

PATENT SPECIFICATION

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(54) APPARATUS FOR SCREEN PRINTING

(71) We, PILOT MAN-NEN-HITSU KABUSHIKI KAISHA, a body corporate organised under the laws of Japan, of No. 7-3, 2-Chome, Kyobashi, Chuo-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to an apparatus for screen printing and more particularly to an apparatus for setting a sheet material to be printed in a predetermined position by restricting forward movement of the sheet material and diverting it at right angles with respect to the transfer direction.

15 Generally, in screen printing a design is painted on a screen material such as silk, nylon or wire with a glue or a resinous material. Sticky ink is poured on one end of the screen and is forced through the open mesh by the scraping action of a squeegee onto a sheet material such as paper, a resin plate, or a metal plate. The open area in the screen allows the ink to pass through, but the solid areas are impermeable. The design thus is transmitted in terms of open and blocked areas of the screen.

20 In order to obtain accurate printed patterns such as printed circuits by multiple screen printings, it is very important to correctly set sheet materials to be printed in a predetermined position.

25 Conventionally, indicative marks, guide plates or positioning pins are provided on a table for placing the sheet material in the predetermined position and, after making repeated test printings the sheet materials are set to the correct position by an operator. Such positioning requires troublesome operations and takes much time.

30 Furthermore, when the sheet material to be printed has a certain thickness such as resin plate or metal plate, stepped shoulders may be formed at junctions between the upper surfaces of the sheet material and the table in the moving direction of the

squeegee. Accordingly, not only is smooth movement of the squeegee not attained but also the squeegee itself or the screen will be damaged with the result that the quality of the printed material is lowered.

35 To eliminate these disadvantages, thin plates, the thickness of which is equal to that of the sheet material to be printed, are provided in both sides of the sheet material in contact therewith to form an even surface along the moving direction of the squeegee. However, each time the thickness or size of the sheet materials to be printed differs, these thin plates have to be replaced by new ones or assembled to other places. In particular, when a plurality of printing machines are connected with each other to perform an automatic continuous printing, the operating efficiency of the machines will be lowered.

40 Accordingly, an object of the present invention is to provide an apparatus for screen printing which automatically sets sheet materials to be printed in a predetermined position and ensures accurate printings.

45 According to the invention, there is provided an apparatus for screen printing comprising a printing table for receiving a sheet of material to be printed, transfer means projecting through the printing table to convey the sheet material upon the printing table, first stopper means arranged at right angles to the transfer means for checking the movement of the sheet material fed on the table by the transfer means, second stopper means provided at right angles to the first stopper means, diverting means movable upon the table at right angles to the second stopper means to divert the sheet material toward the second stopper means, means for operating the diverting means while the sheet material is in contact with the first stopper means, and means for positioning the transfer means and the first stopper means below the surface of the printing table after the sheet material is set to a predetermined position

by the first and second stopper means.

Preferably, the diverting means has an upper plate which is in the same horizontal plane as the upper surface of the sheet material in the printing position, and the printing table is provided with apertures which communicate with suction or evacuating means. When the sheet material is not large enough to close every suction aperture in the table, the upper plate of the diverting means closes the remaining apertures so as not to reduce the suction efficiency.

The apertures made through the table in the area within which the diverting means is movable may be arranged in rows inclined with respect to the pushing means, so that the probability that a straight end portion of the sheet material partly closes a row of suction apertures is reduced. Accordingly, the suction efficiency of the negative pressure means is increased.

The pushing means may be moved by a two stage driving means, one being for long distance and the other for short distance, so that the diverting means may be adjusted for use with any size sheet material with ease. Normally, only the short distance driving means is operated to correspond to a short printing cycle using one size of sheet.

In order to set the sheet material in the printing position, the table is elevated toward the screen or, alternatively, the screen may be lowered toward the table.

Thus, in the present invention not only is the sheet material to be printed automatically set in a predetermined printing position, but also the squeegee can smoothly move on the screen and any size sheet material may be automatically printed.

Furthermore, in the case when the printed sheet is automatically discharged from the apparatus by the transfer means, a plurality of the present apparatus may be connected with each other, or other machines such as a press machine may be connected with the present apparatus to provide an automatic printing system.

In the accompanying drawings:

Figure 1 is a plan view of an embodiment of an apparatus according to the present invention and showing means for setting a sheet material in a predetermined position, Figure 2 is a perspective view of the apparatus shown in Figure 1,

Figure 3 is a partially sectioned side view of the apparatus shown in Figure 1 in which the table is in a lowered position and the squeegee block system is omitted, and

Figure 4 is a partially sectioned side view of the present apparatus shown in Figure 1 in which the table is raised to the printing position.

The apparatus according to the present invention is the same as the conventional apparatus insofar as a sheet of material 1 having been set in a predetermined position on a table 2 is printed by ink while a squeegee 85 (see Figure 4) travels upon a screen 80. However, as opposed to the conventional apparatus, the present apparatus is provided with means for setting the sheet material 1 in the predetermined position by restricting transfer movement of the sheet material and diverting it at right angles with respect to the transfer direction.

Referring now to the means for restricting the transfer movement of the sheet material 1 to be printed, it comprises a transfer device 10 for sheet materials and stopper device 20. The transfer device 10 may be a known endless belt conveyor, a plurality of aligned rollers arranged in parallel, or any other appropriate means. The transfer device 10 partially projects above an upper surface of a table 2 so that the sheet material 1 to be printed travels slightly above the table surface, as shown in Figure 2. However, the transfer device 10 is entirely concealed below the table surface after the sheet material has been set in the predetermined printing position, so that the sheet material 1 is placed upon the table 2 in contact therewith as shown in Figure 4. In the embodiment shown in the Figures, the transfer device 10 has two endless conveyor belts 13, 14 each of which is wound around two pulleys 11, 12 and disposed in a slot 3a, 3b of the table. The slots 3a, 3b are parallel to the transfer direction of the sheet material 1. Both endless conveyor belts 13, 14 rotate in the direction shown by arrows in Figure 1, as the pulleys 11 are in frictional contact with rollers 17, 18 which are, in turn, driven by a motor 15 through an appropriate transmitting means 16.

The table 2 is controlled to be movable from the lowered position shown in Figure 3 to the raised printing position shown in Figure 4 where the sheet material 1 comes close to the screen 80. To this end, a shaft 8 is fixed at its upper end to the table 2 and has a cam roller 9 at its lower end which is received by a cam 63. The shaft 8 passes through a hollow bearing 61 secured to machine frame 60 and is movable up and down through the hollow bearing 61. Thus, when drive means 64 for the table 2 is operated, the table 2 goes up, independently of the transfer device 10 as shown in Figure 4, and the upper surface of the table 2 directly contacts to the sheet material 1 and carries the latter along with the upward movement of the table. On the contrary, when the shaft 8 moves down, the table goes down to the position shown in Figure 3 with the sheet material remaining on the transfer device 10.

The stopper device 20 comprises vertical bar members 21, 22 provided at the forward end of the table 2 and means for projecting the bar members 21, 22 above the table to restrict the advancement of the sheet material 1 by the transfer device 10 and for retracting the bar members 21, 22 below the table 2 so as to re-advance the sheet material 1. The means for projecting and retracting the bar members 21, 22 includes an air cylinder 23 whose piston rod 24 is pivotably connected at one end with one end of a lever 25 rotatably supported on the table. The other end of the lever 25 is pivotably connected to the lower end of the bar member 21. The other bar member 22 is pivotably connected at its lower end with a lever 27 which is operated by a link 26 pivoted to the lever 25. In the state shown in Figure 3 wherein the piston rod 24 of the air cylinder 23 is extended, the upper parts of the bar members 21, 22 project above the table 2. When the piston rod 24 is retracted, the upper parts of the bar members 21, 22 are concealed below the upper surface of the table 2.

The sheet material 1 which is prevented from advancing by the stopper device 20 is then pushed away at right angles with respect to the transfer direction by diverting means 40. The diverting means has a pushing member 41 which pushes the sheet material 1 up to standard plane 31 of a frame member 30. The pushing member 41 comprises an upper plate 41a, a lower plate 41c, and three vertical plates 41b, 41b', 41b'' fixedly interposed between the upper and lower plates. The central vertical plate 41b' has an end surface which is slightly projected beyond the end surfaces of the other two vertical plates 41b, 41b''. The three vertical plates 41b, 41b', 41b'' pass through three associated slots 4a, 4b, 4c in the table 2. The pushing member 41 is movable along the slots 4a, 4b, 4c by rollers 41d at the bottom of the member. The rollers 41d run on a platform 55. When the pushing member 41 is advanced toward the standard plane 31 of the frame member 30 by its driving means, the central vertical plate 41b contacts to the sheet material 1 by its projecting end surface and pushes the sheet material to the standard plane 31 of the frame member 30. The upper plate 41a of the pushing member 41 may have a projecting end surface at its centre portion for pushing a relatively thick sheet material 1. As the sheet material 1 is not always accurately square shaped or rectangular shaped, the projecting end surface of the pushing member is effective to set such sheet materials to the predetermined position.

In order that the pushing member 41 may

be adapted to various sizes of the sheet materials 1, the driving device for the pushing device comprises a long distance driving means and a short distance driving means, both means being operable at every printing cycle. In the present embodiment, the long distance driving means moves a threaded member 44 and a device thereon along a long screw shaft 43, as the threaded member 44 is threadedly engaged with the screw shaft 43. The short distance driving means moves the pushing member 41 as far as the stroke of an air cylinder 42. The pushing member 41 is connected to a piston rod 45 of the air cylinder 42 through a spring 46 so as not to apply an excessively high pushing pressure to the sheet material 1. The air cylinder 42 has a base 47 which is moved along a guide fixed to the lower plate 41c of the pushing member 41. The base 47 has a fork 49 fixed at the bottom of the base, and the fork 49 engages with vertical grooves 48 in the threaded member 44. The screw shaft 43 engaged with the threaded member 44 is rotatably supported by bearings 50, 51 and is driven by a motor 54 through gears 52, 53.

The table 2 has an arm 5 at the end opposite to the pushing member 41. When the sheet material 1 is elevated by the table 2 to a level where the upper surface of the sheet material 1 is on the same horizontal plane as the upper surface 32 of the frame member 30, the arm 5 of the table cooperates with the arm of the frame member 30, so that, thereafter, the frame member 30 goes up along with the elevation of the table 2. On the other hand, when the table 2 is elevated for a certain distance, the upper surface of the table 2 comes to contact with the bottom surface of the upper plate 41a of the pushing member 41, so that, thereafter, the pushing member goes up also along with the elevation of the table 2. Accordingly, it is preferable that the upper plate 41a of the pushing member 41 has the same thickness as the sheet material 1. Thus, the frame member 30 and the pushing member 41 not only set the sheet material 1 in the predetermined printing position but also provide a relatively long even surface in cooperation with the sheet material 1, so that the screen 80 is not damaged when the squeegee 85 moves beyond the length of the sheet material 1. In order to temporarily fix the sheet material 1, which has been set in the predetermined position, on the table 2, the table 2 has a number of apertures 6, 7 or slots on the upper surface thereof and a hollow space between the upper and lower surfaces thereof, the hollow space being connected to vacuum or negative pressure generating means (not shown). The apertures 7 at a table portion on which the

pushing member 41 moves are arranged in rows which are inclined with respect to the front edge of the upper plate 41a of the pushing member 41. After the transfer device 10 is concealed in the slots of the table 2, the vacuum generating means is operated. This operation may be before or after the table contacts the lower surface of the upper plate 41a of the pushing member 41. Remaining vacuum suction apertures 6 which are not closed by the sheet material are covered by the lower surface of the upper plate 41a of the pushing member 41. When the sheet material 1 is relatively thick, it is preferable to attach an elastic sheet to the lower surface of the upper plate 41a to enhance the suction efficiency. The vacuum suction may be released while the table 2 is lowered after a printing operation.

A crank 65 rotatable by the driving means 64 is connected to links 66, 67, 68 and so as to reciprocate the squeegee block 81 from left to right as shown in Figure 4. The squeegee block 81 is guided by two bars 82, 83 and comprises the squeegee 85 moved up and down by a cylinder 84 and a doctor blade 86. An air cylinder 69 is connected to links 70, 71 so as to swingably move a member 73 about a shaft 72, so that the screen 81 can be replaced with another one and cleaned when needed. A frame 74, to which the screen is removably mounted, is swung up about a pin 77 when a hook 76 in a positioning member 75 fixed to the guide bars 82, 83 is released. This swinging up movement of the frame 74 is facilitated by a spring 78.

Referring now to the operation of the present apparatus, the sheet material 1 fed upon the table 2 is delivered by the transfer device 10 in the direction shown by arrows in Figure 1. The sheet material 1 comes into contact with the bar members 21, 22 projecting above the table and its advancement is arrested. Then, a limit switch (not shown) contained in the stopper device 20 is operated to supply an electrical signal to an air valve of the cylinder 42, so that the vertical plate 41b of the pushing member 41 pushes the sheet material against the standard plane 31 of the frame member 30 which is at right angles with respect to the initial sheet transfer direction. Thus, the sheet material 1 is set in a predetermined position.

As soon as the sheet material is set to the predetermined position, an electrical signal is supplied by another limit switch (not shown) to the drive means 64 for the cam 63, whereby the table starts to elevate.

As the table 2 elevates, the endless belt conveyors 13, 14 are concealed in the slots 3a, 3b of the table, so that the sheet material 1 is directly placed upon the table and goes up along with the elevation of the table 2.

Then, the upper surface of the table comes to contact with the lower surface of the upper plate 41a of the pushing member 41. At this time, the vacuum generating means is operated to temporarily fix the sheet material 1 upon the table 2 at the predetermined position and the air cylinder 23 is operated to conceal the bar members 21, 22 from the upper surface of the table 2.

When the table 2 is further elevated to a level where the upper surfaces of the sheet material and the frame member 30 are on the same horizontal plane, the arm 5 of the table acts on the arm of the frame member 30 to elevate the latter along with the elevation of the former. Then, the sheet material 1, frame member 30 and the pushing member 41 are elevated to a printing position where the upper surfaces of the three are level with each other and the upper surfaces of the latter two act as guide plates for the squeegee, as shown in Figure 4.

As soon as the table stops elevating at the printing position, the crank 65 is rotated the movement of which is transmitted to the squeegee block 81 through the links 66, 67 and 68, so that the squeegee block 81 moves in the direction towards the right as shown in Figure 4 for printing. At this time, the squeegee 85 is moved down by the air cylinder 84 and the doctor blade 86 is moved up.

After the printing, the squeegee block 81 moves towards the left as shown in Figure 4. At this time, the squeegee 85 is moved up by the air cylinder 84 and the doctor blades 86 is moved down for uniformly coating ink upon the screen.

The table 2 starts to lower and the vacuum suction is released while the table is lowered. Then, the pushing member 41 goes back by the action of the air cylinder 42. As the lowering movement of the table is ended, the transfer device 10 is operated to send out the printed sheet material 1, which is detected by a limit switch (not shown) provided in the table 2 and thereby projects the bar members 21, 22 for arresting the next sheet of material to be printed.

In the embodiment mentioned above, although the table 2 is moved up and down, the screen may be moved up and down as long as the sheet material is set to the predetermined printing position. Furthermore, although the limit switches are employed for automatically and operatively connect each succeeding steps of the operation, other detecting means may be used such as photocells and contact switches.

WHAT WE CLAIM IS:—

1. An apparatus for screen printing comprising a printing table for receiving a



pushing member 41 moves are arranged in rows which are inclined with respect to the front edge of the upper plate 41a of the pushing member 41. After the transfer device 10 is concealed in the slots of the table 2, the vacuum generating means is operated. This operation may be before or after the table contacts the lower surface of the upper plate 41a of the pushing member 41. Remaining vacuum suction apertures 6 which are not closed by the sheet material are covered by the lower surface of the upper plate 41a of the pushing member 41. When the sheet material 1 is relatively thick, it is preferable to attach an elastic sheet to the lower surface of the upper plate 41a to enhance the suction efficiency. The vacuum suction may be released while the table 2 is lowered after a printing operation.

A crank 65 rotatable by the driving means 64 is connected to links 66, 67, 68 and so as to reciprocate the squeegee block 81 from left to right as shown in Figure 4. The squeegee block 81 is guided by two bars 82, 83 and comprises the squeegee 85 moved up and down by a cylinder 84 and a doctor blade 86. An air cylinder 69 is connected to links 70, 71 so as to swingably move a member 73 about a shaft 72, so that the screen 81 can be replaced with another one and cleaned when needed. A frame 74, to which the screen is removably mounted, is swung up about a pin 77 when a hook 76 in a positioning member 75 fixed to the guide bars 82, 83 is released. This swinging up movement of the frame 74 is facilitated by a spring 78.

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As soon as the sheet material is set to the predetermined position, an electrical signal is supplied by another limit switch (not shown) to the drive means 64 for the cam 63, whereby the table starts to elevate.

As the table 2 elevates, the endless belt conveyors 13, 14 are concealed in the slots 3a, 3b of the table, so that the sheet material 1 is directly placed upon the table and goes up along with the elevation of the table 2.

Then, the upper surface of the table comes to contact with the lower surface of the upper plate 41a of the pushing member 41. At this time, the vacuum generating means is operated to temporarily fix the sheet material 1 upon the table 2 at the predetermined position and the air cylinder 23 is operated to conceal the bar members 21, 22 from the upper surface of the table 2.

When the table 2 is further elevated to a level where the upper surfaces of the sheet material and the frame member 30 are on the same horizontal plane, the arm 5 of the table acts on the arm of the frame member 30 to elevate the latter along with the elevation of the former. Then, the sheet material 1, frame member 30 and the pushing member 41 are elevated to a printing position where the upper surfaces of the three are level with each other and the upper surfaces of the latter two act as guide plates for the squeegee, as shown in Figure 4.

As soon as the table stops elevating at the printing position, the crank 65 is rotated the movement of which is transmitted to the squeegee block 81 through the links 66, 67 and 68, so that the squeegee block 81 moves in the direction towards the right as shown in Figure 4 for printing. At this time, the squeegee 85 is moved down by the air cylinder 84 and the doctor blade 86 is moved up.

After the printing, the squeegee block 81 moves towards the left as shown in Figure 4. At this time, the squeegee 85 is moved up by the air cylinder 84 and the doctor blades 86 is moved down for uniformly coating ink upon the screen.

The table 2 starts to lower and the vacuum suction is released while the table is lowered. Then, the pushing member 41 goes back by the action of the air cylinder 42. As the lowering movement of the table is ended, the transfer device 10 is operated to send out the printed sheet material 1, which is detected by a limit switch (not shown) provided in the table 2 and thereby projects the bar members 21, 22 for arresting the next sheet of material to be printed.

In the embodiment mentioned above, although the table 2 is moved up and down, the screen may be moved up and down as long as the sheet material is set to the predetermined printing position. Furthermore, although the limit switches are employed for automatically and operatively connect each succeeding steps of the operation, other detecting means may be used such as photocells and contact switches.

WHAT WE CLAIM IS:—

1. An apparatus for screen printing comprising a printing table for receiving a



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5 sheet of material to be printed, transfer means projecting through the printing table to convey the sheet material upon the printing table, first stopper means arranged at right angles to the transfer means for checking the movement of the sheet material fed on the table by the transfer means, second stopper means provided at right angles to the first stopper means, 10 diverting means movable upon the table at right angles to the second stopper means to divert the sheet material toward the second stopper means, means for operating the diverting means while the sheet material is in contact with the first stopper means, and 15 means for positioning the transfer means and the first stopper means below the surface of the printing table after the sheet material is set to a predetermined position by the first and second stopper means. 20

2. An apparatus as claimed in Claim 1, wherein the printing table comprises a pair of first slots spaced from each other and parallel to the second stopper means, and 25 the transfer means comprises a pair of endless belt conveyors which can project above the surface of the table through the slots.

3. An apparatus as claimed in Claim 2, wherein the printing table comprises a plurality of second slots at right angles to the first slots, and the diverting means can project above the table through the second slots and is guided along the second slots. 30

4. An apparatus as claimed in any preceding claim, wherein the diverting 35

means and the second stopper means have flat upper plates, respectively, the upper surfaces of both of which are level with the upper surface of the sheet material with which the apparatus is designed to be used when the table is moved up to a printing position by the positioning means. 40

5. An apparatus as claimed in Claim 4, wherein the table comprises evacuating apertures therethrough, the apertures being arranged in rows inclined with respect to the upper plate of the diverting means in the area in which the diverting means is movable, and those apertures not closed by the sheet material at the printing position are closed by the upper plate of the diverting means. 45

6. An apparatus as claimed in any of Claims 3 to 5, wherein the diverting means is movable, by an air cylinder connected to a nut threaded on a rotatable screw shaft, toward and away from the second stopper means, the air cylinder having a piston rod connected to the diverting means by means of a spring. 50

7. An apparatus for screen printing, substantially as herein described, with reference to the accompanying drawings. 55

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