

Aug. 12, 1969

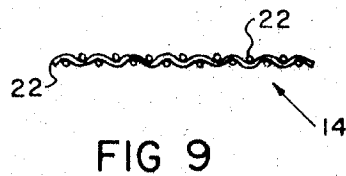
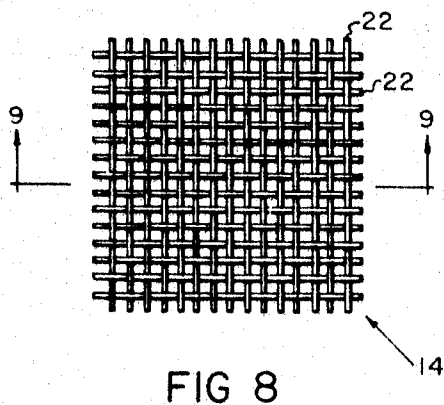
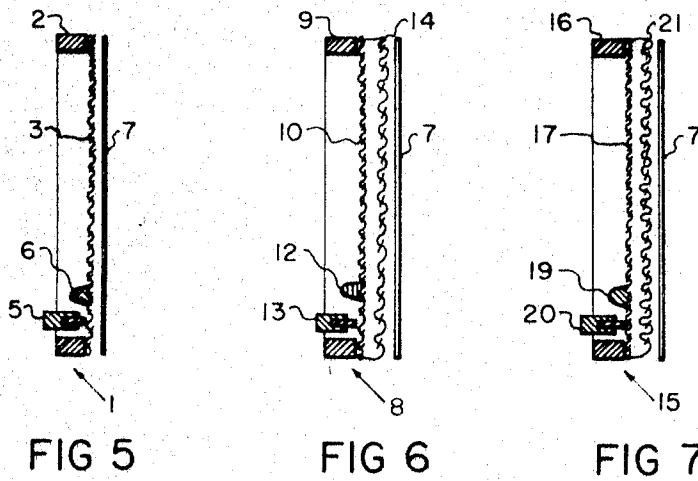
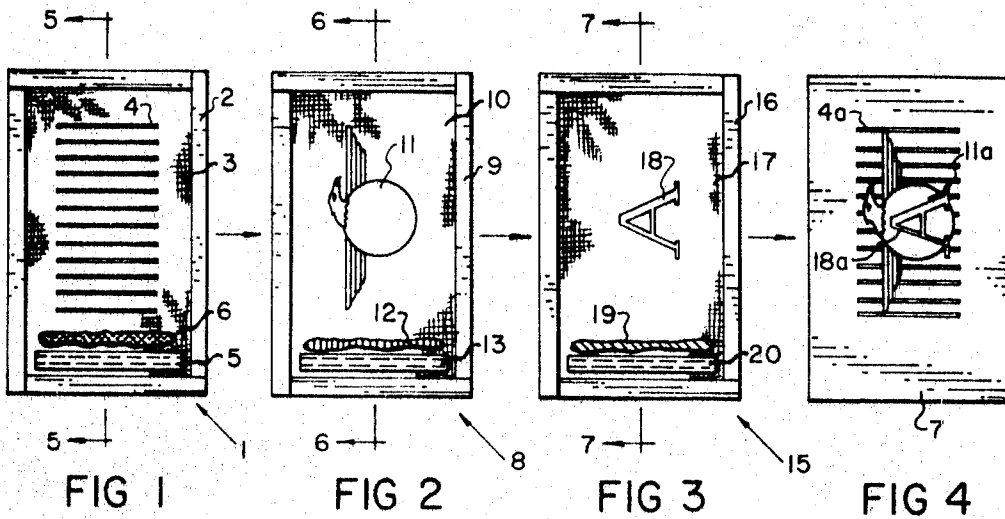
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3,460,471

APPARATUS FOR MULTICOLOR SCREEN PROCESS PRINTING

Filed July 28, 1965

4 Sheets-Sheet 1



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APPARATUS FOR MULTICOLOR SCREEN PROCESS PRINTING

Filed July 28, 1965

4 Sheets-Sheet 2

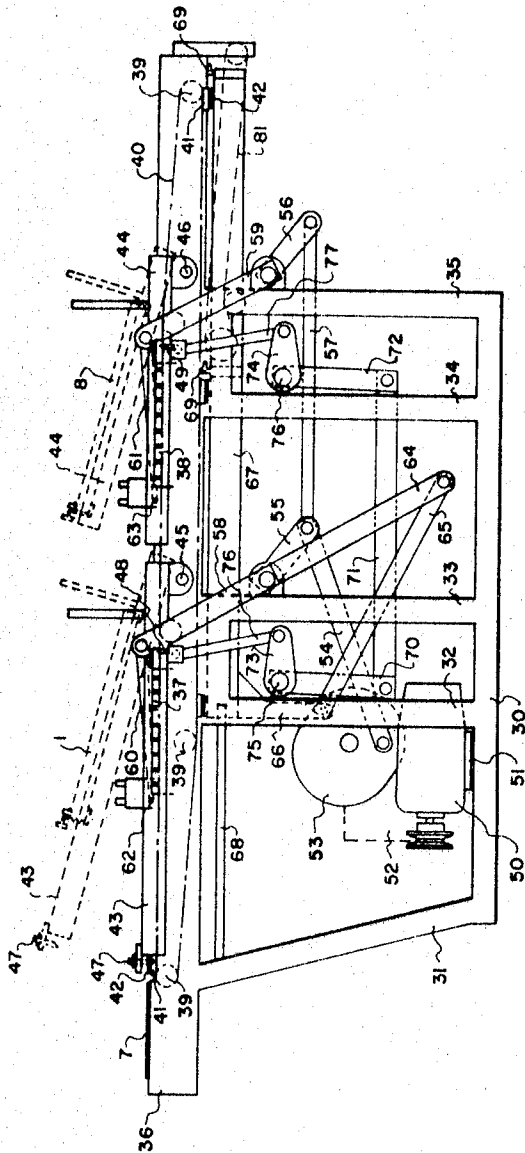


FIG 10

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APPARATUS FOR MULTICOLOR SCREEN PROCESS PRINTING

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4 Sheets-Sheet 3

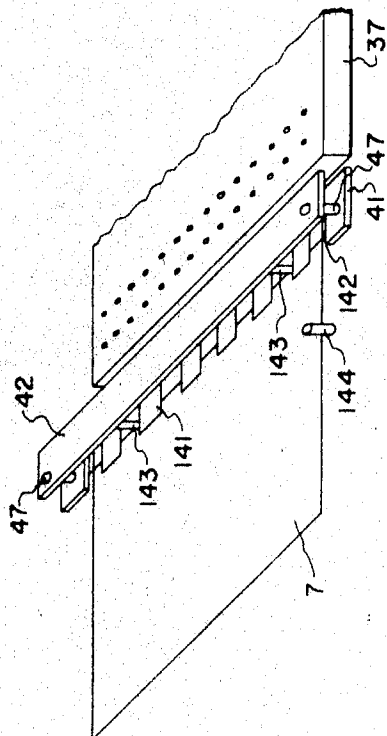


FIG 11

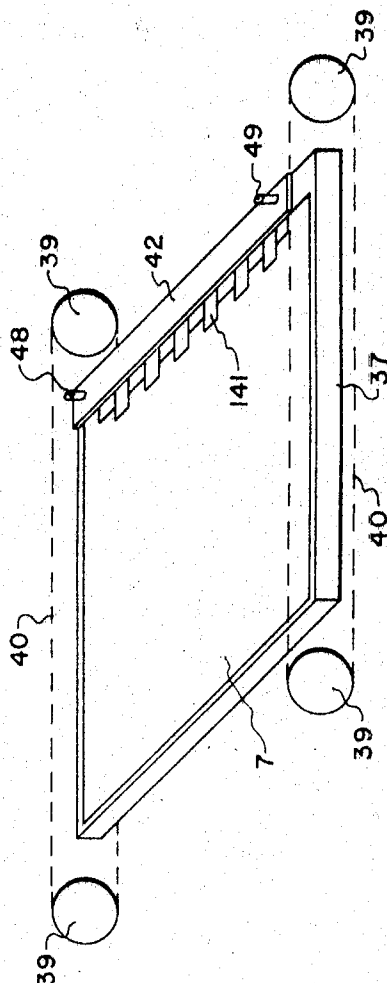


FIG 12

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APPARATUS FOR MULTICOLOR SCREEN PROCESS PRINTING

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4 Sheets-Sheet 4

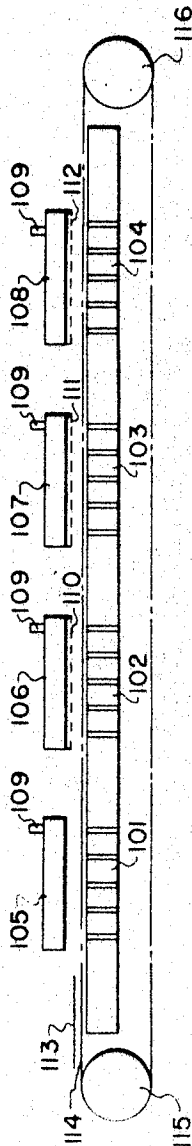


FIG 13

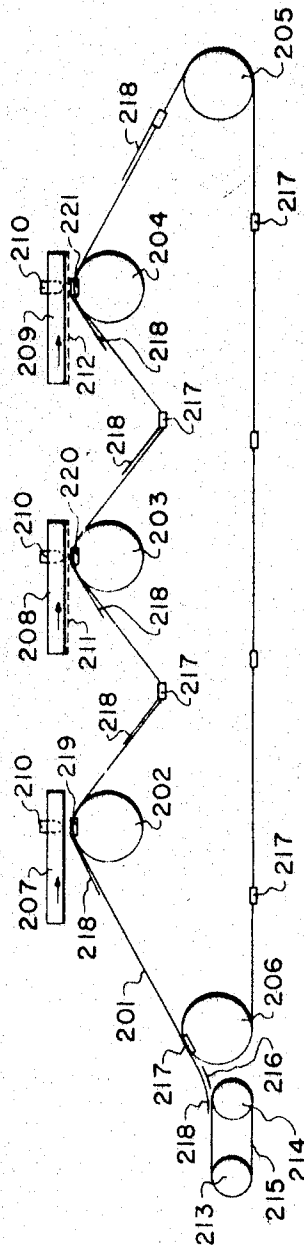


FIG 14

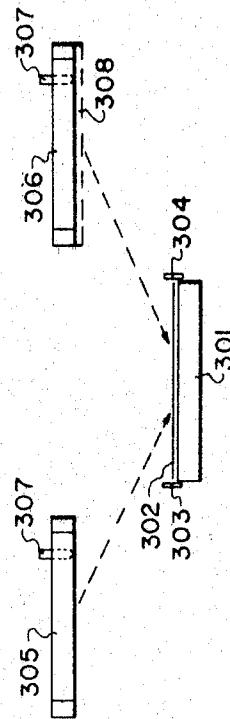


FIG 15

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APPARATUS FOR MULTICOLOR SCREEN PROCESS PRINTING

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Int. Cl. B41f 15/04; B41l 13/00; B41m 1/12

U.S. Cl. 101-115

7 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for multicolor screen process printing includes feed means for moving a flat printing stock successively through a plurality of printing stations. The plurality of printing stations are arranged for screen process printing of different colors in preselected designs. The second printing station and any stations subsequent thereto each include a screen printing stencil provided with a second printing station and any stations subsequent thereto printing stencil with wet ink on the printing stock applied at the previous printing station. The feed means for moving the flat printing stock is cooperable with registration means such as registration pins engageable with a gripper bar on the feed means, to register the stock accurately in relation to each printing station, thus providing for multicolor printing without offset printing from the second and subsequent screen stencils.

This invention relates to new and useful improvements in screen process printing and more particularly to a method and/or apparatus for screen printing a plurality of colors on an object without waiting for individual colors to dry before the next pattern of color is applied.

In the past, screen process printing has been used in both single color and multicolor printing operations. Where a single color printing operation is undertaken, there is no particular problem since the printed object is merely stored on a suitable drying rack until the ink or other coating material has dried. When multicolor printing has been carried out using screen process equipment, it has been necessary to print one pattern of color on the object being printed, allows said pattern to dry, and then screen printing another color pattern onto the object to produce the desired combination of colors. The screen process printing of objects which required an intermediate drying step has been highly ineffective since it is very slow and requires an excessive storage capacity for the printed objects between the various printing stages.

In the past, attempts have been made to develop processes or apparatus which permit multicolor printing without waiting for the printed areas to dry before application of additional printed patterns. These attempts have included various spacer arrangements for the printing screens to prevent smudging of the color and have included various attempts to speed the drying of the ink or coating between printing stages. All in all, the attempts to develop processes or apparatus for multicolor screen process printing without intermediate drying have been singularly unsuccessful and to this day no commercial multicolor screen printing equipment is available which does not require intermediate drying of the printed areas.

It is one object of this invention to provide a new and improved process of screen process printing in which a plurality of colors may be separately impressed upon an object to be printed without intermediate drying of the printed colors.

Another object of this invention is to provide a new and improved apparatus for multicolor screen process printing which does not require intermediate drying of the separate applications of colored patterns.

A feature of this invention is the provision of a new and improved process for screen process printing in which an object to be printed is printed in separate color patterns using a plurality of stencil screens wherein each screen subsequent to the first screen stencil is provided with a spacing screen having a mesh and filament size such that the printing screen is not contacted by the ink from the previous printing stage.

Another feature of this invention is the provision of a new and improved apparatus for multicolor screen process printing in which an object to be printed is continuously and intermittently moved from one station to another and is printed with a plurality of color patterns at each of the printing stations, each printing station subsequent to the first being provided with a spacing screen having a mesh size and filament size such that the ink from the previously printed areas will not touch the surface of the screen stencil at that printing station.

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

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

FIG. 1 is a plan view of a screen stencil for impressing a color pattern on a printed object,

FIG. 2 is a plan view of a second screen stencil for impressing a second color pattern on a printed object,

FIG. 3 is a plan view of a third screen stencil for impressing a third color pattern on a printed object,

FIG. 4 is a plan view of a printed object which has been printed using stencils shown in FIGS. 1, 2 and 3,

FIG. 5 is a view in section taken on the line 5-5 of FIG. 1,

FIG. 6 is a view in section taken on the line 6-6 of FIG. 2,

FIG. 7 is a sectional view taken on the line 7-7 of FIG. 3,

FIG. 8 is a detail plan view of the spacing screen shown in FIGS. 6 and 7,

FIG. 9 is a view in section of the screen shown in FIG. 8,

FIG. 10 is a view in elevation of an apparatus designed to carry out the process illustrated in FIGS. 1 to 9, inclusive,

FIG. 11 is a schematic view, in perspective, of the feeding stage of the apparatus shown in FIG. 10,

FIG. 12 is a schematic view, in perspective, of the printing stations in the apparatus shown in FIG. 10,

FIG. 13 is a schematic view of a four-station printing apparatus utilizing the improved process of this invention, and

FIG. 14 is a schematic view of the invention applied to a cylinder screen press, and

FIG. 15 is a schematic view of the invention utilizing a plurality of stencils at a single station.

This invention comprises a new and improved method and apparatus for multicolor screen process printing. In the broadest sense, the method can be carried out by hand operation or by a crude apparatus capable of performing the individual steps. In a more commercial form, the invention comprises not only the process but the new and improved apparatus for carrying out the multicolor printing operation.

In the improved method of this invention an object, such as a flat sheet of paper or other material, is printed

at a first printing station using a stencil screen to impress a preselected pattern of color thereon. The printed object is then moved to another printing station while the printing ink is still wet. At this printing station a second stencil is moved into very precise registration with the printed object so that a second ink pattern may be printed thereon before the ink from the first printing station has been allowed to dry. The second printing station includes a stencil having a stencil screen and provided with a spacing screen interposed between the stencil screen and the printed object. The spacing screen is preferably formed of materials to which the ink is nonadherent and having a thickness and mesh opening such that the ink from the first printed area will not touch the surface of the stencil screen at the second printing station. With the spacing screen in position, the second stencil is brought into precise, accurate registration with the printed object and a second ink pattern forced through the stencil to print the desired pattern on the printed object in accurate registration with the first pattern. The registration of the second pattern with the first may be in close proximity thereto or may overprint the first pattern. The accurate registration is required, not for separation of the printed patterns, but to prevent the spacing screen itself from printing a pattern offset in relation to the first pattern.

If a third or fourth color is to be printed on the printed object, the object is moved to a third or fourth printing station where a stencil is moved into accurate registration with the printed object. As in the case of the second printing station, the stencil at the third or fourth printing station is provided with a similar spacing screen which prevents the wet ink from the previous printing stations from contacting the surface of that stencil screen. By using this arrangement of printing stencils and spacing screens and by very accurate registration of the subsequent stencils with the printed areas on the object being printed, it is possible to obtain multi-color prints, with or without overprinting of previously printed areas, without the necessity of waiting for drying of each of the separate printing stages.

Referring to the drawings by numerals of reference and more particularly to FIGS. 1 to 9, there is illustrated, somewhat schematically, the stencils which are used in the various stages of operation of the new and improved process of this invention. In FIG. 1 there is shown a stencil 1 comprising a frame 2 and stencil screen 3 having an open portion of preselected pattern 4. Stencil 1 is provided with squeegee 5 and printing ink 6. In FIG. 5, which is a section taken on the line 5—5 of FIG. 1, the relationship of the stencil 1 to a flat sheet 7 which is being printed is illustrated. The stencil is placed against sheet 7 and squeegee 5 moves the ink 6 along the surface of screen 3 to impress a pattern through openings 4 onto the surface of sheet 7.

After the printing at the first station is complete the stencil 1 is lifted and the printed sheet 7 is moved while the ink is still wet to a second printing station shown in FIG. 2. At the second printing station, as shown in FIG. 2, there is provided a screen stencil generally designated 8 which comprises a frame 9 and stencil screen 10. The screen 10 is provided with an open portion of preselected pattern 11. Stencil 8 is also provided with ink 12 which is of a different color from the ink in stencil 1 and is provided with squeegee 13. Stencil 8 is also provided with a spacing screen 14 which prevents screen 10 from touching the wet ink on the surface of sheet 7. The details of this printing station are more clearly seen by reference to FIG. 6 which shows the relationship of screen 10 to spacing screen 14 and sheet 7. At this printing station, while the ink pattern impressed at the first printing station is still wet, the spacing screen 14, secured on frame 9, is placed against the sheet 7 with stencil screen 10 in precise, accurate registration with sheet 7 so that

a second color may be printed on said sheet in precise registration with or overprinting the previously printed pattern. With the stencil in such precise registration, squeegee 13 is operated to cause ink 12 to be forced through stencil 10 at the open mesh portion 11 to impress a second pattern on sheet 7 (in this case overprinting the background printing 4^a).

Next, stencil 8 and spacing screen 14 are lifted and sheet 7 is moved to another printing station while the ink from the previous printing stages is still wet. Sheet 7 is moved to the printing station shown in FIGS. 3 and 7 of the drawing. In this position there is provided a screen stencil 15 comprising a frame 16 having a stencil screen 17 with an open mesh portion of preselected pattern 18 therein. Stencil 15 is provided with ink 19 of a different color from that used with stencils 1 and 8 and is provided with squeegee 20 for application of the ink to sheet 7. Stencil 15 is also provided with a spacing screen 21 as shown in section in FIG. 7.

At the third printing station, while the ink from the previous printing stages is still wet, spacing screen 21, secured in frame 16, is placed against sheet 7 with stencil screen 17 in precise accurate registration with the previously printed areas on said sheet. While the stencil is in such precise registration squeegee 20 is operated to force ink 19 through the open mesh portion 18 to print a third color pattern on the printed sheet.

In FIG. 4 sheet 7 is shown as a finished product with the separate printed areas sectioned thereon and the separate printed areas identified as 4^a, 11^a and 18^a corresponding to the stencil openings through which the respective colors were forced.

Spacing screens 14 and 21 are identical and may be used in one or more additional printing stages if desired. Printing screen 3 (or 10 or 17) is preferably formed of threads or filaments about 0.0014—.0002 in. in diameter and having a mesh size of about 200 to 400 threads (or filaments) per inch. In FIG. 8, and FIG. 9 there are shown additional detail views of screen 14 (or 21). Screen 14 consists of a woven network of monofilaments 22 of a material to which the printing ink is preferably nonadherent. The filaments are preferably about 0.0014 to 0.013 inch in diameter and form mesh size of about 4 to 200 filaments per inch. The size of the filaments and screen opening is selected such that the screen printing stencils are spaced a sufficient distance from the printed sheet to prevent the ink from the previously printed portion from touching the stencil screen. For this purpose, it is essential that a screen be used which is formed of monofilaments and that the spacing screen be of the aforementioned mesh size. In addition, it is absolutely necessary that the ink used in the process be thixotropic. Thixotropic inks which will lay down a thin printed layer (e.g., 0.0004—.004 in. wet thickness) are preferred. In order to prevent offset printing from the spacing screen the monofilaments in the screen are preferably of a material to which the thixotropic printing ink is nonadherent. Suitable materials for the monofilaments 22 include stainless steel, nylon, polyesters (e.g., Mylar), or polytetrafluoroethylene (Teflon). In FIGS. 6 and 7 the spacing screens 14 and 21 are shown slightly spaced from the respective stencils 8 and 15. However, in actual commercial construction, the spacing screens 14 and 21 are affixed tightly to the stencil frames 9 and 16 and are moved with stencils 8 and 15 into and out of printing engagement with sheet 7.

This process, using thixotropic inks and printing stencils and spacing screens as described above, is quite versatile in commercial application. It is possible to print solid colors, line work, and half tones in a plurality of colors without waiting for the drying of each printing stage. The use of thixotropic inks, which are laid down in thin layers, with printing stencils and spacing screens

as described, makes possible the printing of successive colors over previously printed areas while still wet.

Accurate registration of successive stencils is desirable for optimum registration of colors in multicolor prints. Accurate registration of the spacing screens in relation to previously printed areas is essential to prevent the spacing screen from printing a screen pattern offset in relation to the previously printed areas.

The mesh size and filament diameter for the printing screens and spacing screens is selected according to the type of printing undertaken. Generally, printing of line work and solid areas can be done with coarser stencils and spacer screens than is required for halftone, fine line designs, type, etc.

In FIG. 10 there is shown a view in elevation of the essential features of an apparatus for carrying out the process as above described. The apparatus shown in FIG. 10 is a continuous screen process printer having two stations for printing sheet stock in two different colors. With obvious modifications the apparatus can be adapted for printing in three or more colors. The apparatus shown in FIG. 10 comprises a frame consisting of base 30 and vertically extending legs 31, 32, 33, 34 and 35. The upper ends of the vertically extending legs support frame 36. The left end of frame 36 constitutes a feed table. The center portion of frame 36 includes flat table portions 37 and 38 which are provided with a plurality of holes for application of a vacuum from a suitable vacuum source (not shown) for holding stock to be printed to prevent wrinkling or shifting during screen process printing at the respective stations.

Frame 36 supports a plurality of sprockets 39 over which there is fed a system of continuous chains 40 shown in dotted lines. There are a pair of chains 40 positioned in parallel on the sprockets 39 and arranged to feed printing stock through the apparatus (see FIGS. 11 and 12). Chains 40 are provided with a plurality of grippers shown in more detail in FIGS. 11 and 12. Grippers include upper plate 42 and lower plate 41 provided with gripping members 141 and 142 which clamp printing stock 7 for movement through the apparatus. At the feeding stage to the apparatus the plates 41 and 42 are registered by pins 47 by insertion into apertures therein. The stock is initially located by front guide pins 143 and side guide pins 144.

There are provided a pair of printing frames 43 and 44 which are pivoted at 45 and 46 on frame 36. Frames 43 and 44 support screen stencils 1 and 8 as shown in the dotted open position in FIG. 10. Screen stencils 1 and 8 in FIG. 10 are the same as stencils 1 and 8 in FIGS. 1 and 2 and are arranged to carry out the function of those screens. Screen stencil 1 in FIG. 10 is a plain stencil without a spacer screen as illustrated in FIGS. 1 and 5. Screen stencil 8 in FIG. 10 is provided with a spacer screen as shown in FIGS. 2 and 6.

Frame 43 is provided with a set of pins 47 which register grippers 41, 42 for initial location of the feedstock being printed in the apparatus. When the grippers are moved to printing position they are accurately registered for printing by pins 48 and 49 which insert into said apertures in gripper members 41 and 42 at the printing stations. The apparatus is provided with a driving mechanism, which will be described in more detail, for moving the conveyor chain 40, opening and closing printing frames 43 and 44, and actuating the screen printing flood bar and squeegee.

The apparatus is provided with motor 50 supported on the framework at 51. Motor 50 is operatively connected, as indicated diagrammatically by the dotted line 52, to cam drive 53. Cam 53 is arranged to operate through linkage 54 to actuate operating levers 55 and 56 connected by drive linkage 57. Levers 55 and 56 operate levers 58 and 59 which are operatively connected

at their upper ends, as indicated by lines 60 and 61 to squeegee and flood bars 62 and 63. The lower end portion 64 of lever 58 is connected through drive linkage 65 to finger 66 on carriage 67. Carriage 67 is supported on a pair of longitudinally extending rods 68 for reciprocal movement longitudinally of the apparatus. Carriage 67 is provided with a pair of pusher pawls 69 which are arranged to engage grippers 41 on the under side of frame 36. Movement of carriage 67 toward the feed table engages pawls 69 with grippers 41 and indexes the chain 40 for movement of the grippers and stock from one printing station to the next.

Cam 53 is also arranged to actuate lever member 70 directly which is in turn connected through linkage 71 to lever 72. Lever 70 and 72 are connected to members 73 and 74 on shafts 75 and 76 which define essentially a pair of bell crank levers. The outer end of lever portions 73 and 74 are connected to push rods 76 and 77 respectively which are arranged to move the printing frames 43 and 44 into and out of printing position.

In operation, a sheet of printing stock 7 is placed on the feed table portion of frame 36 and is secured by grippers 41, 42. The movement of carriage 67 by cam 53 causes pawls 69 to engage grippers 41 on the under side of the frame 36 and to move the feed chain 40 the distance between successive printing stations, which coincides with the distance between the feed point and the first printing station. When the chain 40 is moved, printing stock 7 is moved to the first printing station and is held smoothly on vacuum table portion 37.

As the printing stock 7 is moved to the first printing station, cam 53 actuates push rod 76 to lower frame 43 to printing position. At the same time, pusher 77 is actuated to lower frame 44 into printing position at the second printing station. After the printing frames are moved into position, further movement of cam 53 actuates levers 58 and 59 to move squeegees 62 and 63 to force colored ink through the screen stencil to impress a preselected pattern on feedstock 7. At the first printing station, printing stock 7 is accurately located by pins 48 which are inserted into said apertures in the gripper members 41 and 42 (see FIGS. 10 and 12). At the first printing station, screen stencil 1 is used to stencil a first preselected pattern of color on printing stock 7. As shown in FIGS. 1 and 5 screen stencil 1 is a plain stencil without any spacer member.

As cam 53 is moved further, squeegees 62 and 63 are moved back to their starting positions and push rods 76 and 77 lift printing frames 43 and 44 in preparation for movement of feed chain 40. At this point, feed chain 40 is actuated by reciprocally movable carriage 67 to index printing stock to the second printing station and to bring new printing stock to the first printing station. At the second printing station, frame 44 is pivoted into printing engagement with the printing stock 7. Printing stock 7 is accurately located with respect to printing frame 8 by pins 49 which are inserted into said apertures in grippers 41, 42. The mechanism described for operation of the screen stencils at the first printing station functions similarly at the second printing station to actuate squeegee 63 and force color through the second stencil in a preselected pattern maintained in precise accurate registration with the previously imprinted pattern on printing stock 7. As shown in FIGS. 2 and 6, printing frame 8 is provided with spacer screen 14 which, in this case, is a screen of Teflon or nylon monofilaments. The monofilaments in screen 14 have a diameter of the order of 0.0014 to 0.013 inch and a mesh of 4 to 200 filaments per inch.

When printing frame 8 is pivoted into contact with printing stock 7, spacer screen 14, which is carried on the printing frame, prevents the wet ink from the first printing operation from touching the undersurface of the screen in the second printing frame. The use of monofilaments in the spacer screen prevents retention of occluded ink in

the screen, while the use of Teflon, nylon, stainless steel, or the like, as the screen filaments prevent retention of ink due to the substantial nonadherence of the ink on those materials.

After squeegee 63 has been actuated to print a second color pattern at the second printing station, the actuating mechanism pivots printing frame 44 upward and feed chain 40 is indexed to a discharge position. After feed chain 40 is indexed beyond the second printing station, the grippers 41, 42 open to release printing stock 7 and drop it onto discharge belt shown by dotted line 81. Discharge belt 81 is operated either intermittently or continuously to discharge the printed stock from the apparatus.

In the above description, the apparatus includes supporting means comprising the supporting frame having first and second printing stations. Feed means, comprising the drive chain 40 and grippers 41 and 42, are operable to move a flat printing stock successively to the printing stations. Means, comprising pins 47 on stencil supporting frame 43, is engageable with the apertures in gripper members 41 and 42 (constituting part of the stock feed means) to position the gripper members and feed means accurately for feeding stock into the apparatus. Registration pins 48 and 49 constitute means at each printing station engageable with apertures in said feed means (apertures in gripper members 41 and 42) to position the same accurately in relation to the stencils at each of said printing stations. As previously described, squeegees on the stencils at the respective printing stations are operable to force a first color through the first stencil and a second color through the second stencil for imprinting the stock with a multicolor pattern.

In the above description, the apparatus described in connection with FIG. 10 of the drawings includes only two printing stations. If a third printing station were desired, to carry out the three-step printing process shown in FIGS. 1 to 3 of the drawings, a third printing station would be added to the apparatus by appropriate extension of the supporting frame to provide an additional printing table and addition of a third pivoted printing frame to support screen stencil 15. Such a frame would be operated by linkages connected to the operating linkages for the other printing frames.

In FIG. 13 there is shown schematically an apparatus for four-stage multicolor printing. The apparatus includes four printing stations comprising vacuum printing tables 101, 102, 103, and 104 with associated stencils 105, 106, 107, and 108. Each of the stencils is provided a squeegee 109 and stencils 106, 107, and 108 are provided with spacer screens 110, 111, and 112. Printing stock 113 is carried on feed belt 114 supported on drive rollers 115 and 116. Drive rollers 115 and 116 are operated by a suitable drive mechanism coordinated in operation with the stencils for precise registration of the printing stock at each successive stencil.

In FIG. 14 there is shown schematically an apparatus for three-stage multicolor printing using cylinder presses. The apparatus comprises a conventional cylinder press modified to provide a plurality of printing stations without intermediate drying of printed stock and with each stencil subsequent to the first station provided with a spacing screen as used in the other embodiments of the invention.

The apparatus comprises a pair of feed chains 201 (similar to those used in FIG. 10) which pass over rotary cylinders 202, 203, and 204, and sprockets 205 and 206. Cylinders 202, 203, and 204 are provided with stencils 207, 208 and 209, respectively. Each stencil is provided with a squeegee 210. Stencils 208 and 209 are provided with spacing screens 211 and 212. At the feed end of the apparatus there is provided a feed arrangement comprising cylinders 213 and 214 for driving feed belt 215. Adjacent belt 215 there is provided a guide 216 for directing sheet feed stock 218 for engagement by grippers 217 (as

in FIG. 10) on chains 201. Cylinders 202, 203, and 204 are provided with recesses 219, 220, and 221 to receive grippers 17 when moving past the adjacent stencil.

In operation, this apparatus functions as a conventional cylinder screen stencil for printing separate colors. The spacing screens 211 and 212 permit printing of successive colors without intermediate drying of the stock. The cylinders rotate and the stencils move as indicated by the directional arrows to print the stock at each station. The ink, printing stencils, and spacing screens are as described for the other embodiments of the invention. The stock is accurately registered in relation to the stencils at each station.

In FIG. 15, the invention is shown schematically as applied to a fixed printing station. Stock 302 is placed on table 301 having registration pins 303 and 304. First stencil 305 and squeegee 307 are moved to print the stock 302 as indicated by the left hand dotted line. Next, stencil 305 is removed and stencil 306 and squeegee 307 moved into place (accurately registered by pins 303 and 304). Stencil 306 is provided with spacing screen 308 which permits printing of successive colors without intermediate drying, as described for the other embodiments of the invention.

While this invention has been described with special emphasis upon the printing of flat stock, it should be noted that the principle of multicolor printing as described herein could be adapted to the printing of cylindrical bottles or other curved surfaces using apparatus well known in the art for printing such objects.

What is claimed is:

1. An apparatus for multicolor screen process printing comprising

- (a) supporting means having first and second printing stations,
- (b) feed means for moving a flat printing stock successively to said printing stations,
- (c) first and second screen printing stencils supported for movement into and out of engagement with the printing stock at said first and second stations, respectively,
- (d) said second stencil including a spacing screen positioned to prevent contact of the stencil with wet ink on the printing stock applied at the first printing station,
- (e) means supported for movement with said first screen printing stencil and engageable with said feed means to position the same accurately for feeding said stock thereto,
- (f) means at each printing station, engageable with said feed means to position the same accurately in relation to the stencils at each of said printing stations,
- (g) squeegees on said stencils for forcing a first thixotropic color through said first stencil and a second thixotropic color through said second stencil.

2. An apparatus as defined in claim 1 which includes operating means to

- (a) move said feed means intermittently to position said printing stock successively at said printing stations,
- (b) move said stencils into and out of engagement with said printing stock in coordination with movement of said feed means, and
- (c) move said squeegees to force color through said stencils while in engagement with the printing stock.

3. An apparatus as defined in claim 1 which includes means for intermittently operating said feeding means, and said position fixing means comprises positioning pins engageable with said feeding means at each printing station.

4. An apparatus as defined in claim 3 in which said feeding means comprises a gripper bar assembly operated by an intermittently operated conveyor and provided with a plurality of registration openings engaged by said positioning pins at each printing station.

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5. An apparatus as defined in claim 3 in which said stencil supporting means are pivotally supported and are pivoted into and out of printing relation to said feeding means in coordination with movement of said feeding means.

6. An apparatus as defined in claim 5 in which said spacing screen is comprised of monofilaments of nylon, polyester, polytetrafluoroethylene, or stainless steel.

7. An apparatus as defined in claim 6 in which said monofilaments have a diameter of about 0.0014 to 0.013 in. and a mesh of 4 to 200 filaments per inch.

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U.S. Cl. X.R.

101—126, 129