Sept. 21, 1965 T. L. LECKIE 3,207,068

STENCIL PRINTING APPARATUS

Original Filed July 13, 1960 9 Sheets-Sheet 1

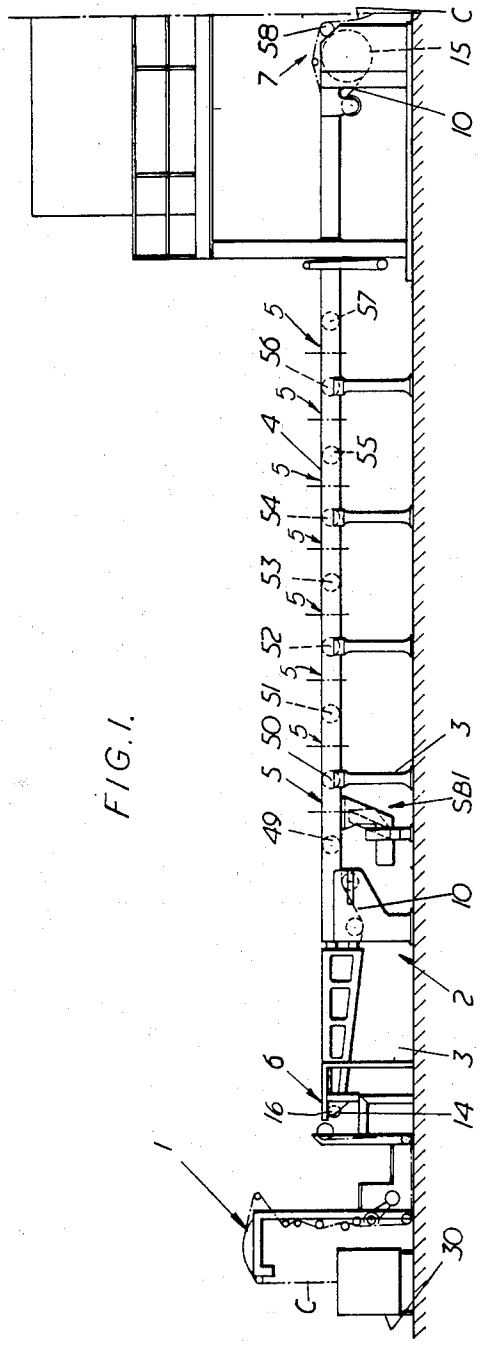


FIG. 1.

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STENCIL PRINTING APPARATUS

Original Filed July 13, 1960 9 Sheets-Sheet 2

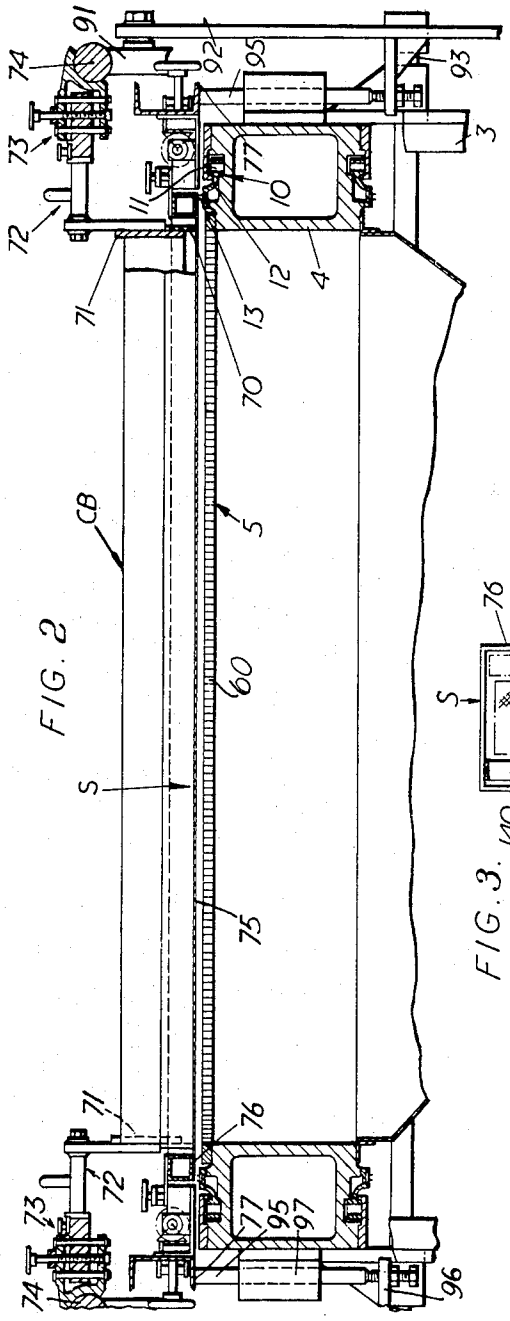


FIG. 2

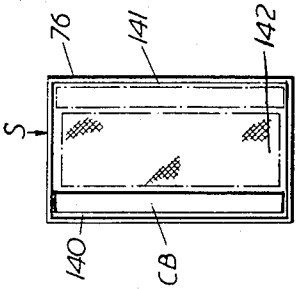


FIG. 3.

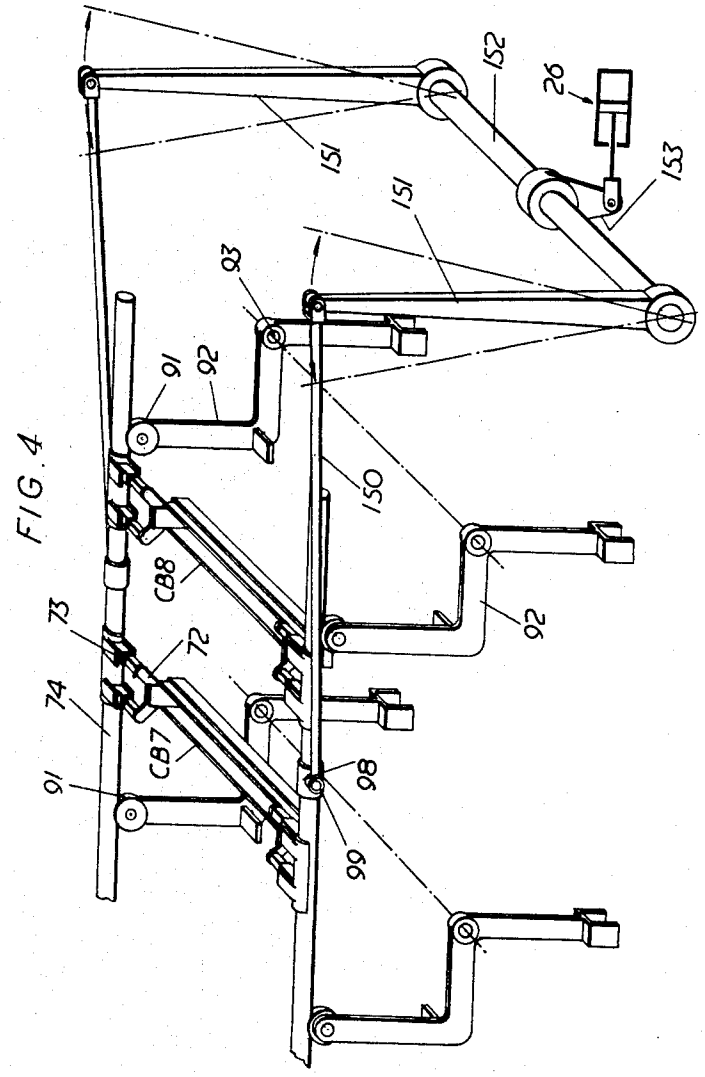
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STENCIL PRINTING APPARATUS

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FIG. 4



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STENCIL PRINTING APPARATUS

Original Filed July 13, 1960 9 Sheets-Sheet 4

FIG. 5

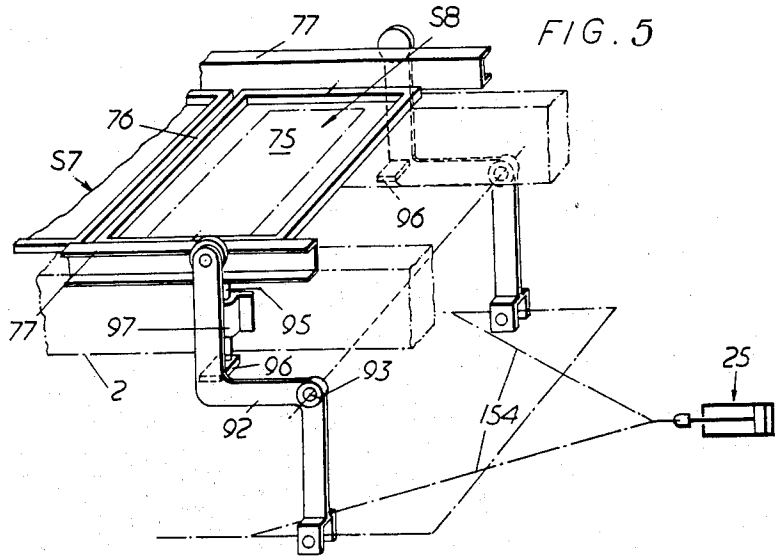
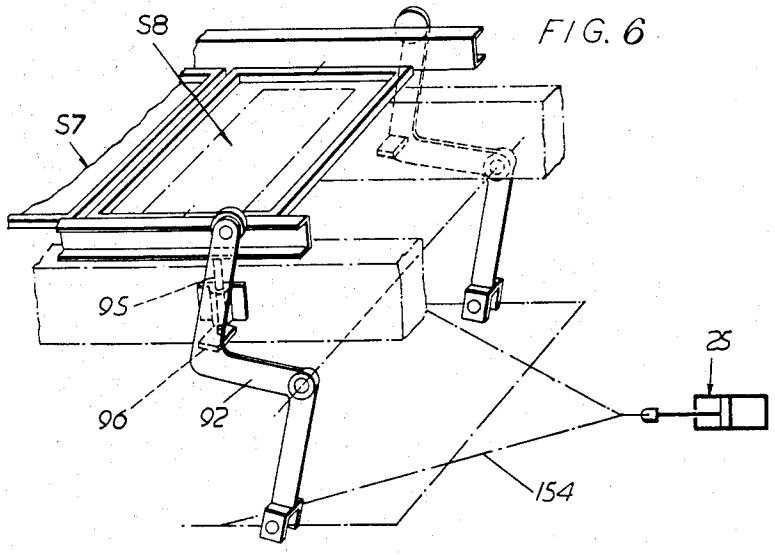


FIG. 6



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STENCIL PRINTING APPARATUS

Original Filed July 13, 1960 9 Sheets-Sheet 5

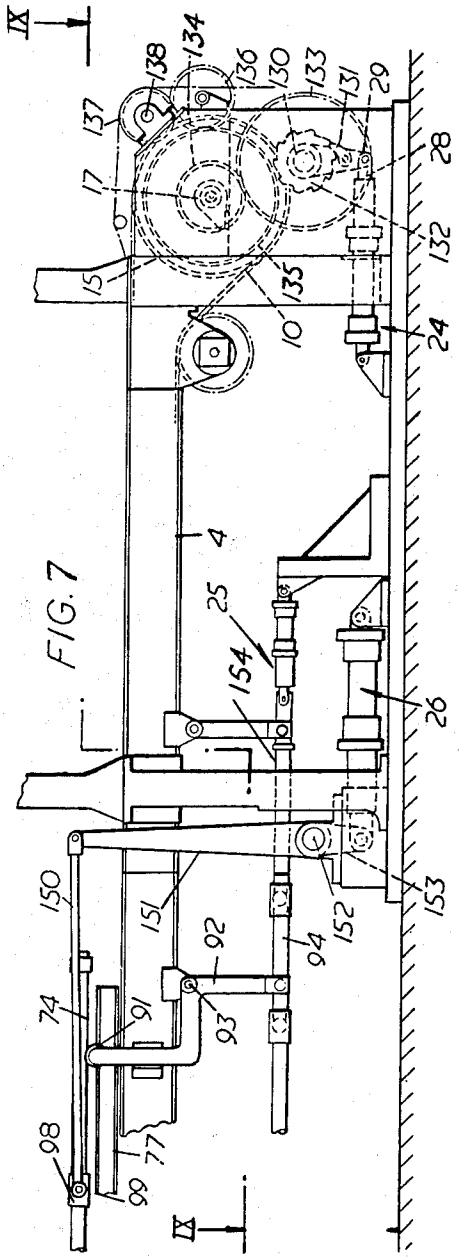


FIG. 7

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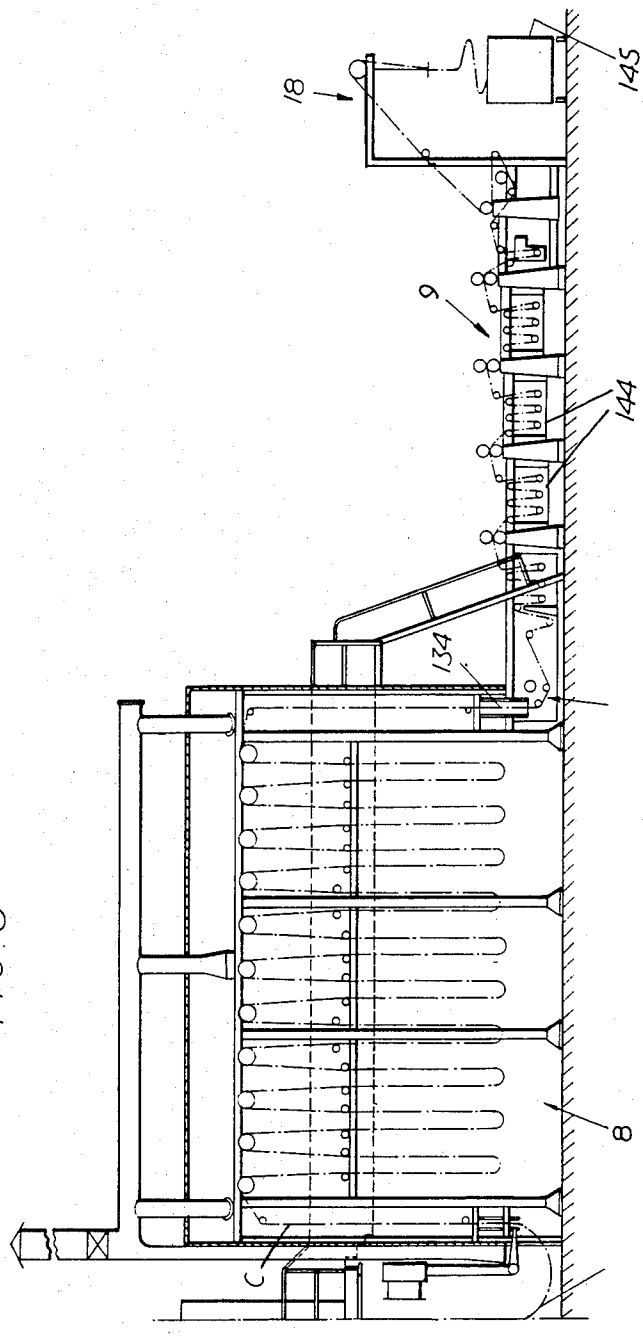


FIG. 8

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STENCIL PRINTING APPARATUS

Original Filed July 13, 1960 9 Sheets-Sheet 7

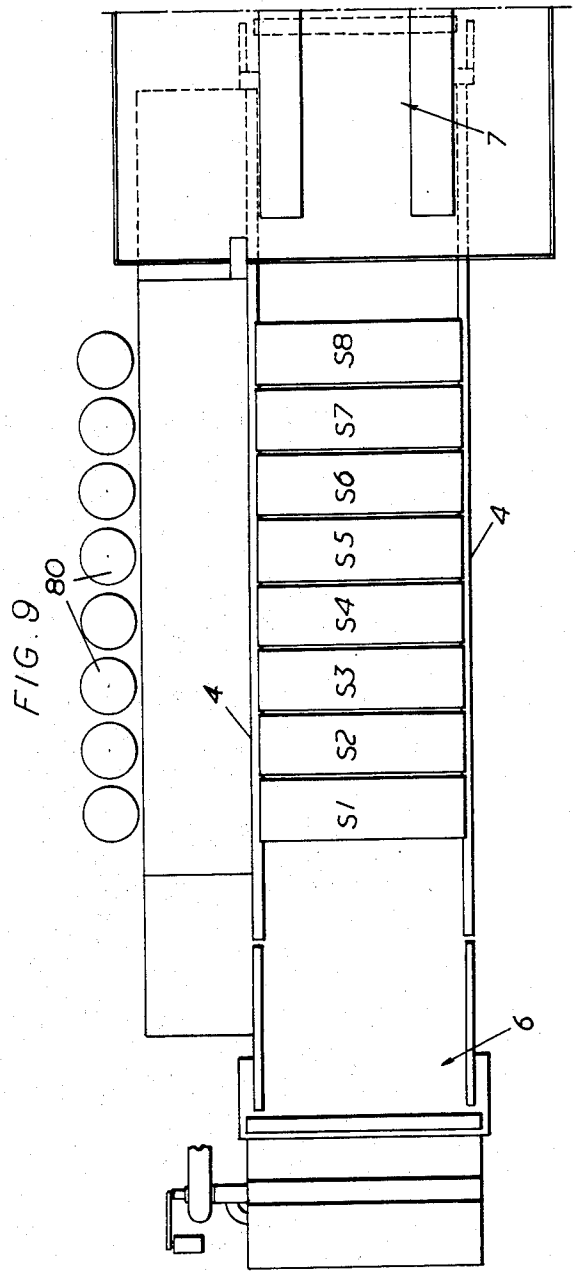


FIG. 9

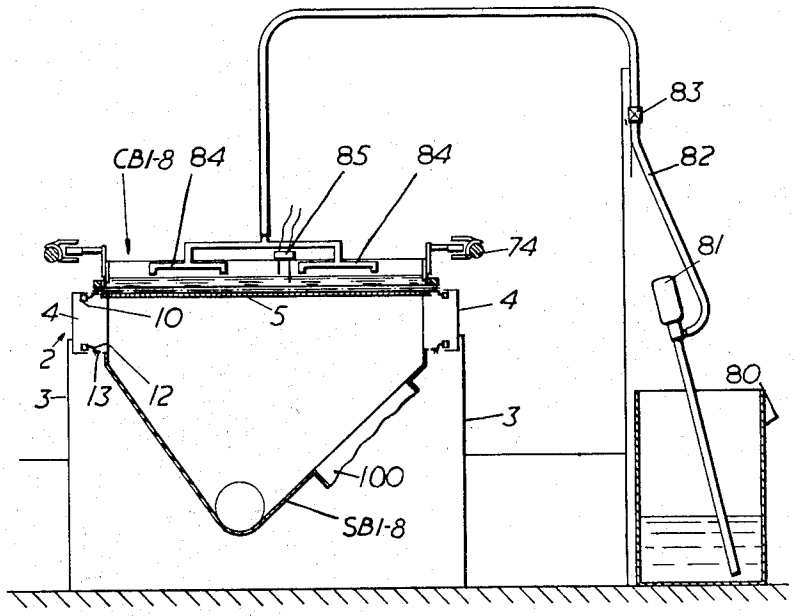
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STENCIL PRINTING APPARATUS

Original Filed July 13, 1960 9 Sheets-Sheet 8

FIG. 10.



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FIG. 11.

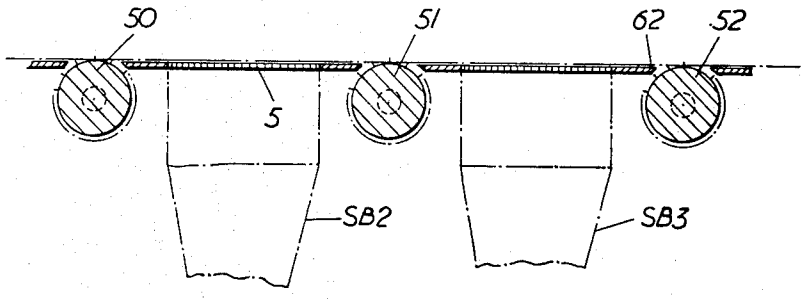


FIG. 12.

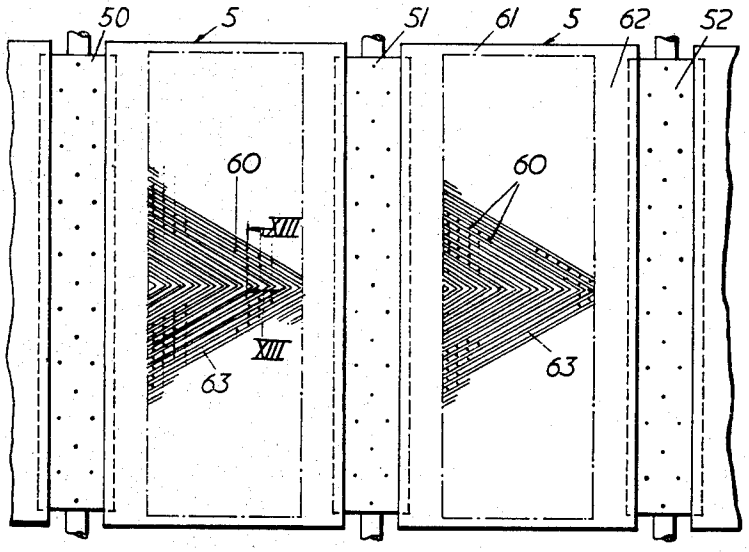
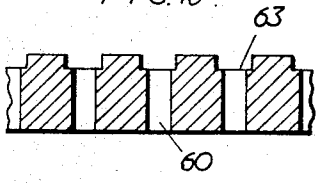


FIG. 13.



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United States Patent Office 3,207,068 Patented Sept. 21, 1965

3,207,068

STENCIL PRINTING APPARATUS

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Original application July 13, 1960, Ser. No. 42,655, now Patent No. 3,129,442, dated Apr. 21, 1964. Divided and this application Oct. 11, 1962, Ser. No. 234,571
4 Claims. (Cl. 101—123)

This application is a division of application Serial No. 42,655 which was filed July 13, 1960, and is now U.S. Patent No. 3,129,442.

This invention comprises a process and machine for the printing of thick fabric in continuous lengths. By thick fabrics I mean fabrics of thickness greater than 1 mm., such as tufted carpets or other pile fabrics (whether the pile is composed of fibres introduced into a fabric base or of yarn pulled out from a woven fabric as in a moquette), or felts, bonded fibre structures or non-woven structures. The invention is particularly applicable to, and will be described with reference to, pile carpets, but it is not limited to these.

Pile carpets, because of their weight and size and the depth of the pile, present printing problems entirely different from those of the printing of ordinary textile materials. In consequence pile carpets have hitherto been made with the use of yarns of different colours, a process which has various drawbacks. It would clearly be advantageous to make the carpet from grey, i.e. natural coloured, yarn and to print it to any desired pattern in a continuous process such that the carpet as delivered from the factory entered a machine and need not be touched by hand until it emerged as a finished printed product. I have produced what I believe to be the first process and machine by which this can be done.

My invention involves the technique of stencil printing, which of course involves movement of the carpet in stepwise fashion through one or more printing stations; this fact introduces some of the problems that arise.

By stencil printing I mean printing through a stencil, whether that stencil is an imperforate sheet with free openings in it or is a screen with numerous meshes. As is well known, a pattern is formed by closing some of the meshes in the screen and leaving the remainder open to constitute stencil openings. All the meshes in a screen may be left open if a fabric to be printed should be of uniform colour throughout. The present invention is particularly useful in, and will be described by reference to, screen printing, but stencils with free openings may be used.

The invention includes numerous novel features as such and also a series of steps employed in sequence as a continuous process. These various features and steps will now be described with reference to the accompanying drawings, which show the preferred machine and in which:

FIGURE 1 is a diagrammatic side elevation of the entry end of the machine;

FIGURE 2 is a section through the upper part only of the machine;

FIGURE 3 is a diagram to show the movement of a colour box over a screen;

FIGURE 4 is a perspective view of two colour boxes and mechanism for moving them; and

FIGURES 5 and 6 are perspective views of a screen and lifting mechanism in two different positions;

FIG. 7 is a diagrammatic side elevation view of the delivery end of the printing part of the machine;

FIG. 8 is a continuation of FIG. 1 showing the delivery end of the machine;

FIG. 9 is a diagrammatic plan view corresponding to FIG. 1;

FIG. 10 is an enlarged diagrammatic cross-section through the printing part of the machine;

FIG. 11 is a diagrammatic side elevation illustrating the engagement of the carpet by pinned rollers;

FIG. 12 is a plan view corresponding to FIG. 11; and

FIG. 13 is an enlarged section on the line XIII—XIII in FIG. 12.

The machine shown is designed for printing pile carpets and comprises a brushing frame **1**, two main side frames **2** each composed essentially of uprights **3** and horizontal members **4** spaced apart from one another by a distance greater than the maximum width of carpet to be printed, an entry station **6** to the printing part of the machine, eight perforated carpet supports **5** spanning the side frames **2** and providing eight printing stations, a take-off station **7**, a steaming vessel **8**, a washing apparatus **9** and a withdrawal and lapping mechnism **18**. The printing stations are defined by rectangular screens, S1–S8, mounted to move vertically, and above each screen there is a colour box, these boxes being numbered CB1–CB8.

At each side there is an endless conveyor consisting of a stenter chain **10** including links **11** with side flanges **12** having upwardly projecting pins **13** which engage the selvedges of the carpet. The chains **10** pass round sprockets, of which end sprockets **14** and **15** and carried by shafts **16** and **17**, and the shaft **17** is intermittently driven. Whenever the shaft **17** turns the carpet is positively driven by the engagement of the pins **13** with the selvedges.

The driving mechanism may take any suitable form. All that is required is that the carpet should be moved in exact steps and halted with accuracy; that while the carpet is moving the screen and colour boxes should be stationary and raised above the carpet; and that when the carpet is stationary each colour box should move across the corresponding screen.

The ram **24** drives the shaft **17**. A stem **28** projecting from the ram cylinder is pivotally connected to an arm **29** that is freely mounted on a shaft **130** and that carries a pawl **131**. This pawl engages a ratchet wheel **132** which is fixed to the shaft and at each ram stroke this wheel is turned through one tooth. The shaft **130** carries a gear wheel **133** which meshes with a gear wheel **134** rigid with the shaft **17**. This driving gear is provided in duplicate, one part on each side of the ram **24**.

In travelling beneath each screen S the carpet slides over the corresponding support **5**, which is a metal table in which many holes **60** are made to allow suction to be applied to the underside of the carpet through the corresponding suction box SB, there being as many suction boxes (SB1–SB8) as there are screens. The top of each suction box is constituted by a perforated part of the support **5**, this part lying within imperforate side edges **61** and end edges **62**, the latter bounding the slots in which the rollers **49** to **57** turn. The holes **60** forming the perforations are arranged in rows with the mouths of all the holes of a row lying in a channel **63** and thus communicating with one another. It is found to be advantageous to make these slots form a herring-bone pattern as shown in FIG. 13. If all the slots run parallel to the warp there is a tendency for the printing to be uneven in tramline fashion. If they all run parallel to the weft there is undesirable resistance to the movement of the carpet. If they are all inclined in the same direction they tend to push the carpet in that direction, but if they are arranged in herring-bone pattern the carpet is kept central.

An important feature of the invention is the use of a free-flowing colouring matter as the printing liquid. In the screen-printing of textile fabrics it is common to use a fairly thick liquid which flows slowly over a horizontal surface and which is forced over the screen by squeegees.

The pile of a carpet is usually at least 3/8" deep, and may be as deep as 3/4". If the colouring matter is of the usual consistency, it will not penetrate the pile deeply.

The viscosity of printing pastes or colouring matter may be measured by the Redwood method described in "Standard Methods for Testing Petroleum and its Products" issued by the Institute of Petroleum, on page 665 of the 16th edition, dated February 1957. Pastes used in conventional engraved roller printing operations are very thick and may have a Redwood No. 1 viscosity figure at 75° F. of from 20,000 seconds to 100,000 seconds. The free-flowing colouring matter used in this invention is much more fluid and in general has a Redwood No. 1 viscosity not exceeding 3000 seconds at a temperature of 75° F. Suitable colouring matters have been found to have viscosities varying between 25 and 1821 seconds. Colouring matters which have a Redwood No. 1 viscosity in excess of 3000 at 75° F. may be used if desired by heating them to a temperature such that their Redwood viscosity is reduced to below about 3000 seconds.

In screen printing as practised hitherto the colouring matter is commonly forced over the screen and through the openings in it by a squeegee which moves across the stencil. No great difficulty arises so long as the colouring matter is a fairly viscous paste. When, however, pile fabrics and particularly pile carpets are to be printed, I have found it necessary to use the free-flowing colouring liquid (of viscosity little greater than that of water) described above, and this introduces entirely new problems. There is difficulty in holding the colouring liquid in the container, particularly when printing is not taking place and the screen is being lifted to allow the carpet to move forward in step-by-step fashion.

In the present process and machine the colouring matter is supplied to each screen S from a colour box CB. Each colour box is of narrow rectangular shape in plan, extends completely across the screen from one side to the other and in width is only a small fraction of the length of the screen. Its narrow end walls are formed by plates **71** carried by arms **72** which are adjustable in height through devices **73** themselves secured to lifting rails **74**. Each screen consists of gauze **75** stretched across the underside of a metal frame **76**, and along the side edges the meshes in the gauze are closed. Along the end edges the meshes are also closed over an area at each end large enough to receive the complete colour box. During the printing operation the colour box is moved from one end edge to the other while the screen is stationary, and it is of course necessary to allow the colouring matter to flow freely through the openings in the screen as the box moves but to prevent it from escaping at the end of each printing stroke.

Each colour box has a flexible lower edge formed by rubber strips **70** which make a seal with the imperforate parts of the surface of the screen S, this edge being kept in contact with the screen during the whole of each printing operation and with the imperforate surface at the end of the screen at the end of each printing operation. When the container is in contact with an imperforate end of the screen the colouring liquid is confined within it by the seal.

FIGURE 3 shows a colour box CB on a screen S. The box is shown in full lines over an imperforate part **140** of the screen and in dotted lines in the position it takes up over another imperforate part **141** at the end of a stroke after traversing the part **142** containing the open meshes.

The wider the colour box, the more difficult it is to make the necessary seal and the greater the width of the imperforate surface required at each end of the screen, with resultant increase in the distance between printing stations. A very narrow colour box, on the other hand, involves slow operation of the machine. A very suitable width of colour box is 4 inches.

The colouring matter required for each colour box CB is supplied to that box from a container **80** by a pump **81** through a pipe **82** containing a manually adjusted valve **83** to distributors **84**. An electrical probe **85** responsive to the liquid level is provided in each box and is electrically connected to cotrol the operation of the pump **81**.

Naturally when the screen is lifted to allow the material to move through one step the colour box must be lifted too. It is found in practice that there is some tendency for a screen to sag when lifted, with the result that the seal between it and the flexible edge **70** ceases to be tight. To avoid the risk of colouring matter escaping through this cause between the screen and box the former is moved through a slightly gearter distance than the latter. The pressure between the screen and the flexible edge in the raised position is therefore greater than in the printing position, and the risk of liquid seeping through the seal is practically eliminated. If this same high pressure were exerted during the printing, the resistance of the flexible edge to movement over the screen would be so high as to make the movement difficult.

In the machine shown all the screens S are carried by rails **77** one at each side. The screen rails must be able to rise to allow the fabric to move, and the rails **74** must not only be able to rise but also must be mounted to reciprocate to carry the colour box over the screen. To enable differential lifting movement to take place, the colour box rails **74** are supported by rollers **91** carried by cranked levers **92** pivoted at **93** and all rigid at their lower ends with operating bars **94**, one at each side. The two operating bars **94** are reciprocated horizontally through inclined rods **154** by the ram **25** when the colour boxes are to be raised, and they rock the levers **92** from the position shown in FIGURES 4 and 5 to that shown in FIGURE 6.

The screen rails **77** are supported by vertical rods **95** which are raised by cam action when the levers **92** rock to lift the rails **74**. The cams are plates **96** rigid with the levers **92** and bearing on the undersides of the rods **95**, which are themselves guided in fixed open-ended sockets **97**.

When each lever **92** is rocked, the cam plate **96** rises through a distance determined by the length of the middle arm of the lever and the angle of rocking. The roller **91**, being carried at the end of the upper arm, moves upwards through a distance that is the difference between the upward movement of the plate **96** (at the junction of the two arms) and the downward movement of the upper end of the upper arm that results from the movement of that end in a circular path. Therefore the screen is moved further than, and pressed more firmly against, the colour box.

In order to reciprocate each colour box over the screen beneath it, the rails **74** are caused to slide over the rollers **91**. Each is engaged by a sleeve **98** which forms a housing for a pivot pin **99** that enters one end of a connecting rod **150**. The other end of this rod is pivotally connected to a crank **151** on a cross-shaft **152**. This shaft can be rocked through a crank **153** by the ram **26** shown in FIG. 7 and diagrammatically in FIG. 4, the movement of the ram being cam-controlled so that each colour box makes one stroke each time the carpet is halted for printing. The lifting movement of the rail **74** described above is permitted by rocking of the connecting rod **150** with simultaneous slight longitudinal movement of the rail **74**.

I claim:

1. A machine for stencil-printing a thick fabric comprising a horizontal perforated support, a stencil having a plurality of openings in its central part and with imperforate ends above the support, means for intermittently moving a fabric over the support and below the stencil, a bottomless container for colouring matter having a flexible lower edge means for lowering the stencil and the bottomless color container whereby the stencil and container are in constant pressure contact during the lower-

ing and whereby the stencil is placed into printing position, means for traversing the container over the stencil from one imperforate end to the other whereby colouring matter can pass through the stencil openings during the traversing but is retained in the container when it is at each end, separate lifting means for the stencil and for the container and mechanism operative to cause the first of these means to lift the stencil to a greater distance than the container is lifted by the second of these means whereby a pressure is maintained between the stencil and the flexible edge to give a sealing effect to said edge.

2. A machine according to claim **1** in which the flexible lower edge is constituted by flexible rubber around the bottom of the container.

3. A machine according to claim **1** including a pair of side rails carrying the stencil, a pair of side rails carrying the container, means for raising the stencil rails, means for raising and reciprocating the container rails and mechanism by which both pairs of rails can be raised simultaneously with the stencil rails rising through a greater distance than the container rails to maintain a pressure between the stencil and the flexible edge of the container to give a sealing effect to said edge.

4. A machine according to claim **3** including a pair of pivoted levers which are rocked to lift both pairs of rails, each lever carrying a roller on which a container-carrying rail is supported, and also a cam plate which bears on the underside of a vertical rod which engages a stencil-carrying rail.

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