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Lambert

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[54] **PRINTER WITH SCREEN FRAME LIFT AND SQUEEGEE SUPPORT PIVOT MEANS**

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[52] **U.S. Cl.** **101/123,** 101/114, 101/126

[51] **Int. Cl.** **B41l 13/00**

[58] **Field of Search** ... 101/114, 115, 123, 124, 129, 101/287, 126

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Primary Examiner—Robert E. Pulfrey
Assistant Examiner—R. E. Suter
Attorney, Agent, or Firm—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

The master frame which supports a transversely movable squeegee assembly and a removable screen chase is coupled by blocks including slide bearings to a rearwardly upwardly inclined shafts forming one member of each support assembly fixed to opposite sides of the table top of the screen printer cabinet. This allows the master frame to be raised and lowered and simultaneously moved rearwardly to permit easy visual inspection of the platen supporting the screen print substrate. The squeegee assembly is supported for movement by yoke members carrying open sided ball bushings at 90° to each other, which in turn slidably receive a pair of mounting shafts fixed to a rack bar in cantilever fashion. The rack bar, being pivoted at its ends, pivots the squeegee assembly about a horizontal axis extending parallel to the front panel of the screen printer. A drive motor fixed to the squeegee assembly mounting plate rotates a drive pinion in mesh with the rack on a side of the bar opposite to that of the horizontal ball bushing. Paired, angled male locator members are inclined 60° to the horizontal, in the same manner as the guide shafts of the support assemboy for the blocks, to accurately locate the master frame relative to female locator members fixed to the top of the cabinet table. A single lifting cylinder centrally located relative to the end bars of the master frame and the support assemblies effects equal force application to both sides of the master frame maintaining horizontal alignment between the same during complete lift of the master frame from the underlying table top. Rotatable clamping members, each carrying a torque screw, effect identical registration of the removable screen printing chase with the master frame during coupling of the chase to the frame. The platen is supported on the table top, beneath the master frame, by means allowing adjustment both fore and aft and to the right or left and dial indicators indicate the extent of shift from neutral positions in either direction for insuring proper relocation of the platen after removal and subsequent replacement.

7 Claims, 8 Drawing Figures

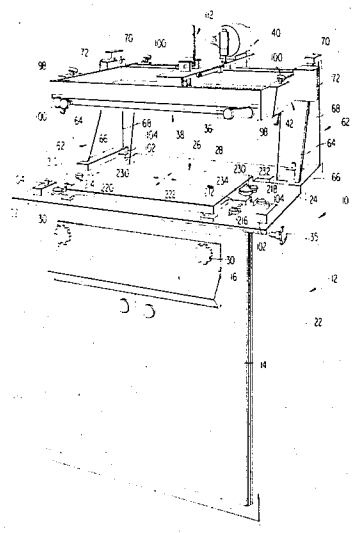
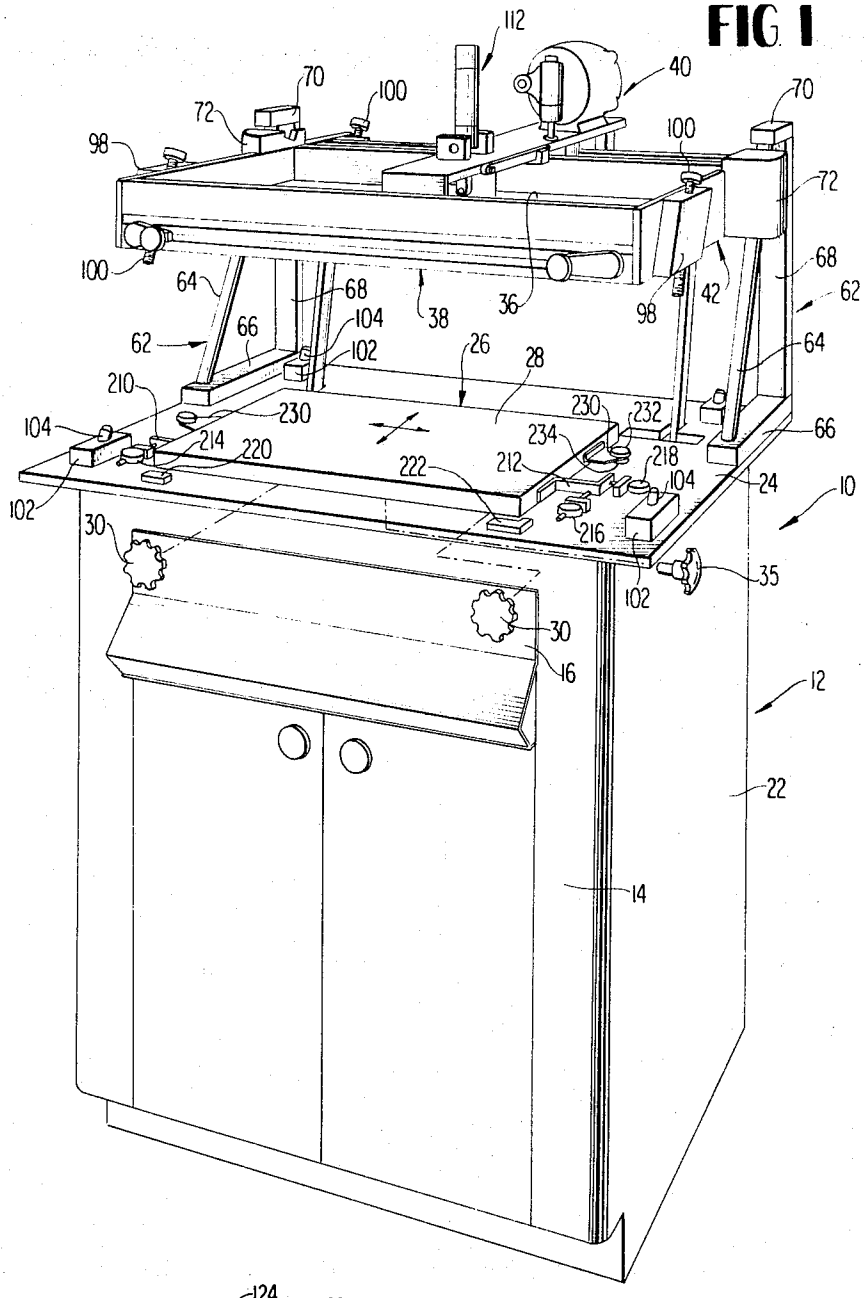


FIG 1



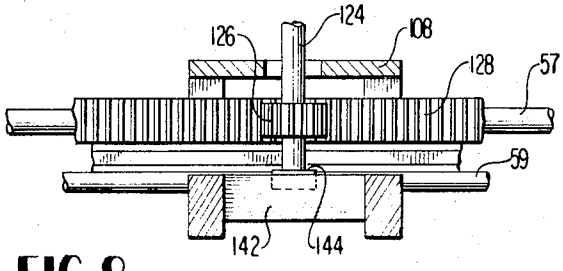


FIG 8

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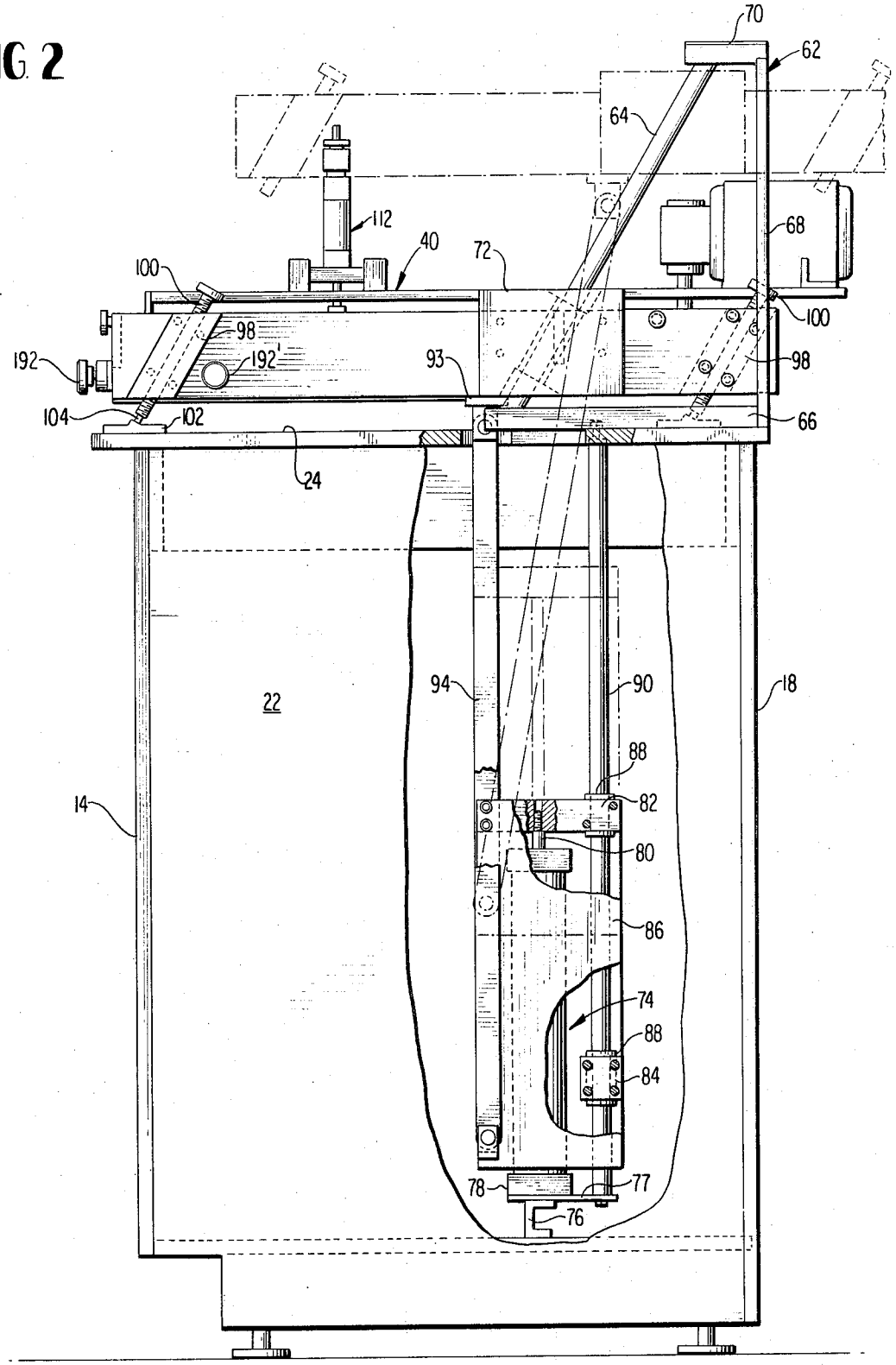
ATTORNEYS

FIG. 2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62
64
112
40
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68
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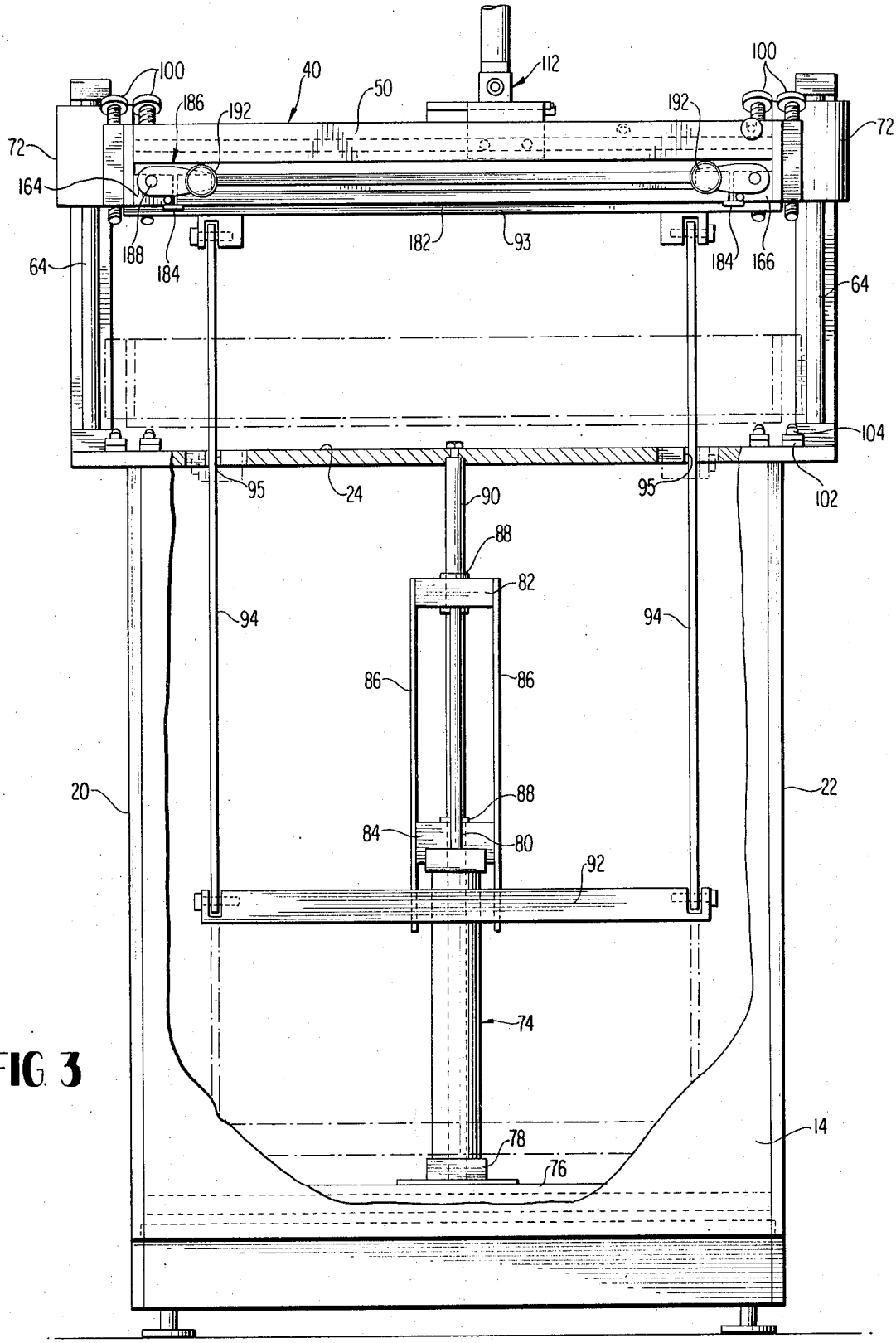
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102
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74
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14
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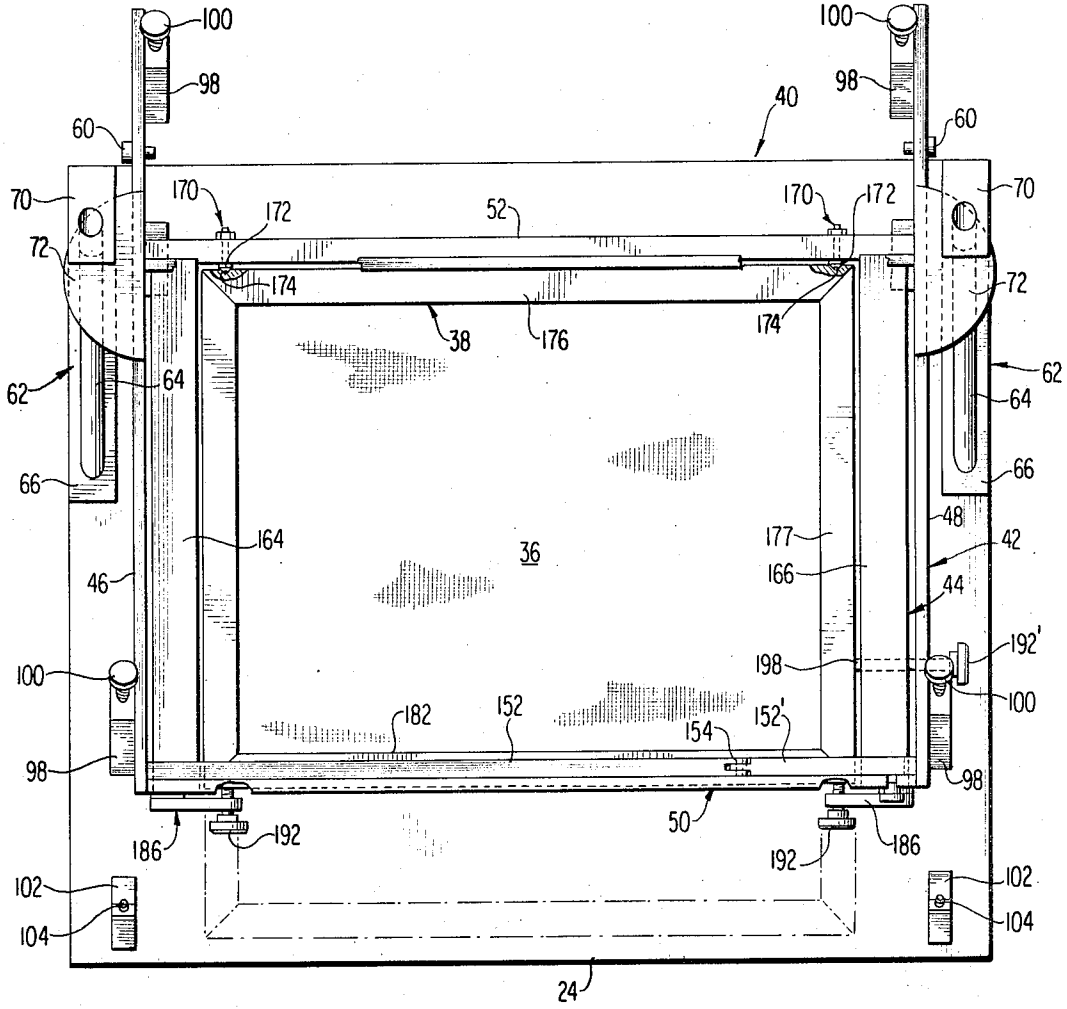
FIG. 3

FIG. 4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164
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170
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42
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192'
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182
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152'
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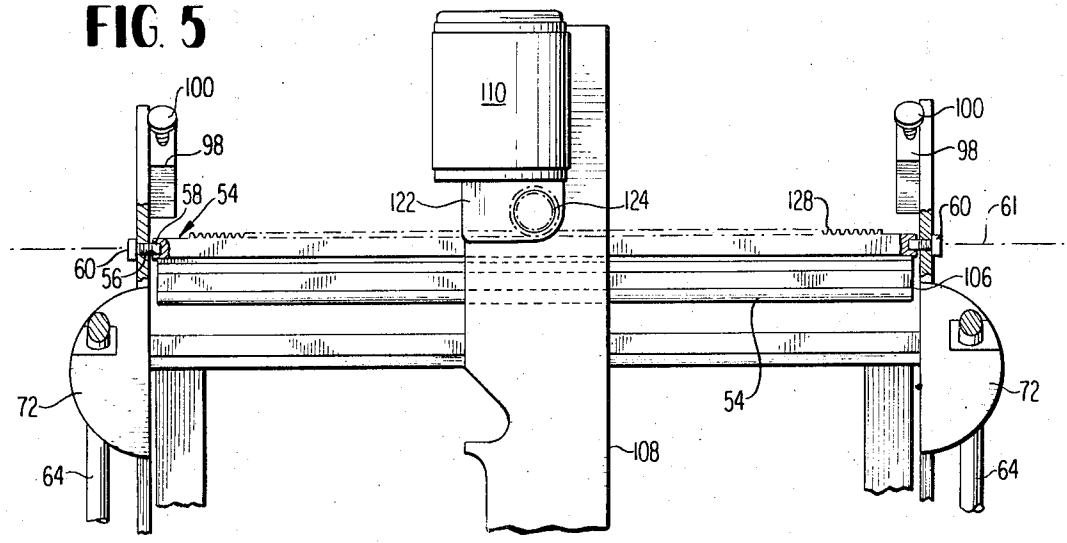
104
24

FIG. 5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54
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61
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72
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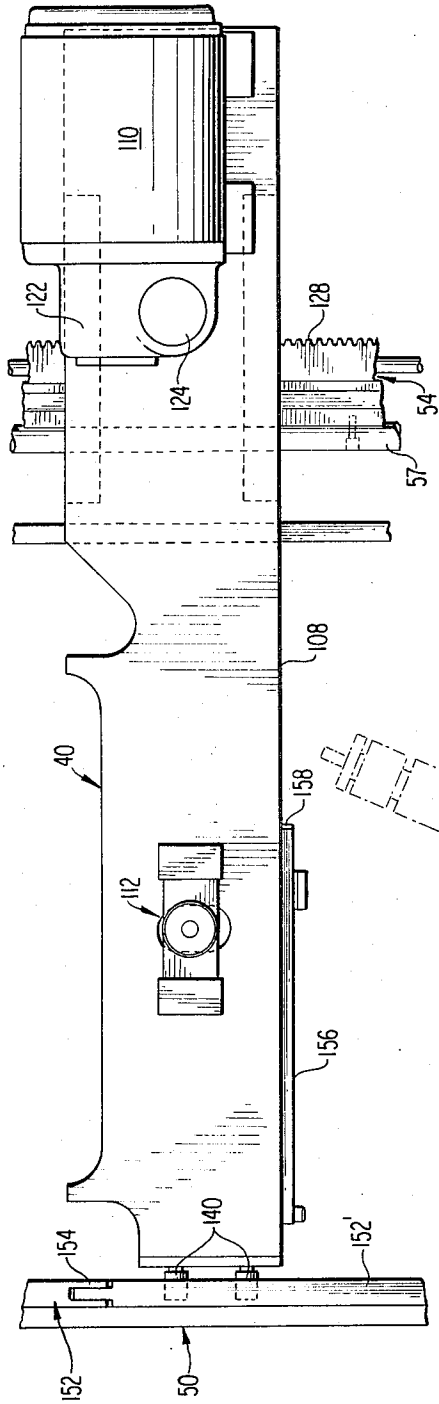
108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108
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112
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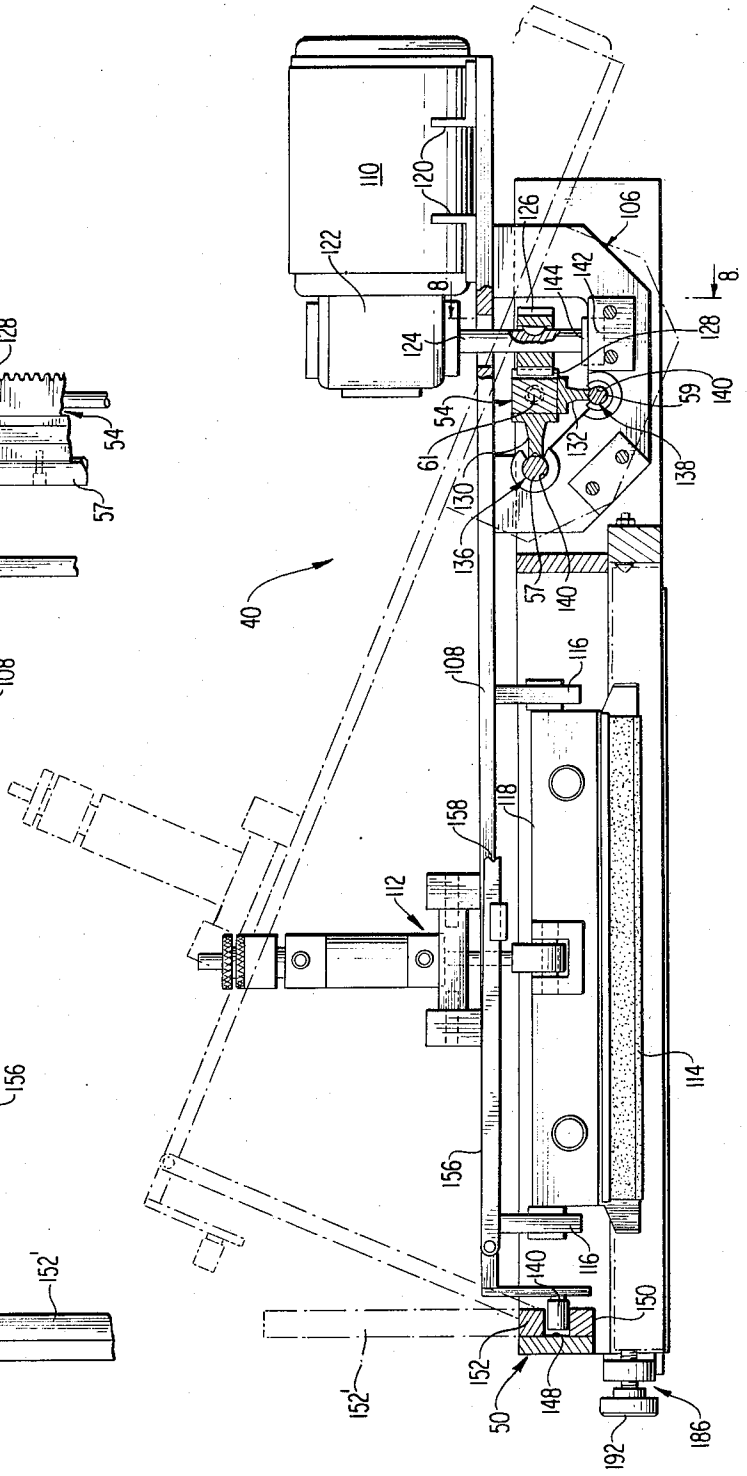
152'
152
50

FIG. 7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158
118
112
114
156
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150
152
152'
50
148
192
186

FIG. 6

PRINTER WITH SCREEN FRAME LIFT AND SQUEEGEE SUPPORT PIVOT MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to screen printing machines and more particularly to a screen printing machine for use in the manufacture of printed circuits requiring extremely close tolerances in the circuit patterns printed on the substrate blanks.

2. Description of the Prior Art

Silk screen printing is an established art and basically involves the employment of a platen or table which has a flat surface supporting a planar blank material for printing thereon. A stencil, commonly called a silk screen, overlies the blank substrate and ink is forced through openings in the screen to produce a printed pattern. The present screen printers are highly automated and operate satisfactorily for screen printing of decals, etc.

In an attempt to employ screen printing as a means for producing printed electrical circuits, sophisticated machines have been required for achieving high fidelity patterns, since the electrical characteristics of the same are highly dependent upon both the thickness and the width of the conductive patterns. The creation of the printed circuits is principally achieved by the use of a resist liquid on localized regions of the blank with the resist preventing removal of the desired metal at localized regions of the metallic surface overlays, during subsequent etching.

One machine capable of producing high fidelity printed electrical circuits was developed which eliminates the necessity of effecting drive means at opposite sides of the moving squeegee assembly and to thereby increase the fidelity of the pattern achieved. This machine is set forth in my U. S. Pat. No. 3,650,208 issued Mar. 21, 1972. The screen printing machine of this application includes a squeegee assembly supported by a squeegee drive bar which extends laterally across the table and above the screen. Front and rear, longitudinally extending fixed bars support the squeegee drive bar on opposite sides of the screen. A longitudinally extending rack fixed to the rear support bar has coupled thereto a driven spur gear coupled in turn to a drive motor supported on the squeegee drive bar to drive the squeegee bar longitudinally in either direction. A ball bushing rod cantilevered in a highly rigid fashion to the side of the rear vertical support bar opposite that carrying the rack circumferentially engages a ball bushing rod with circumferential contact in excess of 180°. The contact surface being directly opposite to the drive pinion and rack opposes the reaction force between the pinion and rack. At the front of the machine, the front support bar is F-shaped in cross sectional configuration with the longitudinally extending groove facing the end of the squeegee drive bar and receiving a plurality of roller bearings carried by the drive bar. The front and rear support bars act in conjunction with end bars to define a rectangular frame assembly which is raised and lowered vertically and, when raised, allows the screen support frame or chase to be released at one end and pivoted at the other end so as to incline downwardly allowing access to the same.

The machine of the referred to patent provides great versatility to the screen printing industry and allows the

screen to be removed readily when the master frame is raised vertically. While, further, due to the employment of the C-shaped open faced bearing opposite to the pinion reaction force on the stationary rack, a drive to one end of the squeegee exists, several disadvantages occur, even with this improved form of apparatus. In raising the master frame including the screen printing frame and the squeegee assembly, vertically, with respect to the underlying table and platen, the master frame assembly and its components tend to obscure the vision of the operator with respect to the underlying platen and the printed work product. Further, in order to have access to the screen and removability of the same, it is necessary to move the screen printing frame relative to the squeegee mechanism prior to disengagement, and complete removal is achieved by allowing the front end of the screen chase to be released and pivoting about the rear end of the screen such that the screen is then inclined downwardly and forwardly toward the front cabinet face.

SUMMARY OF THE INVENTION

This invention is directed to an improved screen printing machine over that set forth in the referred to application which readily employs features common to the same but which allows ready viewing of the printed workpiece by the machine operator after a minimum raising of the master frame vertically. This is achieved by effecting simultaneous rearward and upward movement of the master frame without in any way compromising the registration of the master frame and screen relative to the underlying platen. The master frame is supported by blocks on either longitudinal end of the machine, which blocks include slide bearings, through which pass a rearwardly inclined guide bar or shaft forming a 60° angle to the horizontal and acting as a part of a support assembly effecting great rigidity and maximum preciseness in vertically rearward shifting of the master frame and the components carried thereby. Inclined male registration or locator members carried at spaced locations along the side of the master frame insure proper registration when the frame is returned to immediate overlying position with respect to the cabinet table with the ends of the male locator members being received by respective fixed female locator members at corresponding positions on the table top. Pivotable links to the master frame and to a center bar which, in turn, is coupled to the movable piston of a central fixed air cylinder insures sliding movement of the master frame upwardly and rearwardly with equal force application to both sides of the rectangular master frame. The longitudinally extending rack bar at the rear of the master frame is pivotably coupled to the same for rotation about a horizontal axis. In turn, the rack bar has a vertical rack on one face extending the length of the same and cantilevered support mounting shafts fixed to the opposite face and a bottom face such that shaft supports are at right angles to each other. The shafts are received within C-shaped, open ball bushings carried on a common yoke assembly which, in turn, is fixed to the horizontal squeegee assembly mounting plate which supports the drive motor. The motor carries a driving pinion in mesh with the rack for moving the squeegee assembly longitudinally from one side of the machine to the other by sliding the same on the shafts. Thus, the yoke assembly supports the squeegee assembly for rotation about a horizontal axis with

respect to the master frame. The screen frame or chase in turn is slidably removed horizontally from guide slots within the master frame such that the screen underlies the squeegee mechanism with the squeegee blades in contact therewith. A filler frame assembly carries at spaced locations convex locating pins and the screen chase carries indentations. Further, the filler frame assembly carries at the front of the master frame a pair of rotatable locking clamps, the free ends of which carry torque screws in line with respective chase locating pins and the indentations in the screen chase or frame so as to properly locate and lock the screen chase in a fore and aft direction each time the same is inserted within the frame assembly. Secondary torque screws carried by the filler frame assembly side bars are employed to lock the screen chase frame sidewise to further insure proper location of the same relative to the platen and the squeegee mechanism.

In turn, means operatively arranged on the table top effect fore and aft and side to side shifting of the platen from a median position as indicated by dial indicators having contact pins in contact with sides of the platen. Thus, by recording the indications on the dial relative to a median position both with respect to fore and aft movement and side to side movement, removal and replacement of the platen may be made each time by the mere act of shifting the platen in directions to insure identical readings of the dial indicators to that occurring during initial placement and setting of the platen thereon for repetitive printing of the same pattern with precise registration to the screen pattern since, in turn, the blank to be printed in each case is accurately located on the platen and beneath the chase screen. Appropriate friction clamping means associated with the platen and the underlying table top accurately maintains the position of the platen once the registered position has been achieved for multi-cycle printing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the improved screen printing machine of the present invention.

FIG. **2** is a side elevational view, partially in section, of the machine of FIG. **1** with the elevated and rearwardly displaced position of the printing head shown in dotted lines.

FIG. **3** is a front elevation of the machine of FIGS. **1** and **2**, partially in section, with the head elevated in contrast to the retracted dotted line position as shown.

FIG. **4** is a top plan view of a portion of the machine shown in the preceding Figures, the dotted line position illustrating the screen chase partially removed from the filler frame assembly.

FIG. **5** is a top plan view of the rear portion of the machine illustrating the pivotable rack bar supporting the traversing squeegee assembly.

FIG. **6** is a side elevational view, partially in section, of the head with the angularly raised position of the squeegee assembly illustrated in dotted line fashion.

FIG. **7** is a top plan view of the portion of the machine shown in FIG. **6**.

FIG. **8** is a sectional elevational view of a portion of the drive apparatus shown in FIG. **6** taken about lines **8-8**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning to the drawings, there is shown an improved screen printing machine **10** of the present invention, which comprises a stationary table **12** of cabinet construction including a front panel **14** which may carry controls or the like at **16**, a rear panel **18**, side panels or walls **20** and **22** on the left and right hand sides respectively, and a flat table top **24**.

The interior of the cabinet table **12** readily carries the components necessary to the operation of the screen printing machine **10**, such as the containers (not shown) for holding the ink and other materials. The present invention is not directed in any way to these features, and those portions of the machine have been purposely left incomplete. To this extent, the table top or platen support surface **24** supports a raised platen **26** preferably having an upper surface **28** and being fixed to the table top **24** by means allowing fore and aft shifting and side to side shifting under control of operating knobs **30** and **35**. The platen surface **28** which may be preferably perforated and to which may be applied vacuum as a hold down means in conventional fashion has positioned thereon the blank sheet (not shown) or other element upon which printing occurs. Means preferably carried by the platen positively locates the blank sheet thereon in conventional fashion in the case of printed electrical circuits. The blank sheet is of conventional laminated construction having an insulative substrate supporting an upper metallic surface upon which the resist coating material is to be printed. These elements are all conventional, and as illustrated in the referred to patent overlying the blank sheet material is, of course, a screen **36** which is common to all screen printing operations. The screen is best illustrated in FIG. **4** and has its marginal edges removably coupled to a screen chase or frame **38** of boxlike configuration, which will be described in detail hereinafter.

The present invention is directed principally to the head or combined screen and squeegee frame assembly **40** which includes a master frame assembly **42** and a filler frame assembly **44** which, in turn, supports the screen chase or frame **38**. In this respect, the master frame assembly **42** comprises side frame members **46** and **48** at the left and right sides, respectively, and relatively thick, planar, front support bar **50** and a planar, rear support bar **52**. These members form the rectangular box frame assembly **40** with their edges being joined in suitable fashion. Preferably, these members are formed of light weight metal such as aluminum and are bolted together or welded to provide a rigid assembly. The side frame members **46** and **48** extend rearwardly beyond the rear support bar **52** and carry between the same rack bar **54**, FIG. **5**, and support bar **54** for rotation about a horizontal axis. In this respect, the ends of rectangular rack bar **54** carry cylindrical recesses **56**, within which are the smooth cylindrical ends **58** of a pair of threaded large screws **60** which are threaded into respective left and right and master frame side bars **46** and **48**. The squeegee assembly **112** is mounted on the rack bar **54** for traversing from side to side across the face of the underlying screen **36** and platen **26** with this assembly rotatable about the horizontal pivot axis **61** as defined by screws **60**, FIG. **5**.

Unlike the referred to application, rather than having the master frame assembly shifted vertically upwardly to a raised position above the table and platen, the mechanism of the present invention allows the frame assembly to be raised but simultaneously moved rearwardly in a simple manner but one in which there is no

compromise with the accurate registration of the squeegee assembly, the screen chase and the underlying platen regardless of the number of times the head is raised relative to the table and returned to platen and blank contact position. In this respect, at both sides of the machine, there are provided support assemblies **62** which consist of an inclined guide shaft **64** which is inclined rearwardly at 60° to the horizontal and maintained in position on a base plate **66** by cooperating vertical rail **68** and cap **70.** Each support assembly is not in reality a triangle, but closely approximates the same, in fact, it is a slight trapizoid but provides the rigidity of a triangular support, Coupled to each of the side frames **46** and **48** of the master frame assembly are blocks **72** which constitute slide bearings for the inclined guide shafts **64** received thereby. Under this type of relationship, the head rises at a 60° angle rearwardly. Thus, as the head is moved in a horizontal plane, it moves to the rear and, therefore, the operator standing at eye level in relationship to the platen **26** has a clear view of the platen and blank without the necessity of raising the head to any great extent. This may seem to constitute a simple maneuver, but it is complicated by the fact that moving the head both vertically and horizontally simultaneously creates alignment problems especially in an environment where the head is continuously being raised and lowered as the screen frames are replaced, and the individual blanks receiving the imprint. Thus, under the arrangement of the present invention, a 12 inch overall vertical lift produces what could only be achieved in the prior machine by a lift of some **18** to **20** inches. Both the time and the amount of energy required to move the mass is thereby considerably lessened.

The raising of the head **40** is achieved through the simple expedient of a single compressed air reciprocating motor **74,** the base of which is coupled to a horizontal support member **76** by coupling **78.** The piston (not shown) slidable within the same is coupled via shaft **80,** which in turn is coupled to a top lift block **82,** the top lift block **82** being coupled in turn to a bottom lift block **84** by side plates **86** forming fixed coupling members extending and therebetween. The blocks carry sleeve bearings **88** which in turn receive a fixed guide shaft or bar **90.** Guide shaft **90** extends vertically between cabinet top **24** and a lower mounting plate **77.** The side plates **86** carry a lift bar **92,** the bar being coupled in turn directly to an underlying frame bar **93** by pinned links **94** defining a clevis connection. Shaft **90** therefore functions as a guide shaft at the center of the machine and is positioned at an equal distance relative to both the right and left support assemblies **62.** Movement of the master frame assembly occurs along and inclined path defined by guide shafts **64.** Further, since rigid generally supports triangular **62** are employed at both ends of the master frame assembly, there is eliminated any play or slop of movement as the head lifts, and under this type of arrangement the squeegee may be moved to left and right simultaneously with raising of the head, if this is in fact desired. The air motor **74** is a simple reciprocating air cylinder of the known type, and the controls and fluid supply lines to the same have been purposely eliminated. The clevis links **94** allows the pure vertical movement of the vertical lift bar **92** to be transmitted to inclined movement of the head assembly, the links **94** oscillating within slots **95** of table top **24.**

By the application of compressed air, the piston extends to move the head **40** to the dotted line position shown in FIG. **2,** which is rearward well as raised. This allows the operator to visually observe the printed pattern on the blank carried on the upper surface of the platen **26.** Even though the head moves both vertically upward and rearwardly, there is no registration problem when returning to the table top **24** of the machine, since on each side frame **46** and **48** of the master frame assembly, there are provided at the front and rear, fixed blocks **98,** each having inclined tapped and threaded holes therein for carrying a threaded female locator member or screw **100,** the ends of which are recessed to receive on a fixed block **102** a male pin or locator member **104,** which is also inclined upwardly and rearwardly at A 60° angle to the horizontal and acts to penetrate the end of female locator member **100.** The screws **100** may be rotated to vary the extent of projection from the bottom end of blocks **98** so as to properly receive the male pins **104.**

A second principal aspect of the present invention resides in the method of mounting the squeegee drive mechanism, since in the present design, similar to that of the referred to application, the squeegee is powered from one side only, thus providing numerous advantages besides low cost and simplicity. The placement of the squeegee drive to one side of the squeegee eliminates immediately alignment and synchronization problems inherent in the prior art drive mechanisms which require parallel drive units on each side of the squeegee bar.

In this respect, by reference to FIGS. **5, 6, 7** and **8,** the details of the arrangement are readily seen. The rack bar **54** pivots about horizontal axis **61** defined by pivot mounting bolts **60** and thus everything coupled thereto pivots about the same axis. Reference to FIG. **6** shows the basic elements pivoting about axis **61** which comprise yoke assembly **106,** squeegee mounting plate **108,** drive motor **110** and the extensible and pivotable squeegee assembly illustrated generally at **112.** In this respect, the squeegee assembly is identical to or very similar to that shown in the referred to application, and there is no need to discuss the details or features of the same with the exception that it is to be noted that the squeegee blades **114** contact the upper surface of the screen **36** and sweep across the same during longitudinal movement from side to side, while further, the squeegee support bar **118** is eccentrically mounted via bearings **116** so as to provide individual end adjustment of the squeegee support bar as set forth in detail in the specification of the referred to application.

It is important to note, however, that the method of supporting the squeegee assembly **112** is somewhat different from the referred to application. In this respect, the motor **110** is fixed to the squeegee mounting plate **108** by brackets **120** and gear reduction means **122** provide a proper rotative speed for output shaft **124** which depends at right angles to that of the motor shaft for motor **110.** The driving pinion **126** is keyed to shaft **124** and meshes with rack **128** which is formed within the vertical rear face of the pivotable rack bar **54.** Horizontally extending ball bushing rods or shafts **57** and **59** extend parallel to each other and are fixed to the front and bottom surfaces of the rack bar **54** by respective horizontal and vertical cantilever coupling members **130** and **132.** In turn, yoke assembly **106** carries at 90°

oriented positions, and open sided ball bushings **136** and **138.** Each ball bushing may be constructed in segmented block form and consists of a semi-cylindrical bearing surface **140** which extends in excess of 180° and completely envelopes the exposed cylindrical surface of the ball bushing shaft or rod facing the moving squeegee assembly **112** with this assembly of course being mounted for movement relative to the fixed ball bushing rods or shafts **57** and **59.** Yoke assembly **106** therefore rotates along with mounting plate **108** and the components carried thereby about axis **61** without in any way disrupting the transverse driving effect of the pinion and rack connection. In this respect, a bearing **142** carried by the yoke assembly **106** receives the enlarged end **144** of drive shaft **124** which in turn carries driving pinion **126.**

The entire gear rack assembly pivots about axis **61** within the master frame so that the whole squeegee assembly **112** may be rotated while centered on the gear rack. This, in effect, allows the screen chase to be inserted within the master frame assembly in an exact horizontal plane from the front of the machine, since readily the squeegee may be lifted out of the way and will not act to interfere with insertion of the screen chase. This provides for several advantages. One is that the unit is less expensive to build, while providing improved registerability. The screen may be preregistered, it may be inserted and removed in about one-fifth the amount of time of any screen holder of the known prior art. This is achieved primarily due to the use of two shafts on which the squeegee traverses which are parallel to each other and both of which are fixed to the gear rack with the gear rack acting as the pivot point. Thus, both good traversing action is achieved while allowing rotation of the traversing mechanism about an axis parallel to the path of traversing movement. Regardless of the tilted or untilted position of the squeegee mounting plate **108,** the drive mechanism is in constant mesh with the rack and accuracy is rapidly maintained.

As stressed in the referred to application, the position of the open face ball bushing **136** opposite that of the rack **128** on the rear face of bar **54** insures that the reaction forces are opposed by bearing surfaces. Thus, in the prior arrangement, the entire force created by the spur gear of pinion **126** wanting to unseat itself from the rack **128** was directed against the good or closed side of the open faced ball bushing **136** and in the arrangement of the present invention the inclusion of a second open faced ball bushing **138** at right angles to the first **136** actually inhibits forward movement toward this bearing **136,** so that the criticality of the open ball bushing is not as great where two 90° ball bushings are employed. Obviously, in the present invention, traversing of the squeegee can occur with the yoke oriented such that the squeegee is in proper horizontal position or at some angle thereto, as in the dotted line position shown in FIG. **6.** The open faced ball bushing **136** is so mounted that the reaction force on the drive mechanism is not dependent upon the structural integrity of a completely surrounded ball bushing due to the fact that the reaction force acts directly on the curved surface of the open faced ball bushing. In addition, the squeegee assembly **112** is provided with multiple roller bearings **146** which are received within a longitudinal groove or slot **148** formed within front rail **50** of the master frame. However, in this case, the front rail **50** comprises a fixed bottom rail portion **150** and a split top rail **152,** including a pivotable portion **152'** which is pivotably coupled at **154** such that it may be raised to dotted line position illustrated in FIG. **6,** thus allowing the roller bearing **146** to be removed from the slot **148** formed thereby. Once the squeegee mounting plate **112** is rotated to the dotted line position, FIG. **6,** a kick stand **156** which is pivotably coupled to the side of plate **108,** may be rotated to a 90° position such that its notched end **158** rests upon the front rail **50** to maintain the inclined position shown in FIG. **6.**

The male and female locator members although primarily used for registration purposes, have another important duty. By turning the threaded female locator members **100,** adjacent portions of the head moves vertically relative to the underlying platen and thus these adjustments allow for complete parallelism to be set up with respect to the platen.

Turning next to the filler frame assembly **44,** it is this filler frame assembly that provides the repeatability in registration which is believed unique in screen printing machines. In that respect, FIG. **4,** the filler frame assembly **44** consists of side frame members **164** and **166** for left and right sides respectively coupled together by support bars **50** and **52.** Bar **52** carries a pair of longitudinally spaced chase locator pins **170** having cone shape, that is, convex heads **172** which are received within concave openings or indentations **174** of the rear screen chase or frame member **176.** In the illustrated machine, the chase locator pins **170** are spaced at an exact distance of 25.187 inches from each other, and this distance remains constant and is employed similarly for the spaced indentations **174** carried by the rear frame member **176** of the screen chase **38.** Thus, by merely dimpling a counter concave hole, that matches the point on the locator pin for every chase manufactured, it allows accurate registration of the same relative to the master frame and all components supported thereby. The location of the chase locator pins **170** tends to set the position of the screen chase **38** on a side to side basis when the same is inserted within an opening defined by the front and new bars and **52** and the filler frame side members **164** and **166.** Locking clamps **186,** as shown in FIGS. **3** and **4,** are pivotably coupled to the filler frame side bars **164** and **166** by means of shoulder screws **188** which define the pivot points for the same. At the outboard end of each clamp **186,** there is provided a torque screw **192** with the tapered tip of the torque screw contacting the chase member **182** and lying in line with respective chase locator pins **170** fixed to the rear frame member **40** at the rear of the chase. Therefore, after the chase **38** is slid horizontally into the master frame assembly such that its dimples **174** contact the points **172** on the end of the locator pins, the locking clamps **186** are swiveled to a position such that the torque screws **192** exert a force through the chase **38,** against the respective pins. The fact that the screws are torque screws allows the force to be exerted against each pin **170** to remain constant regardless of the amount of rotation of the same by the operator. Otherwise, the operator could overtighten the screws **192,** and different operators would force the screen chase into the frame assembly to a greater or lesser extent and readily affect the accuracy of registration of this component to the other components of the system.

Side to side locking is achieved by side torque screw **192'** whose end **198** bears on frame member **177.**

The operation of the torque screws, which are quite conventional and readily purchasable items on the market, is quite simple. They may be preloaded to whatever torque desired, that is, with a screw having a range between **84** foot pounds torque to **365** foot pounds, a value of, for instance, **100** foot pounds torque may be pre-set. Conventionally, a threaded stud is included in the handle mechanism, and the handle mechanism is machined so that it rotates freely around the stud, except that the stud is dimpled to receive a ball bearing which is pressed into the dimple by a socket set screw in the master handle. Further, there is a spring involved such that the tighter one turns the spring and the further down the socket set screw is turned, the stronger the force is that keeps the ball bearing in the dimple in the stud. If set for 100 pounds, the ball bearing will stay in the dimple until the 100 pounds torque is exceeded. Then it flops out and allows the handle to spin freely regardless of the continued attempts to tighten down on the assembly. Under this arrangement in the present invention, the various screens are accurately maintained in a position of high registration regardless of the number of times they are replaced or removed and reinserted.

The importance of accurate registration of the screen chase with respect to the raisable and rearwardly shiftable head is amplified by the fact that the present invention also allows for accurate registration of the platen with respect to the table regardless of the number of times that the platen is removed or replaced for reuse at a later date. Normally, platens are provided for a single or a minimum number of jobs and, assuming reprinting of certain patterns at daily or monthly intervals, there is no loss of registration of the same by the simple expedient of first providing means for shifting the platen, both side to side and fore and aft, and, secondly, means for giving a ready visual indication of the exact position of the same, whether shifted or not for replacement in that exact position. In that respect, reference to FIG. **1** illustrates that by rotation of control knobs **30,** the platen may be mechanically moved fore and aft, that is, towards the front or the rear of the machine, while rotation of knob **35,** depending upon the direction effects, by conventional mechanical means, shifting of the platen **26** to the left or right, that is, from side to side. Further, the platen **26** is provided with various abutment members, a left hand abutment member **210** and a right hand abutment member **212** which contact the projecting ends of dial indicators **214, 216** and **218.** In this respect, dial indicators **214** atd **216** measure the fore and aft or front and rear movement of platen **26,** while dial indicator **218** measures the displacement of the platen from right to left. In this respect, the overall movement of the platen through the mechanism of control knobs **30** and **35** is one inch to the right and one inch to the rear. Therefore, the dial indicators read from 0 to full capacity, a total of one inch each. The platen is moved by rotation of these knobs until they contact blocks known as the zero blocks, the blocks being indicated at **220** and **222** respectively, with the platen **26** coupled to the adjusting knobs **30.** The platen is set such that the head surfaces contact respective stops **220** and **222** and at that time the dial indicators are adjusted manually to zero position. Now, since there is an inch of movement totally for each dial indicator, the platen position is adjusted by using the dial indicators as a guide to crank the platen away from its initial position one-half of an inch or so both in a front to rear or fore and aft direction and from left to right or vice versa from right to left, so as to move it slightly out of the way of the stops as indicated in the drawing. The shifting is initially limited to one-half inch so that each dial shows a one-half inch allowance for variation from this so-called mean position. Thus, the platen is now in a true mean or nominal position and the final set up of a specific job is achieved by first bringing the screen in contact with the platen effecting a first print out, printing and visually ascertaining the register between the screen and the underlying blank. If lack of registration occurs, minor shifting of the platen in either direction is effected until after several printings, the image now completely lines up with the screen and in this instance the initial set up is complete. Thus, due to the slight shifting, the dial indicators **214, 216** and **218** may read rather than **500** or nominal position, positions such as **483, 542** and **764,** for instance. Thus a record is made of the dial indicator numbers after set up is complete and any time subsequent to the particular run in question, the plate may be readily set to exact registration with the screen providing the particular job by merely shifting the position of the platen to positions read out from the dial indicators as **483, 542** and **764.** Set up time is greatly reduced. The dial locators allow ready determination of accurate registration after the initial somewhat tedius set up.

To prevent misalignment during multiple runs or printouts, a pair of L-shaped generally triangular plates **230** extend outwardly from the sides of the platen and carry notches therein which are received within overlying and underlying friction pads **232** and **234,** the knobs carrying the open pad being rotated move the pads together and to frictionally lock the flexible plate **230** between their soft frictional surfaces and thereby prevent shifting during the sweeping traverse of the squeegee assembly in either direction.

What is claimed is:

1. In a screen printing machine including a table for supporting blanks to be printed, the improvement comprising:

a rectangular master frame assembly,

a squeegee assembly supported on said master frame assembly for traversing movement across the master frame assembly from side to side and generally parallel to said table,

a screen lying intermediate of said squeegee assembly and said blank,

fixed guide shaft means inclined rearwardly and upwardly from said table on each side thereof,

bushing means carried by said master frame assembly on respective sides thereof and slidably receiving respective guide shaft means, said bushing means being located toward the rear of said master frame assembly,

means for raising and lowering said master frame assembly on said guide shaft means, said screen being carried by a rectangular screen chase coupled to said master frame assembly and moveable therewith, said means coupling said screen chase to said master frame assembly including a filler frame assembly, including means for sliding said screen chase relative to said master frame assembly for fa-

cilitating removal and replacement of the chase, said filler frame assembly and said screen chase including abutting frame members, one of said members including projecting registration pins carried at longitudinally spaced positions and said other member carrying dimples at respective positions for receiving said pins, rotatable clamps carried by said filler frame assembly and rotatable into overlying position with respect to a frame member of said screen chase, and a torque screw carried by each clamp for contacting a frame member of said screen chase with the axis of the torque screws being generally in line with the pins and dimples on respective members,

whereby; registration is achieved by forcing said screen chase in contact with said filler frame assembly under torque forces limited by said torque screws.

2. In a screen printing machine including a table for supporting blanks to be printed, the improvement comprising:

a rectangular master frame assembly,

a squeegee assembly supported on said master frame assembly for traversing movement across the master frame assembly from side to side and generally parallel to said table,

a screen lying intermediate of said squeegee assembly and said blank,

fixed guide shaft means inclined rearwardly and upwardly from said table on each side thereof,

a horizontal base member supporting the lower end of said rearwardly and upwardly inclined guide shaft means,

a vertical support member extending upwardly from the other end of said base member and generally intersecting the axis of said inclined guide shaft means,

means coupling the upper end of said guide shaft means and said vertical support member,

blocks carried by said master frame on each side thereof for carrying said bushing means,

a vertically oriented, centrally located reciprocating air motor fixed relative to said table and including a reciprocating piston therein,

a lift bar operatively coupled to said piston and extending generally between a pair of link members on each side of said rectangular master frame assembly and being operatively coupled to said piston at the center thereof,

said pair of link members pivotably coupled to respective ends of said lift bar and to respective sides of said master frame assembly for raising and lowering said master frame assembly by forces exerted on said master frame assembly in the vicinity of respective bushing means.

3. In a screen printing machine including a table for supporting blanks to be printed, the improvement comprising:

a rectangular master frame assembly,

a squeegee assembly supported on said master frame assembly for traversing movement across the master frame assembly from side to side and generally parallel to said table,

a screen lying intermediate of said squeegee assembly and said blank,

fixed guide shaft means inclined rearwardly and upwardly from said table on each side thereof,

bushing means carried by said master frame assembly on respective sides thereof and slidably receiving respective guide shaft means, said bushing means being located toward the rear of said master frame assembly,

means for raising and lowering said master frame assembly on said guide shaft means,

cooperating oppositely inclined axially aligned mutually engageable locator means carried by said table and said frame assembly respectively, said locator means including multiple pairs of male and female locator members, one of said members being carried by said table top and extending upwardly therefrom at the same angle of inclination as said inclined guide shaft means and said other member carried by said master frame and inclined downwardly in axial alignment with said other locator member of said pair.

4. The screen printing machine as claimed in claim **3,** wherein each female locator member comprises an axially shiftable, threaded screw with an internal recess in the end facing the other member and each male locator member comprises a fixed pin projecting upwardly from said table top.

5. In a screen printing machine including a table for supporting blanks to be printed, the improvement comprising:

a rectangular master frame assembly,

a squeegee assembly supported on said master frame assembly for traversing movement across the master frame assembly from side to side and generally parallel to said table,

a screen lying intermediate of said squeegee assembly and said blank,

fixed guide shaft means inclined rearwardly and upwardly from said table on each side thereof,

said rearwardly and upwardly guide shaft means being supported by a horizontal base member at one end thereof,

a vertical support member extending upwardly and generally intersecting the axis of said inclined guide shaft means from the other end of said horizontal base member,

bushing means carried by said master frame assembly on respective sides thereof and slidably receiving respective guide shaft means, said bushing means being located toward the rear of said master frame assembly,

a yoke assembly,

a pivotable rack bar carried by said master frame assembly and extending between the sides thereof and mounted for pivoting about a horizontal axis generally parallel with said table,

a squeegee drive plate, said yoke assembly fixed to said squeegee drive plate and receiving said pivotable rack bar, said drive plate supporting a drive motor and said squeegee assembly,

ball bushing shaft means cantilever supported on said pivotable rack bar,

a drive pinion operatively coupled to said motor and being in mesh with said rack bar for driving said drive plate transversely from side to side relative to said frame assembly, and

open sided ball bushing means carried by said yoke and supporting said ball bushing shaft means.

6. The screen printing machine as claimed in claim **5,** wherein said open sided ball bushing means com-

prises: a pair of open sided ball bushings and said ball bushing shaft means comprises a first cantilever mounted shaft fixed to the side of said bar opposite said rack and a second cantilever mounted shaft fixed to the bottom of said rack.

7. The screen printing machine as claimed in claim 6, wherein said squeegee drive plate extends parallel to the plane of said table, and said drive pinion is carried by a shaft extending downwardly at right angles to the plane of said plate, and terminating within a sleeve bearing carried by said yoke assembly.

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