

Dec. 25, 1951

A. C. BARLOW ET AL
STENCIL PRINTING MACHINE

2,579,461

Filed Sept. 4, 1945

5 Sheets-Sheet 2

FIG 2

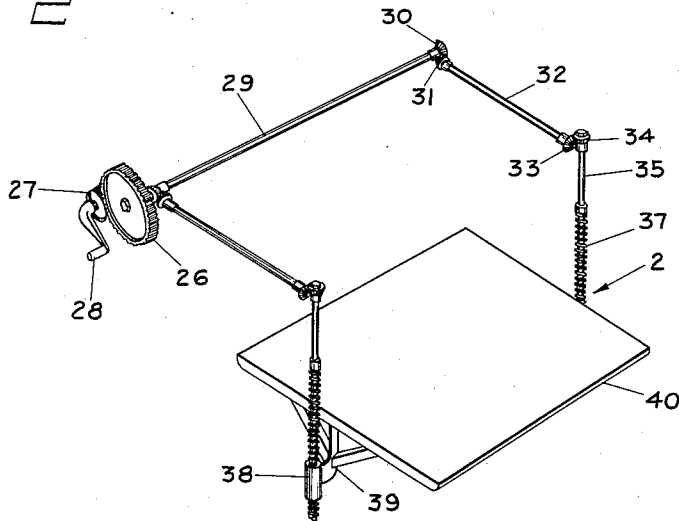
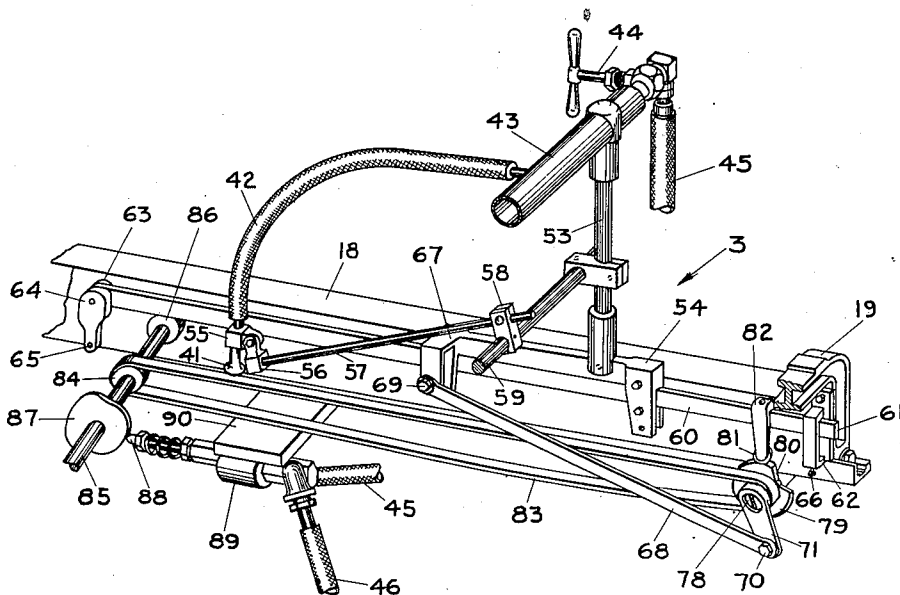


FIG 3



INVENTOR.
ALMUS C. BARLOW
WILLIAM V. PAUL
BY
Ralph L. Chappell
ATTORNEY

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Fig 4

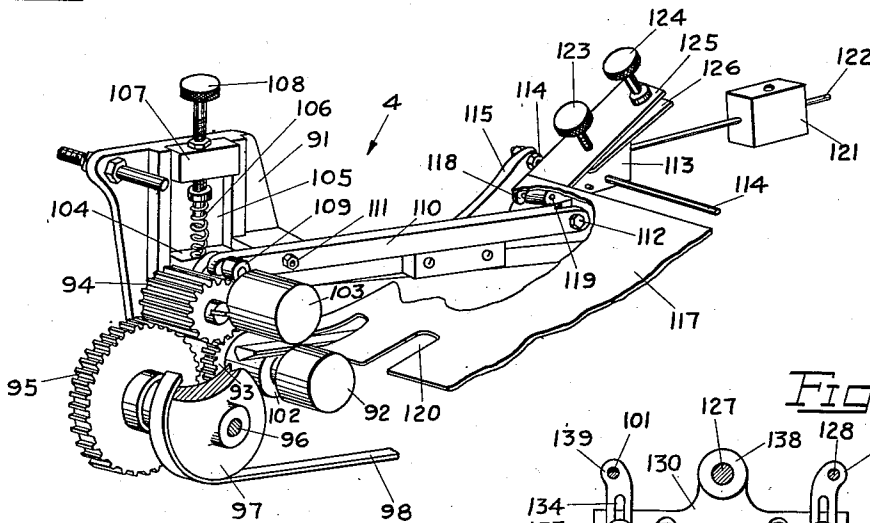


Fig 6

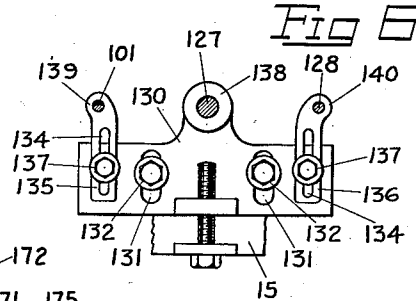
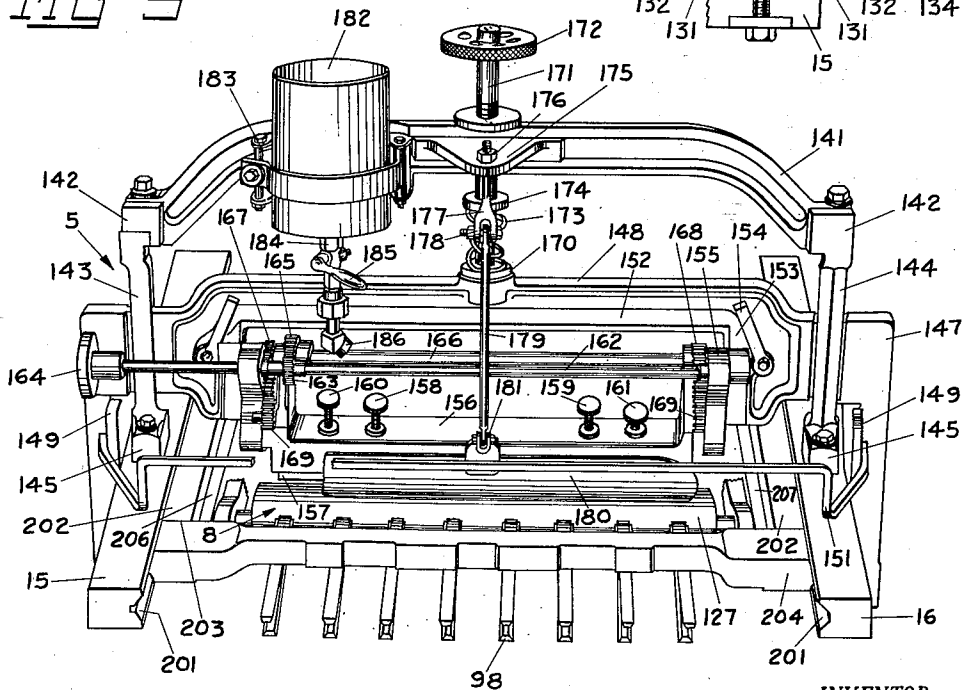


Fig 5



INVENTOR.
ALMUS C. BARLOW
WILLIAM V. PAUL
BY
Ralph L. Chappell
ATTORNEY

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Fig 7

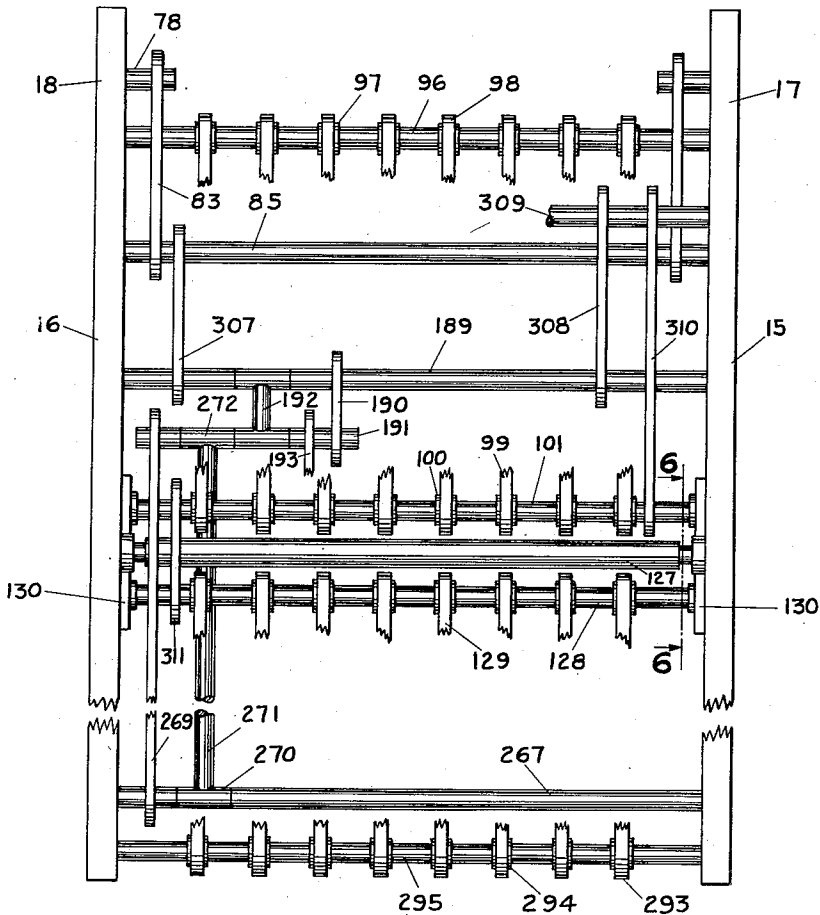
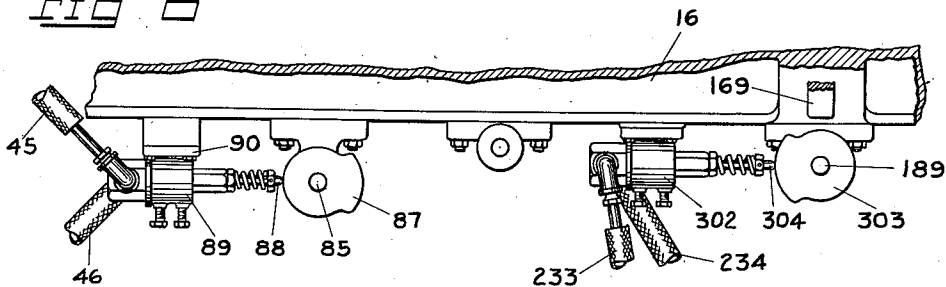


Fig. 4



INVENTOR.
ALMUS C. BARLOW.
BY WILLIAM V. PAUL
Napht Chappell
ATTORNEY

Dec. 25, 1951

A. C. BARLOW ET AL

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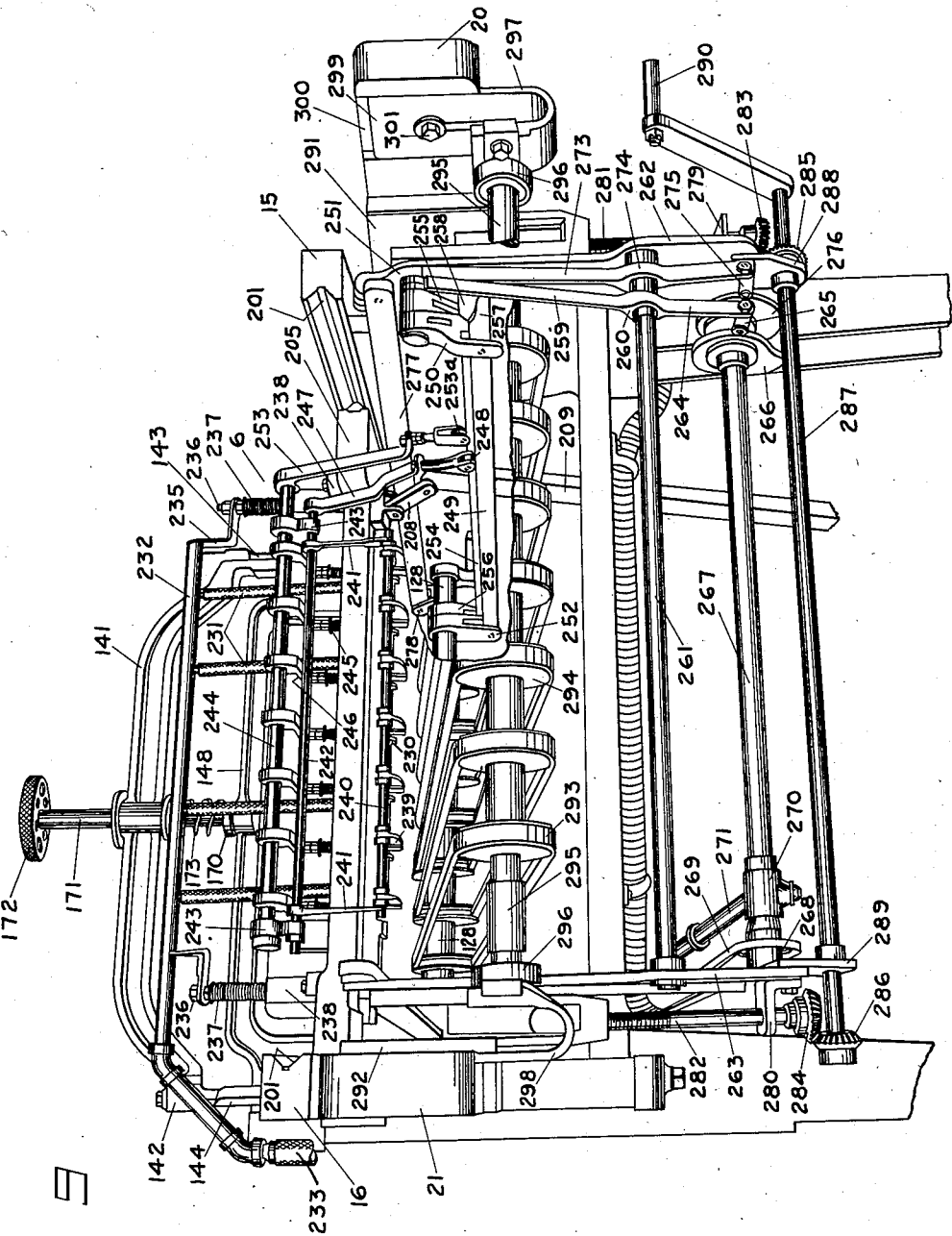


FIG 5

INVENTOR.
ALMUS C. BARLOW
WILLIAM V. PAUL
BY
Ralph A. Chappell
ATTORNEY

UNITED STATES PATENT OFFICE

2,579,461

STENCIL PRINTING MACHINE

Almus C. Barlow, Chula Vista, and William V.
Paul, Coronado, Calif.

Application September 4, 1945, Serial No. 614,336
13 Claims. (Cl. 101-124)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

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This invention relates to printing machines and more particularly to those of the silk screen type wherein an impression is made upon a work piece by passing paint, ink, or the like through a stencilled pattern of the screen onto a work piece arranged below the screen.

It has heretofore been the practice in this art to hinge a screen on a bed frame; lift the screen; place a work piece to be printed on the bed frame; lower the screen; apply paint on the screen; impress the paint on the work piece by drawing the paint with a manually operated squeegee over the screen to force it through a stencil; lifting the screen; and manually removing the so printed work piece. These briefly outlined steps in the conventional silk screen process of printing are slow, tedious and leave much to be desired in the quality of work that can be produced.

The principal objects of the present invention are therefore, to provide a printing machine of the silk screen type that is semi-automatic; that has many times the productive capacity of machines heretofore available for the same purpose; and that greatly improves the quality of work accomplished.

Other objects of this invention are to provide for moving the work piece and screen relative to a printing element called a "squeegee" instead of moving the "squeegee" over the screen as has heretofore been the practice; to provide for making "off-contact" prints resulting in sharper, clearer, more perfect images than has heretofore been possible; and to reduce the size of printing surfaces in the machine, yet provide an endless printing base.

Other objects of the invention are to provide improved elements and arrangements thereof in a machine of this character; and to accomplish the noted objects in a facile, relatively economical and highly efficient manner.

In accomplishing these and other objects of the present invention, we have provided improved details of structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of my improved printing machine showing the general assembly.

Fig. 2 is a detail perspective view of the work piece feed tray.

Fig. 3 is a detail perspective view of the mechanism for forwarding work pieces from the feed tray to the conveyor assembly.

Fig. 4 is a detail perspective view of the ejector mechanism near the feed end of the machine.

Fig. 5 is a detail perspective view of the co-operative platen printing base and squeegee printing mechanisms.

Fig. 6 is a detail elevational view of the adjustable platen and conveyor shaft supporting block taken on the line 6-6, Fig. 7.

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Fig. 7 is a diagrammatic top plan view of the synchronized drive system for the conveyors, platen, feed and delivery mechanisms.

Fig. 8 is a detail side elevational view of a portion of the machine chassis having the piston valves for timing the vacuum lines to the feed and stripping mechanisms.

Fig. 9 is a detail perspective view of the work piece gripping and stripping mechanisms and the delivery end of our improved printing machine.

Fig. 10 is a detail sectional view of the work piece gripping and stripping mechanism.

Referring more in detail to the drawing:

In Fig. 1, the general assembly of my printing machine is shown, wherein 1 designates the main chassis or frame; 2, the feed tray; 3, the feed mechanism; 4, the ejector mechanism support; 5, the squeegee assembly; 6, the silk screen frame with gripping mechanism attached; 7, the screen frame oscillating mechanism; and 8, the work piece stripping and delivery mechanisms.

The chassis

In Fig. 1 is shown the chassis 1, which preferably comprises upright side and/or end legs 10 and 11, the lower ends of which are braced by stringers 12 and 13 and end plates 14. The upper ends of the legs 10 and 11 are inter-connected and braced by side rails 15 and 16 and by suitably arranged transverse bracing members. Outriggers 17 and 18 extend outwardly from the end 10 of the chassis, the outriggers being suitably mounted and based on the chassis and being connected by a yoke 19 at the outer ends. Oppositely arranged outriggers 20 and 21 extend outwardly from the opposite end 11 of the chassis, these latter outriggers being suitably inter-connected braced and mounted on the chassis in approximately the plane of the rails 15 and 16 and the outriggers 17 and 18.

Arranged transversely of the outriggers 17 and 18 in outwardly spaced relation to the end 10 of the chassis is a supporting block 22 on which is mounted a guide finger support 23. Substantially similar finger supports are mounted on or adjacent the outriggers 17 and 18. End guide fingers 24 as well as side guide fingers 25 depend from such finger supports a distance sufficient to accommodate and guide an adequate supply of stock to be printed for a substantial printing job.

A sprocket 26 is rotatably mounted on the outrigger 17 on the exterior face thereof which is driven by a pinion 27 also rotatably mounted on the outer face of the outrigger 17 which pinion is in turn provided with a handle 28 for driving the same and transmitting motion to a shaft 29 supporting the sprocket 26. The shaft 29 extends transversely between the riggers 17 and 18 and is suitably rotatably mounted therebetween.

The feed tray

As more clearly shown in Fig. 2, the sprocket shaft 29 for the pinion driven sprocket 26 is provided with bevel gears 30 adjacent its ends which gears mesh in driving relation to bevel gears 31 on shafts 32 that are arranged perpendicularly to the shaft 29 and extend outwardly from the chassis. Bevel gears 33 on the outer ends of shafts 32 drivingly engage bevel gears 34 on the upper ends of vertically arranged shafts 35. The shafts 34 are rotatably mounted in brackets 36, Fig. 1, that are suitably mounted on and depend from the riggers 17 and 18 in oppositely disposed relation.

The shafts 35 are threaded, as indicated at 37, such threads being arranged to mate with threads in collars 38 in such a manner that rotation of the shafts moves the collars up and down the shafts in accordance with direction of rotation of the shafts. The collars 38 are provided with brackets 39 upon which a bed plate 40 is mounted for supporting a quantity of work pieces (not shown) such as sheets of paper, felt, metal, tile, glass, linoleum, ply board and the like between the end and side guide fingers.

It will be apparent that a supply of work pieces may be placed on the bed plate 40 and that such work pieces will be held in desired position by the guide fingers 24 and 25. Actuation of the handle 28 transmits motion to the bed plate 40 through the shafts, gears and threads to raise the plate and feed the work pieces.

The feed mechanism

We have devised an arrangement for moving individual work pieces from the top of the stack on the bed plate 40, the details of which are shown in Figure 3. This mechanism preferably consists of a series of suction cups 41 designed to engage the upper surface of successively presented work pieces. The suction cups 41 are operatively connected with the lines 42 leading to a source of reduced pressure or a partial vacuum by way of a manifold 43. The manifold 43 is provided with a pressure regulating valve 44 interposed between the manifold and the vacuum line 45.

The line 45, as shown in Fig. 1, extends from the manifold to the lower left hand portion of the chassis where it connects, as at 46, with a vacuum pump 47. The pump 47 is preferably of the oil seal type and is driven through the power take-off 48 of an electric motor 49. The pump and motor are suitably supported on a bed plate 50 arranged transversely on the upper edges of the stringers 12 and 13, while the electric current for the motor 49 comes through the leads 51 of a control box 52 that is suitably mounted on the legs 11 and rail 16.

As clearly shown in Fig. 3, the manifold 43 is supported by a pair of vertically arranged rods 53 (Fig. 1) which in turn, are each supported by a riser bracket 54.

In order to make the suction cups 41 adjustable to take care of work pieces of different thicknesses and size, they are preferably provided with heads 55 that are adjustably vertically connected with cooperative heads 56. The heads 56 each support one end of a rod 57, the other end of which is slidably adjustably mounted in a clamp 58. The clamp 58 is laterally adjustably mounted on a cross-rod 59 which is adapted to support a series of said clamps in such a manner that, the lines 42 being flexible, the suction cups may be spaced from each other in desired relation.

It being apparent that the suction cups pick up the uppermost work pieces in a stack on the bed plate 40, we have provided for moving the suction cups forwardly in a circular and reciprocating motion in such a manner that the work pieces may be fed to be printed and the suction cups returned to engage succeeding work pieces. In carrying out this function of the device, the riser bracket 54 is mounted on a floating bar 60. The outer end 61 of the bar 60 is vertically reciprocable in the guide bracket 62 and the opposite inner end thereof is swivelled, as at 63, in a yoke 64 that is swivelly mounted on the outrigger 18, as indicated at 65. Vertical movement of the end 61 of the float bar 60 is limited by a set screw 66 in the bracket 62 to accommodate vertical lift of the suction cup to stacks of work pieces of different thicknesses.

The float bar 60 is moved synchronously with actuation of the printing machine by the following arrangement: 67 designates a head on the riser bracket 54 to which a link 68 is pivoted, as indicated at 69. The other end of the link 68 is pivotally mounted, as at 70, on an arm 71 that is fixed to a cam shaft 78, the shaft 78 being rotatably mounted in the outrigger 18, as more clearly shown in Fig. 7. A cam 79 is mounted on the shaft 78 and has a low lobe portion 80 on its periphery that is followed by a cam follower 81 on an arm 82, which latter arm is fixed to the float bar 60. The cam shaft 78 is driven by a chain or belt 83, the inner run of which is mounted on and driven by a sprocket or pulley 84, mounted on a line counter shaft 85 arranged transversely between the side rails and outriggers and having rotatable bearing support thereon, as at 86.

It is thus apparent that as the line shaft 85 rotates, its motion is transferred to the cam 79 for alternately lifting and lowering the float bar 60. At the same time, the arm 71 on the cam shaft causes the link 68 to move the riser bracket 54 in a substantially horizontal reciprocating motion. This in turn causes the suction cups to lift work pieces and move them forwardly.

In order to release the work pieces, the vacuum in the line 45—46 to the vacuum pump 47 should be cut-off at or just prior to the extremity of movement of the suction cup 41 to the left in Fig. 3 and to this end a cam 87 is arranged on the line counter shaft 85. The cam 87 is provided with lobe portions related to the lobe portions of the cam 79, which act on the spring-pressed plunger 88 of a piston type valve 89 that is supported as by a bracket 90 on the outrigger 18 in interposed relation in the vacuum line 45—46 for cutting-off the reduced pressure in the line and allowing atmospheric pressure on the work pieces to remove the same from the suction cups. Thereafter, the suction cups may be moved backwardly toward the work piece bed plate to engage and move succeeding work pieces.

The ejector mechanism

In Fig. 4, 91 designates one of a pair of brackets that are oppositely mounted on the outriggers 17 and 18, Fig. 1. The brackets 91 form a rotatable support for a feed roller 92 one end of which is provided with a gear 93 that meshes with a gear 94 that is also rotatably mounted on the bracket 91. The gear 94 is adapted to be driven by a gear 95 that is mounted on the end of a shaft 96 adjacent thereto. The shaft 96 is also shown in Fig. 7 and is rotatably supported at its ends in the outriggers 17 and 18 in such a manner as to

form a rotatable support for sheaves or pulleys 97 which in turn support conveyor belts 98 the inner runs 99 of which are mounted on aligned sheaves or pulleys 100 supported by a shaft 101, that is mounted on the side rails 15 and 16, as shown in Fig. 7. The feed roller 92, Fig. 4, is provided with spaced grooves 102 through which the belts 98 travel in such a manner as not to interfere with an upper feed roller 103 which latter roller is cooperative with the feed roller 92 to meter the feed of work pieces to the printing machine.

The upper feed roller 103 is adjustable vertically by means of blocks 104 that are adjustably mounted in ways 105 in the brackets 91 and which blocks rotatably support reduced ends of the roller 103. The feed roller 103 is full-floating and operates against an adjustment spring 106, the lower end of which bears against the block 104 and the upper end of which is mounted on and bears against a boss 107 that is fitted within the ways 105 and onto the lower end of an adjustment screw 108.

The reduced end, Fig. 4, of the upper feed roller 103 reacts against a follower roller 109 that is rotatably mounted upon a bar 110, fulcrumed, as at 111, on the bracket 91. The end of the bar 110 opposite the roller 109 is fixed, as at 112, to a supporting block 113, the block 113 being pivotally supported on and by the pivot bar 114. The outer ends of the pivot bar 114 are mounted in arm extensions 115, the opposite ends of which are fixed to arms 116, Fig. 1, that extend upwardly from the brackets 91.

The blocks 113 pivotally support an ejector tray 117 by means of a downwardly turned lip 118 or the like that may be secured to the block 113 by a pin 119. The tray 117 is of such a length and width that it traverses the path of work pieces fed to the rollers 92 and 103 by the feeding mechanism, Fig. 3, and is preferably provided with slots, notches or recesses 120 which fit over and pass the conveyor belts 98 to fall below the point of clearance between the rollers 92 and 103 at the conveyor belts 98. The ejector tray 117 is finely counterbalanced by weights 121 that are adjustably mounted on the counterbalance bars 122 that project inwardly relative to the machine from the tray supporting blocks 113.

In order to adjust the ejector tray for ejection of relatively rigid material, adjustment screws 123 and 124 are provided on an ejector tray supporting plate 125, such screws 123 and 124 being adapted to bear against an adjustment plate 126 fixed on each of the blocks 113 to pivot the ejector tray 117 angularly relative to the plate 126.

It is thus apparent that the ejector tray 117 may be adjusted to fine tolerances for passing work pieces of desired thickness below the ejector tray, below the feed roller 103, on top of the conveyor belts 98 and on top of the feed roller 92. Thus, when work pieces of greater thickness than desired, or when a plurality of work pieces, are accidentally fed to the conveyor belts 98, such additional thickness of material raises the floating roller 103 to fulcrum the bearing roller 109 upwardly on the fulcrum 111 which, through the other end of the bar at 112, lowers the ejector tray 117 to drop the notched end 120 of the ejector tray over the conveyor belts 98 to pick up the undesired work piece or a plurality thereof and thus avoid feeding the printing machine improperly.

The squeegee assembly

Once each work piece has been delivered by the feed mechanism and has passed the ejector tray, the conveyor belts 98, Fig. 5, pass each work piece to a platen 127, Fig. 5, which platen provides an endless printing base giving a substantially point contact by which substantially off-contact prints are made upon the work pieces as later more fully described.

The platen 127 is vertically adjustable along with the supporting shafts 101 and 128, Fig. 7, for the inner runs 99 and 129 of the conveyor belts, by means of bearing brackets 130, Fig. 6, which brackets have adjusting slots 131 through which bolts 132 pass for engagement in the side rails 15 and 16, Fig. 7.

The brackets 130 are also provided with ways 134 in which arms 135 and 136 are slidably adjustably mounted, as by bolts 137. Roller bearings 138 on the brackets 130 support the ends of the platen. Roller bearings 139 and 140 support the ends of the conveyor belt shafts 101 and 128, respectively.

While the screen per se is superimposed on each work piece at the time the work piece passes over the platen 127, such screen and frame therefor are co-related with the stripping and delivery mechanisms of the printing machine and will for that reason be described later herein.

In Figs. 1 and 5, 141 designates a yoke for the squeegee or printing element of this printing machine. The yoke 141 is mounted at its ends 142 on the upper ends of supporting posts 143 and 144, the lower ends of which have bases 145 that are mounted on the side rails 15 and 16 of the main chassis, as by the bolts illustrated. The posts 143 and 144 are slotted longitudinally, as particularly shown at 146, Fig. 1, to slidably receive a squeegee supporting bar or yoke 147, the outer ends of which are arranged exteriorly of the side rails 15 and 16 and the inner web or head portion 148 of which is arranged interiorly of said posts below the yoke 141.

In order to allow controlled vertical reciprocation of the squeegee yoke 148 in the slotted ways of the posts 143 and 144, latching dogs 149 are pivoted to the side rails 15 and 16, as shown at 150, Fig. 1. The upper ends of the dogs 149 are secured to an operating arm 151 that may be suitably operated and in this instance is adapted for manual operation or reciprocation in a horizontal plane in slidably supported relation to the upper ends of the rails 15 and 16.

The supporting bar web 148 is adapted to removably receive a squeegee unit consisting of a head yoke 152 adapted to slidably fit within the yoke 147 and having bearing surfaces 153 against which latching dogs 154 may be turned to bear against and hold the squeegee unit 152 in the supporting bar 147. Mounted on and supported by the squeegee unit head yoke 152 are oppositely arranged bearing blocks 155 that support therebetween a preferably cast channel 156 for receiving an elongated block (not shown) within its interior. The lower end of the channel is longitudinally slotted to receive a conventional rubber squeegee strip 157 by which printing material may be spread upon a work piece therebeneath. Headed screws 158 and 159 are screwed into the block just referred to, to hold the block and squeegee within and relative to the channel 156. Set screws 160 and 161 are mounted in and extend through the channel 156 to bear against the block and adjust the same laterally in a de-

sired manner to insure a uniform application of printing material to the work piece.

It is sometimes desirable to adjust the squeegee longitudinally relative to a work piece and the printing machine and to this end the blocks 155 are journaled to receive a transverse shaft 162, the left hand side of which, Fig. 5, is provided with a pinion 163. The shaft 162 extends outwardly toward the left, Fig. 5, and terminates in a handle portion 164 by which the pinion 163 may be turned in either direction. The pinion 163 acts on a gear 165 that is mounted on a shaft 166 supported at its ends in journals in the blocks 155. The shaft 166 is additionally provided with gears 167 and 168 that mesh in driving engagement with racks 169 to adjust the squeegee supporting casting angularly longitudinally relative to a work piece.

Mounted on the squeegee unit head 152 is a boss 170 in which a stem 171, Fig. 1, is arranged, which stem extends upwardly through the main supporting yoke 141 and is provided with threads engageable with threads in a passage through the yoke 141 by which the limit of reciprocation of the head or bar 148 in the posts 143 and 144 may be adjusted by turning the handle 172 to effect the desired adjustment. A spring 173 on the stem 171 bears against the boss 170 and an oppositely disposed bearing boss 174 to resiliently cushion the head 148 during its vertical reciprocation.

Extending laterally from the yoke 141 is a flange 175 that supports one end 176 of an arm 177, the other end of which is provided with a yoke to pivotally mount, as at 178, a connecting rod 179 to which is attached a paint trap 180, the lower edge of which is adapted to depend below and cover the printing edge of the squeegee 157. The trap 180 is pivotally connected to the connecting rod 179, as at 181 and is additionally pivotally connected at its ends adjacent its lower edge by pivoting links to the squeegee channel.

It will thus be apparent that the connecting rod 179 being in fixed relation to the yoke 141 at its upper end and in pivotal relation to the squeegee 157 at its lower end, as the squeegee is raised, the paint trap 180 is pivoted and drawn over the squeegee in a downward direction and to the left relative to Fig. 1. As the squeegee is lowered, the upper end of the paint trap connecting rod remaining fixed, the lower pivoted links of the paint trap push the paint trap upwardly to the right to allow paint therein to contact the squeegee and thus allow the squeegee to spread the paint.

In order to supply the paint trap 180 with a supply of painting material, a bucket 182 is provided, which is preferably mounted on the yoke 141, as by the strap bracket 183, mounted on the yoke. The bucket has an outlet line 184 that may be controlled by a valve 185 to admit desired amounts of painting material to a line 186 that leads to the paint trap 180.

In order to vertically reciprocate the squeegee yoke 148, the lower ends of the arms 147 of such unit are provided with cam followers 187, Fig. 1, adapted to ride upon the peripheries of cams 188, which cams are mounted on the outer ends of the main drive shaft 189. As shown in Fig. 7, the main drive shaft is driven by a sprocket connected by a belt or chain 190 with a sprocket on a stub shaft 191. The stub shaft is connected to and supported by the main drive shaft by a knee joint 192. Also mounted on the stub shaft 191 is a sprocket which has a belt or chain 193

that leads downwardly to a sprocket 194 on a drive shaft 195 of a gear box 196, Fig. 1. The gear box 196 is connected by a clutched driven shaft 197 with the drive shaft of an electric motor 198 that has leads 199 connected with a control box 200 that is suitably supported on the chassis, for example on the end members 10, as shown in Fig. 1.

It is thus apparent that energization of the motor 198 and consequent actuation of gear box 196 rotates the sprocket 194 and, through the chain or belt 193, transmits rotary motion to the main drive shaft through the chain or belt 190. Rotation of the main drive shaft 189 turns the cams 188 to raise or lower the squeegee unit depending upon the position of high or low lobe portions of the cams relative to the cam followers 187 on the squeegee unit.

The screen frame and oscillating mechanisms

As shown in Figs. 1 and 5, the side rails 15 and 16 are provided with ways 201 that are arranged to slidably reciprocally receive the side rails 202 of a silk screen supporting frame 203. The side rails of the frame are connected by end members 204, Fig. 5, and 205, Fig. 9. The screen frame is further provided with seat 206 and 207, Fig. 5, along the inside bottom edges of the side rails thereof on which a wooden or like frame may be removably mounted as by suitable wedges known in the art.

It is customary in the practice to tack or otherwise secure a silk screen having a suitable stencil to such a wood frame and in this instance the frame may be respectively provided with a plurality of screens having various suitable stencils depending upon the work to be done.

In order to reciprocate the frame 203 in the ways 201 and thus cause a silk screen on the frame to be moved relative to the squeegee printing element, the frame 203 is provided with links or lugs 208, Fig. 9, the links or lugs 208 being connected to the upper ends of rocker arms 209. The lower ends of the arms 209 are fixed to a shaft 210, Fig. 1, that is rotatably supported in bearings 211 or blocks that preferably form a part of and extend upwardly from the chassis stringers 12 and 13. Also fixed on the shaft 210 and preferably arranged inwardly relative to the arms 209 are complementary rocker arms 212 that extend at an angle to the arms 209 and have slots 213 in which the crank pins of pitmans 214 engage. The pitmans 214 are mounted on the drive shaft 195 of the gear box 196 and rotate to throw the arms 212 in an up and down direction to pivot the arms 209 and reciprocate the screen frame 203 in a horizontal direction in its ways 201.

In some instances, it is desirable to adjust the length of stroke of the screen frame 203 depending upon the size of work pieces to be printed. The length of stroke of the frame 204 is adjusted by adjusting the position of the pitman crank pins relative to the length of the rocker throw arms 212.

In accomplishing this adjustment, the gear box 196 is provided with a base 215, the ends of which are slidably mounted in tracks 216 on the interior faces of the stringers 12 and 13. At one end of the gear box base 215 a rack gear 217 is mounted that also slides in one of the tracks 216 and engages a sprocket 218 that is mounted on a shaft 219. The sprocket 218 engages a pinion 220 on a shaft 221 rotatably supported by a bearing block 222. The shaft 221 rotatably supports another sprocket 223 to which a

chain 224 is connected. The chain 224 in turn is connected at its upper end to a sprocket mounted on a shaft 225 that is rotatably supported in depending relation from the side rail 15. The shaft 225 has mounted thereon a sprocket 226 that is engaged by a pinion mounted on a shaft 227 which shaft is driven by a manually operated handle 228.

It is thus apparent that as the handle 228 is turned, its motion is transmitted through the sprocket 225, chain 224, shaft 220, pinion 218 and cooperative gear rack 217 to move the gear box base 215 along the stringers 12 and 13 in the corresponding direction of rotation of the handle 228.

As the gear box is moved to the left, Fig. 1, rotation of the pitmans 214 reciprocates the rocker throw arms 209 in such a manner as to approach their extreme limit of throw; that is to say, maximum movement of the rocker throw arms 209 is obtained by moving the gear box to the left, Fig. 1, whereas minimum throw of the arms 209 is obtained by movement of the gear box to the right relative to Fig. 1. Increase and decrease in the length of stroke of the screen frame 204 is accordingly provided for relative to the squeegee with which is coacts.

The work piece gripping mechanism

When the silk screen frame 203 moves to the right relative to Fig. 1, the machine is designed to feed work pieces to the left from the feed tray, also relative to Fig. 1. The screen frame should be, and is, therefore, provided with an arrangement for gripping the work pieces and holding them in registry with the frame in a manner now to be described.

The screen frame as heretofore indicated is provided with the end bar 205, Figs. 9 and 10, which has associated therewith a channel or chamber 205a, the bottom surface of which is provided with an inwardly directed lateral extension plate 229, Figs. 1 and 10, the rear bottom edge of which is provided with stops 230, Figs. 9 and 10, against which the ends of the work pieces abut. The member 205 is hollow and is perforated at its lower surface to provide suction openings 205b by which an imposed vacuum may act on the upper surface of the work pieces to hold the same in registry with the frame. The upper surface of the chamber 205a is also perforated to receive tubes 231 leading to a manifold 232 which in turn is provided with a vacuum line 233 which connects as at 234 with the vacuum pump 47, Fig. 1. The manifold 232 has brackets 235 at its ends, which brackets are resiliently supported by stems 236 and springs 237 on bearing blocks 238 that are mounted, as by bolts, on the frame end member 205.

Should the work pieces be out of registry with the stops 230, they will expose the vacuum line openings 205b and insufficient vacuum will be applied to hold the work pieces in place. It is contemplated that such deficiency may be employed to advantage by causing a shut-off of the electrical system and stopping of the machine to prevent improper printing of work pieces.

Cooperative with the suction chamber 205a in holding work pieces in registry with the frame are gripping fingers 239 the end of each of which is fixed to a gripping finger bar 240, having ends mounted on grip finger bar forks 241. The forks 241 are mounted at their upper ends on a fork shaft 242 and the shaft 242 is provided with cam

shaft brackets 243 at its ends for mounting said shaft 242 relative to a push rod lug shaft 244. The grip fingers 239 are positioned on the bar 240 in such a manner as to engage a work piece abutting the stop lugs 230, when in the position shown in Fig. 9. The arrangement is such that the noted position is maintained throughout the length of stroke of the silk screen frame. As the frame approaches the end of its stroke, that is in a direction to the left relative to Fig. 1, spring loaded release means or push rods 245 that are mounted in the chamber 205a in alignment with the grip fingers 239 are forced downwardly, Figs. 9 and 10, by the ends of push rod lugs 246 on the shaft 244. This action of the lugs and rods forces the work piece away from the vacuum chamber 205a and displaces the work piece from its engagement with the stop lugs 230.

Simultaneously with downward movement of the release means or push rods 245, the grip fingers 239 are moved to the left relative to Fig. 1 by movement of the grip finger bar 242 by means of a fork shaft cam bracket 247. The bracket 247 is provided with a follower 248 that rides on a floating bar 249. The outer end of the floating bar 249 is pivoted to a yoke 250 which in turn is pivoted to a mounting bracket 251 suitably secured to the side rail 15. The other end of the bar 249 is pivoted to a yoke 252 which in turn is pivotally mounted on the conveyor belt shaft 128.

It is apparent, therefore, that inward movement of the bar 249 on its yokes, that is to the right relative to Fig. 1, raises the bar 249 throughout its length approximately in the same plane whereupon the follower 248 riding on the bar 249 pivots the fork shaft cam bracket 247 upwardly and outwardly in an arc to rotate the shaft 242 and cause the grip fingers 239 to move outwardly relative to the chamber 205a, thus tending to draw the work pieces out from under the silk screen frame.

The push rod lug shaft 244 is provided at an outer end thereof with an arm 253 that supports at its lower end a follower 253a. The follower 253a rides on another floating arm 254 that is pivoted at one end to a yoke 255 and at its other end to a yoke 256 on the conveyor belt shaft 128. It is apparent here also that inward pivotal movement of the yokes 255 and 256 raises the arm 254 and consequently raises the follower 253a to pivot the arm 253 outwardly and upwardly. This movement of the arm 253 rotates the shaft 244 and forces the lugs 246 downwardly to depress the spring loaded release means or rods 245. The rods 245 then engage the upper surface of a work piece to force it downwardly out of registry with the stop lugs 230 and thus cooperate with the grip fingers 239 to remove the work pieces from the silk screen frame.

In order to provide for pivoting the yokes and thus raising the floating bars 249 and 254 to move the grip finger and pusher lug shafts, the ends of the arms 249 and 254 are extended to form bearing pieces 257 and 258. The arm end 257 is engageable by one end 259 of a lever 260 that is fixed to a shaft 261 rotatably mounted in supporting brackets 262 and 263 that are adjustably mounted in and depend from the side rails 15 and 16. The other end 264 of the lever 260 has a follower 265 that rides the periphery of a cam 266 that is mounted on a shaft 267 rotatably driven by a sprocket or pulley 268 and

a chain or belt 269, the chain 269 leading to a sprocket on the stub shaft 191, Fig. 7.

270 designates a bearing rotatably mounted on the grip finger shaft 267 for supporting one end of a knee joint 271, the other end of which is mounted in a bearing 272 on the stub shaft 191, Fig. 7.

The end 258 of the floating arm 254 is adapted to be engaged by the end 273 of a lever 274, the opposite end of which is provided with a follower 275 that rides on a cam 276 which is also mounted on the grip finger shaft 267.

It is thus apparent that as the grip finger shaft 267 rotates, the high and low lobe portions of the cams 266 and 276 cause the cam followers of the levers 260 and 274 to alternately push the yokes 250 and 255 inwardly and upwardly and then let them return to downward position by gravity to thus effect rotation of the bars 242 and 244 through the arms 247 and 252 to actuate the grip fingers 239 and pusher rods 245.

The delivery mechanism

The grip finger assembly is full floating and gradually recedes below the top level of the silk screen frame 203 as the frame travels to the extreme of its stroke, that is to the left relative to Fig. 1. This receding action strips pliable materials being processed from the silk screen where viscous materials tends to hold the work to the silk screen. The depth to which the grip finger assembly recedes is adjusted by raising or lowering a retractor lug bar 277 together with the cam assembly associated with the finger grip and cam shaft 267 as well as the conveyor belt assembly in a manner now to be described.

The lug bar 277 is pivoted at its outer end to the bracket 262 and at its inner end is pivoted to the side rail 15, as indicated at 278. Outwardly extending bracket flanges 279 and 280 are provided on the brackets 262 and 263, the flanges being provided with openings for the passage of threaded adjustable rods 281 and 282. The lower ends of the rods 281 and 282 are provided with level gears 283 and 284 which cooperatively respectively engage bevel gears 285 and 286 on a shaft 287 rotatably supported in brackets 288 and 289 that form extensions of the brackets 262 and 263. The shaft 287 is provided with an operating handle 290 turning of which moves the adjusting rods 281 and 282 upwardly or downwardly relative to threaded apertures in substantially U-shaped brackets 291 and 292 that are vertically mounted in the side rails 15 and 16, respectively.

It is thus apparent that the handle 290 may be turned in desired direction to raise or lower the retractor lug bar 277 as well as the gripper shaft and cam shaft assemblies.

It is also desirable to adjust the conveyor belt assembly in substantially corresponding relation to the grip finger and push the rod cam assemblies and to this end, conveyor belts 293 that are supported at one end by the shaft 128, Fig. 7, are extended to pulleys 294 that are mounted on an outer conveyor shaft 295. The ends of the conveyor shaft 295 are mounted in bearings 296 that are supported on substantially J-shaped brackets 297 and 298, the upper ends 299 of which are adjustably mounted in vertical ways 300 in the outer ends of the rails 15 and 16, as by the set screws or bolts 301.

In order to correlate application of vacuum and atmospheric pressure to the operation of the grip fingers and push rod cams in such a manner as not to impede release and stripping of

work pieces from the silk screen frame, a piston type valve 302, Fig. 8, is interposed in the vacuum line 233—234 and actuated by a cam 303 on the drive shaft 189 for example. A spring pressed plunger 304 rides the cam 303 and acts on the valve 302 to start and stop vacuum action in the line 233—234.

Suitable start-stop mechanisms 305 and 306, Fig. 1, are also provided for actuating and de-energizing the compressor pump motor 49 and the gear box driving motor 198.

Operation

The operation of a printing machine constructed as described is as follows:

A supply of work pieces is mounted on the feed tray table 40, Fig. 2, arranged at the right hand end of the machine relative to Fig. 1. The start-stop mechanisms 305 and 306 are then operated to energize the motors, whereupon power is transmitted from the electric motor 198 to the gear box 196 and through the chain or belt 193 to the stub shaft 191, Fig. 7. From the stub shaft 191, power is transmitted through the chain 190 to the main drive shaft 189 and by a chain and sprocket mechanism 307, Fig. 7, to the line counter shaft 85. Power is also transmitted from the main drive shaft through a chain and sprocket connection 308 to a stub shaft 309 and from the stub shaft 309 through a chain and sprocket assembly 310 to the feed belt roller 101. The line counter shaft 85 operates the cam shaft 78 through the belt connection 83. A chain and sprocket assembly 311 extends from the feed belt roller 101 to the feed belt roller shaft 128 to operate the same. The stub shaft 191 drives the grip finger shaft 267 through the chain 269 and sprocket 268. The cam shafts 78, the conveyor belt shafts 96, 101, 128 and 295, the stub shaft 309, the counter shaft 85, the main drive shaft 189, the stub shaft 191 and the grip finger shaft 267 all operate synchronously with the platen 127 rotating freely, and which platen, with the conveyor belt shafts 101 and 128 is vertically adjustable by the brackets 130, Fig. 6, to effect "off-contact" prints.

The cam shafts 78 move the suction cups 41 to feed work pieces as in Fig. 3 to the conveyor belts 98, Figs. 4 and 7, where the work pieces pass between the feed rollers 92 and 103, Fig. 4, and continue on in supported relation by the conveyor belts 98 or are ejected by the ejector mechanism tray 117.

Passing the ejector tray 117, the conveyor belts 98 pass the work pieces toward the platen, Fig. 5, but prior to reaching the platen, the silk screen frame 203 is moved to the right, Fig. 1, by the links 208, Fig. 9, rocker arms 209, throw arms 212, Fig. 1, and pitmans 214 which are actuated by the gear box 196. The length of throw of the screen frame 203 to the right is such as to cause abutment of the leading edge of the work pieces with the stop lugs 230, Figs. 9 and 10, on the screen frame end member 205, the bottom face of such work piece being engaged by the upper surfaces of the gripper fingers 239. As the work pieces cover the vacuum perforations back of the plate flange 229, Figs. 1 and 10, sufficient suction is provided to hold each work piece against the plate flange 229 to effect registry, alignment or securing of the work piece below the screen frame.

Continued movement of the pitmans 214 reciprocates the throw arms 212 to move the screen frame to the left, Fig. 1, and thus deliver the work piece over the platen 127, Fig. 5, below the squeegee printing element 157. The cam 188, Fig.

1, is so arranged on the main drive shaft 189 as to lower the squeegee yoke synchronously with movement of the silk screen frame to the left, Fig. 1. Downward movement of the squeegee pivots the paint material trap to the right, Fig. 1, and exposes the squeegee to paint and a silk screen that has previously been mounted on the frame 203. Continued motion of the screen frame to the left, Fig. 1, causes the squeegee to scrape paint over the silk screen and thus print the work pieces through a suitable stencil in the silk screen.

As the screen frame approaches the extremity of its stroke toward the left, Fig. 1, the cams 266 and 276, Fig. 9, that are synchronously driven by the sprocket chain drive 269 act on the levers 269 and 274 to lift the floating bars 249 and 254 to rotate the arms 247 and 253 and withdraw the grip fingers 239 and simultaneously push the rods 245 downwardly to strip the work piece from the screen frame and force it downwardly and outwardly relative to the machine to deliver it to the conveyor belts 293 at which time the work pieces may be collected and stacked in a suitable manner.

As the screen frame 203 completes its stroke to the left, Fig. 1, and its direction of movement is reversed by the pitmans of the gear box acting on the throw arms, the cam 188 on the main drive shaft causes raising of the squeegee frame yoke, whereupon the paint material trap is drawn to the left, Fig. 1, under the squeegee to prevent further supply of painting material. The operation just described may then be repeated at various speeds and lengths of stroke to successively act on and print the work pieces delivered to the conveyor from the feed tray.

Depending upon the type of material, the platen roller 127 with the conveyor shafts 101 and 123 may be adjusted in the brackets 130 and the conveyor shaft 295 may be adjusted along with the grip finger assembly to aid in stripping work pieces and removing the same from the silk screen frame. This latter adjustment of such assembly is effected by manipulation of the handle 290 and setting of the bolts 301 in the side rails 15 and 16.

It is also contemplated that pivotal movement of the latching dogs 149 for the squeegee assembly may be synchronously correlated, by a cam and shaft therefor, with rotation of the grip finger shaft, for example, to allow lowering of the squeegee when the screen frame starts its travel from right to left, Fig. 1, below the squeegee and to lock the squeegee yoke in raised position at the end of the right to left stroke of the silk screen frame to prevent application of painting material by the squeegee to the frame during the return stroke of the frame from left to right relative to Fig. 1.

While we have shown but one embodiment of our invention, it is apparent that the device is susceptible to modification without departing from the spirit of the invention. We do not wish, therefore, to be limited by the disclosures set forth, but only by the scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

We claim:

1. In a printing machine, a support, a screen reciprocably mounted on the support, a printing element reciprocably mounted on the support, means for reciprocating said screen and printing

element in cooperative relation, means for supplying the screen and printing element with printing material, a platen on the support cooperative with the screen and printing elements, means for feeding work pieces between the platen and screen, means interposed between the feeding means and platen for ejecting work pieces of predetermined character, means on the screen for clamping work pieces thereto, and means for stripping work pieces from the screen.

2. In a printing machine, a support, a screen horizontally reciprocably mounted on the support, means for controlling the length of stroke of reciprocation of the screen, a printing element vertically reciprocably mounted on the support, cooperative means for reciprocating the screen and printing element in predetermined relation, a platen rotatably mounted on the support below the screen, a work piece feed bed adjustably mounted on the support, means for successively removing work pieces from said bed, means for ejecting work pieces of predetermined character, a conveyor for receiving work pieces and leading the same to the platen, means on the screen for gripping work pieces presented thereto at one end of the reciprocating stroke of the screen, means for causing cessation of operation of the machine upon misalignment of work pieces relative to the screen, means for stripping work pieces from the screen at the opposite end of the reciprocating stroke of the screen, and a conveyor synchronized with the first named conveyor leading from the platen to the delivery end of the machine opposite the work piece feed bed.

3. In a printing machine, a support, a screen reciprocably mounted on the support, means for controlling the length of stroke of reciprocation of the screen, a printing element reciprocably mounted on the support, cooperative means for reciprocating the screen and printing element in predetermined relation, a platen rotatably mounted on the support below the screen, a work piece feed bed mounted on the support, means for successively removing work pieces from said bed, a conveyor for receiving work pieces and leading the same to the platen, means for gripping work pieces presented thereto at one end of the reciprocating stroke of the screen, and means for stripping work pieces from the screen at the opposite end of the reciprocating stroke of the screen.

4. In a printing machine, a support, a screen horizontally reciprocably mounted on the support, a printing element vertically reciprocably mounted on the support, cooperative means for reciprocating the screen and printing element in predetermined relation, a platen rotatably mounted on the support below the screen, means for adjusting the platen relative to the screen and printing element, means for successively feeding work pieces to said platen, means for gripping work pieces presented to the screen, and means for stripping work pieces from the screen.

5. In a printing machine, a support, a screen horizontally reciprocably mounted on the support, means for controlling the length of stroke of reciprocation of the screen, a printing element vertically reciprocably mounted on the support, cooperative means for reciprocating the screen and printing element in predetermined relation, a platen rotatably mounted on the support below the screen, means for successively presenting work pieces to said platen, a conveyor for receiving work pieces and leading the same to the platen, means on the screen for gripping work pieces presented thereto, means for stripping work

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pieces from the screen, a conveyor synchronized with the first named conveyor leading from the platen to delivery end of the machine, and means for adjusting the platen and conveyors relative to the screen and platen.

6. In a printing machine, a support, a screen horizontally reciprocally mounted on the support, means for controlling the length of stroke of reciprocation of the screen, a printing element vertically reciprocally mounted on the support, cooperative means for reciprocating the screen and printing element in predetermined relation, a platen rotatably mounted on the support below the screen, means for successively presenting work pieces to said platen, a conveyor for receiving work pieces and leading the same to the platen, means on the screen for gripping work pieces presented thereto, means for stripping work pieces from the screen, a conveyor synchronized with the first named conveyor leading from the platen to delivery end of the machine, means for adjusting the platen and conveyors relative to the screen and platen, and means for adjusting one of the conveyors independently of the other of said conveyors.

7. In a printing machine, a support, a screen horizontally reciprocally mounted on the support, means for controlling the length of stroke of reciprocation of the screen, a printing element vertically reciprocally mounted on the support, cooperative means for reciprocating the screen and printing element in predetermined relation, a platen rotatably mounted on the support below the screen, a work piece feed bed adjustably mounted on the support, means for successively removing work pieces from said bed, means for ejecting work pieces of predetermined character, a conveyor for receiving work pieces and leading the same to the platen, means on the screen for gripping work pieces presented thereto at one end of the reciprocating stroke of the screen, means for causing cessation of operation of the machine upon misalignment of work pieces relative to the screen, means for stripping work pieces from the screen at the opposite end of the reciprocating stroke of the screen, a conveyor synchronized with the first named conveyor leading from the platen to delivery end of the machine opposite the work piece feed bed, means for adjusting the platen and said conveyors relative to said platen and screen, and means for adjusting one of said conveyors and said stripping means independently of said platen and screen.

8. In a printing machine, a screen, a printing element mounted for oscillation toward and away from said screen, said screen being mounted for oscillation past said printing element during contact of said printing element therewith, work feed means effective to convey work pieces into engagement with said screen, release means for freeing work pieces from said screen, driving means, means connecting said screen to be oscillated by said driving means, means connecting said printing element to be oscillated by said driving means, means connecting said release means for actuation by said driving means, and adjusting means for varying the oscillation stroke of said screen.

9. In a printing machine, a frame adapted to

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hold a screen, a cylindrical platen disposed to roll against a screen in said frame, conveyor belt means adapted to convey work pieces into engagement with the screen in said frame, stop members on said frame adapted to engage the edge of work pieces as the latter are fed to said frame by said conveyor belt means, and suction means effective to place individual work pieces on said conveyor belt means.

10. In a printing machine, a frame adapted to hold a screen, vacuum means adapted to hold a work piece against said screen during a printing operation, means for controlling the application of vacuum to said vacuum means, a release member effective to free a work piece from the screen, and means for synchronizing said vacuum controlling means and said release member.

11. A printing machine comprising a stencil frame reciprocable in a predetermined plane, a printing element movable to and from an operative position wherein it is in wiping contact with one surface of a stencil carried by said frame, means for actuating said frame and printing element in predetermined time relation, suction means carried by said frame for clamping a relatively rigid work piece to the other surface of the stencil, a rotatable platen positioned to contact the work piece opposite said printing element, and means carried by the stencil frame for stripping the work piece from the stencil after it has been printed.

12. The invention defined in claim 11, comprising in addition a feed bed for supporting a stack of work pieces, means for successively removing work pieces from said bed, means for rejecting work pieces of predetermined dimensions, a conveyor for moving the unrejected work pieces into contact with the stencil, and means becoming operative upon misalignment of a work piece relative to the stencil for stopping the machine.

13. A printing machine comprising a stencil frame reciprocable in its own plane, suction means carried by said frame for holding a work piece in contact with a stencil carried by said frame during a printing operation, a push rod operable to free the work piece from the screen, and means synchronized with said push rod for rendering said suction means operative and inoperative.

ALMUS C. BARLOW.
WILLIAM V. PAUL.

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