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PRINTING SQUEEGEE APPARATUS

This invention relates to printing squeegee apparatus. In particular to a squeegee apparatus for screen printing, which includes an elastic or flexible receptacle for storing a printing material which is pressed by a roller to squeeze the material out onto a screen.

Background of the Related Art

It is well known to use screen printing for forming electronic circuit patterns on an insulating substrate. It is also known that screen printing needs a screen which is laid on an insulating board for printing. Also known are a squeegee apparatus which functions as a spatula for traveling above the screen to apply a specified amount of printing material thereto. The material is then squeezed through the screen onto the substrate.

The squeegee apparatus prints a layer of printing material on the insulating substrate according to a specified electronic circuit pattern. The pattern is formed by the printing holes formed through the screen. The drilled substrate is separated from the screen, and heated to dry and set the circuit pattern. A screen utilized for such process may be made of stainless steel mesh, for example.

The squeegee apparatus stores printing material in a substantially triangular space defined between two plates, which are nearly equal in width to the screen. The material can drop or fall naturally toward the screen through a slit formed at the bottoms of the plates, positioned at the apex of a substantially right angle.

Such a conventional squeegee apparatus allows printing material to drop naturally (i.e. by gravity) through the slit. However, is printing material of high



viscosity of the material is utilized, it is difficult to assure an even supply of printing material along the overall width of the slit. Thus, uneven printing may result and general printing precision is reduced. .

Therefore, it becomes necessary to always monitor the state of the printing material supply and long term continuous operation cannot be reliably assured.

Thus, it has been required to provide a roller squeegee apparatus for screen printing which can operate continuously for a long time. Also, a roller squeegee apparatus which is effective to equalize and improve printing precision, and stabilize printing operations, is highly desirable.

Summary of the Invention

Thus, it is an object of the present invention to overcome the drawbacks of the related art.

It is a further object of the invention to provide a roller squeegee apparatus which can function smoothly, even for long periods of continuous operation.

The present invention also seeks to provide a roller squeegee apparatus which is effective to equalize and improve printing precision, as well as providing stable printing operation.

According to one aspect of the invention, there is provided a roller squeegee apparatus for screen printing, comprising: first means for supplying a printing material; an elastic receptacle formed of a resilient material for receiving the printing material supplied by the first means and, having an opening to which a printing squeegee is fitted; and second means for kneading the printing material in the receptacle by rolling or pressing the receptacle, so as to squeeze the material out of the squeegee.



Specifically, the apparatus is characterized by an elastic or flexible tubular receptacle having one open end connected to a printing material supply port, and another open end which is connected to a printing squeegee. Further, one or more rollers is provided which may be driven for squeezing the receptacle, whereby the printing material is forcibly fed to, and extruded from, the squeegee. According to this structure, uneven printing is avoided regardless of a viscosity of the printing material, such that highly precise printing is possible.

Brief Description of the Drawings

Fig. 1 is a front view partially in cross section showing an embodiment of this invention;

Fig. 2 is a plan view of Fig. 1;

Fig. 3 is a front view in cross section of the printing material squeegee;

Fig. 4 a front view in cross section showing a main portion of the squeegee;

Fig. 5 is a front view in cross section showing a modified squeegee according to the invention;

Fig. 6 is a front view in cross section showing another modified printing material squeegee;

Fig. 7 is a front-view in cross section showing still another modified printing squeegee;

Fig. 8 is a front view partially in cross section showing the second embodiment of the invention;

Fig. 9 is a front view partially in cross section showing the third embodiment of the invention.

Fig. 10 is a cross section showing a fourth preferred embodiment according to the invention; and

Fig. 11 is a front view of squeegee apparatus for screen printing, showing an example utilizing a printing squeegee according to the invention.

Description of the Preferred Embodiment



Hereinbelow, a preferred embodiment of the invention will be explained in detail with reference to the drawings.

The preferred embodiment of the present invention are explained below with reference to the drawings. As shown in Figs. 1 and 2, a screen 2 is laid on an insulating substrate 1, which is set on a screen process printer. The printer (not shown) supports, above the screen, a roller squeegee apparatus 4 including a printing material squeegee 3.

The roller squeegee apparatus 4 includes a pair of frames 5 and 50, which are each square or rectangular, but with one open side in cross section. The open sides of the frames 5 and 50 face each other. The frames 5 and 50 have guide pins 5a and guide holes 5b on their open sides. The frames 5 and 50 are separably joined by hydraulic cylinders and pistons 6a, which operate as clamps, so as to form a casing open on both sides. The casing contains a flexible receptacle 7 and a roller 8 for rolling the receptacle 7. Although not shown in the drawings, the hydraulic cylinders 6 are properly provided, not only on the top of the casing, as illustrated, but also on both sides at the bottom of the casing.

The hydraulic cylinders 6 and pistons may be replaced by servo motors and rods reciprocally connected with the motors. The receptacle 7 takes the form of a tube or a bag having a closed end. The receptacle 7 is made of synthetic resin such as nylon or an elastic or flexible material such as rubber, so as not to be easily broken or damaged when it contains a printing material 9, such as ink or soldering paste, and is rolled. If the receptacle 7 is tubular, its one end is connected to the printing material supply port 10 formed in the frame 5.



The other end is joined by a proper adhesive or the like to the printing material squeegee 3. which protrudes between the frames 5 and 50 toward the screen 2. Alternatively, the other end may be joined separably in the form of a cassette utilizing a fastener, which can engage with a rough surface.

If the receptacle 7 is bag-like, or flexible, it takes the form of a cassette containing a specified amount of printing material 9. The closed end of the bag is properly fixed at the supply port 10, and the other end is connected to the squeegee 3.

The printing material supply port 10 is connected to a printing material tank 13 through a valve chest 12, which has a ball 11 or another check valve.

The receptacle 7 may have an opening, not shown, in parallel with the port 10, the frame 5 may have structure, not shown, which is similar to the valve 12 having the check valve. This valve may be connected to the opening in the receptacle 7 to release or discharge air bubbles, which may be contained in some types of printing material. The receptacle 7 is supplied with the material 9 stored in the tank 13. The tank 13 is supported properly by the frame 5 and belongs to it.

Alternatively, printing material may be supplied through a flexible pipe from a printing material tank, which is properly supported on the screen printer or the like.

If there is a need to control the temperature of the material, the casing is closed and a temperature control means (not shown) is provided therein, while another temperature control means (not shown), such as a diode and heater may be provided in the tank 13 as well. As shown in Fig. 3, the printing material squeegee 3 is nearly triangular with two thin plates 3a,



which are specified in length and width, and which may be formed of resin, carbon or metal.

The right left sides of the squeegee are locked in contact with side plates 3b, while the bottom side is open, and a slit 15 is formed at the opposite apex. The squeegee 3 holds the printing material 9, which can be extruded through the slit 15. The plates 3a are joined or connected properly at least at their tops to the frames 5 and 50. it is therefore possible to control the width other slit 15 by the hydraulic cylinders 6 arc. adjusting the distance between the frames 5 and 50.

It is also possible to fix or keep the condition or state of the printing material. The side plates 3b re fixed to and suspended from one of the frames 5 and 50. The bottoms of the side plates 3b are finished like a mirror surface for slidable contact with the screen 2 in consideration of oscillation or fluctuation of the printing material squeegee 3.

each side plate 3b is rectangular or nearly trapezoidal and has a specified width between the front and rear sides of the squeegee 3. The side plates 3b are positioned on the right and left sides of he squeegee 3. The side plates 3b contact with the screen so that the casing weight is applied on the screen because the casing weight is not applied to the squeegee 3. The side plates 3b function to press the screen 2 on the substrate 1, so that the printing precision is improved. Therefore, a support table or frame (S in Fig. 1) is specially provided to bear the casing weight applied on the side plates 3b.

The roller 8 is made of rubber, synthetic resin or other elastic material. The roller 8 has a shaft 16, which extends on its axis and protrudes at both ends. The ends of he shaft 16 are supported rotatably on a pair of brackets 7 Each bracket 17 is coupled to one end of a telescopic arm 18, the other end of which



engages horizontally with a telescopic drive 19. Alternatively, the roller 8 may not be soft, but may be made of metal or other hard material.

The telescopic drive 19 is either a hydraulic cylinder or a servo motor. The drive 19 is coupled with a collar 20 having a thread in its inner peripheral surface. The collar 20 engages with a screw shaft 21 which is supported rotatably on its vertical axis by the frame 50. The top of the shaft 21 protrudes from the top of the frame 5, and is connected to an electric motor 22 through a proper speed reducing mechanism. The pair of motors 22 are adapted to rotate synchronously with each other. The rotations of the shafts 21 at the same time can move the drives 19 vertically at the same time and same pitch through the collars 20. While the drives 19 are moving vertically, the telescopic arms 18 can be moved toward or away from the receptacle 7.

When printing is made with the printing material 9 applied on the screen 2, the electric motors 22 are rotated in synchronism to lift the telescopic drives 19 through the collars 20 along the screw shafts 21. When the receptacle 7 is filled with the material 9, and printing has started; the motors 22 are rotated reversely to lower the drives 19, and the telescopic arms 18 are extended from the drives 19 toward the frame 5.

When the telescopic arms 18 have extended, the receptacle 7 is interposed between the roller 8 and the inner wall of the frame 5. The roller 8 moves downward in compressive contact with the receptacle 7. As a result, the receptacle 7 is rolled and squeezed from up to down, therefore, the inside printing material 9 is forcibly moved toward the squeegee 3, and extruded through the slit 15 toward the screen 2. The lift of the lowered roller 8 functions to suck



upward the material 9 in the squeegee 3. is effective when the roller squeegee apparatus 4 is removed after printing.

Therefore, by lowering the roller 8 at a constant speed, the amount of printing material 9 extruded from the squeegee 3 is made constant, so that, the material 9 can be equally applied on the screen 2. In screen process printing, a screen 2 laid on a substrate 1 moves in a horizontal direction (right in Fig. 1). Alternatively, the substrate 1 and screen 2 may be fixed the roller squeegee apparatus 4 may instead move horizontally. Some types of printing material are very likely to harden if they are not kneaded constantly. By repeating the vertical movement of the roller 8 and the reciprocation of L relative to the receptacle 7, not merely to extrude the material 9, it is possible to constantly or always knead the material 9 in the receptacle 7.

As may be appreciated in Fig. 4, if the rolling action of the roller 8 alone cannot assure that an consistent amount of printing material 9 is extruded from the slit 5, a pair of auxiliary rollers 25 may be provided to contact with and pinch the receptacle 7 above the printing material squeegee 3. one or both of the auxiliary rollers 25 may be moved horizontally by a hydraulic cylinder or a servo motor (not shown) so that the rollers 25 approach each other. The rollers 25 are made of elastic material such as rubber and synthetic resin. consequently, the receptacle 7 can be squeezed immediately above the squeegee to extrude the material 9 forcibly and equally.

The printing material squeegee 3 of this invention may be adapted for proper replacement depending on the viscosity of the printing material 9. If the viscosity of printing material 9 is low, a roller 30 may, as shown in Fig. 5 be positioned in the slit 15 of the squeegee 3



and supported rotatably by a shaft 31, which is supported on the side plates 3b. The roller 30 may be soft and made of rubber, synthetic resin or the like, or alternatively be hard and made of synthetic resin, metal or the like.

If the viscosity of printing material 9 is high, a roller 32 may, as shown in Fig. 6 be supported rotatably at specified distance below the slit 15 in the printing material squeegee 3. The roller 32 has a shaft 33 supported the side plates 3b, which are widened, of the squeegee 3. The roller 32 may be soft and made of rubber, synthetic resin or the like or alternatively be hard and made of synthetic resin, metal or the like.

The bottom of the printing material squeegee 3 slides on the screen 2 when either the screen or the roller squeegee apparatus 4 moves horizontally. It is therefore desirable that the squeegee 3 be inclined a little in the driving direction toward the sliding surface. For this purpose, as shown in Fig. 7, each plate 3a of the squeegee 3 may have a bracket 34 fixed to a side of it, a shaft 35 may be swingably connected to the bracket 34, and can be telescoped by a hydraulic cylinder 36 or a servo motor, which may be fixed to a support frame 37 supported by the printer. This enables the squeegee 3 to incline forward and backward a specified angle with respect to the screen 2.

Specifically, when the roller squeegee apparatus 4 or the screen 2 moves in the direction A, the printing material squeegee 3 is inclined as shown by the two dot chain lines. When the apparatus 4 or the screen 2 moves in the direction B, the squeegee 3 is inclined as shown by the two dot chain lines.

The second embodiment of the invention is described below. In the previous embodiment, the receptacle 7 can be squeezed between the roller 8 and the inner wall of the frame 5. In the present



embodiment, as shown in Fig. a, the receptacle 7 can be squeezed by two rollers 8 and 8a. Specifically, the bracket of a telescopic arm 18 is a little longer than in the previous embodiment, and has a slot 27, through which the shaft 16 of a roller 8 extends, provided are a hydraulic cylinder or a servo motor 27 for rotating the shaft 16, and an actuator 28 for telescoping from it. The receptacle 7 can be pinched between the roller 8 and the roller 8a, which is supported rotatably on a shaft 9. Otherwise, the structure is similar to that of the previous embodiment, therefore redundant explanation is omitted for brevity.

With the rollers 8 and 8a squeezing an upper portion of the receptacle 7, the electric motors 22 are actuated to rotate the screw shafts 21 in synchronism, with lower the rollers 20. At the same time, the servo motors 27 are rotated to move the shaft 16 toward the shaft 29. As a result the rollers 8 and 8a move downward while rolling the receptacle 7 to extrude the printing material 9 toward the squeegee 3.

The third embodiment of the invention will now be described hereinbelow. As with the second embodiment, redundant description similar to that of the first embodiment will be omitted. As shown in Fig. 9, in place of the screw shafts 21, a rod 21a supports a number of sleeves 2c above one other with spacers 60 interposed. The sleeves 20a support rollers 8 through telescopic drives 19, telescopic arms brackets 17 and shafts 16, respectively. The rollers 8 can rotate and move toward and away from the receptacle otherwise, the structure is the same as in the first embodiment. Accordingly, by protruding the rollers 8 in descending order downward along the receptacle 7, it is possible to squeeze the printing material 9 in the receptacle 7 downward and toward the squeegee 3.



The third embodiment shown in Fig. 9 may be modified extensively in the fourth embodiment shown in Fig. 10. As shown in Fig. 10, a support 70 in place of the screw Shafts 21 supports cylinders 71. Each cylinder 71 engages with a piston rod 72, which can reciprocate relative to the receptacle 7, and to which a press plate 73 is fixed. Otherwise, the structure is the same as in the first embodiment, and therefore the repeated explanation is omitted. In this embodiment, by protruding the press plates 73 in descending order downward along the receptacle 7, it is possible to squeeze the printing material 9 in the receptacle 7 downward and toward the squeegee 3. By repeating this operation, the material 9 can be kneaded.

For multicolor printing, as shown in Fig. 11, a turret board 38 such as a rotatable disc may be supported above the screen 2. The board 38 may carry roller squeegee apparatuses 4 fixed to its periphery at specified intervals in such a manner that the positions of the apparatuses 4 can be adjusted. The respective printing material squeegees 3 may slidably contact with the screen 2. The printing material tanks 12 and receptacles 7 of the apparatuses 4 may contain printing materials 9 of different colors, respectively. When one of the colors is needed, the board 38 can be rotated until the associated apparatus 4 faces the screen 2. Then, the receptacle 7 of this particular apparatus 4 can be squeezed similarly to the above method to apply the material 9 from the squeegee 3.

The roller squeegee apparatuses may not be limited to screen printing. Instead, such a thin film formation may be made that paste is stored in a receptacle 7 and squeezed out to coat a post card or another paper with a thin film of paste from a printing material squeegee 3. [00321



By rolling with the rollers the receptacle containing printing material., the invention makes it possible to effectively supply printing material in a printing method which needs highly viscous printing material. It is also possible to make constant and equal the amount of printing material extruded from the squeegee onto a screen. Therefore, the printing precision can be improved. In addition, it is possible to not only squeeze printing material out by means of the rollers, but also always knead thixotropic material in the receptacle by repeating the rolling up and down. As a result, the material can be equally dispersed, so that continuous printing operation for long time periods is possible, and the operation can be stably assured.

The present invention is not limited only to the description as herein disclosed but may be modified and embodied in other ways without departing from the scope or inventive concept of the invention as set forth above.





What is Claimed:

1. A roller squeegee apparatus for screen printing, comprising:
first means for supplying a printing material;
a receptacle formed of a resilient material for receiving said printing material supplied by said first means and, having an opening to which a printing squeegee is fitted; and
second means for kneading said printing material in said receptacle by rolling or pressing said receptacle, so as to squeeze said material out of said squeegee.
2. A roller squeegee apparatus as set forth in claim 1, wherein said receptacle is tubular in configuration and connected at a first open end thereof to a printing material supply port, and a second open end thereof which is connected to a squeegee, and further including one or more rollers for pressing said receptacle.
3. A roller squeegee apparatus as set forth in claim 2, wherein said roller being able to move horizontally toward and away from said receptacle by being driven by a hydraulic cylinder or a servo motor, said cylinder or servo motor being so supported by a casing that it engages with a screw shaft, which is rotated by an electric motor, and that it can move vertically along said receptacle.
4. A roller squeegee apparatus as set forth in claim 2, wherein said roller is supported such that it can move toward and away from said receptacle, and upward and downward along said receptacle, where said receptacle is squeezed between said rollers and the inner wall of a casing, which supports said rollers.





5. A roller squeegee apparatus as set forth in claim 3, wherein said roller being able to move horizontally toward and away from said receptacle by being driven by a hydraulic cylinder or a servo motor, said cylinder or servo motor being so supported by a casing that it engages with a screw shaft, which is rotated by an electric motor, and that it can move vertically along said receptacle.

6. A roller squeegee apparatus as set forth in claim 3, in which said casing includes means for controlling opening and closing of said printing material squeegee.

7. A roller squeegee apparatus as set forth in claim 3, in which said casing includes means for controlling opening and closing of said printing material squeegee.

8. A roller squeegee apparatus as set forth in claim 3, wherein said casing is able to keep the slit of said printing material squeegee open at a specified angle.

9. A roller squeegee apparatus as set forth in claim 2, wherein said roller includes a pair of rollers, which are so supported that they can move toward and away from said receptacle, and upward and downward along said receptacle, whereby said receptacle can be squeezed by pinching it between said rollers and moving them toward each other,

10. A roller squeegee apparatus as set forth in claim 2, wherein said roller consisting of a plurality of rollers, which are arranged above one another in a multistage line and in such a manner that they can move toward and away from said receptacle, whereby said receptacle can be squeezed from upper and lower



sides by said rollers moving horizontally toward said receptacle in downward order.

11. A roller squeegee apparatus as set forth in claim 10, wherein said roller being able to move horizontally toward and away from said receptacle by being driven by a hydraulic cylinder or a servo motor, said cylinder or servo motor being so supported by a casing that it engages with a screw shaft. which is rotated by an electric motor, and that it can move vertically along said receptacle.

12. A roller squeegee apparatus as set forth in claim 2, wherein said roller consisting of a pair of rollers for so pinching said receptacle that they can squeeze it near said printing material squeegee.

13. A roller squeegee apparatus as set forth in claim 2, wherein said printing material supply port being connected through a check valve to a tank for storing a specified amount of printing material, said tank being supported by a casing, which supports said rollers.

14. A roller squeegee apparatus as set forth in claim 13, wherein said roller being able to move horizontally toward and away from said receptacle by being driven by a hydraulic cylinder or a servo motor, said cylinder or servo motor being so supported by a casing that it engages with a screw shaft. which is rotated by an electric motor, and that it can move vertically along said receptacle.

15. A roller squeegee apparatus as set forth in claim 13, in which said casing includes means for controlling opening and closing of said printing material squeegee.





16. A roller squeegee apparatus as set forth in claim 7, wherein said casing is able to keep the slit of said printing material squeegee open at a specified angle.

13. A roller squeegee apparatus as set forth in claim , wherein said casing including a pair of frames, which are rectangular in cross section with one open side, and which are joined separably face to face, whereby the space between said frames can be adjusted.

17. A roller squeegee apparatus as set forth in claim 2, wherein said printing material squeegee having a slit, in and along which a roller is supported rotatably, whereby said roller can adjust the amount of extrusion of printing material which is low in viscosity.

18. A roller squeegee apparatus as set forth in claim 2, wherein said printing material squeegee having a slit, outside which a roller is supported rotatably at a specified distance and in parallel, whereby said roller can adjust the amount of extrusion of printing material which is high in viscosity.

