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[11] **3,857,337**

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[54] **SCREEN PRINT TABLE WITH CONVEYING AND SHEET REGISTERING MEANS**

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[52] **U.S. Cl.** **101/123,** 101/126, 271/48

[51] **Int. Cl.** **B41f 15/08,** B41f 15/20

[58] **Field of Search** 101/126, 43, 123, 124; 271/48

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[57] **ABSTRACT**

A sheet material for screen printing is set to a predetermined position on a table by a first stopper checking the transfer movement of the sheet material, and a diverting device pushing the sheet material against a side stopper plate. The diverting device and the side stopper plate have flat upper surfaces which are made on the same level as the upper surface of the sheet material at the printing position.

3 Claims, 4 Drawing Figures

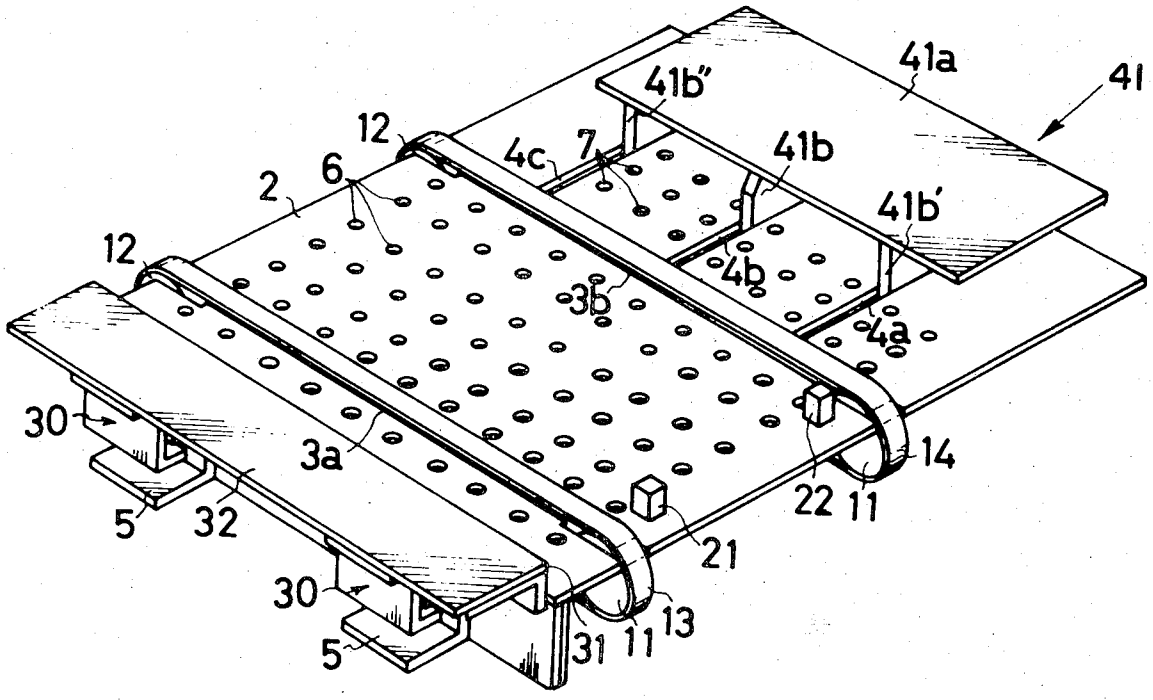


FIG. 1

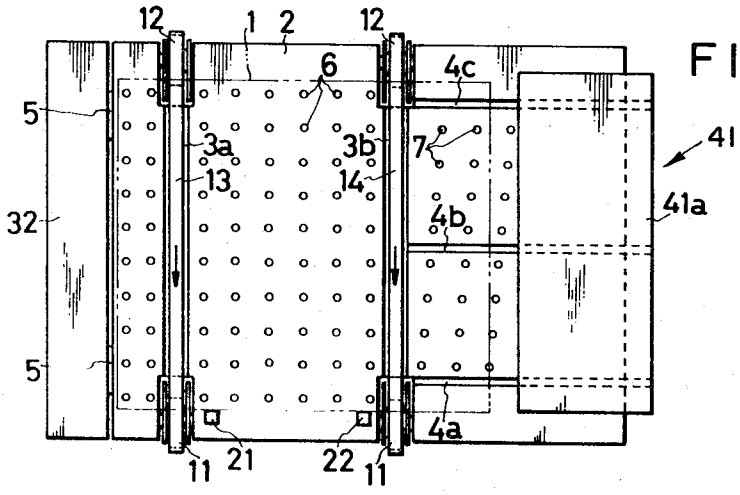


FIG. 2

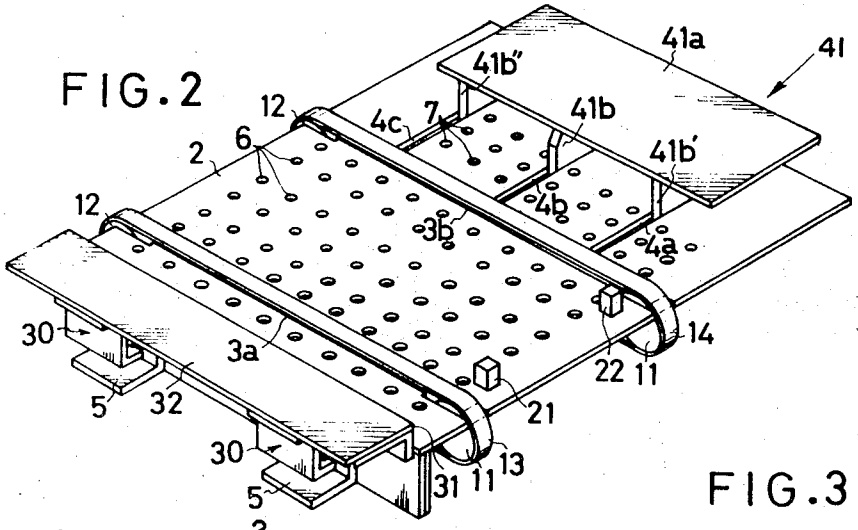


FIG. 3

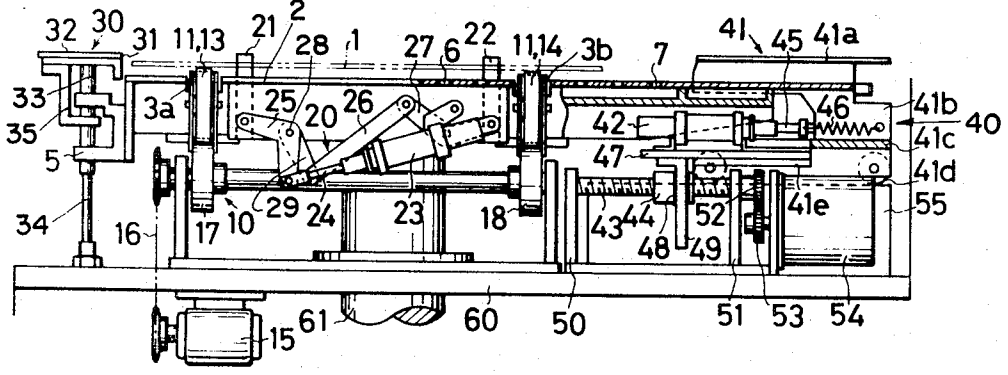
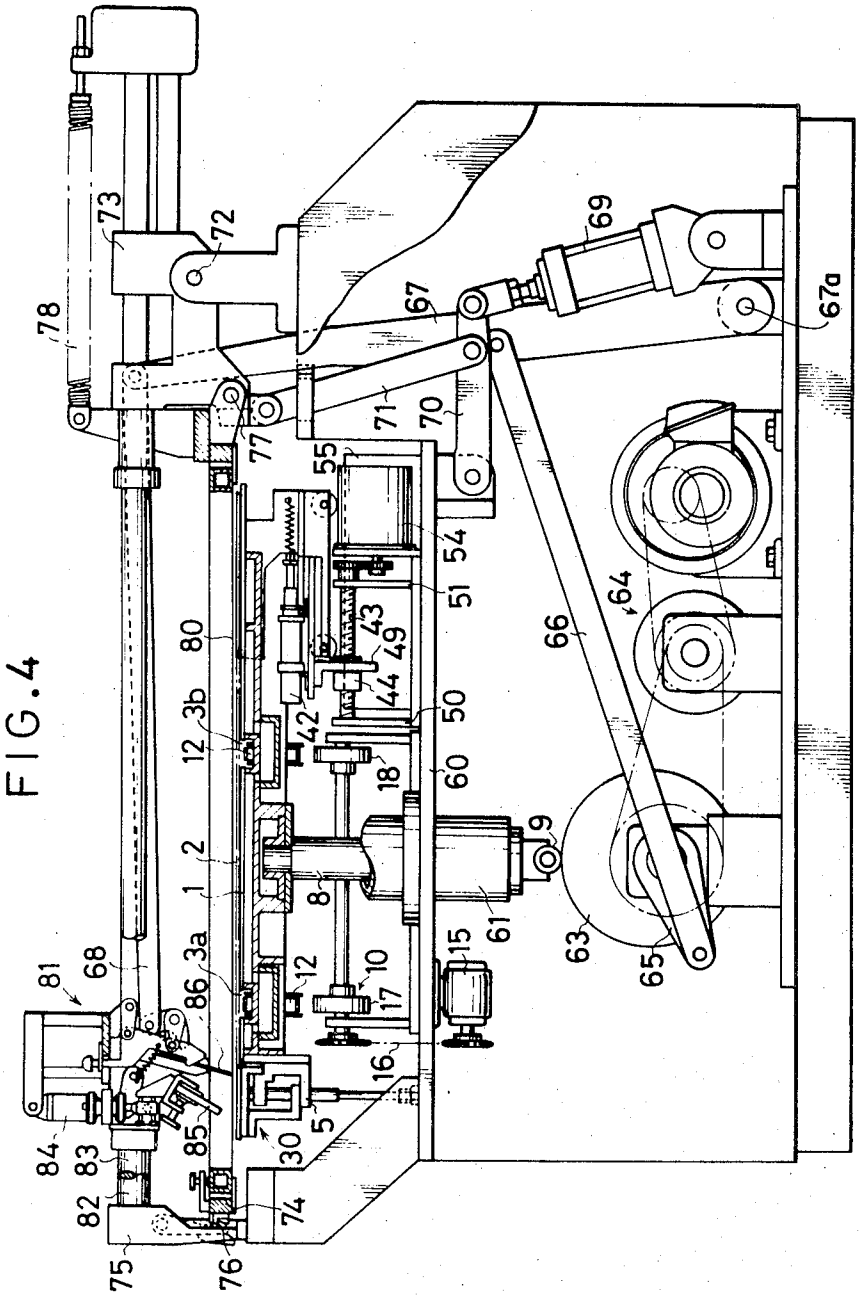


FIG. 4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SCREEN PRINT TABLE WITH CONVEYING AND SHEET REGISTERING MEANS

DISCLOSURE

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

Generally, in screen printing a design is painted on a screen material such as silk, nylon and wire by glue or resin 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 on a sheet material such as paper, resin plate, metal plate or the like. 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.

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

When the sheet material to be printed has a certain thickness such as a plastic 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 the smooth movement of the squegee not attained but also the squeegee itself, or the screen, will be injured with the result that the quality of the printed material is lowered.

To eliminate this problem the prior art has suggested to provide, thin plates, the thickness of which is equal to that of the sheet material to be printed are provided on both sides of the sheet material and in contact therewith to form an even surface along the moving direction of the squeegee. However, every time when the size of the sheet materials to be printed differs, these thin plates have to be substituted by new ones or assembled at other places. Especially, when a plurality of printing machines are connected with each other to perform an automatic continuous printing operation, the operation efficiency of the machines will be lowered.

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

Another object of the present invention is to provide an apparatus for screen printing which insures smooth movement of squeegee and is free from any injury or damage to the screen by movement of the squeegee.

Another object of the present invention is to provide an apparatus for screen printing of the type mentioned above wherein sheet materials of any size are automatically set to the predetermined printing position to allow the smooth movement of the squeegee.

According to an apparatus of the present invention, a sheet material for screen printing is set at a predetermined printing position on a table by a first stopper (first stop means) checking the transfer movement of the sheet material and a diverting means pushing the sheet material against a side stopper plate. The side stopper plate has a flat upper surface which is arranged

on the same horizontal plane as the upper surface of the sheet material when the table is lifted to a predetermined printing position. The diverting means comprises a flat upper plate attached to which there are vertical plates. The vertical plates are guided through slots formed in the table and are for pushing the sheet material against the side stopper plate. The flat upper plate has substantially the same thickness as the sheet material.

The present apparatus is so constructed that not only sheet material of any size can be automatically set to a predetermined printing position, but also a squeegee can smoothly move on a screen beyond the sheet material without injuring the screen. In addition, when the sheet material is not large enough to close every suction aperture in the table, the flat upper plate of the diverting means closes the remaining apertures so as not to lower the suction efficiency.

Preferably the vertical plate of the diverting means is connected to a piston rod of an air cylinder, the air cylinder being carried on a base plate. The base plate is connected to a threaded block, which advances by a motor driven screw shaft extending in parallel to the guide slots for the vertical plates. In such an arrangement, when a small-sized sheet material is to be printed after a large-sized sheet material has been printed, the screw shaft is first driven by a motor to advance the vertical plates of the diverting means to a certain extent and then the air cylinder is actuated to complete the pushing of the sheet material against the side stopper plate. Such two-stage pushing operations are not only effective for various sizes of the sheet materials but also reliable because the final pushing operation is effected by the air cylinder.

Also preferably, a number of apertures are made through the table for applying vacuum suction to the sheet material on the table. The apertures between the guide slots are formed along lines in the direction transverse of the slots. The lines are inclined with respect to an inner end line of the flat upper plate of the diverting means. In such an arrangement, when the inner end of the flat upper plate contacts the sheet material at the printing position, the apertures arranged along the inclined lines are closed by either the sheet material or the flat upper plate except those at the intersection of the inner end line of the flat upper plate and the inclined line of the apertures. Thus, as most of the vacuum apertures are completely closed, effective vacuum suction is applied to the sheet material.

The aforementioned and other objects and features of the present invention will be apparent from the following detailed description of a specific embodiment thereof, when read in conjunction with the accompanying drawings, in which:

FIG. 1 is a plane view of an apparatus according to the present invention and showing means for setting a sheet material to a predetermined position,

FIG. 2 is a perspective view of the apparatus shown in FIG. 1,

FIG. 3 is a partially sectioned side view of the present apparatus in which the table is in its lower position and a squeegee block system is omitted, and

FIG. 4 is a partially sectioned side view of the present apparatus in which the table is elevated to the printing position.

Referring to an apparatus shown in FIGS. 1 to 4, a transfer device 10 of a sheet material 1 to be printed comprises a pair of parallel endless conveyor belts 13, 14 which are wound around pulleys 11, 12 disposed in slots 3*a*, 3*b* of a printing table 2, respectively. Directly below the pulleys 11, 12 are respectively disposed rollers 17, 18 which normally contact to the belt conveyors 13, 14 therebetween under pressure. The rollers 17, 18 are driven by a motor 15 through a relevant transmitting device 16, so that both endless conveyor belts 13, 14 are rotated in the direction shown by arrows in FIG. 1. The conveyor belts 13, 14 as well as the pulleys partially project above the upper surface of the table 2 so that the sheet material 1 is conveyed on the table 2 with a space remaining between the sheet material and the upper surface of the table 2.

The table 2 is constructed to be movable from the lower position shown in FIG. 3 to an elevated printing position shown in FIG. 4 where the sheet material 1 comes close to a screen 80. To this end, a shaft 8 is fixed at its upper end to the table 2 and has a cam roll 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, as shown in FIG. 4, and the pulleys 11, 12, of which axes are supported by vertically elongated grooves in the table, fall down to the lowest position of the grooves so that the pulleys 11, 12 as well as the belt conveyors 13, 14 come below the upper surface of the table 2. Thus 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 and the pulleys 11, 12 are pushed up by the rollers 17, 18, respectively, so that the belt conveyors 13, 14 as well as the pulleys are partially projected above the upper surface of the table 12 with the sheet material lifting on the belt conveyors 13, 14 as shown in FIG. 3.

The stopper device 20 comprises vertical bar members 21, 22 provided at 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 and for retracting the bar members 21, 22 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 its end with one end of an angled lever 25 securely connected to a pin 28 rotatably supported to the lower plate of the table, the other end of the lever 25 being pivotably connected to the lower end of the bar member 21. A lever 29 is securely connected to the pin 28 at the upper end thereof and pivotably connected at the lower end thereof to the lower end of a lever 26. The lever 26 is pivotably connected at the upper end thereof to one end of an L-shaped lever 27 which is pivotably connected to the lower plate of the table 2 at the curved portion thereof. The L-shaped lever 27 is pivotably connected to the lower end of the bar member 22 at the other end thereof. In the state shown in FIG. 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 pulled back the levers 25, 29 and the pin 28 integrally rotate in the counterclockwise direction, so that the L-shaped lever 27 is rotated in the clockwise direction through the lever 26. Thus, the upper parts of the bar members 21, 22 are concealed below the upper surface of the table 2.

The sheet material 1 of which transfer movement is checked by the stopper device 20 is then pushed away to the 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 against a side stopper plate 30. The side stopper plate 30 is provided at the end of the table 2 and has a vertical plane 31 which is parallel to the belt conveyors 13, 14. The pushing member 41 comprises an upper plate 41*a*, a lower plate 41*c*, and three vertical plates 41*b*, 41*b'* 41*b''* fixedly interposed between the upper and lower plates. The central vertical plate 41*b'* has an end surface which is slightly projected beyond end surfaces of other two vertical plates 41*b'*, 41*b''*. The three vertical plates 41*b*, 41*b'*, 41*b''* pass through associated three slots 4*a*, 4*b*, 4*c* formed, in the table 2 at right angles with the belt conveyor 14. The pushing member 41 is movable along the slots 4*a*, 4*b*, 4*c* by rolls 41*d* at the bottom of the member. The rolls 41*d* run on a platform 55. When the pushing member 41 is advanced toward the side stopper plate 30 by its driving means, the central vertical plate 41*b* contacts to the sheet material 1 by its projecting end surface and pushes the sheet material to the vertical plane 31 of the side stopper plate 30. The upper plate 41*a* of the pushing member 41 may have a projecting end surface at its center portion to push a relatively thick sheet material 1. When the sheet material 1 is not acurately square shaped or rectangular shaped, the projecting end surface of the pushing member is effective to make the side end of the sheet material contact with the vertical plane 31 of the side stopper plate 30 with the forward end of the sheet material contacting to the stopper bar 21.

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 way driving means and a short way driving means. In the present embodiment, the long way 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 way driving means moves the pushing member 41 as long as the stroke of an air cylinder 42. The pushing member 41 connected to a piston rod 45 of the air cylinder through a spring 46 so as not to apply excessive high pushing pressure upon the sheet material 1. The air cylinder 42 is mounted on a base 47 which is slidably engaged with guide grooves 41*e* provided at the lower plate 41*c* of the pushing member 41. The base 47 has a bifurcated fork 49 fixed at the bottom of the base, and the fork 49 engages with vertical grooves 48 in the threaded member 44 in such a manner that the fork 49 can vertically slide along the grooves 48. 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 an end opposite to the pushing member 41 through the arm of which an upper shaft 33 loosely passes. The shaft 33 slidably encloses the upper end portion of a lower shaft 34. The side stopper plate 30 and an arm 35 are securely connected to the upper shaft 33. 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 side stopper plate **30**, the arm **5** of the table cooperates with an arm of the side stopper plate **30**, so that, thereafter, the side stopper plate **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 **41***a* of the pushing member **41**. When the table is further elevated, the pushing member goes up along with the elevation of the table **2**, as the base **47** is engaged with the guide grooves **41***e* of the pushing member and as the fork **49** slides along the grooves **48**. In the apparatus the upper plate **41***a* of the pushing member **41** has the same thickness as the sheet material **1**. Thus, the side stopper plate **30** and the pushing member **41** not only set the sheet material **1** to 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 injured or damaged while 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 to a predetermined position, on the table **2**, the table **2** has a number of apertures **6, 7** 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 table portions between the slots **4***a* – **4***c* along which the pushing member **41** moves are arranged along lines in the transverse direction of the slots. The lines are inclined with respect to an inner end line of the flat upper plate **41***a* of the pushing member. After the belt conveyors **13, 14** have been concealed in the slots **3***a*, **3***b* of the table **2**, the vacuum generating means is operated. This operation may be effected before or after the table contacts to the lower surface of the upper plate **41***a* of the pushing member **41**. Those vacuum suction apertures **6** which are not closed by the sheet material are covered by the lower surface of the upper plate **41***a* of the pushing member **41**. When the sheet material **1** is relatively thick, it is preferrable to attach an elastic sheet at the lower surface of the upper plate **41***a* to enhance the suction efficiency. The vacuum suction may be released while the table **2** is lowering after printing operation.

A crank **65** rotatable by the driving means **64** is connected to links **66, 67, 68** so that when the crank **65** is rotated, the lever **67** swings about a pivot **67***a*. Thus the squeegee block **81** reciprocates from left to right in FIG. **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 so that when a piston rod of the air cylinder **69** is extended from the position shown in FIG. **4**, the link **71** moves up and, thereby, a member **70** is swung up about a shaft **72**. At this time, as a magnetic brake in the driving means **64** is being operated, the crank **65** is unmovable and the squeegee block **81** is set to the position. A frame **74**, to which the screen **80** is removably mounted, is swung up when the piston rod of the cylinder **69** is extended as mentioned above. At this position, when a hook **76** in a member **75** fixed to the guide bars **82, 83** is disengaged from the frame **74**, the frame **74** can be swung down about a pin **77** and replaced with another one or cleaned when needed. This swinging movement of the frame **74** is facilitated by a spring **78**.

Referring now to the operation of the present apparatus, the sheet material **1** is fed upon the table **2** by the belt conveyors **12, 13** in the direction shown by arrow in FIG. **1**. The sheet material **1** collides against the bar members **21, 22** projected above the table and is restricted in its advancement. Then, a limit switch (not shown) contained in the stopper device **20** is operated to supply electric signal to an air valve of the air cylinder **42**, so that the vertical plate **41***b* of the pushing member **41** pushes the sheet material against the vertical plane **31** of the side stopper plate **30**; which is at right angles with respect to the initial sheet transfer direction. Thus, the sheet material **1** is set to a predetermined position.

As soon as the sheet material is set to the predetermined position, an electric signal is supplied by a 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 conveyers **13, 14** are concealed in the slots **3***a*, **3***b* of the table, so that the sheet material **1** is directly placed upon the table and rises 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 **41***a* 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 side stopper plate **30** are on the same horizontal plane, the arm **5** of the table acts on the arm **35** of the side stopper plate **30** to elevate the latter along with the elevation of the former. Then, the sheet material **1**, side stopper plate **30** and the pushing member **41** are elevated to a printing position where the upper surfaces of the three are even and the upper surfaces of the latter two act as guide plates for the squeegee, as shown in FIG. **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, 68**, so that the squeegee block **81** moves in the right direction in FIG. **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 to the left direction in FIG. **4**. At this time, the squeegee **85** is moved up by the air cylinder **84** and the doctor blade **86** is moved down for uniformly coating ink upon the screen.

The table **2** starts to lower and the vacuum suction is released during the lowering motion of the table. 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 the next succeeding sheet material to be printed.

We claim:

1. A screen printing apparatus comprising a table having a top surface with plurality of apertures, therethrough means connecting each of said apertures with a vacuum source, said table top surface having a plural-

ity of elongated openings, a pair of belt conveyors which are parallel and are provided through said elongated table openings for feeding a sheet material to be printed on said table, first stop means for checking the feeding movement of the sheet material fed onto said table by said belt conveyors, means to move said first stop means vertically, a second stop means provided at one end of said table parallel to said belt conveyors, a diverting means for pushing the sheet material against said second stop means, means for lifting said table to a predetermined printing position with said belt conveyors remaining below the top surface of said table, a screen provided above said table, and a squeegee above said screen and movable in a direction transverse to the feed movement of said belt conveyors, wherein said second stop means is a plate having a flat upper surface whose level is on the same horizontal plane as the upper surface of the sheet material when said table is lifted to said predetermined printing position; said table having a plurality of slots, and said diverting means comprises a flat upper plate and vertical plates attached to said flat upper plate and guided through said slots formed in said table for pushing the sheet material against said second stop means, said flat upper plate having substantially the same thickness as the sheet material, whereby in said printing position the squeegee may move smoothly over the flat surface formed by said upper surface of said second stop means, said upper surface of the sheet material and the upper surface of said flat upper plate of said diverting means.

2. An apparatus as claimed in claim **1** wherein said diverting means further comprises, under said table, an air cylinder having a piston rod, said piston rod connected at its outer end with said vertical plate, a base plate carrying said air cylinder and connected to a threaded block, a screw shaft extending in parallel to said slots for said vertical plates, said threaded block being engaged with said screw shaft and advanced by the rotation thereof, and a motor for driving said screw shaft.

3. An apparatus as claimed in claim **1** wherein said apertures are formed between said slots and are arranged along lines in the transverse direction of said slots, said lines being inclined with respect to an inner end line of said flat upper plate of said diverting means.

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