United States Patent [19]

Gardner et al.

[11] **3,868,699**

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

[54] **PRINTING MACHINE**

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[52] **U.S. Cl.** **354/12**

[51] **Int. Cl.** **B41b 17/38**

[58] **Field of Search** 95/4.5; 354/12

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Primary Examiner—John M. Horan
Attorney, Agent, or Firm—Warren, Rubin & Chickering

[57] **ABSTRACT**

A printing machine having an elongated font member provided with a series of longitudinally spaced image defining areas and being mounted for lengthwise movement; an elongated image receiving receptor member mounted for lengthwise movement perpendicularly to and traversing the font member; means for moving the members for juxtaposing any of the image areas on the font member and a succession of adjacent areas on the receptor member; and means effecting a direct image transfer from the font member to the receptor member. Width codes are provided on the font member for providing an automatic advance of the receptor member for proper spacing of successive image transfers.

4 Claims, 17 Drawing Figures

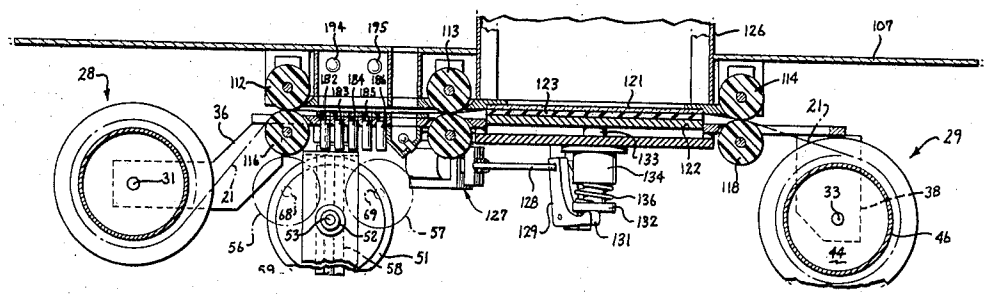

Fig. 1

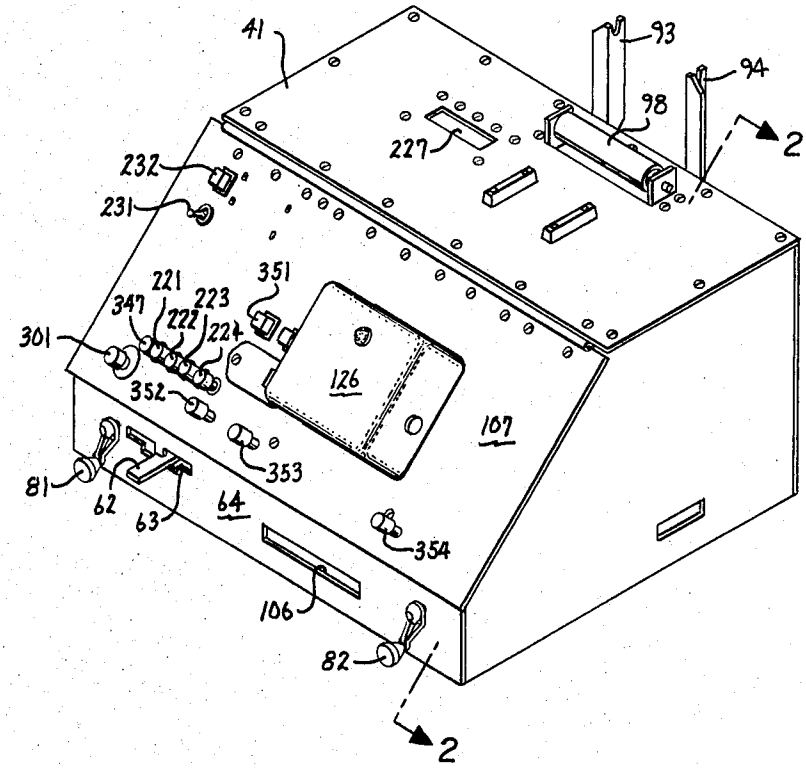
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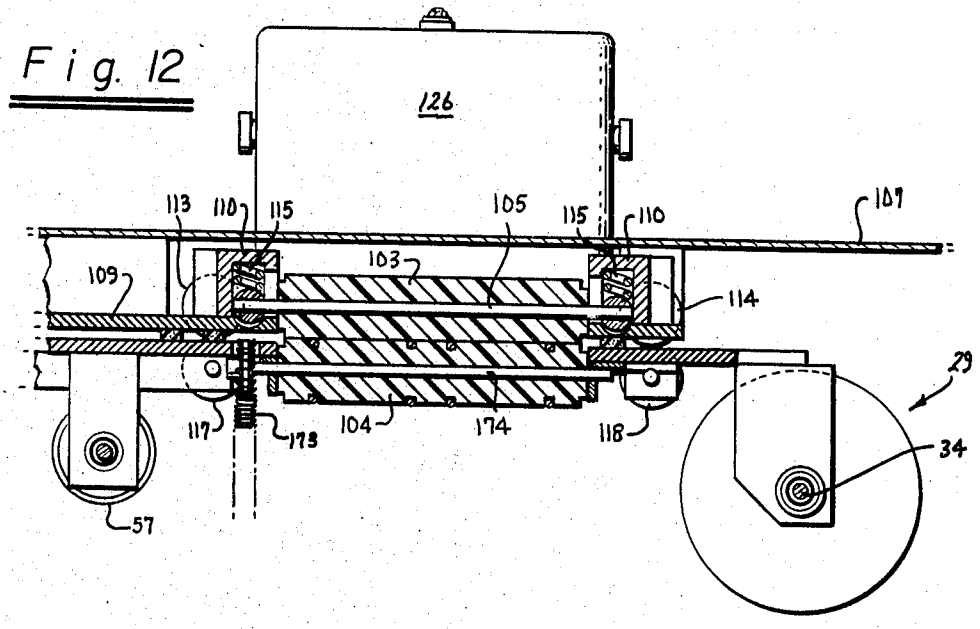
Fig. 12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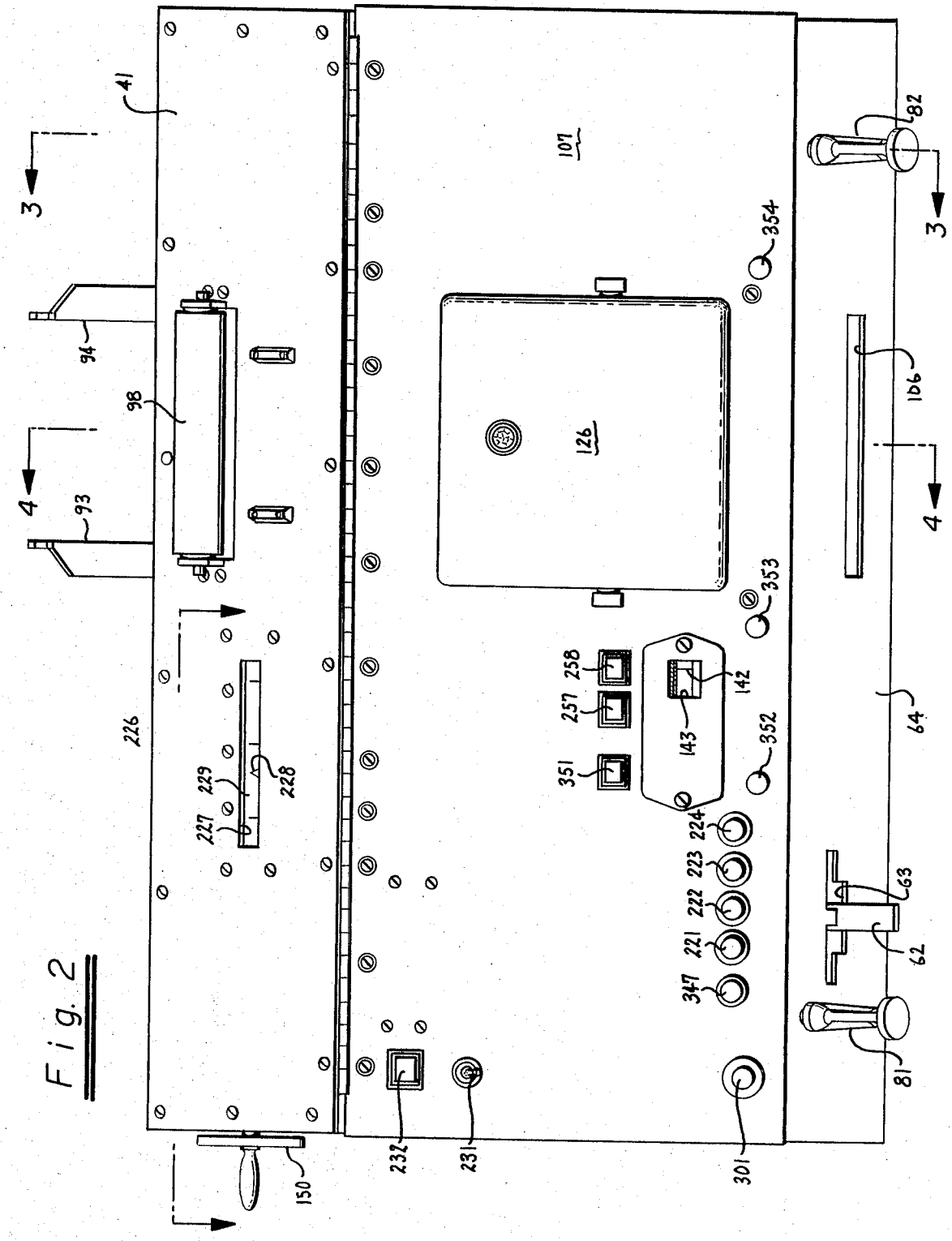
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Fig. 2

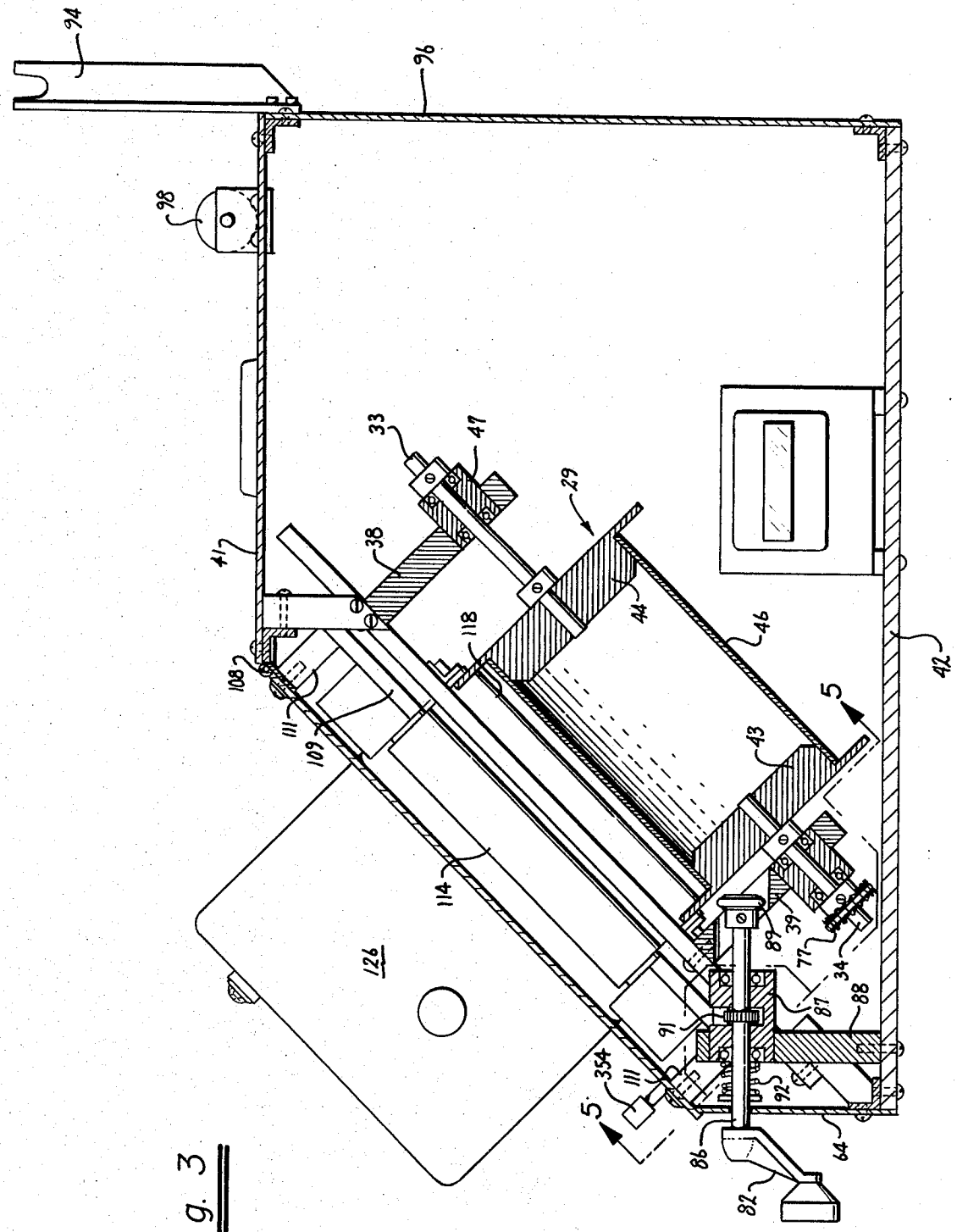
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Fig. 3

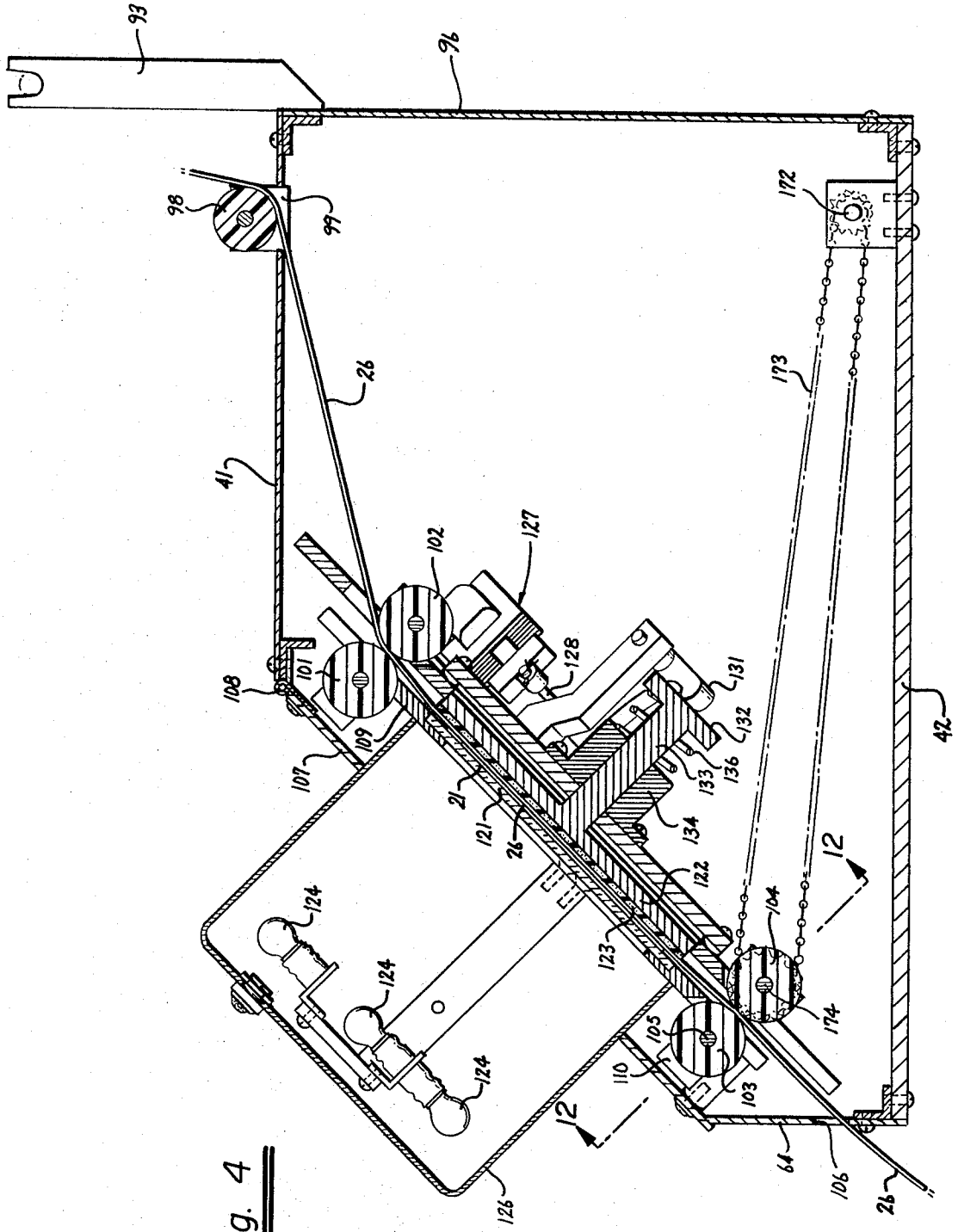
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Fig. 4

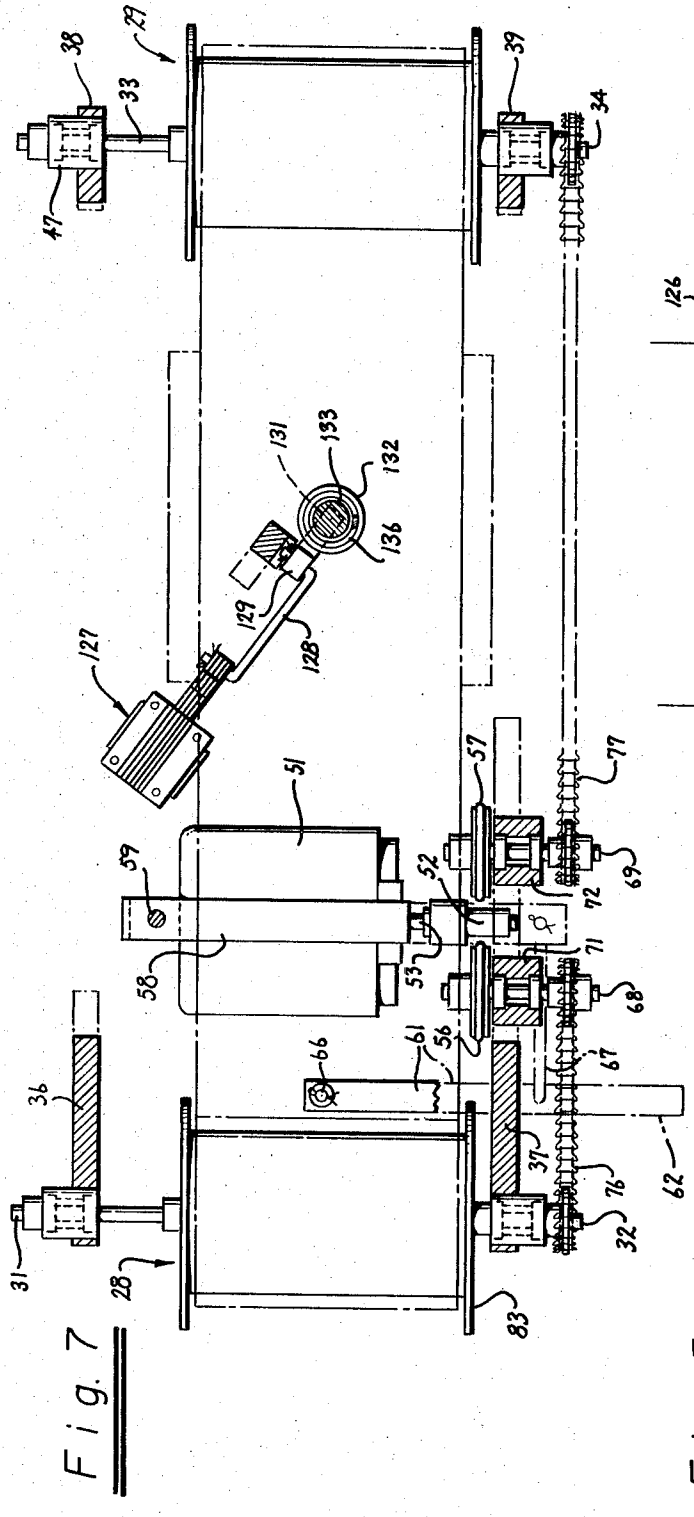


Fig. 7

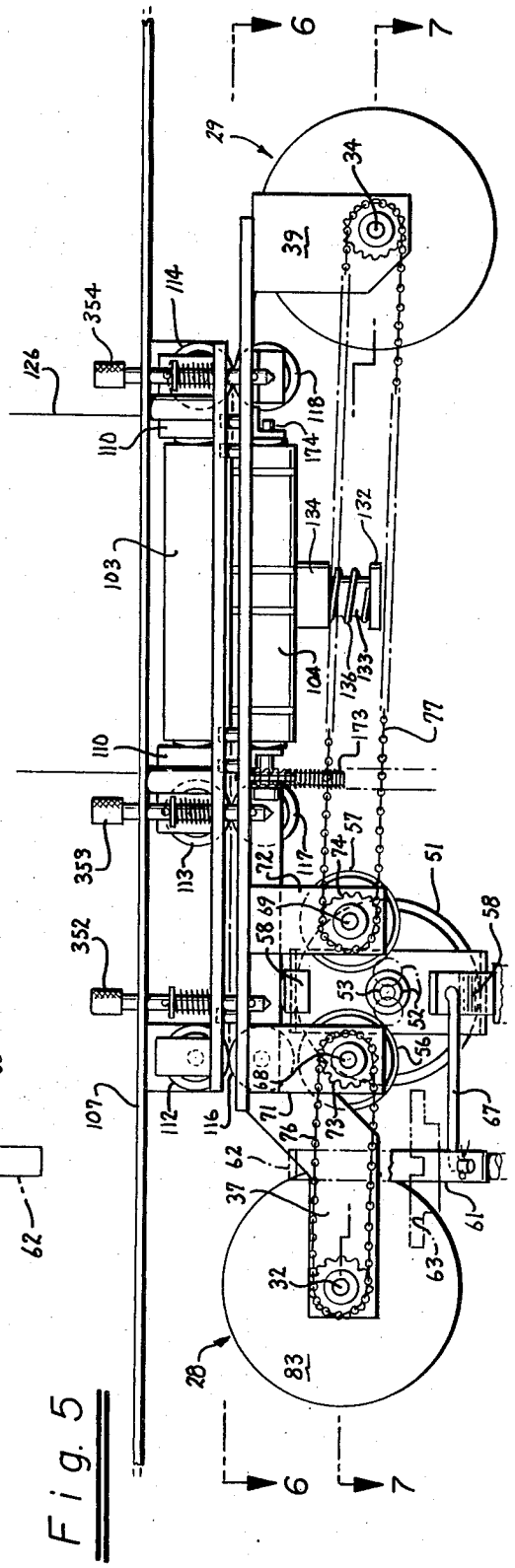


Fig. 5

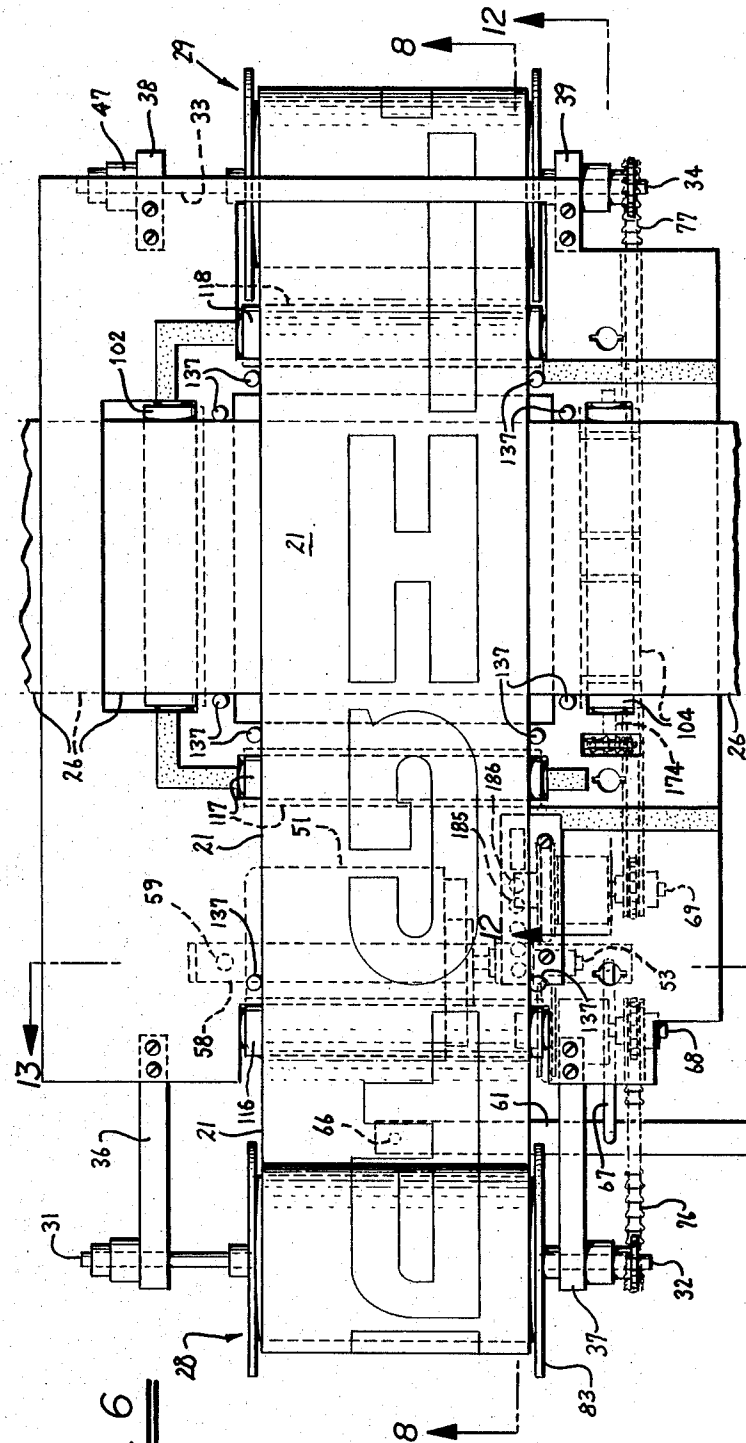


Fig. 6

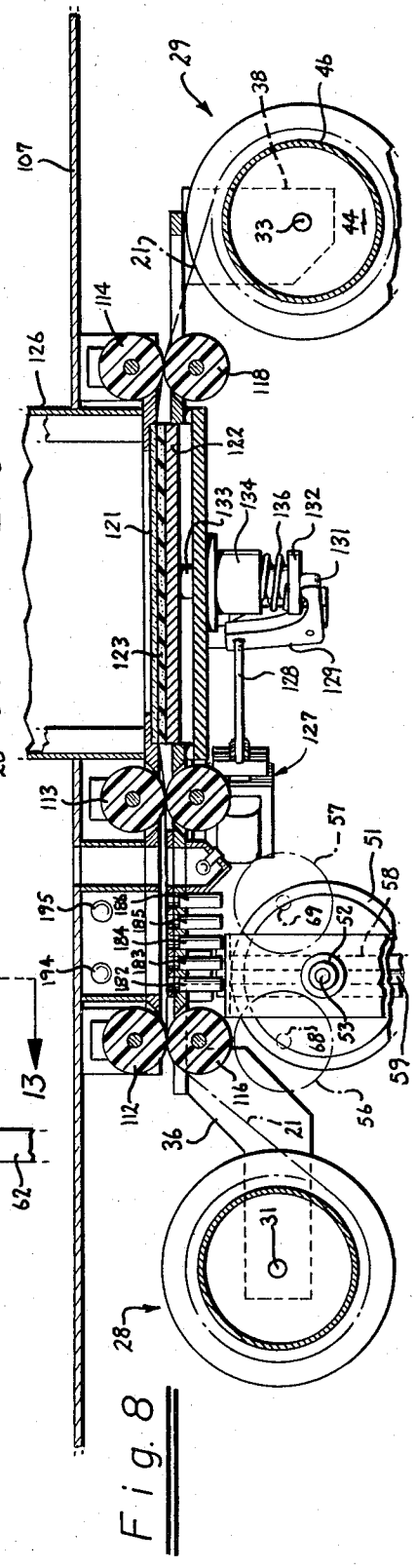


Fig. 8

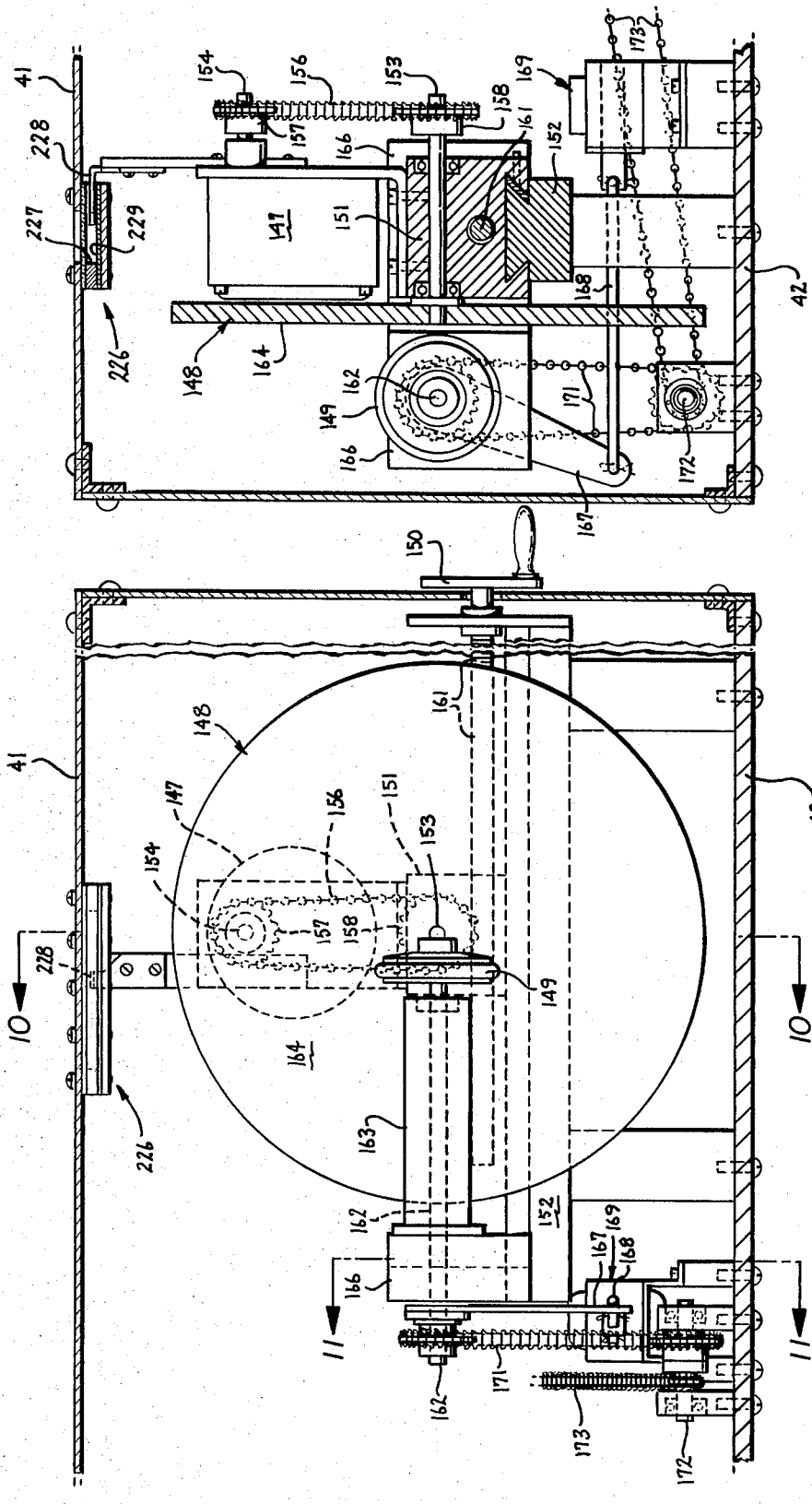
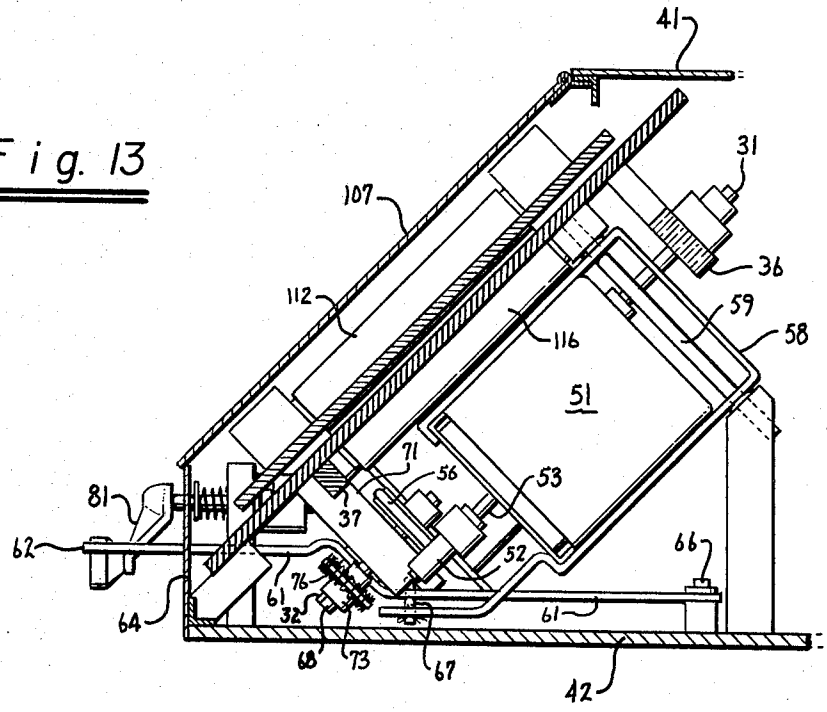


Fig. 9

Fig. 10

Fig. 13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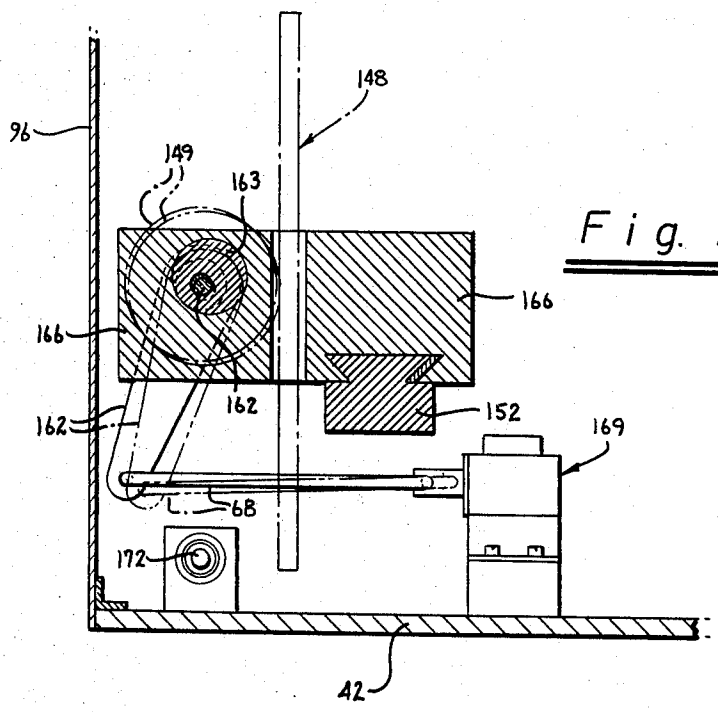
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Fig. 11

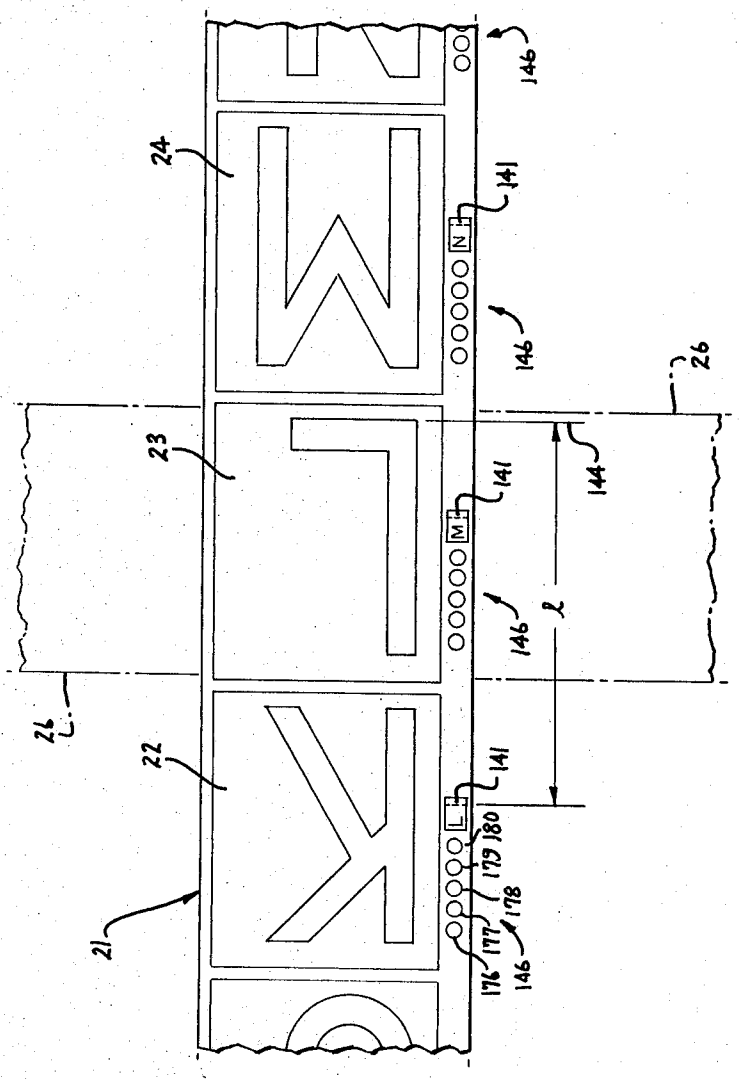
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Fig. 14

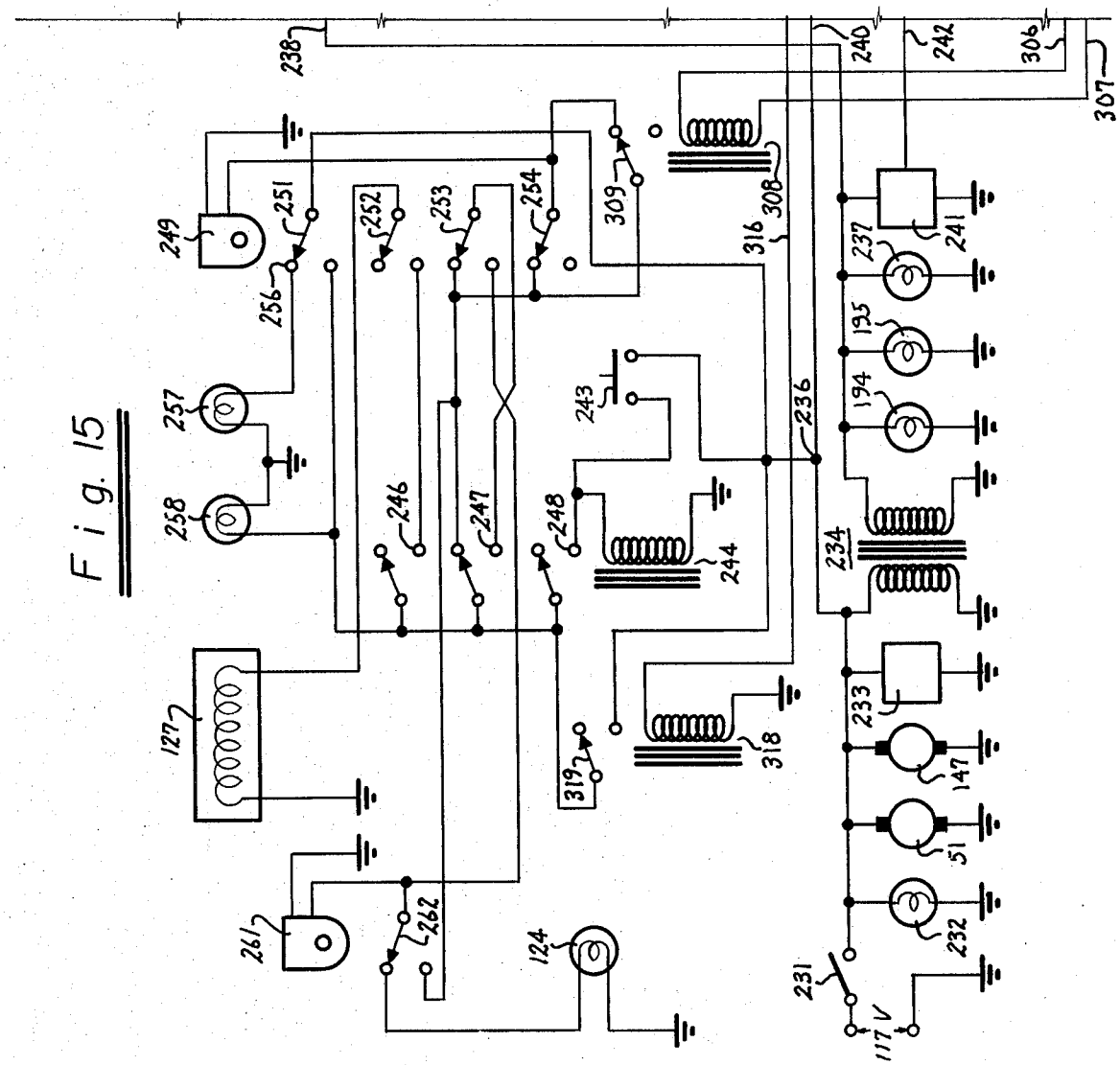
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Fig. 15

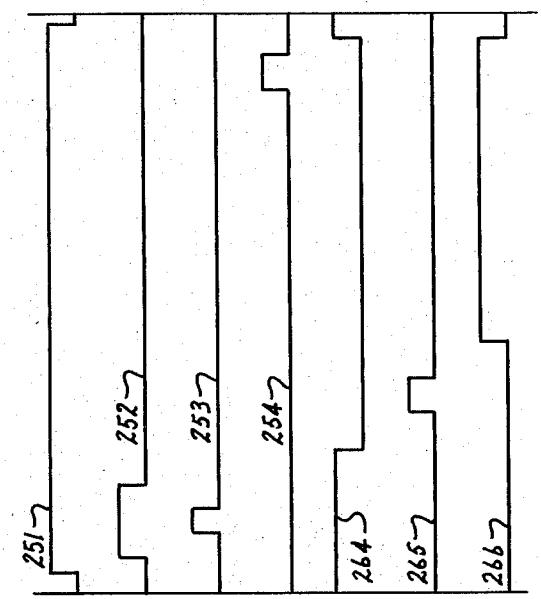
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Fig. 16

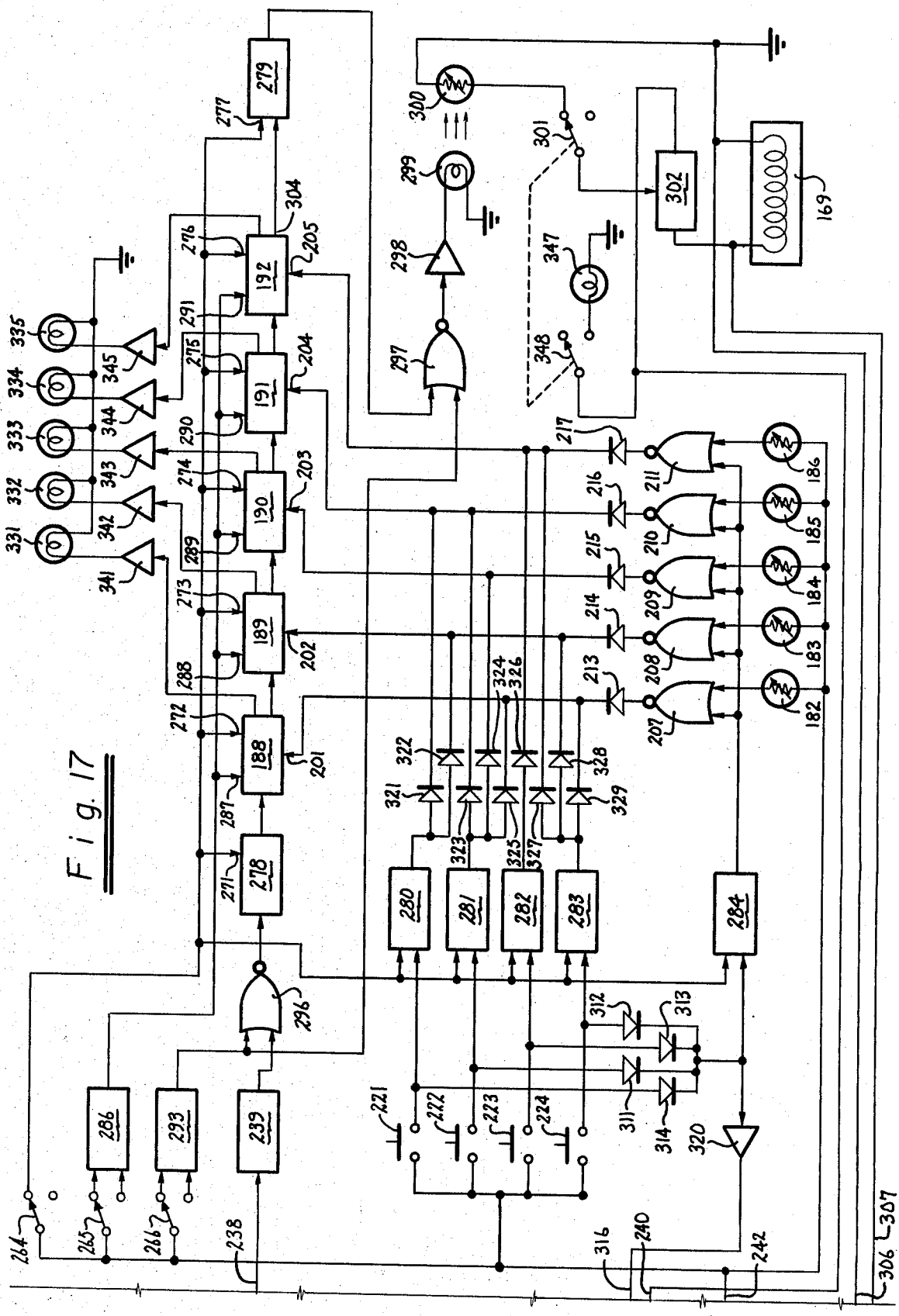

Fig. 17

PRINTING MACHINE

The invention relates to imaging and composing devices such as photocomposers and more particularly to apparatus for composing large alpha-numeric display characters.

An old and continuing problem in the printing art has been the production of large display letters, numbers or characters such as used for signs, banners and the like where a requirement for such characters may be in the order of 4 to 6 inches or more to provide ready readability at a distance. In printing, large wooden letters dominated display typesetting in the last century following the development of routing and pantographic machines for relative mass production of such type. Wooden letters now require prohibitive amounts of labor to use and, therefore, have been largely abandoned although they are still in use for occasional work where skilled and time consuming labor is needed to print acceptable letters. Difficulties in the use of wooden type may be readily observed in the presence of voids in ink distribution in the printed copy and the presence of nicks and other imperfections in the type occasioned by long handling, storage and use. Ironically, images which were readily and cheaply available from wood type in earlier times are still needed but have now become expensive and inefficient to obtain. Hand lettering which is one substitute for wood display lettering is also expensive and has become a somewhat neglected skill.

Large sizes of type may also be photographically achieved. Generally, however, such processes require repetitious blow-ups entailing the use of considerable and expensive equipment as well as the use of expensive photographic materials expended in the several steps. Also such equipment is limited as to size of characters which can be economically produced; and the quality of the product falls off with the number and extent of enlargements.

An object of the present invention is to provide a simple, compact, modest sized and relatively inexpensive machine which is nevertheless capable of producing large display characters of highest quality and will additionally automatically provide for proper spacing of successively printed characters. Another feature of the present invention is that the spacing between characters may be easily and precisely adjusted manually for individual kerning or letter spacing, or for uniformly large or for uniformly small spacing.

Another object of the present invention is to provide a printing machine of the character described which is simple and relatively foolproof in its operation and provides a simple technique of printing large letters on demand; easy and precise positioning of characters on a common base line without reference to size or shape of the character; and provides the foregoing without requiring judgmental decisions of any sort on the part of the operator. As another feature of the invention the apparatus provides greater operator-machine communication encouraging competence and improved accuracy and speed of operation.

A further object of the present invention is to provide a machine of the character described which is capable of printing an elongated strip or banner in a continuous length of any desired length.

Still another object of the present invention is to provide a printing machine of the character above which

will permit customized or personalized fonts for each user including trademark logoes, proprietary typestyles, penline flourishes, decorated letters, postal indicia, paste-up grids, self-made overlays for repetitive forms, etc. Fonts may be readily interchangeable in the machine and large amounts of fonts stored in the machine at one time for selective use and information storage.

The invention possesses other objects and features of advantage, some of which of the foregoing will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of this specification. It is to be understood, however, that variations in the showing made by the drawings and description may be adopted within the scope of the invention as set forth in the claims.

Referring to said drawings:

FIG. **1** is a perspective view of a printing machine constructed in accordance with the present invention.

FIG. **2** is a plan view of the machine on a somewhat enlarged scale.

FIG. **3** is a cross-sectional view taken substantially on the plane of line **3—3** of FIG. **2.**

FIG. **4** is a cross-sectional view taken substantially on the plane of line **4—4** of FIG. **2.**

FIG. **5** is a cross-sectional view taken substantially on the plane of line **5—5** of FIG. **4.**

FIG. **6** is a cross-sectional view taken substantially on the plane of line **6—6** of FIG. **5.**

FIG. **7** is a cross-sectional view taken substantially on the plane of line **7—7** of FIG. **5.**

FIG. **8** is a cross-sectional view taken substantially on the plane of line **8—8** of FIG. **6.**

FIG. **9** is a fragmentary cross-sectional view taken substantially on the plane of line **9—9** of FIG. **2.**

FIG. **10** is a fragmentary cross-sectional view taken substantially on the plane of line **10—10** of FIG. **9.**

FIG. **11** is a cross-sectional view taken substantially on the plane of line **11—11** of FIG. **9.**

FIG. **12** is a cross-sectional view taken substantially on the plane of line **12—12** of FIGS. **4** and **6.**

FIG. **13** is a cross-sectional view taken substantially on the plane of line **13—13** of FIG. **6.**

FIG. **14** is a fragmentary front elevation of a portion of the font strip forming a part of the present machine.

FIG. **15** is a schematic wiring diagram of a portion of the electrical controls in the present machine.

FIG. **16** is a graphic representation of the several timing cycles in the operation of the machine.

FIG. **17** is a schematic wiring diagram of the electronic circuitry used for reading the width codes of the present apparatus.

The printing machine of the present invention comprises briefly an elongated strip or length **21** of flexible material providing a series of longitudinally spaced image defining areas **22, 23** and **24** as seen in FIG. **14** and which is mounted for lengthwise movement in the machine as seen in FIGS. **6** and **8**; an elongated strip or length **26** of flexible material providing an image receiving member mounted for lengthwise movement in the machine, as seen in FIGS. **4** and **6,** perpendicularly to and traversing the imaging bearing font strip **21**; means, more fully hereinafter described, for moving members **21** and **26** for juxtaposing any of the image areas **22–24** and a succession of adjacent image receiv-

ing areas on member **26**; and means effecting a direct image transfer from member **21** to member **26.**

The mounting and drive means for the font strip **21** will be best seen in FIGS. **3, 5, 6, 7** and **8** and comprise a pair of end reels **28** and **29** about which the elongated strip **21** is wound in the manner of a scroll; and reels **28** and **29** are journaled for rotation in each instance on stub shafts **31** and **32,** and **33** and **34** journaled for rotation in supporting brackets **36** and **37,** and **38** and **39** in turn supported from the top and bottom walls **41** and **42** of the housing for the machine, see FIG. **3.** Preferably the reels **28–29** and shafts **31–34** are arranged for easy and rapid interchangeability for font strips **21.** A typical construction is seen in FIG. **3** where each of the reels is formed with a pair of end disc hubs **43** and **44** which are secured to shafts **34** and **33,** respectively, and which support a hollow cylinder **46** about which strip **21** is wound. Supporting bracket **38** is spaced sufficiently from hub **44** to permit withdrawal of the latter from cylinder **46** for removal of the cylinder, likewise from hub **43** and insertion of a new cylinder. In this operation it will be noted that shaft **33** will slide in an axial direction through its supporting bearing **47** carried by bracket **38.**

As will be understood strip **21** may be of any desired length to carry the number and types of fonts desired to be contained on one font strip. A full set of letters and numbers of 5 inches in height will require a font length of about 35 feet. Due to this length and the need for rapid movement fron one character to another, a motorized advance is used for gross movements of the strip with final precision positioning being accomplished manually. The motorized advance comprises an electric motor **51,** see FIGS. **5, 7, 8** and **13,** which is provided with a drive cylinder **52** on its drive shaft **53** which may be brought into selective drive engagement with spaced drive wheels **56** and **57.** As will be best seen in FIGS. **7** and **13,** motor **51** is mounted in a surrounding cage **58** which is journaled on shaft **59** located at the end of motor **51** opposite to drive cylinder **52** thus permitting the motor to swing laterally between drive wheels **56** and **57.** Swinging of cage **58** to effect such selective drive engagement is here effected by a manually engageable lever **61** having a forward end **62** projecting through an opening **63** provided in a front base wall **64** of the housing and having its rear end pivoted on a vertical pin **66** supported by the bottom wall **42** of the housing. Lever **61** is connected medially of its length to cage **58** by an arm **67** so that as lever **61** is swung to the left as seen in the drawings FIGS. **1, 2** and **7,** drive cylinder **52** will be moved into driving engagement with wheel **56;** and as lever **61** is swung to the right as viewed in these drawings, drive cylinder **52** will be moved to the right and into driving engagement with drive wheel **57.** In the first instance the font strip will be driven to the left at a relatively high rate of speed, and in the second instance the font strip will be driven at an equal speed to the right. Drive wheels **56** and **57** are secured to shafts **68** and **69** which are journaled in bearing blocks **71** and **72** and are fitted at their forwardly extending ends with sprocket wheels **73** and **74.** The latter are connected by drive chains **76** and **77** to reel shafts **32** and **34,** respectively. Opening **63** may be formed as seen in FIGS. **1** and **2** for providing easily recognizable left, right and center positions for lever end **62.**

With a little practice the operator will be able to advance the font strip to within a few characters of the one desired. Final movement of the font strip is accomplished by a pair of hand cranks **81** and **82** mounted at the front of the machine, see for example FIGS. **1, 2** and **3,** and which are selectively movable into engagement with the front hub disc **83** in the case of reel **28** and **43** in the case of reel **29.** A typical construction is illustrated in FIG. **3** where crank **82** is connected to shaft **86** mounted for longitudinal reciprocation in bearing **87** supported by bracket **88** from the bottom wall **42** of the housing. The rubber drive wheel **89** is mounted at the inner end of shaft **86** and will move on inward displacement of the shaft into driving engagement with hub disc **43.** A ratchet **91** is preferably mounted on shaft **86** to limit rotation to a clockwise direction advancing the font strip to the right as seen in the drawings. A spring **92** here engages bearing block **87** and a spring rest on shaft **86** and normally biases the shaft to an outward position disengaging drive wheel **89** from hub disc **43** as illustrated, and requiring the operator to push in on crank **82** to effect driving engagement. Crank **81** and its driving connection to hub disc **83** is constructed in a similar manner except that its ratchet prevents rotation of crank **81** only in a counterclockwise direction moving the font strip to the left.

As a feature of the present invention, each of the characters on the font strip have their height dimensions extending lengthwise of the strip and are related to the width of the image receiving member, receptor strip **26** so that the height of each of the letters, see FIG. **6,** will lay crosswise of strip **26.** With this relationship only one image defining area **22–24** will be placed in juxtaposition to strip **26;** and thus the image transfer will be exclusively confined to the juxtaposed character. Transfer of the image from strip **21** to strip **26** may be effected in any conventional manner such as by photographic process, electrostatic printing, etc. As here shown, a photographic process is used and the portions of strip **21** surrounding the image defining area are formed opaque with the image defining area itself being translucent; and member **26** is formed of photosensitive material such as photographic paper. Such paper may be obtained in long continuous lengths of 100 feet or more provided in rolls which may be here mounted on roll supporting brackets **93** and **94,** see FIGS **1, 2, 3** and **4,** secured to and extending upright from the rear wall **96** of the housing of the machine. Paper is fed from a paper roll **97** so supported around a roller carried by the top wall **41** of the housing through an opening **99** in the wall, between opposed pairs of rollers **101** and **102,** located above the juxtaposed area of strip **21,** between rollers **103** and **104** below such juxtaposed area, see FIG. **4,** and discharged through a lot **106** in front housing wall **64.**

With reference to FIG. **4** it will be seen that the housing is provided with a front downwardly sloping panel **107** which is hinged along its upper edge as seen at **108** to swing from a closed position as seen in FIG. **4** to elevated position exposing the interior parts as seen in FIG. **6.** A mounting plate **109** is supported from the underside of panel **107** and spaced in relation thereto by a plurality of studs **111,** see FIG. **3,** and which in turn supports rollers **101** and **103.** Preferably these rollers are provided with shafts **105** which are mounted in plate supported bearings **110,** see FIG. **12,** containing springs **115** urging the rollers downwardly into engage-

ment with rollers **102** and **104**. Additional rollers **112**, 113 and **114** are similarly carried by mounting plate **109**, see FIG. **8**, and these rollers are similarly spring pressed against a set of lower rollers **116**, **117** and **118** which support the font strip **21** for movement between its end reels **28** and **29**. Also carried by plate **109** between rollers **101** and **103** and rollers **113** and **114** is a transparent plate **121** which provides a planar support for the font strip. A platform **122** is mounted at the underside of the receptor strip **26** and is movable to and from plate **121** for pressing strips **21** and **26** into and out of direct contact. A compressible rubber pad **123** may be carried by platform **122** for direct engagement with receptor strip **26** so as to ensure a full face-to-face pressurized engagement of the juxtaposed strips for printing. Exposure of the receptor strip **26** is effected by a plurality of lamps **124** here mounted within a light box **126** carried by panel **107** in registration with the transparent plate **121**.

Means for reciprocating platform **122** to secure the strips for printing and to release the strips for movement is here effected by a solenoid **127**, see FIGS. **4**, 7 and **8**, which is connected by link **128** to bell crank **129**, best seen in FIG. **8**, which has one end **131** disposed for engagement with the outer end **132** of a stem **133** mounted for reciprocation in a supporting bearing **134**. A spring **136** mounted between bearing **134** and stem end **132** biases the platform to a lowered, open position. Energizing of solenoid **127** causes bell crank to displace the platform to its raised position clamping together the two intersecting strips in registration with the open bottom of light box **126** for exposure of receptor material **26**.

One of the important features of the present invention is the elimination of any need of a shutter or the like to control the image transfer or the masking off of areas not to be printed. This is accomplished by making the font strip opaque except for its image defining area so that only the image defining area will be printed on the receptor member. Also the light box is sealed in registration with the transparent plate which is in turn light sealed with only the juxtaposed areas of strips **21** and **26** so that only exposure of the desired portions will be effected. It will also be observed that the width of receptor strip **26** is selected to correspond with the height of the font characters to be printed. And in all cases up to the full dimensions of the light box and plate **121** controlled exposure is obtained without the use of shutters or masks or the like. The machine as illustrated is constructed for use in a dark room. It is, of course, feasable to attach an enclosure to the machine and particularly to the portions containing the unexposed film so as to enable operations under room light conditions. The easy and rapid interchangeability of different types of photosensitive materials is one of the features of the machine. Practically all photosensitive materials now on the market may be used. Since only a single direct contact print is used, as contrasted to a series of enlargements, there is a most economical use of photosensitive material. A series of pins **137** are preferably deployed as seen in FIG. **6** so as to cofunction with the other parts above described for very precise guidance of the perpendicularly traveling strips into the confronting overlapping position for printing.

With the right angularly related strip arrangement as here used the only precision required in positioning the font strip **21** is to obtain a uniform base line of a series of transferred images on the receptor material **26**. This is true regardless of the width of the letter or character on the font strip. The base line of the character is the only factor which remains constant in the application of the image to the receptor material. Means for obtaining such base alignment of the image areas on the receptor strip here comprises a line **141** on each of the image areas **22–24**, see FIG. **14**, which will be aligned with a cross hair **142** appearing in a window **143** in the front panel **107** overlying the font strip just ahead of light box **126**, see FIG. **2**. Line **141** is spaced by a uniform distance **1** from the base line **144** of the adjacent downstream character with which line **141** is identified. For example, in the illustration, FIG. **14**, line **141** will be physically positioned adjacent to the letter K although it is used to fix the position of letter L in printing position. Preferably line **141** is a dashed line in which the dashes will disappear only when brought into registration with the solid line of cross hair **141**. As a further aid to the operator the letter L will appear adjacent line **141** in image area **22** for identifying the character L in printing position **23**. In like manner the letter M will appear adjacent line **141** in image area **23** for identifying the next downstream character which would be in printing position when the associated line **141** was in registration with the cross hair. This precise positioning of the font strip may be quickly and easily accomplished by the use of hand cranks **81** and **82** as above explained. Because the viewing frame on the font is offset one frame from the printing frame, it makes it possible to view the letter being exposed even at the time the exposure is being made by the contact printing process which precludes any viewing of the font being exposed. This information enables the operator to be working ahead of the machine. As the exposure is being taken, the operator may prepare to position the next letter. The constant visual information thus provided prevents psychological block and improves operator-machine communication. The two strips are precisely and tautly held by the pressure plate during exposure and are otherwise relaxed for free running through the machine.

As another and important feature of the present invention, the movement of the receptor strip **26** may be automatically controlled according to the width of the last image transfer in order to obtain a desired predetermined spacing of the next successive image transfer. As will be understood since the structure of various characters, letters for example, varies with different letters of the alphabet and different type faces, spacing between adjacent letters must be individually tailored to obtain good overall appearance. In good spacing, the white area between the combining letters of a word is well distributed producing an effect of uniformity of "color" throughout the word. This variable spacing is here obtained by the use of a plurality of width codes on the font strip correlated with each of the image defining areas **22–24**; and means reading the width code and controlling the operation of the advance of the receptor member by a distance determined by the width code correlated with the last preceding image transfer. For example with reference to FIG. **14**, width code **146** in image area **22** will be correlated with the character, letter L, in image area **23**.

Advancement of the receptor strip **26** is here effected by drive roller **104**, see FIG. **4**, which is connected to a drive motor **147** and a multiple ratio transmission,

disc **148** and drive wheel **149** which is subject to manual operation, crank **150**, for controlling the drive ratio for establishing a predetermined spacing constant between adjacent image transfers. Thus, the amount of spacing between letters is controlled by two factors. One is the setting of the drive ratio of the transmission, and the other is the code provided on the font strip. The code insures proper optical or visual appearance of space between letters, and the manually operable means **149** may be used to uniformly vary the size of such space.

With reference to FIGS. **9** and **10** it will be seen that electric motor **147** and driving disc **148** are mounted on a carriage **151** in turn mounted for reciprocation on a horizontal rail **152**. Disc **148** is provided with a shaft **153** which here extends horizontally parallel to motor shaft **154** and is connected thereto by a chain **156** entrained around sprocket wheels **157** and **158** on these shafts. Hand crank **150** is connected by lead screw **161** to carriage **151** so that rotation of hand crank **150** will be accomplished by reciprocation of carriage **151** and drive disc **148** and electric motor **147** carried thereby.

Drive wheel **149** and its shaft **162** are carried by an elongated supporting member **163** with the shaft **162** and axis of rotation of wheel **149** parallel to the driving face **164** of disc **148**. Member **163** is supported for rotation in a bearing block **166** in turn supported from the bottom wall **42** of the housing, see FIGS. **9, 10** and **11**. With reference to FIG. **11** it will be seen that shaft **162** is eccentrically mounted in member **163** so that upon rotation of member **163** in bearing block **166** drive wheel **149** will be advanced to and retracted from the face **164** of disc **149**. Such rotary displacement of member **163** is here effected by an arm **167** connected and depending from member **163** and being connected by link **168** to solenoid **169**. Normally wheel **149** will be spaced from its driving engagement with disc **148** as seen in FIG. **10**, but will be advanced into such driving engagement upon energizing of solenoid **169** as seen in FIG. **11**. Connection of drive wheel **149** to the paper advance roller **104** here includes a chain **171** entrained around sprocket wheels on shaft **162** and idler shaft **172**, and a drive chain **173** entrained around drive sprocket on idler shaft **172** and shaft **174** for drive roller **104**. Accordingly, upon energizing of solenoid **169**, driver roller **104** will be rotated to advance the receptor strip **26** at a rate dependent upon the setting of the multiple ratio disc transmission **148–149**. In the present construction motor **147** has a constant speed, e.g., synchronous motor, so that the amount of advancement of the receptor strip **26** will be a function of time of energizing of solenoid **169**.

Accordingly, the width code reading means here functions as a timing means for energizing solenoid **169** according to the width code read. With reference to FIG. **14**, each of the width codes **146** comprises a plurality of code areas **176, 177, 178, 179** and **180** which may be encoded to provide a binary value representing the width of the correlated image area, that is, the width code in image area **22** being correlated with the width of the character in image area **23**. In the present instance, area **176** has a value of 1, area **177** a value of 2, area **178** a value of 4, area **179** a value of 8, and area **180** a value of 16. Thus a total value of 31 is assigned to the widest character in a given set of characters. The width code reading means accordingly comprises a plurality of devices **182, 183, 184, 185** and **186**, see FIG. **17**, arranged for sensing code areas **176–180** and being connected to a timing device comprising a plurality of serially connected countdown flip flops **188, 189, 190,** 191 and **192** having an output connected to and controlling the operation of solenoid **169**. In the present embodiment the code areas **176–180** are selectively light transmissive, providing its count when blocked and not counting when transparent. A pair of lamps **194** and **195**, see FIGS. **8** and **15**, are mounted for light transmission onto one side of the code areas **176–180**; and the sensing devices here comprise a plurality of photoelectric cells **182–186** mounted on the opposite side of the code area for sensing light transmitted thereto. The outputs of photoelectric cells **182–186** are connected to the present inputs **211, 212, 213, 214** and **215** of the countdown flip flops **188–192** through NOR gates **207, 208, 209, 210** and **211**, the connection of the latter to the flip flops being made through diodes **213, 214, 215, 216** and **217**.

As a further feature of the present invention spacing between sequential image transfers may also be performed manually by the use of a plurality of manually engageable switches **221, 222, 223** and **224**, see FIGS. **1, 2** and **17**, and which are connected as more fully hereinafter described to the countdown flip flops **188–192** for providing various fractional spacings. These manual adjustments may be used in the place of the automatic width code spacing as herein above described. For example, individual closing of the switches will provide for 30 percent, 40 percent, 50 percent and 60 percent of maximum spacing and will normally be used for individualized kerning. In considering percentage spacing, 100 percent spacing would be that used for the widest letter or character, a space somewhat larger than the letter itself. All other letter widths as represented by movement of the receptor strip are fractional multiples.

A spacing standard is, of course, set by the variable drive transmission provided by disc **148** and drive wheel **149**. Font sizes up to approximately **5** inches in height will vary in width into roughly three classes: Class **1**, up to 1 ¾ inches; Class **2**, between 1 ¾ inches and about 3 ½ inches; and Class **3**, from about 3 ½ inches to about 5 inches. Accordingly and as another feature of the present apparatus, a visible indicator **226**, see FIGS. **2, 9** and **10**, is provided for showing the relative radial position of drive wheel with respect to disc **148** and accordingly the drive ratio. Indicator **226** comprises a window **227** formed in the top wall **41** of the housing; an indicator hand or pointer **228** positioned for viewing through window **227** and mounted for movement with carriage **151**; and an indicator scale **229** mounted directly below pointer **228** in window **227** and having suitable indicia markings thereon as for example lines for indicating the Class **1**, Class **2** and Class **3** positions above referred to. Of course, the operator may adjust the pointer to any intermediate position to produce special effects, i.e., larger or smaller spacing between the characters. After the hand wheel **150** has thus been set for a particular font in the machine, the code on the font strip will take over automatically to set letter spacing subject to further manual adjustment by way of switches **121–124**.

A more detailed description of the operation of the machine and several electrical components involved follows. The machine is turned on and off through a power switch **231**, FIGS. **2** and **15**, with power lamp

232 indicating when power is on. The primary power circuit, FIG. 15, is also connected to drive motors 51 and 147; optionally to a running time hour meter 233; a stepdown transformer 234 and to input terminal 236 of the balance of the circuit shown in FIG. 15. Terminal 236 is also connected to input 240, see also FIG. 17. Transformer 234 supplies a reduced voltage to photocell lamps 194 and 195; character illuminating lamp 237, at window 143; terminal 238 for providing a 60 Hz signal to squaring circuit 239, see FIG. 17; rectifier 241 which provides a 5 volt DC circuit to terminal 242 for the photoelectric cells 182–186, see FIG. 17.

The desired character to be printed is advanced into printing position by use of a power advance lever 62 and with final adjustment as required being made by use of hand cranks 81 and 82. Printing operation is initiated by closing switch 243, FIG. 15, which may conveniently be a foot switch, energizing relay coil 244 closing relay switch contacts 246, 247 and 248 and energizing sequence timer motor 249. There are seven timer switches 251, 252, 253, 254, and 264, 265 and 266 associated with this timer and the sequence of their operation is illustrated in FIG. 16. Switch 251 normally engages contact 256 which energizes ready lamp 257, see FIGS. 2 and 15. Switch 251 is the first to change position causing ready lamp 257 to go out and printing lamp 258 to come on. Through timer switch 251 and contacts 248, relay is locked on for the rest of the primary cycle. Timer switch 252 next closes energizing platform solenoid 127. Timer switch 253 next closes which stops sequence timer motor 259 and energizes exposure timer motor 261. Timer switch 262, associated with exposure timer motor 261, next closes furnishing current to the exposure lamps 124, FIGS. 4 and 15, to expose a photosensitive paper 26. Exposure timer motor 261 will be set for proper exposure time following which switch 262 will change position turning off lamps 124 and restoring the operation of sequence timer motor 249. Timer switch 252 next opens which turns off the current to solenoid 127 allowing spring 156 to lower platform 122 to its normal position releasing the font strip 21 and receptor strip 26 for free longitudinal movement.

The three remaining timer switches operated by sequential timer motor 249 are shown in the upper left hand corner of FIG. 17. Switch 264 to this point of the operation has been closed holding the width computer generally depicted in FIG. 17 in a cleared state by applying a positive potential from terminal 242 to the clear input terminals 272, 273, 274, 275, 276 and 277 of the countdown flip flops 188–192 as well as flip flops 278, 279, 280, 281, 282, 283 and 284. Switch 264 changes position removing the potential from the clear input terminals of the several flip flops following which switch 265 closes which sets R–S flip flop 286 and sends a signal to the load input terminals 287, 288, 289, 290 and 291 of the five countdown flip flops 188–192 which causes them to preset if there is a signal at their preset inputs 201–205. Signals at these preset inputs are derived from the width code as above explained. When light strikes a photoelectric cell 182–186, the resistance of such a cell lowers and allows a current to flow to NOR gates 207–211 which turns off the gate and thus does not send a signal on to the respective preset input terminal 201–205. If light is blocked from the photocells 182–186 by the width code, the opposite happens and current is not allowed to flow to the connected NOR gate 207–211 which in turn does send a signal through blocking diodes 213–217 to the respective preset input 201–205.

Timer switch 265 then opens and timer switch 266 closes which resets R–S flip flop 293 and causes it to stop sending a signal to NOR gates 296 and 297. NOR gate 297 is then turned on and sends a signal to driver amplifier 298 which in turn energizes a photon coupler comprising light lamp 299 and photocell 300. When photocell 300 receives the light from lamp 299, the resistance of the photocell is lowered and allows current to flow through auto advance switch 301 into a triac power controller 302 which in turn energizes solenoid 169 for initiating the paper drive. At the same time NOR gate 296 which is not locked off by a signal from R–S flip flop 293 is receiving a square wave from squaring circuit 239 which turns NOR gate 296 on and off at 60 Hz. This signal is fed to flip flop 278 which divides it by 8 and sends it on to the string of countdown flip flops 188–192. These flip flops then count down from their preset state to zero. When zero is reached, a signal appears at output terminal 304 and is applied to R– S flip flop 279 starting it and sending a signal on to NOR gate 297 which locks it off and in turn turns off driver amplifier 298 and de-energizes the triac power controller 302 and solenoid 169 thus stopping the movement of the receptor strip 26. Triac power controller 302 also controls power output at terminals 306 and 307 which controls the energization of relay coil 308, see lower right corner of FIG. 15. Energizing of relay 308 opens relay switch 309 associated therewith allowing timer switch 254 to open near the end of the timer cycle and turn off timer motor 249 until the countdown flip flops count down to zero and turn off the triac power controller 302, which in turn turns off relay 308 closing contact 309 and restarting timer motor 249. Timer switch 254 then closes, timer switch 266 opens, and timer switch 264 closes clearing the width computer. Timer switch 251 then opens turning off timer motor 249 and printing lamp 258 and turning on ready lamp 257, thus ending the cycle.

For spacing between words, where nothing is to be printed, one of the manual spacing switches 211–224 is operated by pressing a connected button on the front panel. Closing of one of the switches 221–224 allows current to flow to the corresponding R–S flip flop 280–283 and through blocking diodes 311, 312, 313 and 314 to driver amplifier 316 and R–S flip flop 284. The output terminals 316 and 317 of amplifier 320 are connected to relay coil 318, see FIG. 15, which closes its relay switch 319 starting sequence timer motor 249 running. Because relay 244 has not been energized and therefore contacts 246–248 have not been closed, the sequence timer will skip over the printing function, that is raising the platform and turning the exposure lamps on. When R–S flip flop 284 receives a signal, it sets and in turn sends a signal on to the five photocell NOR gates 207–211 which locks them off so that signals from the photocells 182–186 are blocked. When the corresponding R–S flip flops 280–283 receive a signal from its manual switch 221–224, it sets and sends a signal through a group of associated blocking diodes 321, 322, 323, 324, 325, 326, 327, 328 and 329 and on to the appropriate preset input terminal 201–205 of flip flops 188–192 to correspond with the width assigned to that particular manual input switch 221–224. The rest of the paper advancing cycle follows in the normal

fashion above described. A plurality of indicator lamps **331, 332, 333, 334** and **335** may be used to show the value of the code read into the flip flops **188–192.** These lamps are here connected to the outputs of flip flops **188–192** by driver amplifiers **341, 342, 343, 344** and **345.**

Automatic advance switch **301** is thrown to its off position when the automatic advance, as determined by the width code, is not to be used. Throwing of this switch to its off position causes an indicator lamp **347** to be energized by a switch **348** ganged to switch **301.** Throwing of switch **301** will normally be done to provide special spacing for a character. After throwing of switch **301,** the normal printing cycle would be started by closing switch **243.** The machine will then print the character but will not space. When the cycle is finished and the ready light **257** comes on, the auto advance switch **301** is turned back on and one of the manual spacing switches **221–224** is operated. The end result is that a character is given a space other than that assigned to it by its width code **147.**

An indicator lamp **351** is here shown mounted on the front panel **107** and is connected to a paper sensing switch (not shown) which comes on to show when the machine is out of photosensitive paper. Front panel **107** is here locked in position by means of a plurality of latch pins **352, 353** and **354** which are insertable through openings in the underlying base plate for detachably securing the panel in its down latched position.

In summary it will be noted that the type comes out right reading, from left to right, aligned with a common base line, and the receptor material is moved automatically after each exposure so that desired spacing between letters is automatically achieved. The perpendicular arrangement of the font and receptor strips removes completely the necessity otherwise required where mounted for parallel movement for simultaneous synchronization with each other. While each strip is here moved in precise steps, the perpendicular arrangement avoids the need of stepping the strips in relation to each other, where errors may be cumulative. While the printing of individual characters or letters have been used for illustrative purposes, it will be understood that the apparatus may print a whole book page at a time or whole return post cards or the like.

It will now be clear that the present apparatus will perform over a wide range of sizes, with excellent end quality and with versatility concerning choice and sizes of material; and that the foregoing is accomplished in a relatively simple machine having few required settings.

We claim:

1. In a printing machine having an elongated first member mounted for lengthwise movement and providing a series of longitudinally spaced image defining areas of different widths, and an elongated image receiving second member mounted for lengthwise movement perpendicuarly to and transversing said first member, and means for moving said members for juxtaposing any of said image areas and a succession of image receiving areas on said second member, and means effecting image transfer from said first member to said second member, said first named means comprising a plurality of width codes on said first member correlated with said image defining areas, and a motor drive and multiple ratio transmission connected to advance said second member by distances determined by said width codes, the improvement comprising:

a motor driven disc having a drive face, and a driven wheel mounted for rotation about an axis parallel to said face;

a carriage supporting said disc and being mounted for reciprocation along said axis;

an electric motor mounted on said carriage and being connected to and driving said disc;

means moving said wheel and face into and out of engagement and being connected to and controlled by said width code reading means;

manually operable means connected to said carriage and effecting reciprocation thereof for controlling the drive ratio of said drive transmission and establishing a selectable spacing constant multiplier for said width codes; and

an indicator showing the relative drive ratio between said wheel and disc.

2. In a printing machine having an elongated first member mounted for lengthwise movement and providing a series of longitudinally spaced image defining areas of different widths, and an elongated image receiving second member mounted for lengthwise movement perpendicularly to and transversing said first member, and means for moving said members for juxtaposing any of said image areas and a succession of image receiving areas on said second member, and means effecting image transfer from said first member to said second member, said first named means comprising a plurality of width codes on said first member correlated with said image defining areas, and a motor drive and multiple ratio transmission connected to advance said second member by distances determined by said width codes, the improvement comprising:

a motor driven disc having a drive face, and a driven wheel mounted for rotation about an axis parallel to said face and being connected for advancing said second member;

means moving said wheel and face into and out of drive engagement and being connected to and controlled by said width codes;

manually operable means formed to effect a relative displacement of said wheel and disc radially of said face;

each of said width codes comprising a plurality of code areas for encoded binary value representing the width of the correlated image area;

a plurality of serially connected countdown flip flops each having a preset input;

said width code reading means sensing said code areas and being connected to said preset inputs; and

a solenoid connected to said wheel-face engagement means for engaging and disengaging said wheel and face and being connected to the output of said flip flops.

3. In a printing machine having an elongated first member mounted for lengthwise movement and providing a series of longitudinally spaced image defining areas of different widths, and an elongated image receiving second member mounted for lengthwise movement perpendicularly to and transversing said first member, and means for moving said members for juxtaposing any of said image areas and a succession of image receiving areas on said second member, and means effecting image transfer from said first member

to said second member, the improvement comprising:

a light transmitting plate juxtaposed to said first member;

a platform juxtaposed to said second member;

power operated means for effecting relative movement of said plate and platform for pressing said members into contact;

illumination means mounted to expose said second member through said image defining areas;

a viewing window spaced longitudinally of said first member from said plate and platform; and

means provided in one image defining area providing base alignment and identification of the adjacent juxtaposed image area and being displaced for viewing through said window.

4. A printing machine as defined in claim **3,** a motor drive for said second member;

a plurality of width codes on said first member correlated with said image defining areas;

means reading said width codes and controlling the operation of said motor drive for advancing said second member by distance determined by the width code correlated with the last preceding image transfer; and

sequential timing means energizing said platform moving means, said illumination means, and said motor drive.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,868,699

DATED : February 25, 1975

INVENTOR(S) : Christina B. Gardner and Bruce A. Odelberg

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 21, change "accomplished" to ---accompanied---.

Column 10, line 43, change "211-224" to ---221-224---.

Signed and Sealed this

twenty-third Day of December 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

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