secondary link chain **398** is mounted outboard of the chain **705** and the drive sprocket **384** which is engaged by the chain **398** is appropriately moved on the support shaft of the paper feed roll to accomodate this change in the flexible transfer member **375**.

It is also understood that the original time delay means embodied in the timer TM may be changed so that the time delay is constant and the light intensity may be varied to obtain the proper exposure of the copy paper on the exposure belt **289**.

ALTERNATE KNIFE ASSEMBLY

An alternate knife assembly **705** is illustrated in FIGS. **36–38** for use in substitution of the knife assembly **305** in the cutter means **16**. The knife assembly **705** operates in substantially the same manner as the knife assembly **305** with only the specific structure being changed. The knife assembly **705** includes generally a

stationary blade **706** and a rotary blade **708.** Both the stationary blade **706** and the rotary blade **708** are manufactured in generally the same way.

The stationary blade **706** includes generally an angle support **709** with a cutting blade **710** mounted thereon. The angle support **709** serves to reinforce the cutting blade **710** so that it is maintained rigid even through the cutting blade **710** is relatively thin. The cutting blade **710** has a sharpened cutting edge **711** on that end thereof projecting over one leg **712** of the angle support **709.** The other leg **714** of the angle support **709** serves to reinforce leg **712** to insure that it does not flex during the cutting operation as will become more apparent. The cutting blade **710** is held on the leg **712** of the angle support **709** by a plurality of pop rivets **715** which extend through appropriate holes **716** in blade **710** and holes **718** in the leg **712** of the angle support **709.** Enough rivets **715** are provided to insure that the blade **710** lies flat against the leg **712** as will become more apparent. The stationary blade **706** is mounted between the mounting bracket **311** attached to the side plates **25** of the side frame **24** and the cutting blade **710** is angled downwardly at its forward end as seen in FIG. **37** and extends generally horizontally between the mounting brackets **311** so that the web **102** of the copy paper passes closely adjacent the cutting edge **711** as it is driven by the feed roll assembly **281** along path P'.

The rotary blade **708** is rotatably mounted between brackets **311** in an operative relationship with the stationary blade **706.** The rotary blade **708** also includes an angle support **719** which mounts a cutting blade **720** with a cutting edge **721** on one of the legs **722** of the angle support **719.** The other leg **724** of support **719** serves to reinforce the leg **722** to maintain it rigid. The cutting blade **720** is shown attached to the leg **722** of support **719** by a plurality of pop rivets **725** which pass through holes **726** in the blade **720** and holes **728** in leg **722.** A pair of generally circular abuttments **729** are mounted at opposite ends of the angle support **719** to each of which is connected a stub shaft **730** that is rotatably mounted in the support bracket **311** about a common aixs. It will be noted that the radius of the circular abuttment **729** is the same as the distance from the centerline of the stub shaft **730** to the cutting edge **721** of blade **720** that projects out from leg **722** so that when the stub shafts **730** are rotatably journalled in slots **314** seen in FIG. **18** through brackets **311,** and leaf springs **315** are positioned under the stub shafts **730** of rotary blade **708** and held in place by detents **318** on brackets **311,** the blade **708** will be constantly urged toward the stationary blade **706** so that the abuttments **729** ride against the cutting edge **711** of the blade **710.** Thus, it will be seen that when the cutting edge **721** of the rotary blade **708** is rotated past the cutting edge **711** of stationary blade **706,** the web **102** of paper passing between the blades **706** and **708** will be cut as is known in the art. The guides **319** carried between the rackets **311** below blades **706** and **708** serve to guide the paper into the opening **248** between the corona units **245** and **246.** It will be noted that one of the stub shafts **730** projets through the side plate **25** of the machine cabinet and is provided with a flat **731** seen in FIG. **38** which engages the driving arm **350** in the same manner as the shaft **316** of the knife assembly **305** engages the driving arm **350.** Thus, it will be seen that the driving arm **350** drives the knife assembly **705** in the same manner as the knife assembly **305** is driven.

Referring now specifically to FIG. **38,** it will be seen that each blade **706** and **708** is made in generally the same manner with the specific rotary blade **708** being illustrated. To make the blade **708,** it will be seen that the angle support **719** is first cut to length and the circular abuttments **729** attached to opposite ends thereof with their stub shafts **730** projecting therefrom. Then the cutting blade **720** is cut to length from a strip of thin spring steel which has the proper temper to adequately hold a cutting edge. The cutting blade **720** and the leg **722** of the angle support **719** are then drilled to form the holes **726** and **728** for the pop rivets **725.** The blade **720** is then installed on the leg **722** using the pop rivets **725.** After the blade **720** is mounted, it is then supported and the cutting edge **721** ground thereon. This insures that the cutting edge **721** will be properly located with respect to the common axis of the stub shafts **730.** It is likewise to be understood that any number of methods may be used for attaching the cutting blade **720** to the angle support **719** such as by spot welding. It will further be understood that a sufficient number of attachment points are provided between the cutting blade **720** and the angle support **719** so that the leg **722** properly supports the cutting edge **721** of the cutting blade **720.** It will further be noted that both the stationary blade **706** and the rotary blade **708** are positioned so that as the cutting edges **711** and **721** come together, they tend to drive the cutting blades **710** and **720** toward the leg of the angle supports **709** and **719** which carry the blades **710** and **720.** Thus, it will be seen that the cutting edges **711** and **721** are always adequately supported to insure proper cutting characteristics of the knife assembly **705.**

While specific embodiments of the invention have been disclosed herein, it is to be understood that full use may be made of modifications, substitutions, and equivalents without departing from the inventive concepts.

We claim:

1. In an apparatus for electrostatically copying images from an original document onto copy paper including a supply of copy paper, an image forming means for reproducing the image on the original document medium onto the copy paper, and conveying means for selectively transporting said copy peper from said supply of copy paper through the image forming means; the improvement comprising:

a single drive motor having a rotary output shaft;

a driving member carried by the rotatable with said output shaft;

a driven member means;

a flexible endless transfer member drivingly connecting said driven member means with said driving member and movable along a prescribed path between said driving member and said driven member means by said driving member;

said conveying means including paper feed means for selectively feeding copy paper along a prescribed path from said supply of copy paper toward said image forming means;

a paper cutting assembly positioned across said prescribed path along which said copy paper is moved by said paper feed means and through which said copy paper passes, said assembly including:

a pair of cutting members positioned in a cutting relationship to each other and between which said copy paper passes, and

positioning means operatively connecting said pair of cutting members for positioning said cutting members in a first cocked position at which said copy paper can freely pass between said pair of cutting members and for moving said cutting members through a second cutting position to cause said cutting members to cut said copy paper; and,

control means carried by said flexible endless transfer member for selectively causing said positioning means to position said cutting members in said first cocked position and to move said cutting members through said second cutting position to cut said copy paper to a prescribed length.

2. In an apparatus as set forth in claim **1** wherein said control means includes:

first cocking member means carried by said endless transfer member at a first predetermined position thereon and movable therewith along said prescribed path of said transfer member, said positioning means located adjacent said prescribed path of said transfer member to be activated by said cocking member means to cause said control means to move said pair of cutting members to said first cocked position;

second release member means carried by said endless transfer member at a second predetermined position thereon and movable therewith along said prescribed path of said transfer member to activate said positioning means as said release member means moves thereby to cause said positioning means as said release member means moves thereby to cause said positioning means to move said cutting member through said second cutting position to cut said copy paper.

3. In an apparatus as set forth in claim **1** wherein said pair of cutting members includes a stationary blade and a rotary blade, each of said blades defining a cutting edge therealong, said rotary blade rotatably mounted with respect to said stationary blade and operatively connected to said positioning means so that said cutting edges are spaced apart to allow said copy paper to pass therethrough when said cutting members are in said first cocked position and so that said cutting edges are in a cutting relationship when said cutting members pass through said second cutting position.

4. In an apparatus as set forth in claim **1** wherein said positioning means includes:

a positioning member operatively connected to said cutting members for positioning said members in said first position and for moving said cutting members through said second position;

resilient means for constantly urging said positioning member to move said cutting members from said first position through said second position, and

latch means for selectively engaging said positioning member to releasably maintain said cutting members in said first position.

5. In an apparatus as set forth in claim **4** wherein said latch means includes a latch member and spring means for constantly urging said latch member into latching engagement with said positioning member.

6. In an apparatus as set forth in claim **5** wherein said control means includes:

first cocking member means carried by said endless transfer member at a first predetermined position thereon and movable therewith along said prescribed path of said transfer member, said positioning member located adjacent said prescribed path of said transfer member to be activated by said cocking member means to cause said positioning member to move said pair of cutting members toward said first cocked position to be engaged by said latch member to maintain said cutting members in said first position; and

second release member means carried by said endless transfer member at a second predetermined position thereon and movable therewith along said prescribed path of said transfer member to move said latch member and release said driving member as said release member means moves thereby to cause said resilient means to move said cutting members through said second cutting position to cut said copy paper.

7. In an apparatus as set forth in claim **6** wherein said first cocking member means and said second release member means are moved along spaced apart, non-intersecting paths and wherein said positioning member is operatively associated only with said path of said cocking member means and said latch member is operatively associated only with said release member means so that said cocking member means operates only said positioning member and said release member means operates only said latch member means.

8. In an apparatus as set forth in claim **7** wherein said positioning member defines a camming surface thereon intersecting said path of said cocking member means and clearing said path of said release member means; and wherein said latch member defines a trip thereon intersecting said path of said release member means and clearing said path of said cocking member means.

9. In an apparatus as set forth in claim **1** further including a cassette for holding a roll of copy paper comprising:

a tubular member having the roll of copy paper wound therearound;

a housing defining a chamber therein and including mounting means for rotatably mounting said tubular member with said roll of copy paper thereon within said chamber, and further defining an opening therethrough for discharge of a layer of copy paper from said roll of copy paper therethrough; and,

braking means carried by said housing and engaging the inside of said tubular member to exert a retarding force on said tubular member as said paper is unrolled from said roll.

10. In an apparatus as set forth in claim **9** wherein said housing includes a plurality of components and locking means for selectively connecting said components to form said housing, said locking means being destroyed upon disassembly of said components.

11. In an apparatus as set forth in claim **10** wherein said components include a main cylinder and an end cap, said main cylinder including a tubular side wall defining said opening along the length thereof and an end wall closing one end of said tubular side wall, and said end cap being adapted to selectively close the opposite end of said side wall; and wherein said locking means includes a plurality of locks on said opposite end of said tubular side wall and a plurality of retainers on said end cap, said locks and retainers co-operating to selectively connect said end cap to said side wall and designed to be destroyed upon disassembly of said end cap and said main cylinder.

12. In an apparatus as set forth in claim **11** wherein each of said locks define an outwardly tapering surface

toward the trailing end thereof and a locking surface at the trailing end thereof; and wherein each of said retainers defines an inwardly tapered surface toward the trailing end thereof and a retaining surface at the trailing end thereof, said tapering surfaces of said locks and said retainers adapted to engage each other and deflect said locks and retainers with respect to each other as said end cap and said opposite end of said side wall are moved toward each other to allow said locks and said retainers to pass by each other and said locking and trailing surfaces to engage each other, said locking and engaging surfaces arranged to cause said locks and retainers to be destroyed if said end cap and main cylinder are forced apart.

13. In an apparatus as set forth in claim **9** wherein said mounting means includes an annular flange adapted to fit within said tubular member for rotatably supporting same, said annular flange defining at least one brake opening therethrough positioned within said tubular member; and, wherein said braking means includes a resilient member projecting through said brake opening and engaging said tubular member for exerting a force thereon resisting rotation of said tubular member.

14. In an apparatus as set forth in claim **9** wherein said mounting means includes an annular flange adapted to fit within said tubular member for rotatably supporting same, said annular flange defining a plurality of cutouts therethrough positioned within said tubular member, and wherein said braking means includes a resilient member comprising a central bearing portion and a plurality of side bearing portions resiliently connected to said central bearing portion, said central bearing portion and each of said side bearing portions extending through said cutouts to engage said tubular member for exerting forces on said tubular member resisting rotation of said tubular member.

15. In an apparatus as set forth in claim **12** wherein said mounting means includes an annular flange adapted to fit within said tubular member for rotatably supporting same, said annular flange defining a plurality of cutouts therethrough positioned within said tubular member, and wherein said braking means includes a resilient member comprising a central bearing portion and a plurality of side bearing portions resiliently connected to said central bearing portion, said central bearing portion and each of said side bearing portions extending through said cutouts to engage said tubular member for exerting forces on said tubular member resisting rotation of said tubular member.

16. In apparatus as set forth in claiam **1** further including a vacuum conveying means and a developer means for developing an electrostatic image on said copy paper into a visual image and having a developing medium therein, the improvement further comprising:

an electrical drive motor having a rotary output shaft;

pump means drivingly connected to said output shaft of said motor for pumping said developing medium onto said copy paper in said developer means;

fan means drivingly connected to said output shaft of said motor, and having an intake and exhaust; and,

first duct means operatively connecting said intake of said fan means to said vacuum conveying means to impose a partial vacuum thereon when said fan means is operating.

17. In an apparatus as set forth in claim **1** further including a light source assembly, the improvement further comprising:

an electrical drive motor having a rotary output shaft;

fan means drivingly connected to said output shaft of said motor, and having an intake and exhaust;

first duct means operatively connecting said exhaust of said fan means to said light source assembly to cool same when said fan means is operating, and,

third duct means operatively connected to said exhaust of said fan means for directing air from said exhaust onto said copy paper.

18. In an apparatus as set forth in claim **1** further including a light source assembly and a vacuum conveying means, the improvement further comprising:

an electrical drive motor having a rotary output shaft;

fan means drivingly connected to said output shaft of said motor, and having an intake and exhaust;

first duct means operatively connecting said intake of said fan means to said vacuum conveying means to impose a partial vacuum thereon when said fan means is operating; and,

second duct means operatively connecting said exhaust of said fan means to said light source assembly to cool same when said fan means is operating.

19. In an apparatus as set forth in claim **1** further including a light source assembly and wherein said improvement further comprises:

second duct means operatively connecting said exhaust of said fan means to said light source assembly to cool same when said fan means is operating.

20. In a machine as set forth in claim **19** wherein said improvement further includes means for directing the air supplied to and heated by said light source assembly onto said copy paper after passage of said copy paper through said developer means to dry said copy paper.

21. In an apparatus as set forth in claim **1** wherein the improvement further comprises:

corona charging means for imposing an electrical charge on said copy paper as said copy paper moves from said supply of copy paper to said image forming means;

power supply means having a first output with a first electrical polarity and a second output with a second polarity opposite to said first polarity; and,

switch means operatively and alternatively connecting said first and second outputs to said corona charging means to alternatively impose aa charge on said copy paper of said first polarity and said second polarity.

22. In an apparatus as set forth in claim **21** wherein said corona charging means includes a first corona unit facing that surface of said copy paper to be electrostatically charged and a second corona unit facing that surface of said copy paper opposite that surface to be charged; and, wherein said switch means includes a first input electrically connected to said first output of said power supply a second input electrically connected to said second output of said power supply means, a first corona output electrically connected to said first corona unit, a second corona output electrically connected to said second corona, and contact means operatively connecting said first input with said first corona output and said second input with said second corona output in a first position, said contact means selectively movable to a second position to operatively connect said first input to said second corona output and said second input to said first corona output.

23. In an apparatus as set forth in claim **22** wherein said switch means includes a housing mounting said in-

puts and said corona outputs along a circular path, said inputs located at diametrically opposite positions on said path and said corona outputs located at diametrically opposite points on said path, said corona outputs shifted 90° with respect to said inputs; and wherein said contact means includes a rotor rotatably carried by said switch housing and having a rotational axis extending through the center of said circular path, a first contact carried by said rotor, and a second contact carried by said rotor, said first contact dimensioned to alternatively connect to said first corona output and to said second corona output, said second contact dimensioned to alternatively connect said second input to said second corona output and to said first corona output, and said first and second contacts arranged so that said second contact connects said second input to said second corona output when said first contact connects said first input to said first corona output and said second contact connects said second input to said first corona output when said first contact connects said first input to said second corona output.

24. In an apparatus as set forth in claim **1** further comprising an image rotating mechanism including:

a support means;

a focusing lens caarried by said support means;

a dove prism carried by said support means a prescribed distance from said focusing lens, having it longitudinal centerline aligned with the image centerline of said focusing lens, and defining an image receiving surface, said image receiving surface having an area just sufficiently large to receive said image from said lens thereon.

25. In an apparatus as set forth in claim **1**, the improvement further comprising:

a single drive motor having a rotary output shaft;

a driving member carried by and rotatable with said output shaft;

an idler member means;

a flexible endless transfer member drivingly connecting said idler member with said driving member and movable along a prescribed path between said driving member and said idler member means by said driving member;

driven member means positioned adjacent said prescribed path and operatively connected to said conveying means for driving same as said driven member is driven;

a flexible engaging member carried by said endless transfer member, said engaging member having a predetermined length shorter than said endless transfer member and located at a predetermined position on said endless transfer member so that said engaging member drivingly engages said driven member to drive said conveying means as said endless transfer member moves said engaging member thereby.

26. In an apparatus as set forth in claim **1** for copying images from microfilm onto copy paper including image forming means for reproducing the image of the microfilm on the copy paper and a viewing screen, the improvement further comprising:

image projection means for projecting the image from the microfilm into said image forming means to cause the image to be reproduced on said copy paper;

projection transfer means for selectively transferring the projected image from said image projection means onto said viewing screen while preventing said projected image from reaching said image forming means when said projection transfer means is in a first position and for allowing said projected image to reach said image forming means when said projection transfer means is in a second position;

a single drive motor having a rotary output shaft;

a driving member carried by the rotatable with said output shaft;

a flexible endless transfer member connected to and moved by said driving member along a prescribed path in a first direction;

a driving element mounted on and movable with transfer member along said prescribed path;

a first driven element operatively connected to said projection transfer means; said first driven element constructed and arranged to be engaged by said driving element to move said projection transfer means from said first position to said second position as said driving element is moved along a first predetermined portion of said prescribed path in said first direction by said transfer member and for releasing said first driving element when said projection transfer means reaches said second position;

a second driven element operatively connected to said projection transfer means; said second driven element constructed and arranged to be engaged by said driving element to move said projection transfer means from said second position to said first position as said driving element is moved along a second predetermined portion of said prescribed path in said first direction by said transfer member and for releasing said second driving element when said projection transfer means reaches said first position.

27. In an apparatus as set forth in claim **26** wherein said projection transfer means is constructed and arranged to be constantly urged toward said first position, and further including holding means for resiliently and releasably maintaining said projection transfer means in said second position when said projection transfer means is moved to said second position.

28. In an apparatus as set forth in claim **27** wherein said first driven element includes a pair of spaced apart first flanges, said first flanges defining an entrance space to allow said driving element to move between and engage said flanges to move said projection transfer means from said first to said second position and defining an exit space to allow said driving element to move from between said first flanges and disengage said flanges and said projection transfer means in said second position; and, wherein said second driven element includes a pair of spaced apart second flanges, said second flanges defining an entrance space to allow said driving element to move between and engage said flanges to move said projection transfer means from said second to said first position and defining an exit space to allow said driving element to move from between said second flanges and disengage said flanges with said projection transfer means in said first position.

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