United States Patent

[11] 3,536,005

[72] Inventor **Charles H. Derrickson**
Chicago, Illinois

[21] Appl. No. **674,864**
[22] Filed **Oct. 12, 1967**
[45] Patented **Oct. 27, 1970**
[73] Assignee **American Screen Process Equipment Co.**
a corporation of Illinois

[54] **VACUUM SCREEN PRINTING METHOD**
10 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **101/129,** 101/115
[51] **Int. Cl.** **B41m 1/12,** B41f 15/10
[50] **Field of Search** 101/115, 116, 129, 114, 124, 126

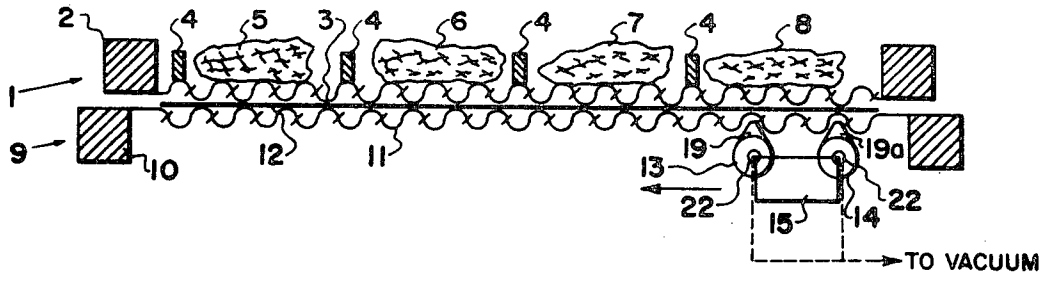
[56] **References Cited**

UNITED STATES PATENTS

1,821,302	9/1931	Gorner	101/129X
2,239,619	4/1941	Murgatroyd et al.	101/115
2,419,694	4/1947	Shuttleworth et al.	101/129
3,129,442	4/1964	Leckie	101/129X
3,137,230	6/1964	Ichinose	101/115
3,221,649	12/1965	Weiss	101/126

Primary Examiner—William B. Penn
Attorney—Neal J. Mosely

ABSTRACT: In the screen printing of porous flat stock such as sheets of porous paper, paper board, woven and nonwoven fabrics, etc., the stock is placed against the underside of a screen stencil. A vacuum is applied to the underside of the stock along a fine line along a knife-edge applicator across the width of the stock which is to be printed. A fine line of vacuum is applied preferably through a very narrow slot along a knife edge in a hollow member connected to a vacuum source and which is operable to apply vacuum along essentially a knife-edge contact. The member having the thin line of application of vacuum is moved along the underside of the porous stock to cause the printing ink to be drawn through the screen stencil onto the stock. A variety of colors of printing ink may be used on the stencils and separated from each other by suitable dams. Thus, the stock is imprinted with a variety of colors in the desired pattern which is present on the stencil. Vacuum means is simultaneously applied to the stock behind the point of application of vacuum for drawing printing ink through the stencil to pull the stock away from the underside of the stencil immediately after printing. This causes the stock to be continuously stripped away from the underside of the stencil and produces a degree of detail in printing which is not possible with other vacuum printing techniques.



Patented Oct. 27, 1970 3,536,005

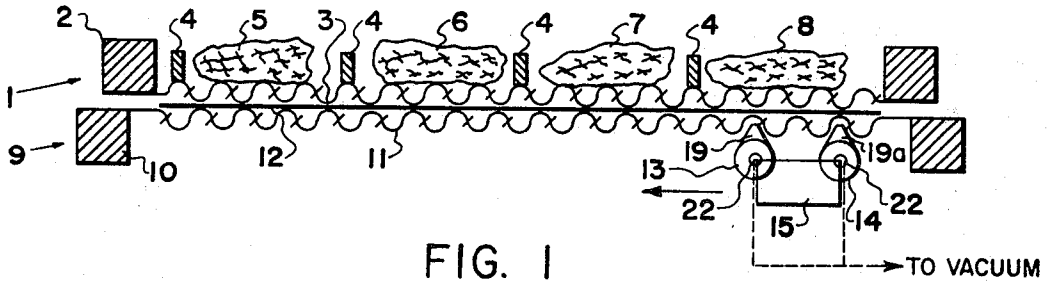


FIG. 1

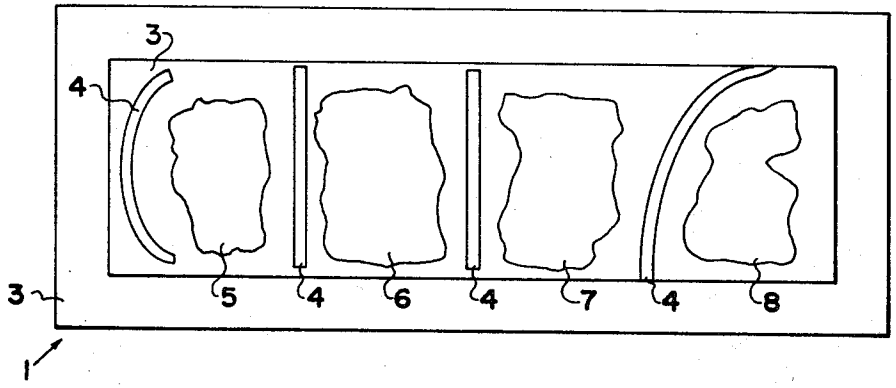


FIG. 2

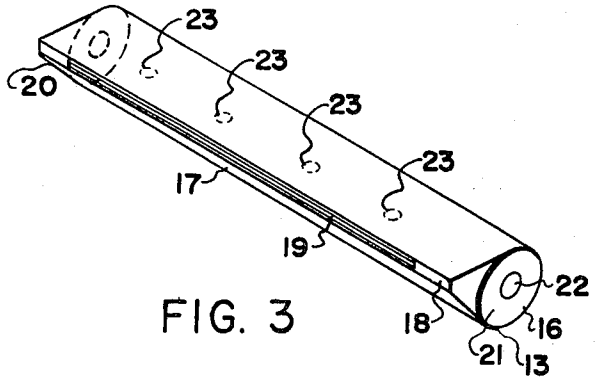


FIG. 3

CHARLES H. DERRICKSON
INVENTOR.

Neal J. Mosely
his attorney

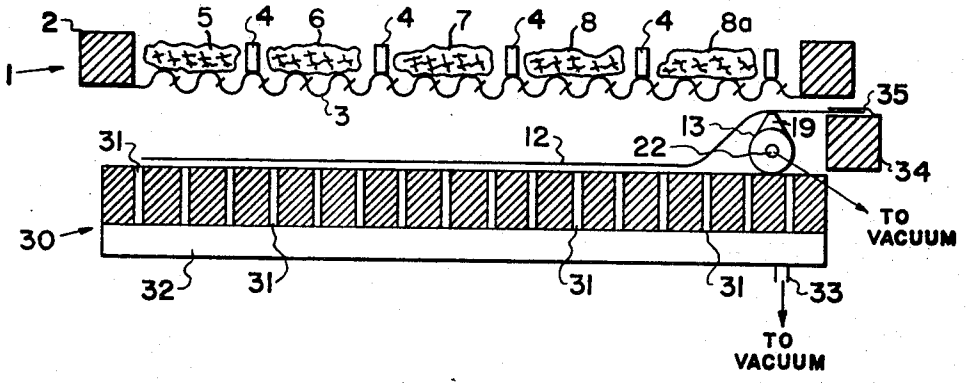


FIG. 4

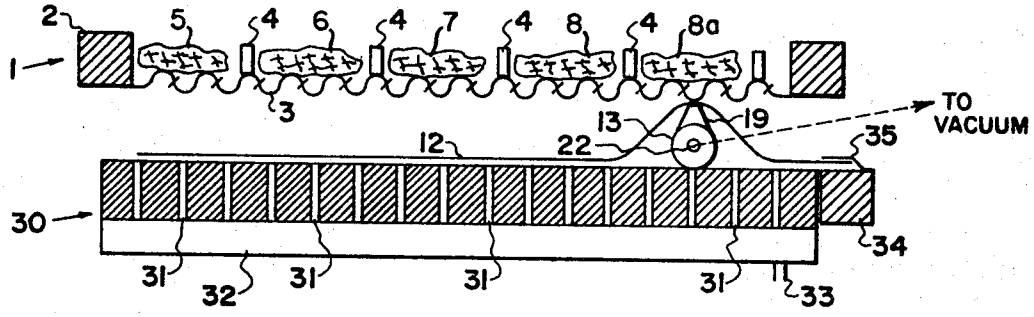


FIG. 5

CHARLES H. DERRICKSON
INVENTOR.

Neal J. Mosely
his attorney

VACUUM SCREEN PRINTING METHOD

BACKGROUND OF THE INVENTION

In the printing of flat stock such as paper or paper board, woven or nonwoven fabrics, etc., one of the major printing techniques which has been used is the process of silk screen printing, also called screen process printing. In screen process printing, a screen stencil is prepared in which the openings of the screen are blocked by a suitable filler or coating material and only selected portions of the screen are open in the desired pattern to be printed. A thick pasty printing ink is placed on the stencil and is forced through the open portions of the stencil by a squeegee onto the stock to produce the desired design imprint.

If a plurality of colors are to be imprinted on the stock, it is generally necessary to dry the printed stock after one color has been printed covering a portion of the desired imprint and then overprinting the other portion or portions of the design in the additional colors, the ink being dried between each application of a different color. This type of multicolor printing is less expensive than other multicolor printing techniques but is relatively inefficient due to the necessity of drying the printed ink between different applications. This difficulty is also present even where the different colors to be printed are in widely separated areas of the stock since it is generally necessary for the ink to be dry before the stock can be placed in contact with another stencil.

In the printing of fabrics and particularly thick fabrics or deep pile fabrics, screen printing is frequently used. The printing of thick fabrics, and particularly deep pile fabrics, has required the development of suitable techniques for drawing the printing ink or other coloring matter into the fabric. Processes or apparatus as shown in U.S. Pat. Nos. 3,129,442 and 3,137,230 are typical of arrangements which use the application of vacuum beneath the printing stock to draw the printing ink or coloring matter into the stock.

In Weiss U.S. Pat. No. 3,221,648, a process and apparatus are described for the vacuum printing of flat stock such as porous paper wherein the stock is held to a concave support by vacuum and is contacted with the underside of a stencil screen and a vacuum applied between the underside of the stencil screen and a stock to cause the printing ink to be drawn through the openings in the stencil to produce the desired imprint on the stock. This method and apparatus is applicable to the printing of flat stock where the colors are widely separated and where sharp detail is not required. This apparatus, however, does not provide sharp detail when very sharp edged designs are used or where fine printing is to be imprinted through the screen stencil. In another patent, Weiss discloses a cylinder press in which vacuum is applied through a cylinder to draw ink through a stencil onto flat stock moved between the cylinder and the stencil. In the Weiss cylinder press, however, the cylinder makes contact with the screen over a rather wide band and draws the ink onto the stock over a wide band on the stock without producing fine detail.

STATEMENT OF OBJECTS AND FEATURES OF THE INVENTION

It is, therefore, one object of this invention to provide a new and improved method and/or apparatus for screen process printing by a vacuum technique.

Another object of this invention is to provide an improved vacuum operated screen process printing technique which provides for the imprinting of stock in very sharp detail.

Another object of this invention is to provide a new and improved method and/or apparatus for vacuum screen process printing of stock which is specially adapted to multicolor printing.

Still another object of this invention is to provide a new and improved method and/or apparatus for screen process printing in which several colors can be printed at the same time.

One of the features of this invention is the provision of a new and improved apparatus and/or method for screen process printing of porous stock in which vacuum is applied along a fine line across the stock while the stock is in contact with the screen stencil and the line of vacuum moved along the stock to cause the printed ink to be drawn through the stencils only at the point of application of vacuum.

Another feature of this invention is the provision of an improved apparatus and/or method for screen process printing of porous flat stock wherein a vacuum is applied in a thin line across the bottom of the stock in contact with the screen process stencils and moved along the bottom surface of the stock for drawing printing ink thorugh the stencil in the desired design and vacuum means is applied to the stock immediately behind the point of application of printing vacuum to pull the stock away from the screen stencil immediately after the imprint is applied thereon.

Still another feature of this invention is an improved apparatus and/or method for vacuum screen printing wherein a plurality of different color printing inks are applied in isolated areas of the screen stencil on the stencil applied to the stock to be printed with the ink being drawn through the stencil in the desired imprint onto the stock by means of a fine line vacuum applied through the stock and moved along the underside of the stock.

Other objects and features of this invention will become apparent from time to time throughout the specification and claims as hereinafter related.

SUMMARY OF THE INVENTION

This invention comprises a new and improved method and apparatus for vacuum screen printing of porous stock. A conventional screen process stencil is used in which the screen has a stencil formed thereon in a conventional manner with the holes in the screen being coated or filled in the areas where no printing is to occur and openings left in the screen wherever printing ink or coloring material is to pass through the screen for producing the desired imprint. The stencil may have a plurality of different colored inks in isolated areas of the stencil or may be provided with a single color printing ink over the entire stencil area. The stencil is placed in contact with the porous stock, preferably a porous flat stock such as a porous paper, paper board, or woven or nonwoven fabric. Vacuum is applied along a thin line on the underside of the stock to draw the printing ink through the stencil onto the stock and the line of vacuum is continually advanced along the undersurface of the stock until the entire desired imprint has been produced on the stock. Preferably, the stock is stripped away from contact with the underside of the screen stencil, for example, by a vacuum stripping mechanism immediately following the application of vacuum to produce an imprint on the stock. This vacuum printing process and apparatus produces a design imprint on the stock which is of very sharp detail. This method and apparatus may be used to produce a multicolor design imprint on the stock without the necessity of multiple printing passes and intermediate drying of the various colored imprints between separate printing steps as has been necessary in previous methods and apparatus for multicolor printing.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings to be taken as a part of this specification, there are clearly and fully illustrated two preferred embodiments of the invention, in which drawings,

FIG. 1 is a sectional view of the apparatus for carrying out a novel process for vacuum screen printing of porous stock,

FIG. 2 is a plan view of the screen process stencil used in the apparatus shown in FIG. 1,

FIG. 3 is an isometric view of the vacuum apparatus used in the embodiment of the invention shown in FIG. 1,

FIG. 4 is a view in section of an alternate embodiment of this invention showing the vacuum imprinting of porous flat stock by a screen process technique at the start of the printing operation, and

FIG. 5 is a sectional view of the apparatus shown in FIG. 4 at an intermediate stage of its operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, and more particularly FIGS. 1 to 3, there is shown a preferred embodiment of the apparatus for practicing the printing method which is a preferred form of this invention.

In FIG. 1, there is shown a screen process stencil 1 comprising frame 2 and stencil screen 3. Stencil screen 3 is prepared in a conventional manner with a coating or other suitable material blocking the holes in the screen at the points where no imprint is to be made with open areas forming the desired imprint. In the embodiment shown in FIG. 1, there are provided a plurality of dams or wall members 4 positioned on stencil screen 3 to provide wells or isolated areas in which there are confined a plurality of distinct masses 5, 6, 7, and 8 of pasty printing ink (preferably thixotropic ink) of different colors for producing a multicolored imprint. Whenever the apparatus is used for imprinting any single color, the dams or wall members 4 are omitted and a single mass of pasty (or thixotropic) printing ink is spread over the stencil.

Beneath the screen stencil 1, there is provided a support member 9 consisting of frame 10 and screen support member 11 on which there is supported a piece 12 of flat stock, such as paper, paper board, or woven or nonwoven fabric, for imprinting.

Underneath supporting screen 11, there are positioned a pair of vacuum applying members 13 and 14 which are supported on member 15 for movement together. Members 13 and 14 are of a construction as shown in FIG. 3. Member 13 is formed of a round tube of pipe 16 which has welded or brazed to it a piece of angle iron material 17 which has a flat portion 18 machined along the angle and a slot 19 formed therein which is relatively narrow. Slot 19 is preferably a hairline slot in a range from about 0.008 to 0.012 in. for application of vacuum along a very fine line of contact.

One end 20 of the pipe and angle iron member is completely sealed and the opposite end is provided with a wall which closes the end as at 21 except for a small central opening 22 for connection to a source of vacuum. The tube portion 16 of member 13 is provided with a plurality of holes 23, shown in dotted line, which open into the space between the wall 16 and angle iron 17. The opening from the tube 16 into the space adjacent to angle iron 17 could also be by means of a slot or any other suitable opening to permit withdrawal of air through slot 19. vacuum-applying member 14 is constructed substantially identical to member 13 and substantially the same reference numerals are applied to the various parts thereof. Slot 19*a* in members 14, however, may be slightly wider than slot 19 in member 13, if desired, since the vacuum applied through this member does not have to be applied along such a fine line.

OPERATION

In this embodiment of the invention, a porous flat stock, such as a porous paper, paper board, or a woven or nonwoven fabric, is placed on supporting screen 11 and screen stencil 1 brought into contact with the stock. Member 15 is moved to press the slotted portion of member 13 against the underside of supporting screen 11 to press stock 12 tightly against screen 3. In this position, the slotted portion of member 14 is adjacent to the underside of supporting screen 11 but does not press the screen at that portion against stencil screen 3. Members 13 and 14 are connected to a source of vacuum, not shown, which applies vacuum along slots 19 and 19*a* in members 13 and 14. The hairline slot 19 in member 13 causes the printing ink on the upper side of stencil 1 to be drawn through stencil screen 3 at any point that a vacuum is free to draw through the open portions of the stencil. This causes the printing ink to be pulled through the screen 3 onto stock 12 in the desired imprint pattern in essentially the same manner as if the ink were forced through by a squeegee acting on the upper surface of the screen. Since slot 19*a* is not pressed against stencil screen 3, but is slightly spaced therefrom, it draws the stock 12 away from the screen 3 at that point. The vacuum which is drawn through the stock 12 not in contact with screen 3 is inadequate to draw the thick printing ink through the screen.

As the support member 15 is moved to the left as indicated by the directional arrow, member 13 moves along the underside of support screen 11 and continually applies a hairline vacuum to the underside of the supporting screen and to the stock to draw the printing ink through in the desired pattern. As member 15 is moved to the left, the vacuum applied through slot 19*a* in member 14 causes the portion of the stock 12 which has been imprinted to be pulled away from contact with the stencil screen 3 immediately behind the line of vacuum applied by slot 19 and thus insures the formation of a sharp, clearly defined imprint on the stock. It is most important that the printing ink be drawn through a screen stencil by application of a hairline vacuum which is moved along the underside of the stock, and it is equally important that the stock be stripped away from contact with the underside of the screen stencil as quickly as possible following the application of the imprint thereto. The stock could be stripped away manually in case of a hand operated process but is preferably stripped automatically by the vacuum applied through slot 19 in stripper member 14. If desired, stock 12 may be secured on supporting member 9 at the start of the printing operation to prevent its shifting during the movement of the slotted vacuum applying members 13 and 14 underneath supporting screen 11. The edge of the stock could merely be taped or otherwise secured to frame 10 or to screen 11. This is not absolutely necessary but in some instances might be desirable to prevent smudging of the imprint due to shifting the stock.

While the apparatus shown in FIGS. 1, 2, and 3 have been described with reference only to the manner of application of a hairline vacuum to a porous stock material for screen process printing and the use of a vacuum stripper member for removal of stock from contact with the stencil screen, it will be obvious that the supporting screen member 9 and screen printing stencil 1 could be supported in any conventional screen process printing machine and that member 15 could be moved relative to supporting screen 11 by any suitable mechanism such as the mechanism conventionally used to move a screen process stencil squeegee in a conventional screen process printer. Any suitable mechanism could be used for moving various components of this apparatus in carrying out the desired process as particular mechanical structure is not of critical importance to the operability of the invention. The vacuum-applying members described above were assembled from pipe and angle irons and do not necessarily represent a finished commercial design.

AN ALTERNATE EMBODIMENT

In FIGS. 4 and 5 of the drawing, there is shown an alternate embodiment of the invention in which a vacuum base for supporting stock performs the dual function of supporting and of stripping the stock away from contact with the screen stencil immediately after application of the hairline vacuum which draws the printing ink through the stencil. In FIG. 4, the apparatus includes a vacuum base 30 having a plurality of apertures 31 which are covered by manifold 32 permitting withdrawal of air for application of vacuum through all of said apertures. Manifold 32 is provided with an outlet opening 33 for connection to a suitable source of vacuum. The screen stencil 1 used in this embodiment of the invention is essentially identical to that used in the embodiment shown in FIGS. 1 and 3 of the drawings and the same reference numerals are applied to the various parts therein. For multicolor printing, the stencil may be provided with wells dividing the pattern into a plurality of separate colors 5, 6, 7, 8, and 8*a*.

The apparatus is provided with a movable bar member 34 or provided with grippers 35 for grasping the end of stock 12 dur-

ing the printing operation. In this form of the apparatus, stock **12** is secured in grippers **35** and supporting bar **34** moved into position adjacent the end of vacuum table **30** as shown in FIG. **5**. Member **13** has vacuum applied thereto through opening **22** and is moved to the left as shown in FIG. **5**. The vacuum-applying slot **19** is operable to apply a hairline vacuum to the underside of stock **12** to draw printing ink through the open portions of stencil screen **3**.

OPERATION OF THE ALTERNATE EMBODIMENT

In this embodiment of the invention, the method of screen printing is essentially the same as that described and shown in FIGS. **1** to **3**. The printing is carried out by applying a hairline vacuum through a porous sheet stock material, which may be a porous paper, paper board, or a woven or nonwoven fabric. The hairline application of vacuum to the underside of the stock is moved along the underside of the stock with the result that the printing ink is drawn through the stencil screen to produce the desired imprint on the stock. Stock is stripped away from the stencil screen immediately after application of the printing vacuum.

In this embodiment of the invention, stock **12** is placed in contact with vacuum table **30** and the end of the stock is secured in grippers **35** on bar member **34**. Vacuum is applied to vacuum table **30** through opening **33** into manifold **32**. Stock **12** is thus securely held on the vacuum table. Stock **12** is pushed against the underside of screen stencil **3** by member **13** with slotted opening **19** applying a hairline vacuum as a result of the connection of opening **22** to a vacuum pump or other suitable source of vacuum. As member **13** is moved to the left, as viewed in FIGS. **4** and **5**, bar **34** is moved into position opposite the end of vacuum table **30**, as shown in FIG. **5**. In this position, the portion of stock **12** to the right of member **13** is pulled by vacuum applied through apertures **31** into contact with the upper surface of vacuum table **30**. As member **13** is moved to the left, the hairline vacuum applied through slot **19** draws the pasty (or thixotropic) printing ink through the open portions of stencil screen **3** to imprint the stock with the desired pattern or design of printing of the stencil. As member **13** moves to the left, the hairline application of vacuum moves therewith and the portion of stock **12** which has been imprinted by ink drawn through the stencil by vacuum applied at slot **19** is pulled back into contact with vacuum table **30**, thus stripping the stock away from contact with stencil screen **3** immediately after printing.

This embodiment of the invention has been illustrated and described for manual operation. It will be obvious to those skilled in the art that the vacuum printing table used may be a part of any conventional screen printing machinery as can be the screen printing stencil. The bar member **34** and grippers **35** are of a type found in conventional screen process printers for holding the ends of sheet stock during a printing operation. The movement of member **13** in the apparatus may be carried out by any suitable mechanical linkage such as that used for movement of a screen printing squeegee in conventional screen process equipment. The particular apparatus used for effecting the movement of the various members in this apparatus is not of critical importance since any suitable supporting means or actuating means could be used.

While this invention has been described fully and completely with special emphasis upon two preferred embodiments thereof, it should be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

I claim:

1. A method of screen process printing which comprises:

a. placing a porous sheet stock in juxtaposition to a screen process stencil having a screen process printing ink distributed thereon,

b. applying a vacuum along a thin line on the underside of said stock while pressing said stock against said stencil,

c. moving the point of application of vacuum across the underside of the stock for at least the distance covered by the design portion of said stencil, whereby the printing ink is drawn through said stencil to imprint said stock with predetermined imprint corresponding to the design of said stencil, and

d. continuously pulling said stock out of contact with said screen stencil immediately behind the point of application of said vacuum.

2. A method in accordance with claim **1** in which said stock is continuously pulled out of contact with said stencil by vacuum means.

3. A method in accordance with claim **2** in which vacuum means for continuously pulling stock out of contact with said screen stencil is moved along with and behind and slightly below said moving point of application of a thin line of vacuum for drawing ink through said stencil.

4. A method in accordance with claim **2** in which the vacuum means for pulling said stock out of contact with said stencil is a vacuum base holding said stock in position and pulling said stock out of contact with said stencil as the point of application of said line of vacuum is moved across the underside of said stock.

5. A method in accordance with claim **1** in which said vacuum is applied along a line having a width of 0.008—0.012 in.

6. A method in accordance with claim **1** in which said stencil has a plurality of different colored screen process printing inks in distinct areas separated by wall members whereby said stock is printed in a plurality of colors simultaneously.

7. A method in accordance with claim **6** in which said stock is continuously pulled out of contact with said stencil by vacuum means.

8. A method in accordance with claim **7** in which vacuum means for continuously pulling stock out of contact with said screen stencil is moved along with and behind and slightly below said moving point of application of a thin line of vacuum for drawing ink through said stencil.

9. A method in accordance with claim **7** in which the vacuum of means for pulling said stock out of contact with said stencil is a vacuum base holding said stock in position and pulling said stock out of contact with said stencil as the point of application of said line of vacuum is moved across the underside of said stock.

10. A method in accordance with claim **6** in which said vacuum is applied along a line having a width of 0.008—0.012 in.