

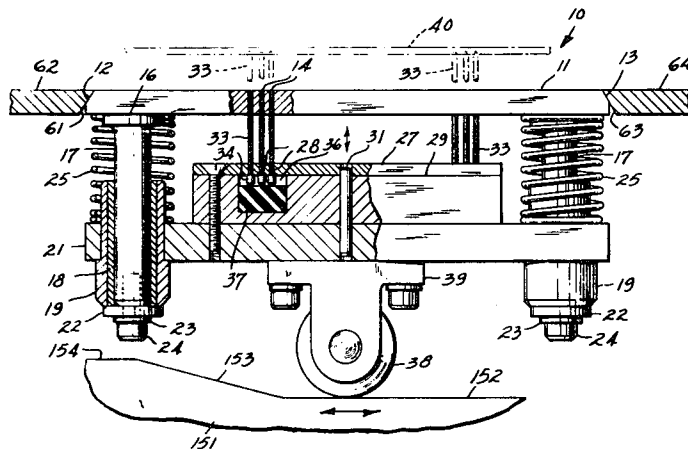
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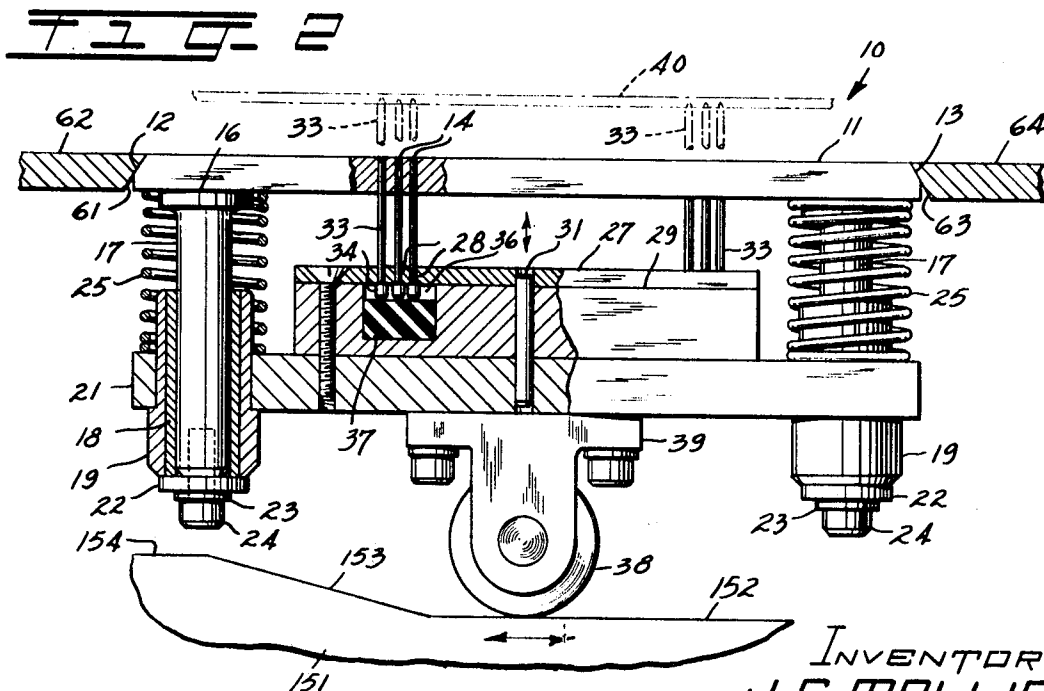
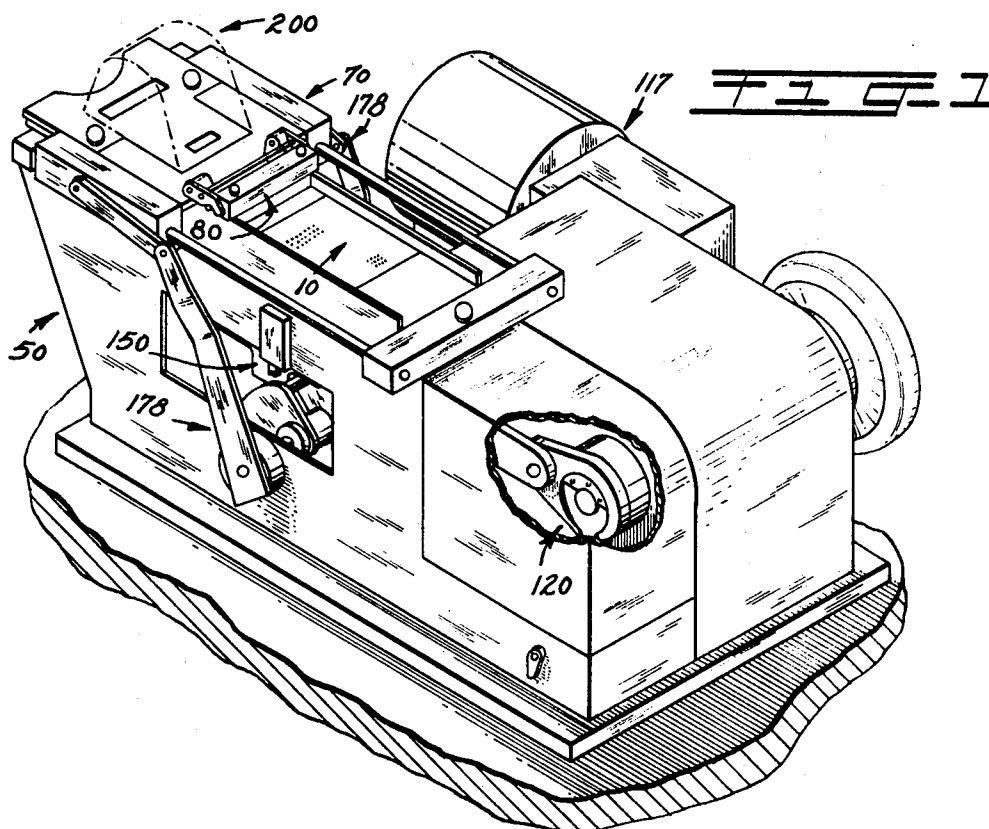
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[54] **APPARATUS FOR APPLYING INK TO HOLES**
6 Claims, 9 Drawing Figs.
[52] **U.S. Cl.**..... **118/50,**
118/215, 118/243
[51] **Int. Cl.**..... **B05c 1/02**
[50] **Field of Search**..... 118/50,
243, 211, 63, 263, 215; 101/103, 41

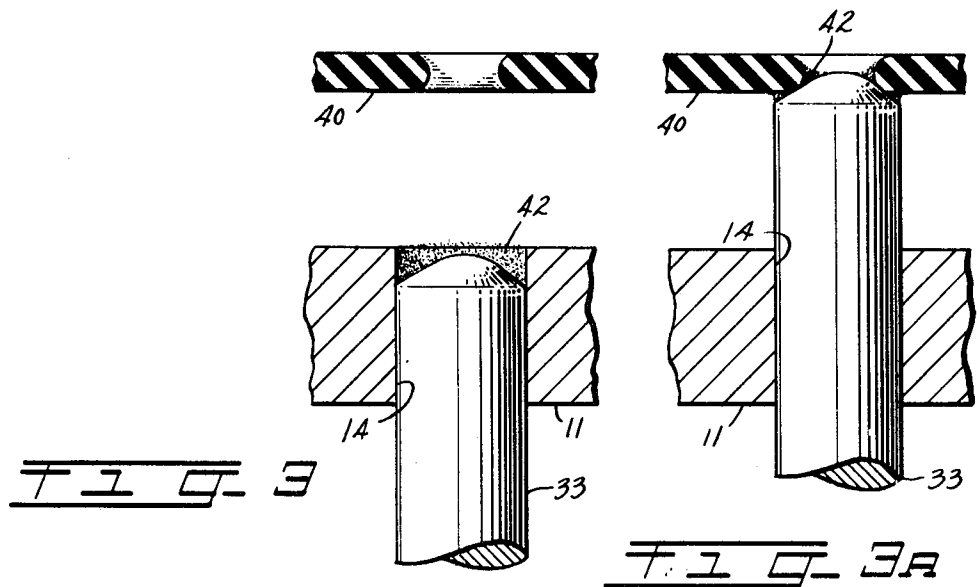
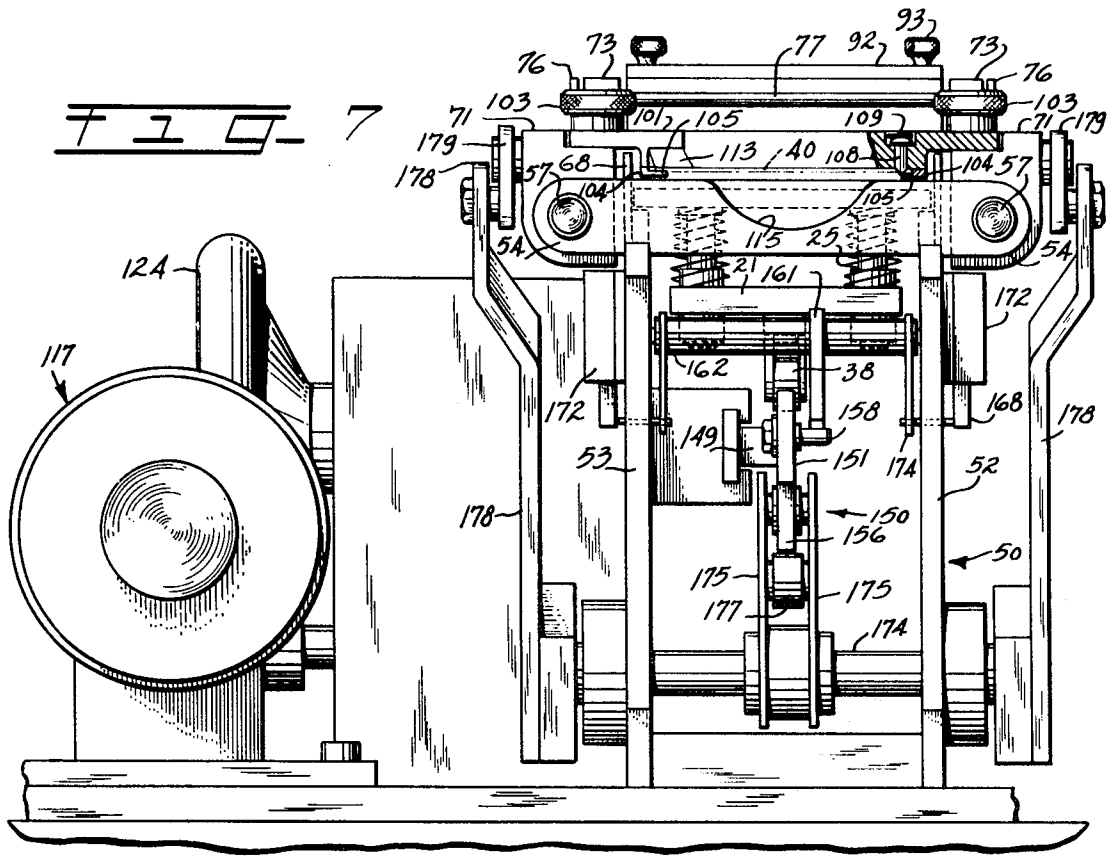
ABSTRACT: Material is applied to holes in a workpiece by transfer pins. The material is first introduced into holes in a template arranged in a pattern corresponding to the holes in the workpiece. Free ends of the transfer pins are then moved through the holes in the template to transfer the material to the holes in the workpiece. The material may then be pulled through the holes by a vacuum.





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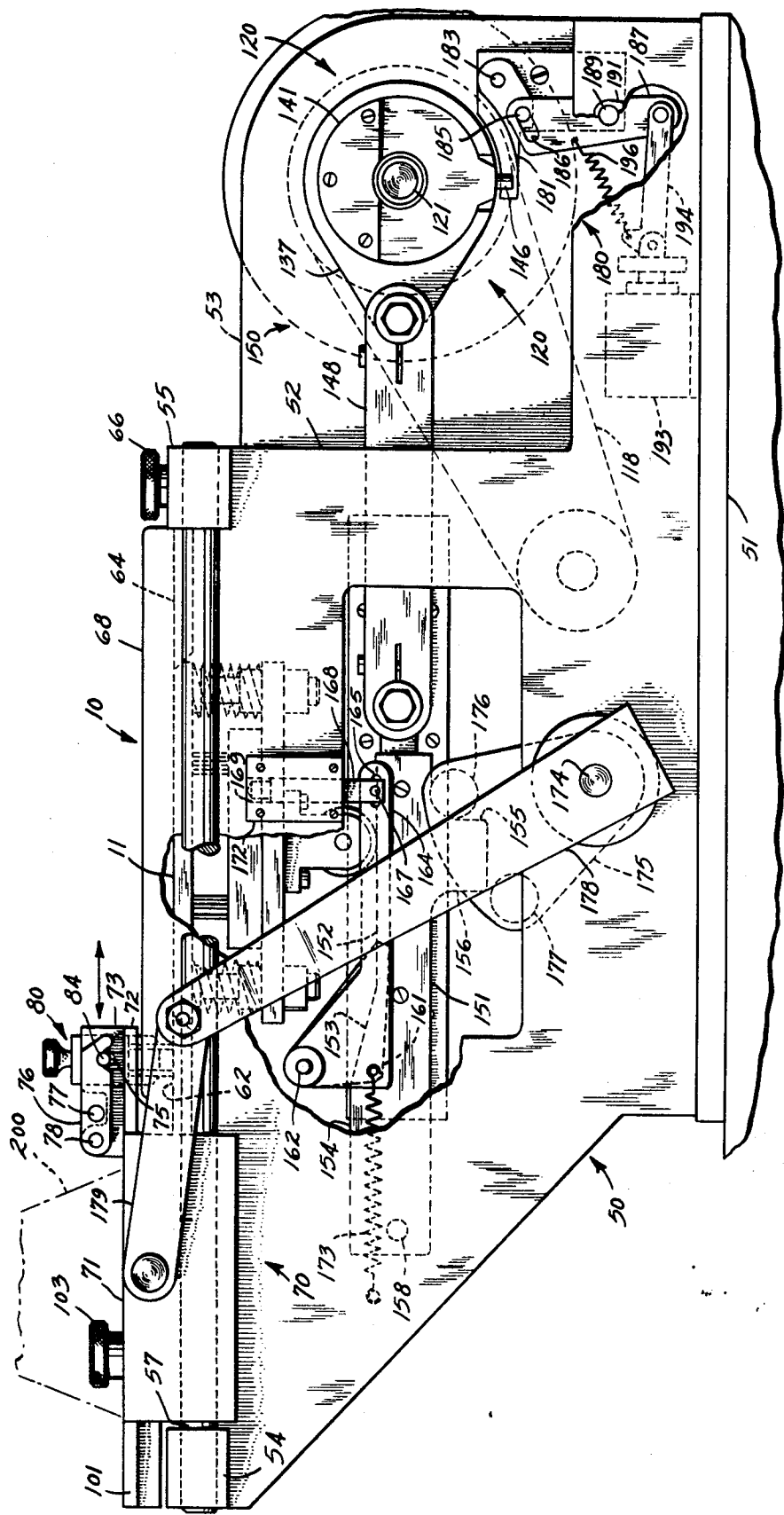


FIG. 4

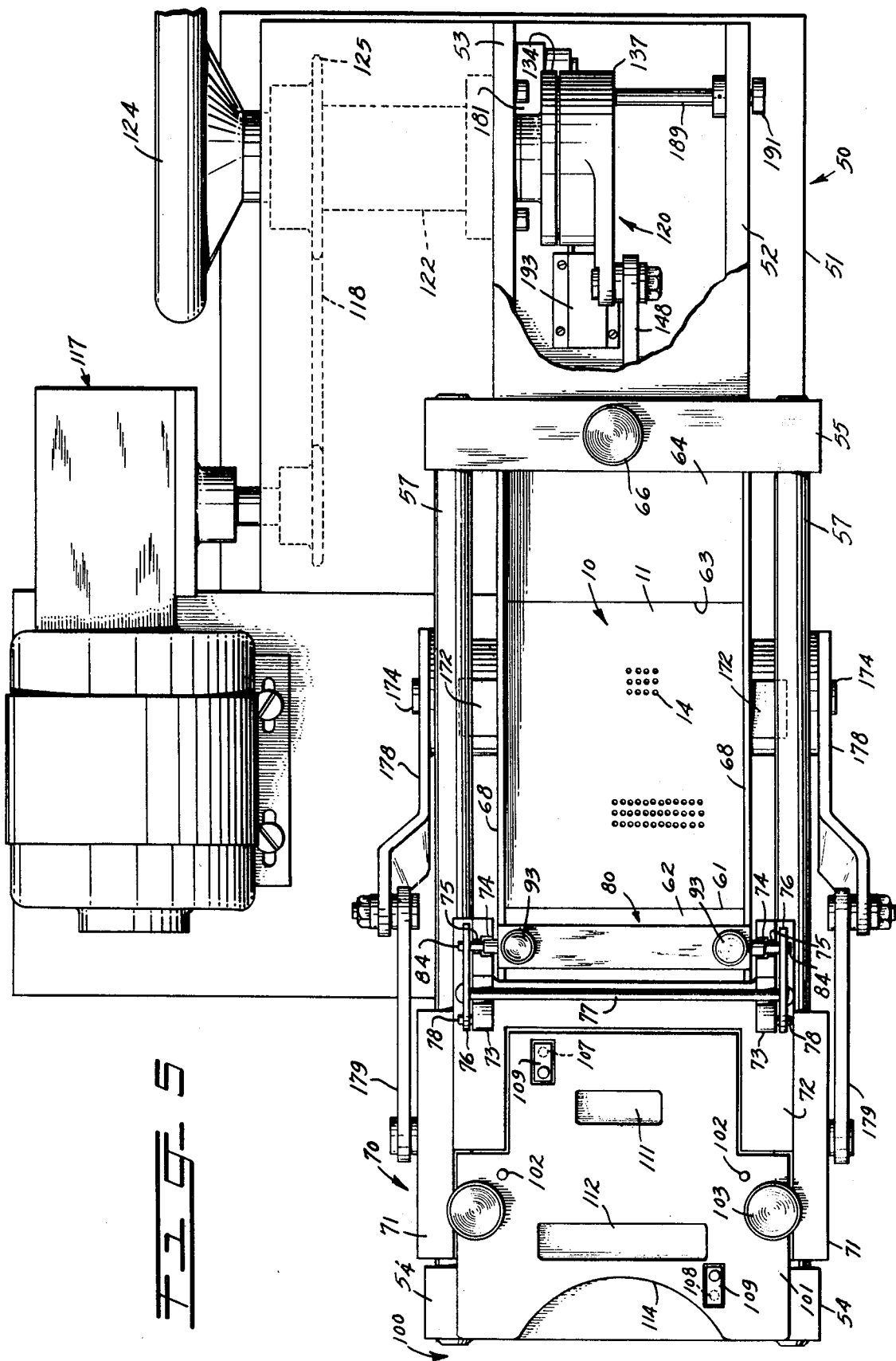


FIG. 6

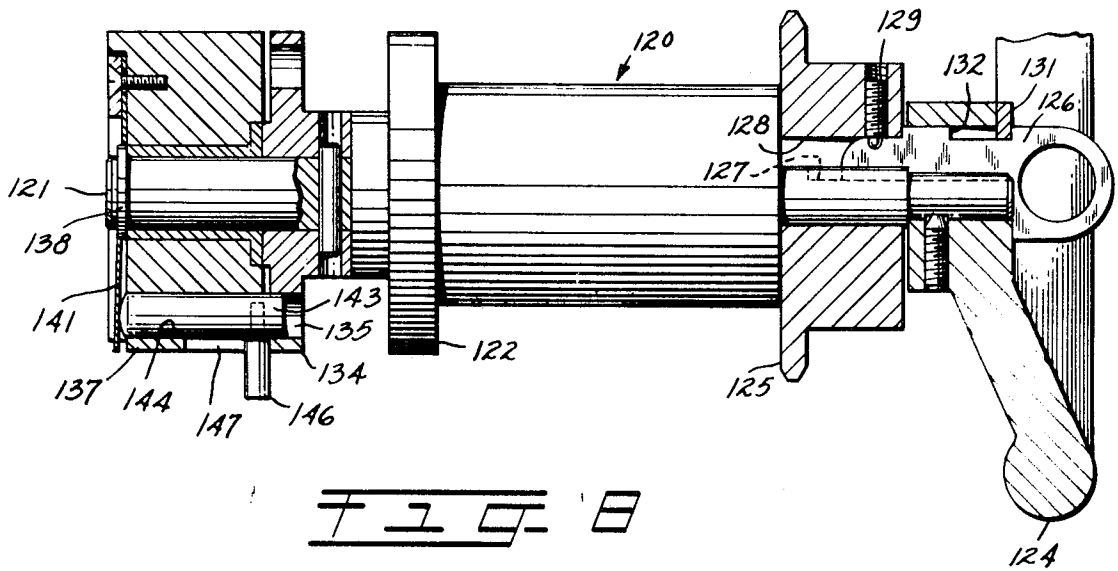
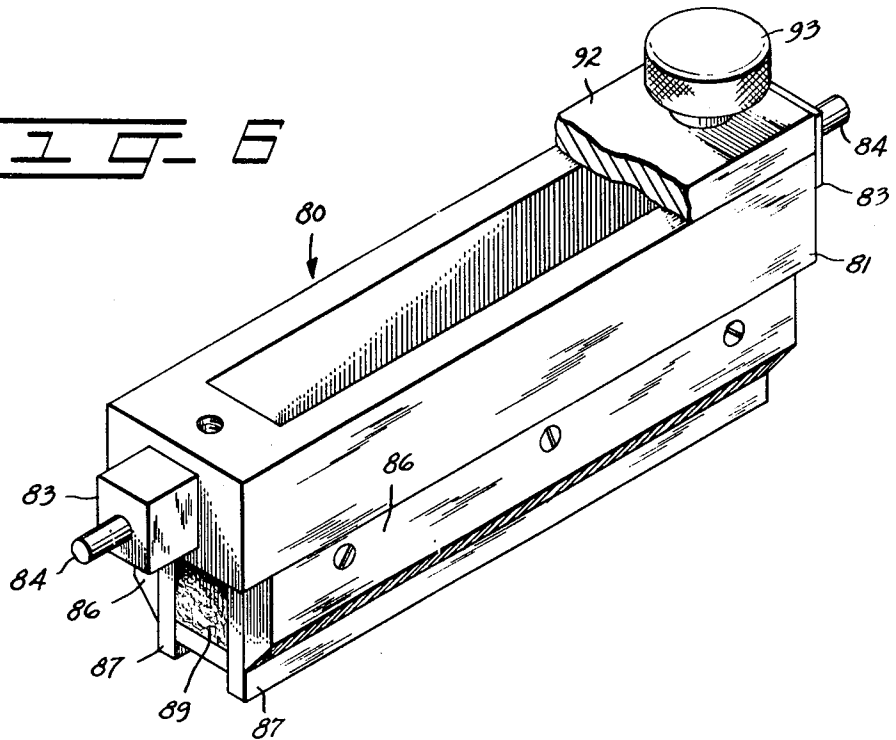


FIG. 7

APPARATUS FOR APPLYING INK TO HOLES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to apparatus for applying material to holes formed in a workpiece, and more particularly, to apparatus for applying adhesive catalytic ink to the periphery and walls of holes formed in a printed wiring board.

In manufacturing printed wiring assemblies on a production basis, the making of reliable electrical connections between the printed wiring and the component lead wires which extend through the holes in the printed wiring board has been a continuing source of difficulty. This is particularly true when the printed wiring is produced by the successive steps of applying catalytic ink through the silk-screening technique and then plating copper onto the ink. Where the hole has a rounded or chamfered edge, it has been found that silk screening does not in all instances give a well-controlled coating of ink to the periphery of the hole. As a result, special techniques have been developed for treating holes, so that both the periphery and a portion of the walls of the holes will be adequately covered.

2. Description of the Prior Art

One method used to coat the periphery and walls of the holes involves the application of ink onto the top surface of the printed wiring board using an array of resiliently mounted pins to which ink has been applied. The array has a pattern corresponding to that of the holes in the printed wiring board, and the tips of the pins are usually rounded or tapered to conform to the edges of the holes. This technique has a disadvantage in that it is difficult to control accurately the amount of ink which adheres to the applicator tip; furthermore, when the ink is fairly viscous, some of the ink is pulled upward when the applicator is raised away from the hole and this ink will occasionally fall back unevenly about the hole.

Another technique which has been taught for applying material to the periphery of holes involves spreading the material across the surface of the printed wiring board, and then removing the excess using a squeegee so that only the quantity which was introduced into the holes remains. This technique is suggested primarily for use with nonconducting solder resist material. It would be disadvantageous for use with catalytic adhesive ink since even minute traces of ink remaining on the surface of the board would result in copper deposition and possible high leakage between the printed wiring lines.

Other apparatus previously utilized or taught for applying ink to the periphery and walls of holes has involved a number of successive steps by the operator, has not provided optimum control of the amount of ink applied, or has involved apparatus not readily suited to high production rates.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an apparatus for applying controlled quantities of adhesive material to holes formed in a workpiece.

Another object of this invention is to provide an apparatus for applying material that aligns the material applying elements accurately with respect to the holes in the workpiece.

A further object is to provide means for applying material which will not contaminate the area surrounding the desired application.

With these and other objects in view, this invention contemplates providing a template having holes therein for receiving material and facilities for displacing transfer pins through the holes and into close proximity with a workpiece to transfer the material from the holes in the template to predetermined holes in the workpiece.

BRIEF DESCRIPTION OF THE DRAWING

The invention will be more clearly understood by reference to the following detailed description of an embodiment thereof, in conjunction with the accompanying drawing, in which:

FIG. 1 is a perspective view of an apparatus for applying ink to holes in a printed wiring board, in the position for loading and unloading, as viewed from the upper side rear;

FIG. 2 is an enlarged cross section of the printing fixture assembly portion of the apparatus shown in FIG. 1;

FIGS. 3 and 3a are enlarged cross sections of a portion of FIG. 2 showing the pins which transfer ink, after the ink has been applied to the pin and then as the ink is being applied to the printed wiring board; FIG. 4 is a side elevation of the apparatus shown in FIG. 1, partially cut away to show the cam slide and clutch tripper mechanisms;

FIG. 5 is a plan view of the apparatus shown in FIG. 1;

FIG. 6 is an enlarged perspective view of a squeegee assembly used as an ink applicator in the apparatus shown in FIG. 1;

FIG. 7 is a front elevation of the apparatus shown in FIG. 1; and

FIG. 8 is an enlarged cross section of the shaft and intermittent clutch assembly for the apparatus shown in FIG. 1.

DETAILED DESCRIPTION

Referring now to FIG. 1, there is shown an embodiment of the invention for applying a viscous adhesive catalytic ink to the periphery and walls of holes in printed wiring boards, especially suited to mass production operations requiring minimum setup time. This apparatus comprises a frame assembly 50 on which is mounted a driving motor 117 connected to an intermittent clutch assembly 120, for operating the apparatus through a slide cam assembly 150 and pivot arms 178—178. A workpiece 40 (FIG. 2) is inserted horizontally into a slot in a reciprocable carriage assembly 70 used as a workpiece holder. The pivot arms 178—178 are connected to the carriage assembly 70 to move it from the loading position shown to a transfer or printing position. In the printing position, the workpiece is adjacent a printing fixture assembly 10 having holes formed therein in a pattern corresponding to the holes formed in the workpiece.

A squeegee assembly 80 mounted on the carriage assembly 70 contains a supply of adhesive catalytic ink to be applied. As the carriage assembly 70 moves, the ink is introduced into the holes of the printing fixture assembly 10. When the carriage is in the printing position, movable pins within the printing fixture assembly are raised through the holes by the motion of a slide cam assembly 150 to apply the ink introduced therein to the workpiece. A vacuum nozzle 200 pulls air through the holes of the workpiece to distribute the ink within the holes.

More particularly, the printing fixture assembly 10 shown in FIG. 2 includes a horizontally disposed flat rectangular printing plate 11, used as a template, having chamfered upper edges 12 and 13 at its front and rear ends and having a plurality of holes 14—14 arranged in a pattern identical to the pattern of the holes in the workpiece which are to be imprinted. A stud 16 is rigidly fixed to the printing plate 11 near each corner, and has a bearing surface 17 whose axis is parallel to the axis of the other studs and essentially perpendicular to the printing plate 11. Each stud 16 receives a slidably fitted bearing sleeve 18 which is tightly fitted in a bushing 19. Each bushing 19 is mounted in a movable lower plate 21 so that the lower plate is maintained parallel to the printing plate 11 but vertically movable relative thereto. A flat washer 22 is attached by a lockwasher 23 and retaining screw 24 at the lower end of each stud 16 to act as a stop for the bushing 19. A compression spring 25, located about each of the studs 16 and bushings 19, engages the printing plate 11 and the movable lower plate 21 to hold the bushing against the stop.

A pin-retaining plate 27, having a plurality of holes 28—28 arranged in a pattern identical to the holes 14—14, is attached

above but separated from the movable lower plate 21 by a spacer 29 located therebetween, and is maintained in accurate alignment with the movable lower plate by dowel pins 31—31. A plurality of transfer pins 33—33, each pin having a head 34 at its lower end, are slidably fitted in the holes 28—28, the upper end of each pin being slidably fitted in the corresponding hole 14 of the printing plate 11. The head 34 of each pin 33 is within a recess 36 of the spacer 29, and is pressed lightly up against the lower surface of the pin-retaining plate 27 by a resilient material 37 located in the recess. The pins 33—33 are of such length that the upper end of each pin is slightly below the upper surface of the printing plate 11, as most clearly shown in FIG. 3, when the bushings 19—19 are against their flat washer 22. The upper end of each pin 33 and the walls of the corresponding hole 14 define a cavity into which ink 42 can be introduced, see FIG. 3.

In this manner, when material is introduced into the holes in the template so as to fill each such hole, an accurately controlled quantity of the material is provided which will then be transferred by the pins to the workpiece, as seen in FIG. 3a. Further, the use of relatively long material transfer pins laterally supported at each end provides precise alignment of the pins and protects them from bending caused by accidental contact during normal use.

As shown in FIGS. 4 and 5, the frame assembly 50 includes a base plate 51 to which are attached two parallel vertical sideplates 52 and 53. A front mounting block 54 and rear mounting block 55, fastened transversely to the sideplates and extending beyond each side of the upper edges thereof, receive a pair of longitudinally extending parallel guide rods 57—57 on which the carriage assembly 70 slides.

The printing fixture assembly 10 is removably mounted on the frame assembly 50, see FIG. 1. The printing plate 11 is held against the top edge of the sideplates 52 and 53 by capturing the chamfered front edge 12 of the printing plate 11 under the chamfered rear edge 61 of a top plate 62 which is attached transversely to the sideplates between the forward ends of the guide rods 57.

The rear edge 13 (FIG. 2) of the printing plate 11 is captured under the chamfered forward edge 63 (FIG. 5) of a retaining plate 64 which is located transversely between the sideplates 52 and 53, immediately forward of the rear mounting block 55 and clamped thereto by a knurled head screw 66. The plates 11, 62 and 64 are arranged with their upper surfaces coplanar so that the squeegee assembly 80 can slide smoothly across these surfaces in sequence. A pair of longitudinally extending vertical guide plates 68—68 are mounted so as to extend above the side plates 52 and 53 from the rear mounting block 55 forward to a point just beyond the position of the squeegee assembly 80 when the carriage assembly 70 is in the loading position, so arranged that the squeegee assembly fits slidably between the guide plates 68 as it moves across the surfaces of plates 62, 11 and 64.

The carriage assembly 70 includes a pair of sidepieces 71—71, slidably fitted on the guide rods 57—57 and transversely connected by a bridging plate 72 fastened to the sidepieces. A pair of brackets 73—73 is mounted on opposite sides of the bridging plate 72 to hold the squeegee assembly 80 (FIG. 5). A transverse slot 75 in the overhanging portion of each bracket 73, having a counterbore 74 (FIG. 5) at the inner end of the slot, provides a loose-fitting guide for the squeegee assembly 80. A pair of hook plates 76—76, rigidly connected by a transverse rod 77, is pivotally mounted on corresponding pins 78—78 which protrude horizontally outward from each bracket 73, with the hook portions adjacent the slots 75, see FIG. 5.

As shown in FIG. 6, the principal element of the squeegee assembly 80 is a stainless steel pot 81 open at its top and bottom, for containing the supply of adhesive ink (not shown). At each end there extends a rectangular cross section boss 83 from which a guide pin 84 extends horizontally still further, for loose-fitting engagement in the counterbores 74 (FIG. 5) and slots 75 (FIGS. 4 and 5) of the carriage assembly 70. A

pair of clamping plates 86—86 holds rubber strips 87—87 in a vertical position along the front and rear edges of the bottom of the pot 81, parallel to the axis of the pin 84. When the squeegee assembly is in place on the carriage assembly 70, the ends of the rubber strips 87 press against the guide plates 68—68 (FIGS. 4 and 5) of the frame assembly, and the bottom edges of the rubber strips 87 press against top plate 62 (FIGS. 4 and 5), so that the ink supply in the pot cannot leak out. Felt pads 89 in recesses of the pot 81 between the rubber strips 87 at each end protrude slightly so as to press against the frame guide plates 68, and thus prevent leakage of ink from between the rubber strips 87. A removable cover plate 92 is held tightly to the open top of the pot 81 by a pair of knurled head screws 93 to prevent the ink supply from drying.

As shown in FIG. 4, in the normal position the hook plates 76 of the carriage assembly 70 bear downward on the guide pins 84 where they extend through the slots 75, to hold the squeegee assembly 80 in place. The hook plates 76 can be rotated upward and forward from the guide pins 84 so that the squeegee assembly can be removed.

As shown in FIGS. 4, 5 and 7, the plate fixture assembly 100 (FIG. 5) is also mounted on the carriage assembly 70. The fixture plate 101, which is the principal element of this assembly 100, extends transversely between recesses in the top surfaces of the carriage sidepieces 71—71 to which it is accurately located by dowel pins 102 (FIG. 5) and held by knurled head screws 103. A pair of longitudinal workpiece guides 104—104 (FIG. 7) having an internal lower lip 105 is attached to the lower surface of the fixture plate, so disposed that a workpiece 40 can be slid easily between the guides 104—104 with the bottom surface of the workpiece resting on the lips 105—105. A pair of pilot pins 107 and 108 (FIG. 5), spring loaded by leaf springs 109, are slidably fitted in pilot holes in the fixture plate 101 to engage registration holes (not shown) in the workpiece 40, for alignment of the workpiece accurately to the plate fixture assembly. To compensate for tolerance buildup between the workpiece registration hole spacing and the fixture plate pilot holes, pilot pin 107 preferably operates in a longitudinally extending slot which is a sliding fit transversely and a loose fit longitudinally. A guide step (not shown) is attached to the fixture plate so that the workpiece can be inserted only to the point where the registration holes in the workpiece are under the pilot pins.

Openings 111 and 112 (FIG. 5) are provided in the fixture plate 101, arranged to expose the region of the workpiece in which are located the holes to be printed, so that the vacuum nozzle 200 (FIG. 4) can act on those holes. A chamfered surface 113 (FIG. 7) in front lower edge of the fixture plate 101 immediately above the space between the longitudinal guides 104—104 provides a guide for the workpiece 40 into the opening between the plate 101 and the lips 105. A recess 114 (FIG. 5) is provided in the fixture plate 101, and a tapering recess 115 (FIG. 7) in the mounting block 54, so that an operator of the apparatus can grasp a workpiece with his fingers to withdraw it when the carriage assembly 70 is in the loading position shown in FIGS. 1, 4 and 5.

In normal operation, driving power is obtained from a continuously rotating electric motor with integral gearhead 117 (FIG. 5), connected by a belt 118 to the shaft and intermittent clutch assembly 120. As shown in FIG. 8, a shaft 121 is rotatably fitted in a bearing block 122 which is fastened to the vertical sideplate 53 (FIG. 5), so arranged that the axis of shaft 121 is transverse to the apparatus. A handwheel 124 is fastened on one end of the shaft 121 to permit manual operation of the apparatus for inspection or setup. A sprocket 125, rotatably fitted on the shaft 121 adjacent to the handwheel 124, engages the drive belt 118 (FIG. 5). A key 126 is slidably fitted in the keyway 127 in the shaft 121 and handwheel 124, so that the key can be pressed fully inward to engage a mating keyway 128 in the sprocket 125 thereby locking the sprocket to the shaft 121. A ball plunger 129 mounted in the hub of the sprocket 125 engages a detent in the key 126 to hold the key in the keyway 128. A stop 131 fastened to the handwheel 124,

and a shoulder 132 on the key 126 prevent the key 126 from being pulled out of the keyway 127.

A clutch-driving disc 134 having a plurality of holes 135—135 is rigidly mounted on the shaft 121 near the end opposite the handwheel 124, with the axes of the holes 135 parallel to the axis of shaft 121 and equidistant therefrom. An intermittent clutch-driven plate 137 is rotatably mounted on the shaft 121 at the end opposite the handwheel 124 and adjacent the clutch-driving disc 134, and is retained by a spring clip 138 fitted in a groove at the end of the shaft 121. A flat spring 141 attached to the end of driven plate 137 bears against a clutch pin 143 which fits slidably in hole 144 of the driven plate, the hole 144 being parallel to the axis of shaft 121 and the same distance therefrom as the holes 135. When the hole 144 is in line with one of the holes 135, the spring 141 can urge the clutch pin 143 into engagement with the hole 135, to cause the driven plate 137 to rotate with the shaft 121. A clutch release pin 146 extends radially from the clutch pin 143 and passes slidably through an axial slot 147 in the driven plate, so that movement of the clutch release pin in a direction away from the handwheel 124 overcomes the force exerted by the flat spring 141 and slides the clutch pin 143 out of engagement with the hole 135, to permit the shaft 121 to rotate independently of the clutch-driven plate 137.

Principal details of the slide cam assembly 150 are shown in FIG. 4 and FIG. 7. A connecting rod 148 (FIG. 4) is rotatably attached to the end of clutch-driven plate 137 and pivotally connected to the cam plate 151. The cam plate is mounted to a backing plate 149 (FIG. 7) slidably fitted in a longitudinal groove in the frame assembly 50, so that rotation of the clutch-driven plate causes longitudinal reciprocating motion of the cam plate 151. The top edge of the cam plate 151 has sequential horizontal cam surfaces 152 and 154 (FIG. 4) connected by a slant surface 153. These surfaces are engaged by the cam roller 38 of the printing assembly 10, as shown in FIG. 2, and are so arranged that as the roller follows the slant surface 153 upward the inking pins 33 are raised from the position for receiving ink to the position where they apply ink to the holes of the workpiece, see FIGS. 3 and 3a. The lower edge of the cam plate 151 includes a downward protruding tooth having a leading edge 155 and a trailing edge 156 (FIG. 4) for engaging cam roller 177.

A striker pin 158 projects transversely from the cam plate 151, so disposed that it can engage a locating pin cam 161 which is rigidly fastened to a transverse shaft 162 rotatably mounted to the frame assembly. A pair of locating pin-operating arms 164, rigidly fastened to shaft 162, extend longitudinally rearward from shaft 162 in an approximately horizontal position. As the cam plate 151 advances, and just before the cam roller 38 engages the cam surface 152, the striker pin 158 contacts the bottom edge of cam 161 to rotate cam 161 and shaft 162 slightly. A connecting pin 167 extends transversely from the lower end of each of a pair of vertical locating pins 168 through a corresponding longitudinal slot 165 near the extreme end of each arm 164, so that rotation of the operating arms 164 causes vertical motion of the locating pins 168—168.

Each locating pin 168 is slidably fitted in a vertical hole 169 of a bracket 172, the brackets being mounted opposite each other on the outer surfaces of the sideplates 52 and 53 of the frame assembly. The brackets 172—172 are arranged such that, when the carriage assembly has been moved to the printing position with the holes in the workpiece positioned approximately above the corresponding holes 14—14 in the printing plate 11, the locating pins 168—168 are under and approximately in line with mating close-fitting holes (not shown) in the underside of the carriage sidepieces 71—71. The upper ends of the locating pins 168—168 are pointed so that, as the pins are raised by rotation of the operating arms 164, the carriage assembly 70 may be moved longitudinally as required to permit the locating pins to enter the holes in the sidepieces 71—71, thus aligning the carriage assembly 70 and workpiece 40 precisely above the printing plate 11. A pair of

springs 173 (FIG. 4) withdraws the pins 168 to a mechanical stop (not shown) when the striker pin 158 is not engaging cam 161.

A shaft 174 is rotatably mounted in the sideplates 52 and 53 with its axis transverse and below the slide cam assembly 150. A pair of sector plates 175, rigidly fixed to the shaft 174 near its center, support cam roller 176 and 177 between the sector plates with the axes of the cam rollers parallel to and equidistant from the axis of shaft 174. In operation, the leading edge 155 (FIG. 4) of the tooth on the cam plate 151 engages the roller 176 as the slide cam assembly 150 moves rearward, to rotate the sector plates 175 from the loading position to the printing position, and the trailing edge 156 of the tooth engages the roller 177 as the slide cam assembly returns to the loading position, to rotate the sector plates 175 back to the loading position. A pair of pivot arms 178—178, rigidly attached to the ends of the shaft 174 outside the sideplates 52 and 53, extend upwardly in the same radial direction as the sector plates 175. The upper end of each pivot arm 178 is coupled to the corresponding sidepiece 71 of the carriage assembly 70 by a connecting link 179 (FIG. 7) pivotally attached at its corresponding ends to the pivot arm and sidepiece, so that rotary motion of the sector plates 175 will cause translation of the carriage assembly along the guide rods 57.

The intermittent clutch assembly 120 (FIG. 4) is controlled by a clutch tripper assembly 180 mounted below the clutch assembly 120 between sideplates 52 and 53. A clutch release cam 181, pivotally mounted on a pin 183 having its axis parallel to the shaft 121, is located adjacent to the clutch-driven plate 137. With the cam 181 in its normal position the cam surface is in helical relation to the axis of shaft 121 so disposed that, at the point in driven plate 137 rotation where the carriage assembly has nearly returned to the loading position, the clutch release pin 146 engages the surface of cam 181. As the driven plate 137 rotates further, the clutch release pin follows the helical path away from the driving disc 134, sliding the clutch pin 143 out of the hole 135 so that the driven plate 137 stops rotating, see FIG. 4.

A pin 185 extending transversely from the cam 181 extends into a slot 186 in a release lever 187, the lever being fastened rigidly on a transverse shaft 189 mounted rotatably between the sideplates 52 and 53 and having an end protruding through plate 52. Rotation of the lever 187 and shaft 189 causes the cam 181 to pivot about the pin 183 away from the clutch-driven plate 137. Such motion disengages the clutch release pin 146 from the cam surface, thereby permitting the flat spring 141 to push the clutch pin 143 into one of the holes 135 in the driving disc 134, see FIG. 8. For manual operation of the clutch, a knob 191 is provided on the exposed end of the shaft 189. Automatic operation is obtained through a solenoid 193 which is mounted on base plate 51 and mechanically connected to the release lever 187 by pivotally attached connecting link 194, so that energizing the solenoid causes the lever 187 to rotate. A spring 196 is connected between the lever 187 and the solenoid end of the link 194 to return the lever and solenoid to the deenergized position.

A nozzle 200 (FIG. 4) connected to a vacuum valve and source (not shown) is mounted over the plate fixture assembly 100 (FIG. 4) by a bracket (not shown), so arranged that when the carriage assembly is in the loading position the openings 111 and 112 (FIG. 5) are under the nozzle 200. A cam-operated switch (not shown) is mounted in such a way that a brief switch closure is obtained just before the clutch-driven plate 137 has reached the loading position, at which the plate stops between operating cycles of the apparatus. The switch closure actuates the vacuum valve, so that a pulse of air preferably less than 1 second in duration is drawn upward through the holes of the workpiece.

A control box (not shown) is mounted in any position convenient for the operator, and typically includes a fuse, a switch with indicating pilot light for the electrical supply, and a momentary contact switch for energizing the solenoid.

With reference to the foregoing description, the operation of this embodiment of the invention is as follows:

A workpiece, having a pattern of holes to which adhesive ink is to be applied, is inserted by an operator into the opening in the plate fixture assembly 100 so that the workpiece rests on the lips 105, with the side to be imprinted facing down, and is pushed inward until it hits the guide stop and is held in place by the pilot pins 107 and 108. The operator then presses the switch which controls the solenoid 193.

Viewed from the direction of FIG. 4, operation of the solenoid rotates the release lever 187 clockwise, pulling the clutch release cam 181 down and thus releasing the clutch release pin 146. The spring 141 pushes the clutch pin 143 into one of the holes 135 in the continually rotating disc 134, so that the clutch-driven plate 137 begins to rotate clockwise. As the slide cam assembly 150 is advanced to the right, the leading edge 155 engages the cam roller 176 and rotates the sector plates 175 clockwise until the tooth-leading edge can pass over the roller 176. Rotation of the pivot arms 178 pulls the carriage 70 and squeegee assembly 80 into the printing position above the printing fixture assembly 10, spreading the ink 42 from the squeegee assembly into the holes 14 of the printing plate 11 as the carriage moves. As the slide cam assembly continues to advance, the striker pin 158 engages cam 161. This rotates the shaft 162 and locating pin arms 164 slightly counterclockwise, and raises the locating pins 168 so that they engage the snug-fitting holes in the carriage sidepieces 71, aligning and locking the carriage in position. As the slide cam assembly advances to its extreme position, the cam surfaces 153 and then 154 pass under the cam roller 38, forcing the plates 21 and 27 upward until the pins 33 contact the holes in the workpiece, as shown in FIGS. 2 and 3a.

As the clutch-driven plate continues to rotate, the slide cam assembly 150 is pulled back to its starting position, and the various other mechanisms return to their start positions in reverse order. The springs 25 return the pins 33 and plates 21 and 27 downward, and then the springs 173 withdraw the locating pins 168 from the carriage sidepieces 71. Finally, the cam plate tooth railing edge 156 engages the roller 177 and returns the carriage to its starting position, so that the plate fixture assembly 100 is under the vacuum nozzle 200. The cam-operated switch actuates the vacuum valve, so that the resulting pulse of air sucks the ink upward in the holes to obtain a smooth coating.

Since the solenoid 193 is operated only momentarily, the clutch release cam 181 returns to its normal position while the driven plate 137 is rotating, and the clutch pin 143 is then withdrawn from the driving disc 134 as the driven plate 137 completes one revolution. This finishes a complete operating cycle. The operator can now grasp the workpiece and withdraw it from the carriage, and proceed to repeat the operation with another workpiece.

As can be seen from the detailed description above, a feature of this embodiment of the invention is the grouping of parts, which are peculiar to one pattern of holes or configuration of workpiece, into two assemblies which are easily removed and replaced: the plate fixture assembly and the printing fixture assembly. This feature provides maximum utility of the basic apparatus with a minimum expenditure for capital equipment and setup time.

As will be appreciated by one skilled in the art, many variations in the apparatus disclosed can be made without departing from the spirit of the invention. For example, the transfer

pins 33—33 may be held stationary and the workpiece 40 and printing plate 11 displaced towards the pins to transfer material from the plate to the workpiece.

What is claimed is:

1. An apparatus for applying catalytic ink to the periphery and walls of holes formed in a predetermined pattern in a printed wiring board, said apparatus comprising:
 - a reciprocable carriage for receiving the printed wiring board;
 - a perforated plate having holes formed therein in a pattern corresponding to the pattern of the holes in said printed wiring board;
 - applicator means for introducing the catalytic ink into the holes formed in said perforated plate;
 - means for moving said reciprocable carriage to a position adjacent said perforated plate;
 - positioning means responsive to movement to said adjacent position for accurately positioning said reciprocable carriage so that said holes in said printed wiring board are in registration with the corresponding holes in said perforated plate;
 - a vertically movable member;
 - a plurality of transfer pins mounted vertically in said vertically movable member and aligned with said holes in said perforated plate; and
 - lifting means for raising the vertically movable member so that the upper ends of said plurality of pins move through the holes of said perforated plate to pick up the catalytic ink introduced therein and apply the ink to the periphery and walls of said holes in said printed wiring board.
2. The apparatus claimed in claim 1; comprising in addition: vacuum means located above the reciprocable carriage for briefly applying a partial vacuum to produce a pulse of airflow through said holes in said printed wiring board so that said catalytic ink spreads smoothly about and within said holes in said printed wiring board.
3. The apparatus claimed in claim 1 wherein said applicator means comprises means for applying catalytic ink across the entire perforated plate while said reciprocable carriage is being moved to said adjacent position, comprising in addition: squeegee means for removing said catalytic ink from said perforated plate while leaving a predetermined amount of said catalytic ink in said holes in said perforated plate.
4. The apparatus claimed in claim 3; comprising in addition: vacuum means located above the reciprocable carriage for briefly applying a partial vacuum to produce a pulse of airflow through said holes in said printed wiring board so that said catalytic ink spreads smoothly about and within said holes in said printed wiring board.
5. The apparatus claimed in claim 1, wherein said plurality of pins are mounted such that their upper ends project partly into but below the top of the corresponding holes in said perforated plate when said vertically movable member is at its lowest position to define a cavity for receiving a predetermined volume of said material.
6. The apparatus claimed in claim 5; comprising in addition: vacuum means located above the reciprocable carriage for briefly applying a partial vacuum to produce a pulse of airflow through said holes in said printed wiring board so that said catalytic ink spreads smoothly about and within said holes in said printed wiring board.