# United States Patent

[11] 3,632,382


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[32] Priority **Dec. 22, 1964**
[33] **Great Britain**
[31] **52,131/64**


[54] **APPLICATION OF LIQUID COLORS TO PAPER CARD OR OTHER SMOOTH SURFACES**
**2 Claims, 12 Drawing Figs.**


[52] **U.S. Cl.** ..... **117/38,** 101/126, 118/401, 118/406, 401/196, 401/264
[51] **Int. Cl.** ..... **B05c 1/16,** B05c 3/20
[50] **Field of Search** ..... 118/401, 406; 101/123, 126, 129; 401/196, 264; 117/37, 38



[56] **References Cited**
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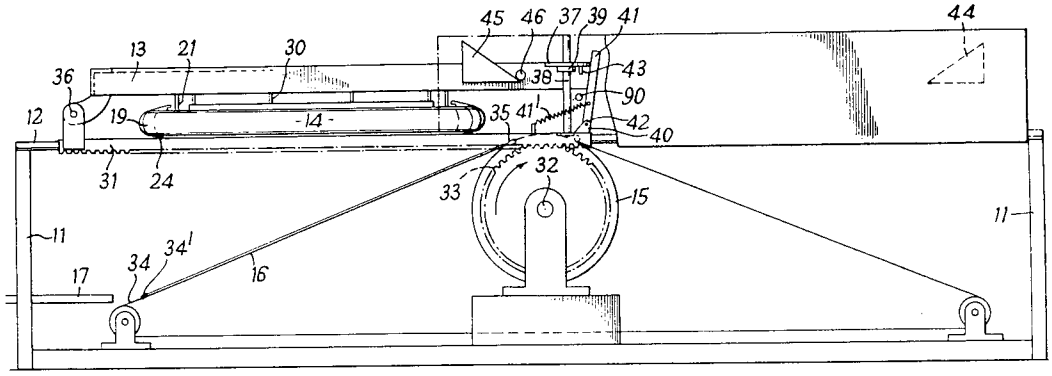
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**ABSTRACT:** Method for applying liquid color to smooth, flexible sheet material in defined areas, said method comprising loading a container, said container having downwardly directed outlets corresponding to the defined areas covered by mesh screen, with the liquid color so that menisci are formed at the lower surface of the screen, and contacting the sheet material to the exterior of said mesh screen so as to break said menisci and transfer the liquid to the surface.

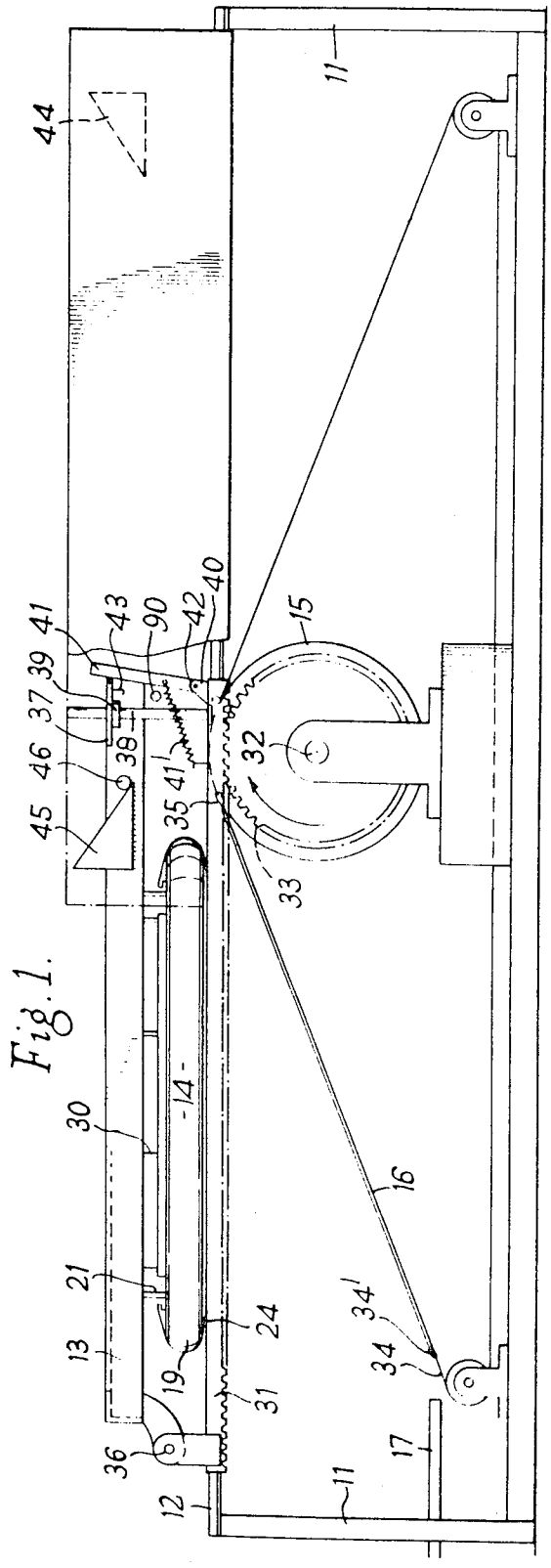



Fig. 1.

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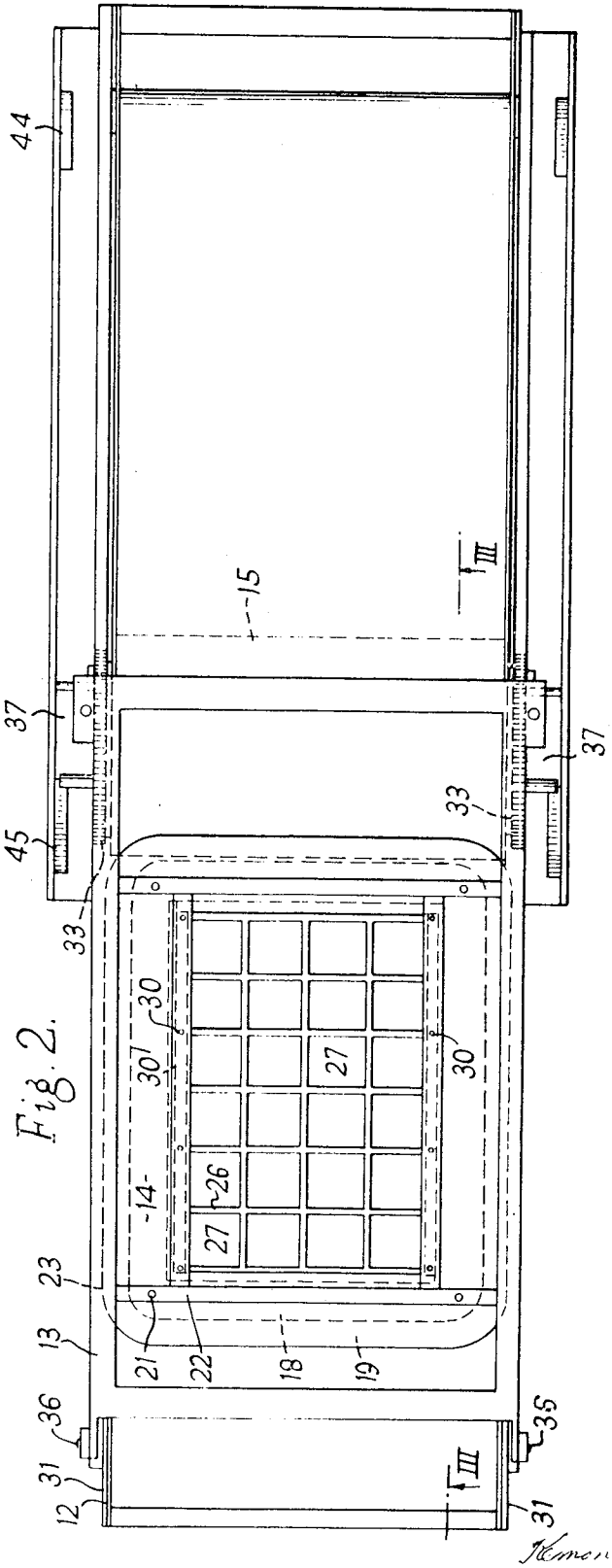



Fig. 2.

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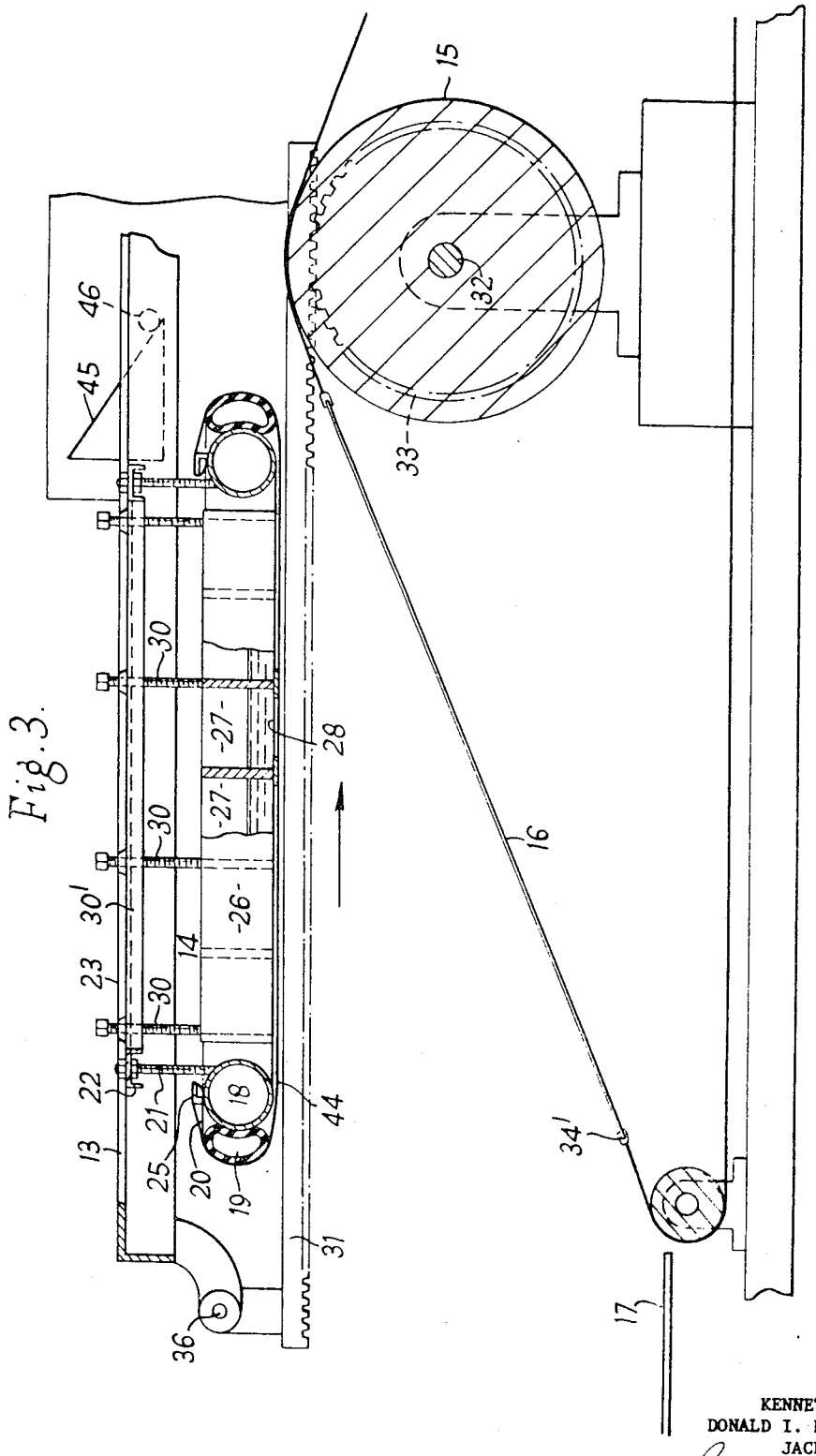



Fig. 3.

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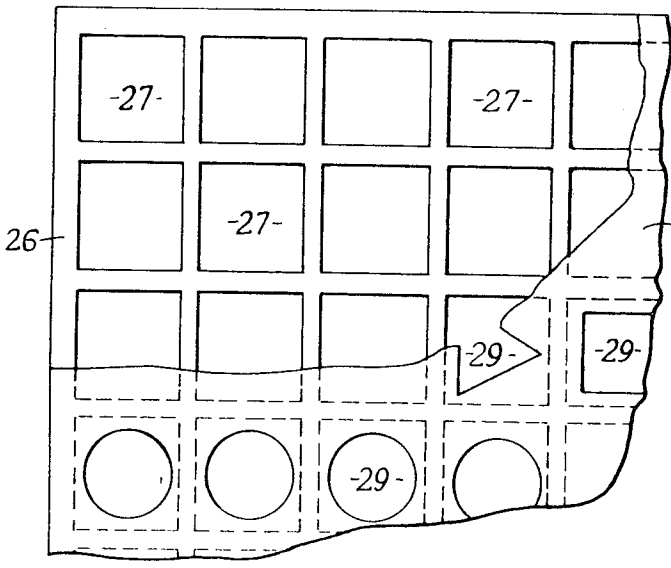



Fig. 4.

Fig. 5.

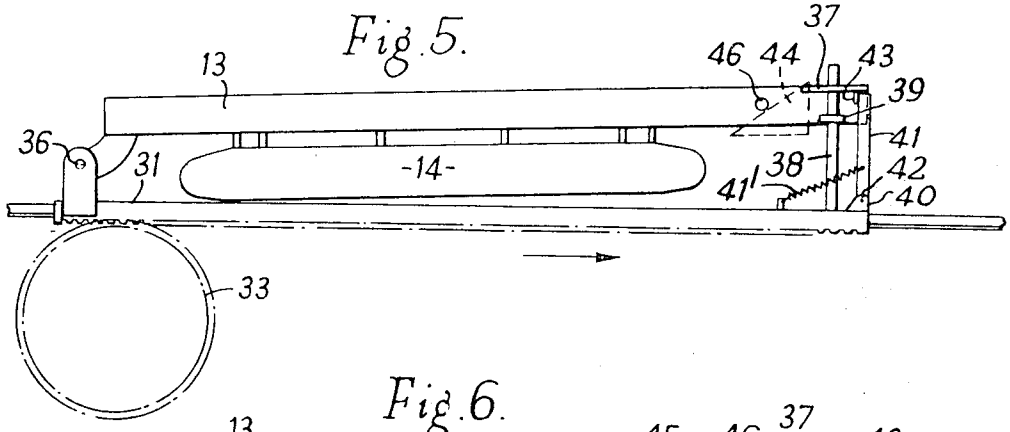
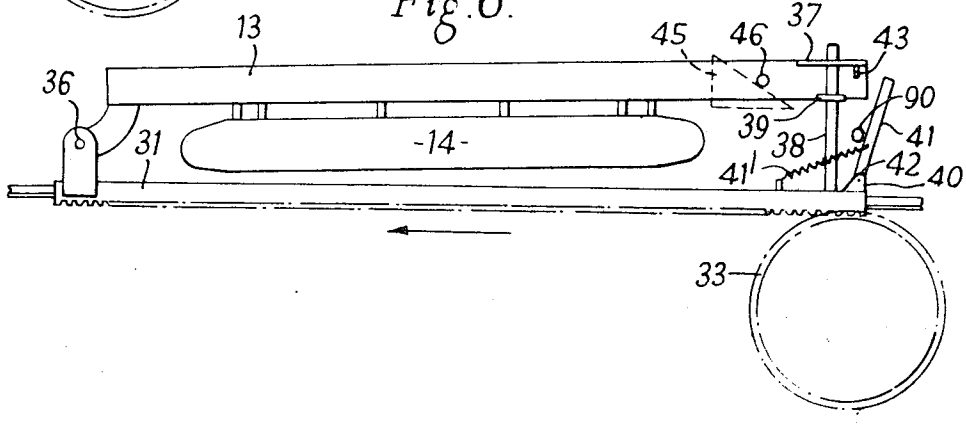



Fig. 6.




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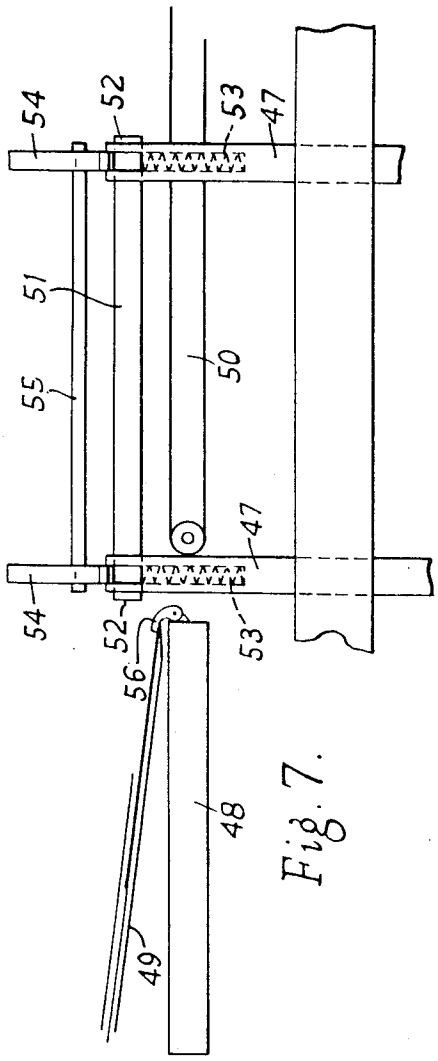



Fig. 7.

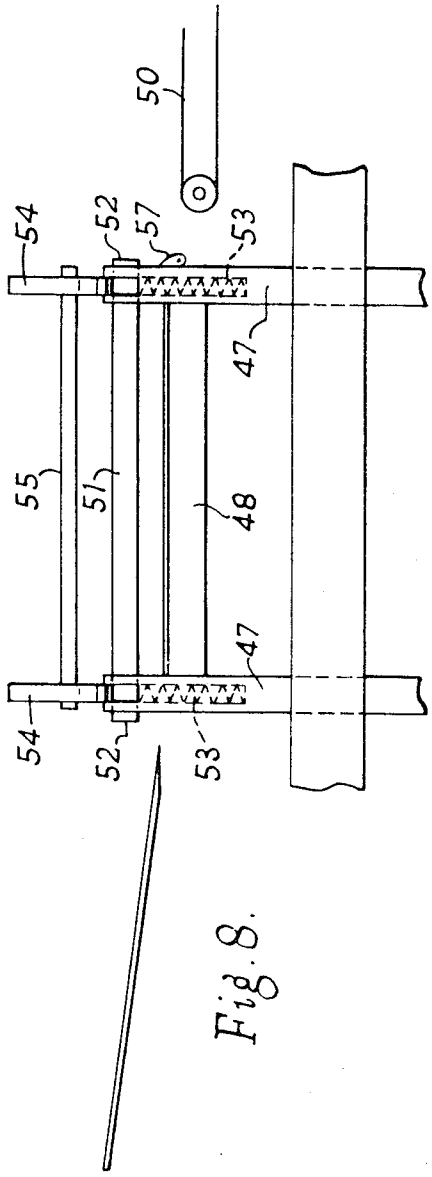



Fig. 8.

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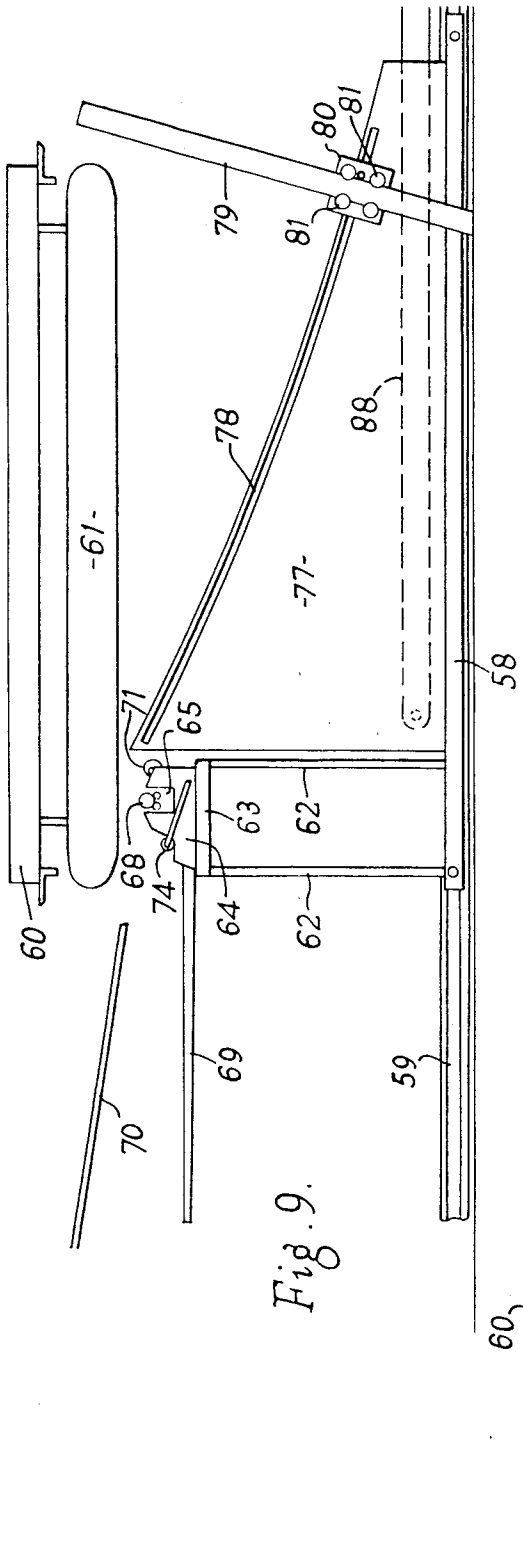



Fig. 9.

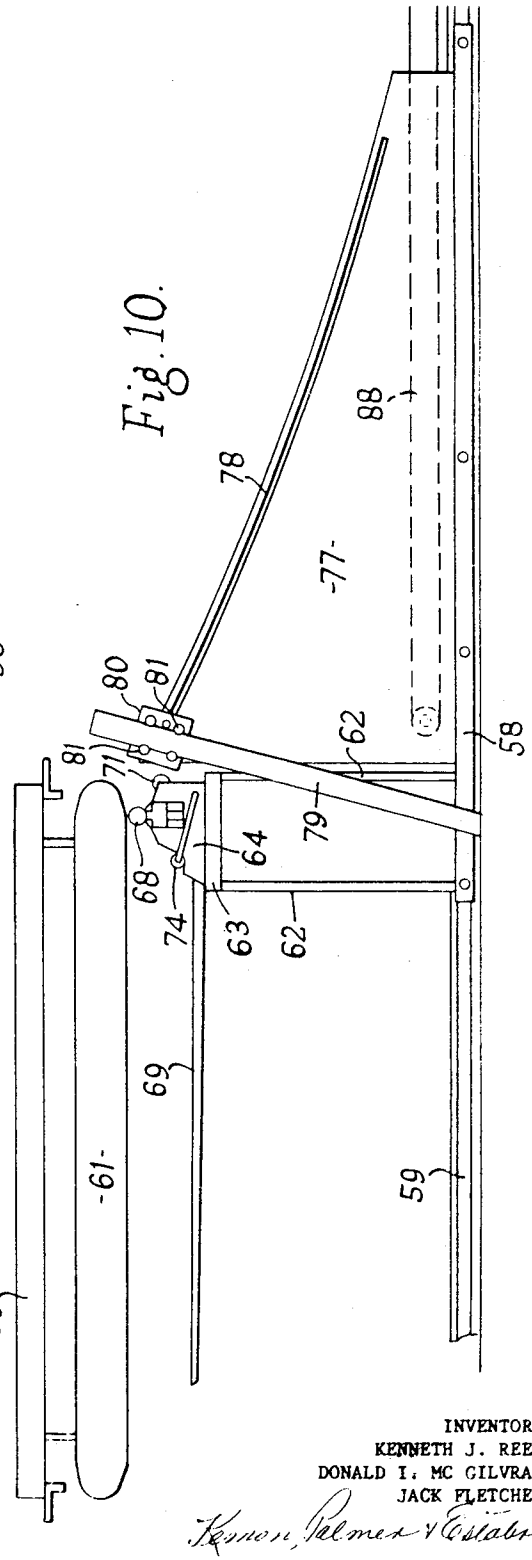



Fig. 10.

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Fig. 11.

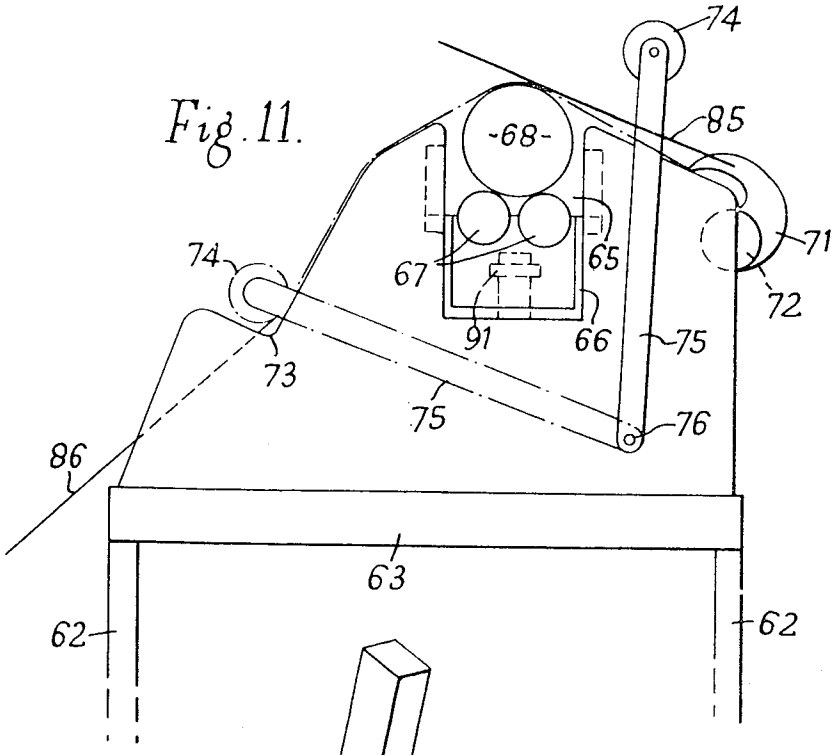
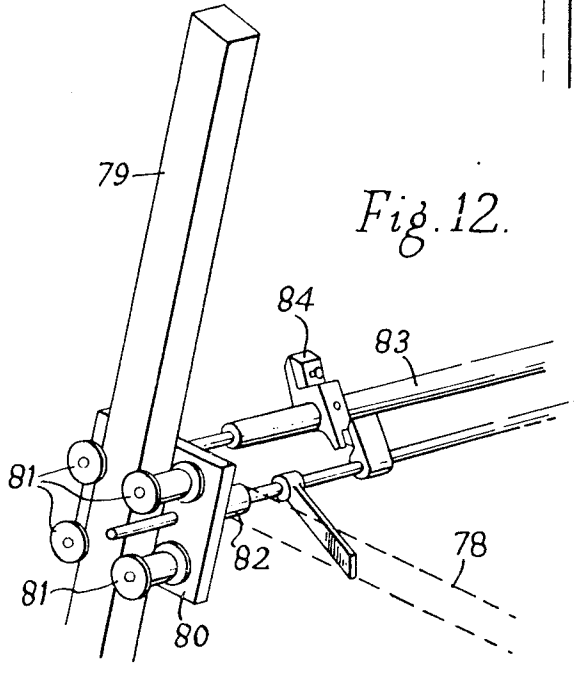



Fig. 12.




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# APPLICATION OF LIQUID COLORS TO PAPER CARD OR OTHER SMOOTH SURFACES

This application is a division of our prior application, Ser. No. 466,862 filed June 24, 1965, now U.S. Pat. No. 3,511,213 dated May 12, 1970.

The present invention relates to a method of applying liquid colors to paper, card and like smooth surfaced materials in accurately defined areas, the invention being of particular utility for example in the production of color cards, that is to say sheets of card and commonly preprinted cards, bearing a number of accurately dimensioned patches of various colors in predetermined accurate spaced relationship to one another and to preinscribed matter which may be present on the cards. Such cards are used in large numbers as guides in the selection of paint.

The apparatus according to the invention comprises a container for liquid color the outlet of which is covered by a mesh screen of a mesh capable of retaining the liquid color in the container, a support for a sheet of paper, card or the like, means for imparting relative movement between the mesh screen and the support to effect contact between a surface of a sheet of paper, card or the like carried on the support and the exterior surface of the mesh screen.

The support for the sheet of paper, card or the like may be a roller arranged for movement so as to effect rolling contact between a surface of the sheet of paper or card carried on the roller and the exterior surface of the mesh screen.

Alternatively the support for the paper sheet, card or the like may take the form of a platen, relative movement being effected between the platen and the mesh screen so as to bring a surface of a sheet, card or the like on the platen first into surface contact with he mesh screen and thereafter to part it from the mesh screen.

Where a plurality of depositions of various different colors is required as in the case of color cards a number of containers for the several colors are provided in fixed position with reference to one another and with coplanar outlets covered by a meshed screen common to all the containers so that separated patches of all the colors may be applied to a sheet of paper or card at a single operation.

Usually a stencil is provided on the inner surface of the meshed screen, the stencil being provided with apertures of a shape, size and location corresponding to the form and location of the color patches required on the paper or card, the stencil and screen being mounted in close surface contact with one another and the stencil in sealed engagement with he walls of the containers.

In the at present preferred arrangement for use in depositing a plurality of deposits of various different colors and making use of a roller to bring a sheet, card or the like into contact with the mesh screen, a mesh screen assembly comprising a plurality of containers for the color liquid, a stencil film or plate and a mesh screen is mounted in a fixed position usually with the screen assembly horizontal and means are provided to feed a sheet or card into a position close to but slightly spaced from the fixed mesh screen and a freely rotating roller utilized to move across the surface of the paper or card in such a manner as to effect what may be termed a "kiss" contact that is to say, contact without or substantially without pressure between the paper or card and the mesh screen, whereby liquid color from within the containers and retained by the mesh screen is transferred to the paper or card, the sheet or card being peeled from the mesh screen in such a manner that unit areas of sheet or card bearing deposited color are parted from the mesh screen immediately or as soon as possible, after the deposition.

The screen assembly and roller are arranged to be movable relative to one another after complete peeling of a sheet or card bearing deposit to permit return of the roller relative to the mesh screen without contact between them, in preparation for a next depositing operation.

A number of forms of machine suitable for carrying out the invention are illustrated by way of example in the accompanying drawings, in which



FIG. 1 is a general view in side elevation of one form of machine according to the invention;

FIG. 2 is a general plan view of the machine of FIG. 1,

FIG. 3 is a view in part sectional elevation on the line III—III of FIG. 2,

FIG. 4 is a part sectional underside plan showing the screen assembly,

FIGS. 5 and 6 are diagrammatic views in side elevation showing various relative positions taken by moving parts of the machine of FIG. 1,

FIGS. 7 and 8 are diagrammatic views in side elevation of an alternative form of machine according to the invention,

FIGS. 9 to 12 illustrate still another form of machine according to the invention,

FIGS. 9 and 10 being diagrammatic views in side elevation showing moving parts in different relative positions,

FIG. 11 is a view on an enlarged scale and elevation of a part of the machine of FIGS. 9 and 10,

FIG. 12 is a perspective view of a detail.

Referring to FIGS. 1 to 6, the machine here shown comprises a supporting structure 11 including guides 12 in which a carriage frame 13 carrying mesh screen assembly indicated by the general reference 14, of a form intended to enable a plurality of separated patches of color to be deposited simultaneously on a sheet, is arranged for guided horizontal reciprocating movement by any convenient driving means (not shown), a support for a sheet intended to receive deposits of liquid color, in the form of a roller 15 and sheet feed means comprising a guided chain conveyor 16 provided with sheet gripping means for feeding sheets singly from a lay table 17 to the roller 15.

The mesh screen assembly comprises a stiff rectangular screen frame 18 formed of metal tubes of circular section surrounded by pneumatic tube 19 of rubber or the like located against the periphery of the tubular screen frame 18 by corner brackets 20.

The screen frame 18 is supported in fixed position by bolts 21 engaged in bars 22 extending between the side members 23 of the carriage frame 13.

Across the underside of the screen frame 18 is stretched a fine mesh screen 24 with its margins extending upwards about the tubes of the frame 18 and enveloping the pneumatic tube 19 and the edge of the screen 24 are retained by wrapping about metal bars 25 fitting within recesses provided on the upper side of the screen frame 18. With the screen 24 so mounted the pneumatic tube 19 can be inflated so that the screen 24 is stretched taut across the underside of the screen frame 18.

Within the screen frame 18 is located a container body 26 for the liquid to be deposited the said body presenting a number of separate compartments 27 in regular or other desired distribution e.g. after the manner of a honeycomb as shown in FIG. 4 the compartments being open at top and bottom.

Against the under surface of the container body 26 is applied a stencil sheet 28 having a number of apertures 29 therein of shapes corresponding to that of the patches of color required to be deposited on a sheet or card, the apertures being located so as to register with the lower ends of individual compartments 27 of the container body 26.

The container body may be formed as a molding or casting in a plastics material of a kind which is unaffected by the color liquid intended to be used and as a particularly suitable material may be mentioned an epoxy-polyamide resin from which a unitary container body 26 can readily be produced by casting on a flat surface having appropriately shaped and distributed mould parts such as wooden blocks mounted thereon.

The stencil may be in the form of an apertured plastic film produced by well known film-producing techniques and again of a material unaffected by the liquid color to be used, and it is applied as shown in FIG. 4, in adhering sealing contact with the underside of the container body 26.

The container body **26** with the stencil sheet **28** attached rests upon the taut mesh screen **24** with close overall surface engagement between the stencil and the mesh screen and the fine mesh screen forms a retaining closure at the outlet ends of the compartments of the container body for liquid.

In the production of color cards, lacquer comprising a pigmented viscous high polymer solution having a viscosity for example in the range 10–15 poise and appropriate flow characteristics and solvent balance has been found particularly suitable and good results have been obtained using a mesh screen woven from nylon thread with about 390 threads per inch and an aperture size of about 0.0012 inch square giving a total free surface of about 21.5 percent, in conjunction with such a lacquer. Such a mesh screen will retain the lacquer to a considerable depth in the compartments of the container body **26** with formation of menisci at the mesh screen.

Screws **30**, adjustable in further bars **30'** connected between the bars **22** on the carriage frame **13** make engagement with their lower ends with the rim of the container body **26** and serve to hold the stencil sheet **28** in engagement with the mesh screen **24** and also permit accurate vertical adjustment of the plane of the mesh screen **24** relative to the screen frame **18**.

The carriage frame **13** carrying the screen assembly frame **18** is connected for movement with a rack bar **31** arranged to make guided horizontal straight line reciprocating movement.

The supporting roller **15** for the sheet intended to receive the deposit is mounted for rotation about a fixed axis **32** with the upper part of its peripheral surface adjacent the plane of movement of the mesh screen when moving towards the roller **15**. On the ends of the roller **15** are mounted pinion wheels **33** of similar diameter to that of the roller for driven engagement by the rack bars so that the roller is driven by the rack bars **31** with a peripheral speed similar to the speed of linear movement of the mesh screen assembly.

Chain conveyors **34** with grippers **34'** of known kind take sheets singly from a lay table **17** to the roller **15** which is also provided with automatically operated grippers **35** of known kind whereby the fed sheet is taken over by the roller.

The carriage frame **13** at the end farthest from the roller **15** is mounted for pivotal movement about a transverse horizontal axis **36** relative to the horizontally guided rack bars **31**.

The other end of the carriage frame **13** is provided with slotted extension pieces **37** the slots in which engage over upstanding posts **38** which are rigid with reference to the rack bar **31** so that the carriage frame at that end may rest under its own weight upon platforms **39** adjustable in height upon the posts **38**.

On a support **40** which is fixed with reference to the rack bar **31** is mounted an upstanding pin **41** capable of rocking about a transverse axis **42**, said pin **41** being biassed by a spring **41'** into engagement with the extension piece **37** on the carriage frame **13** and capable of movement into a position beneath said extension piece **37** and into engagement with a stop **43** in a raised position of the adjacent end of the carriage frame **13** and its extension piece **37**.

Wedge-shaped elements **44** and **45** are provided in fixed positions for engagement with a roller **46** extending transversely from the carriage-frame **18** to control movements of the carriage frame **18** and the parts carried thereby about the horizontal end pivot axis **36** in a manner permitting the carriage to occupy a lowered position during its movement with the rack bar **31** in one direction and a raised position during its movement with the rack bar in the other direction.

The operation of the above-described machine is as follows:

Liquid color is loaded into the compartments **27** of the container body **26** to an appropriate depth e.g., ⅛ to 3/16 of an inch in the case of lacquer the liquid being retained in the compartments by the fine mesh screen **24**, menisci of the liquid being formed at the undersurface of the mesh screen within bounded areas corresponding to the apertures **29** in the stencil plate.

Sheets to receive the deposit are taken in single succession from the lay board **17** by the chain conveyor **34** to the roller **15** and are taken up by the grippers **35** on the roller. The grippers may be of known kind and they are operated automatically in timed sequence in a manner and by devices well known in the art of printing.

At the commencement of a depositing operation the carriage frame **18** and the mesh screen assembly **14** carried thereby occupy a position as shown in FIG. **6** in which it is tilted upwards through a small angle to the horizontal through engagement of the roller **46** with the upper inclined surface of the fixed wedge member **45**, the pivoted pin **41** however being displaced from beneath the extension **37** on the carriage frame **13** by engagement with a fixed stop **90** (FIGS. **1** and **6**).

The rack bar **31** is now moved by any convenient driving means (not shown) so that the roller **15** with a sheet affixed thereto is rotated, in the clockwise direction in the drawings, and the carriage frame **13** moved horizontally. During the early part of this movement the roller **46** on the carriage frame **13** moves down the fixed wedge member **45**, FIG. **6** so that the carriage frame moves downwards about its pivot **36** until the extension piece **37** rests upon the adjusted platform **39** on the post **38** so that the surface of the mesh screen **24** is now located and moves in the required horizontal path, determined with great accuracy by means of the adjusting screws **30** applied against the edges of the container body, and such that rolling engagement is made between the sheet on the roller **15** and the surface of the mesh screen without or substantially without pressure, the engagement being an approximate line contact and such that the menisci of liquid color at the screen are broken to effect the color transfer to the sheet. The sheet is led downwards by virtue of its being gripped by the roller grippers **35** so that it is parted from the mash screen with a peeling action immediately or very soon after receiving the liquid color. As the sheet leaves the mesh screen the liquid color menisci reform at the surface of the screen.

As the carriage frame **13** approaches the end of its movement in this direction the roller **46** meets and rides up the other fixed wedge **44** so that it is again tilted upwards about the pivot **36**, and it is held in this tilted position by engagement of the pivoted and spring-biased pin **41** beneath the extension piece. Thus, during return movement of the rack bar **31** and the carriage frame **13** the upwardly tilted condition of the latter is maintained and no contact can take place between the mesh screen and the roller.

At the end of the return stroke as indicated in FIG. **6**, the roller **46** reengages with the first-mentioned wedge **45**, so that the machine is set for commencement of the next succeeding deposition operation.

FIGS. **7** and **8** illustrate a further form of machine suitable for use in carrying out the invention.

The machine here shown comprises a supporting body structure including four fixed vertical columns **47** disposed at the corners of a rectangle, a stiff bedplate or platen **48** arranged for horizontal reciprocation in a fixed plane between a position external of the body structure and beneath a lay board **49** as shown in FIG. **7**, and a position within the body structure as shown in FIG. **8** and a moving conveyor **50** movable in unison with the platen **48** between a position within the body structure as shown in FIG. **7** and a position outside the body structure at the side thereof remote from the lay board **49** as shown in FIG. **8**.

At the upper end of the body structure is mounted a carriage frame **51** having corner extensions **52** engaged and guided in vertical slots formed in the upper ends of the columns **47**.

The extensions **52** rest upon compression springs **53** contained in bores in the upper ends of the columns **47** and they are engaged on their upper sides by cams **54** adapted to move the carriage frame **51** downwards to a predetermined extent, return movement being effected by the springs **53**.

The cams **54** are carried by cam shafts **55** mounted in vertically adjustable bearings (not shown) to enable the extent of

downwards movement imparted to the carriage frame **51** by the cams to be determined with accuracy.

Within the carriage frame is fixedly mounted a frame and mesh screen assembly comprising container body, stencil plate and a fine mesh screen similar to that described above with reference to the machine of FIGS. **1** to **6**.

In operation, with liquid color retained in the container by the mesh screen and the carriage frame **51** in its raised position as shown and the platen **48** beneath the lay board **47** as shown in FIG. **7**, a sheet is taken on to the platen **48** by automatically operated gripping devices **56** of conventional form provided on the platen. The platen **48** together with the sheet is now moved to the position within the body structure as shown in FIG. **8**, the conveyor **50** at the same time being moved from the position within the body shown in FIG. **7** to the position outside the body structure shown in FIG. **8**.

The cam shafts **55** and the cams **54** are now rotated and the carriage frame **51** thereby lowered to an extent effecting contact without or substantially without pressure between the mesh screen and the sheet the engagement being such that the menisci of color at the underside of the screen are broken and color applied to the sheet.

Further rotation of the cams **54** permits the carrying frame to rise under the lift of the springs **53** to disengage the mesh screen from the sheet and the menisci reform at the underside of the screen in readiness for a succeeding operation.

Meantime the grip of the gripper devices **56** of the platen **48** upon the sheet which has received the deposit is released and the sheet gripped by gripping devices **57** on the body structure. The platen **48** is now returned to the position beneath the lay board **49** (FIG. **7**) in readiness to receive the next sheet and the conveyor **50** moved into position beneath the sheet bearing the deposit and retained in the body structure by the grippers **57**. Thereafter the grip of the grippers **57** is released and upon execution of the next cycle of operations the sheet bearing deposited color is removed from within the body structure.

Conveniently, the conveyor **50** may be provided with driven endless belts in well-known manner adapted to effect transfer of a sheet thereon from the conveyor **50** to a drying zone.

The at present preferred construction of machine for carrying out the invention is illustrated in FIGS. **9** to **12**.

The machine here shown comprises a flat bed plate **58** arranged for horizontal reciprocating movement in guides **59**, beneath a fixed frame **60** supporting in fixed position a mesh screen assembly **61** of the form similar to that previously described.

On the flat bed plate **58** are mounted fixed posts **62** supporting a platform **63** extending transversely across the machine and beneath the mesh screen assembly **61**.

Upon the platform **63** is mounted a pair of upstanding parallel end plated **64** (FIG. **11**) having slots **65** therein forming guides for bearing members **66** for the ends of a pair of parallel and freely rotating rollers **67** supporting a third freely rotating roller **68** carried in the valley between the pair of rollers **67**.

The bearing members **66** are capable of up and down movement in the slots **65** between a lowered position as shown in FIG. **11** and a raised position determined by an adjustable stop **91**.

From the platform **63** extends a table **69** for the reception of sheets intended to receive deposit, said table in one extreme position of the bed plate **58** extending beneath a sheet lay table **70** as shown in FIG. **9**.

The end plates **64** on the platform **63** are of a general convex contour at the upper edges and the roller **68** in its raised position projects above the upper parts of the end plates.

Sheet grippers **71** are provided on a cross-shaft **72** mounted at the side of end plates **64** away from the sheet table **69** (FIG. **11**) and at a level at all times below that of the upper part of the surface of the roller **68**.

The end plates **64** at the sides away from the grippers **71** are provided with notches **73** also at a level at all times below that of the upper part of the surface of the roller **68**, for the reception of a cross bar **74** mounted between arms **75** pivotally connected with the end plates at **76** so that the cross bar **74** may be rocked between a position in the notches **73** as shown in dotted lines in FIG. **11** and a position above the level of the upper part of the surface of the roller **68** and above the grippers **71** as shown in full lines in FIG. **11**.

Up and down movements of the roller bearing members **66**, opening and closing of the grippers **71** and rocking of the cross bar **74** are effected automatically in timed sequence by means (not shown) provided on the machine.

On the sliding bed plate **58** at the side of the platform **63** away from the sheet table **69** are fixedly mounted a pair of plates **77** one at each side of the machine, said plates being furnished with cam slots **78** of a profile inclined downwards from the platform **63**, as shown in FIGS. **9** and **10**.

At the end of the machine away from the lay table **70** are mounted a pair of parallel guide bars **79** in fixed positions inclined at a small angle to the vertical and these bars **79** form guides for cam followers **80** (FIG. **12**) each provided on one side with antifriction rollers **81** for cooperative engagement with a guide bar **19** and on the other side with a roller **82** for cooperation with a cam slot **78**.

Between the cam followers **80** extends a rod **83** carrying automatically actuated sheet grippers **84**.

The cam slots **78** effect downward and upward movement of the cam followers **80**.

The operation in this case is as follows:

With liquid colors contained to appropriate depth (with lacquers approximately ⅛ to 3/16 of an inch) in the containers of the container body of the mesh screen assembly **61** and retained therein by the mesh screen, menisci will be present at the underface of the screen of the fixed assembly **61**.

With the bed plate **58** in a position in which the sheet plate **69** extends below the lay table **70** and the platform **63** is close to the edge of the lay table i.e., a position further to the left of that shown in FIG. **9**, the roller-bearing members **66** and the rollers **67** and **68** are in the down position in the slots **65** in the end plates **64** on the platform **63** and the cross bar **74** is held in its raised position i.e., the full line position in FIG. **11**. In this position the edge of a sheet on the lay table **70** extends over the roller **68** and under the cross bar **74** approximately as shown at **85** in FIG. **11** and the grippers **71** on the cross-shaft **72** are operated to grip the loading edge of the sheet.

The bed plate **58** is now moved in the direction away from the lay table **70** and as movement begins the cross bar **74** is moved downwards towards the notches **73** in the end plates **64** on the platform **63** so that the sheet is drawn down in a manner wrapping it closely over the still depressed roller **68** as shown in dotted lines at **86** in FIG. **11**. Movement of the bed plate **58** in this direction continues until its other extreme position i.e., that shown in FIG. **10** is reached, the trailing portion of the sheet resting on to the sheet table **69** and the cam followers **82** being caused by the cam slots **73** to rise to the upper ends of the guide bars **79** to the position shown in FIG. **10** in which position the sheet grippers **84** on the cross-shaft **83** between the cam followers **80** are opposite and slightly below the upper part of the surface of the roller **68**.

Throughout the movement of the bed plate **58** in this direction the roller **68** remains lowered so that no contact takes place between the moved sheet and the mesh screen of the fixed assembly **61**.

The sheet grippers **71** on the platform **63** are now opened and the grippers **84** on the cross-shaft **83** between the cam followers **80** closed to take a grip on the leading edge of the sheet.

The bed plate **58** and parts carried thereby are now moved in the reverse direction i.e., to the left from the position of FIG. **10** and the roller-bearing members **66** caused to rise into the position against the stop **91** so that the sheet is lifted by the roller **68** to an extend to bring the part of the sheet over the roller **68** into a position for engagement with the menisci of color at the underside of the mesh screen but without or sub-

stantially without pressure against the screen itself so that during this movement of the bed plate color is transferred to the sheet over areas corresponding to apertures in the stencil plate behind the screen.

During movement of the bed plate in this direction the cam followers **80** are caused by the cam slots **78** in the plates **77** moving with the bed plate to move downwards along the guide bars **79** so that the sheet, held by the grippers **84** between the cam followers moves continuously beneath the cross bar **74** retained in the notches **73** on the travelling platform **63** thence upwards over the roller **68** also on the travelling platform and finally downwards by virtue of the grip of the downwardly moving grippers **84**.

The contact between the sheet and underside of the mesh screen assembly **61** is a line contact and acquisition of a unit line of color by the sheet is followed immediately by peeling or parting of that unit line from the mesh screen assembly.

With movement of the roller **68** past the end of the sheet the grippers **84** between the cam followers now in their lowered position are opened and the sheet bearing the deposit patches is freed e.g., to fall upon a receiving moving conveyor such as **88** (FIG. **9** and **10**) mounted in the bed of the machine.

In practice, in a machine of the kind illustrated in FIGS. **9** to **12** a metal roller **68** of about ½ inch in diameter has been found to produce satisfactory results.

The contact between the paper sheet or card and the mesh screen is in all cases arranged to take place without or substantially without the application of liquid-transferring pressure upon the mesh screen, as contrasted with conventional screen printing methods in which force is applied to cause liquid to pass through the screen by what may be described as extrusion, on to the receiving surface.

The utilization of a fine mesh screen of the kind, and in the manner, described, in addition to preventing flow of the liquid from the containers by gravity, enables patches of color to be deposited with desirably straight or near straight edges as viewed by the naked eye as contrasted with edges of saw tooth form obtained with a screen of coarser mesh.

Given an appropriate solvent balance in the lacquer which may readily be determined and adjusted by trial, the wet area of lacquer when first received on the sheet or card is substantially free of flow pattern and the colored area after drying will exhibit the desirable perfectly plain smooth surface.

It is desirable to maintain the depth of liquid in the containers within limits for which purpose replenishment is effected at intervals from suitable sources, for example, by the use of motoring pumps arranged for automatic operation to deliver a fixed quantity of liquid after execution of a predetermined number of depositing cycles by the machine.

In some cases the containers may be closed at their lower ends and the stencil plate and fine mesh screen located at the upper face of the containers and the sheet or card being applied over the assembly and in such case the containers may be connected through U-tubes with suitably located reservoirs to maintain the surface of the liquid in the containers in contact with the mesh screen.

What is claimed is:

**1**. A method of applying patches of liquid color in accurately defined areas on smooth flexible sheet material, said method comprising the steps of:

charging said liquid color into a container having downwardly directed outlets shaped to correspond with the required patches and covered by a mesh screen which prevents flow of said liquid from the containers by gravity while permitting formation of menisci at the lower surface of said screen;

presenting a surface of said sheet to the exterior of said mesh screen substantially without pressure against said screen;

causing said surface to contact said liquid menisci and to break said menisci with resultant transfer of liquid from said menisci to said surface;

and withdrawing said surface from the exterior of said mesh screen substantially without relative movement between said surface and said screen in the plane of said screen, to reform said menisci at the lower surface of said screen and leave said transferred liquid on the surface of said sheet.

**2**. The method of claim **1** in which said sheet is presented to the exterior of said mesh screen in such a manner as to make substantially line contact with said menisci and said line of contact is advanced progressively across said sheet and screen.

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