May 25, 1965 H. D. SHORT ETAL 3,185,084

DYEING OF PILE FABRICS

Filed Oct. 19, 1962 3 Sheets-Sheet 1

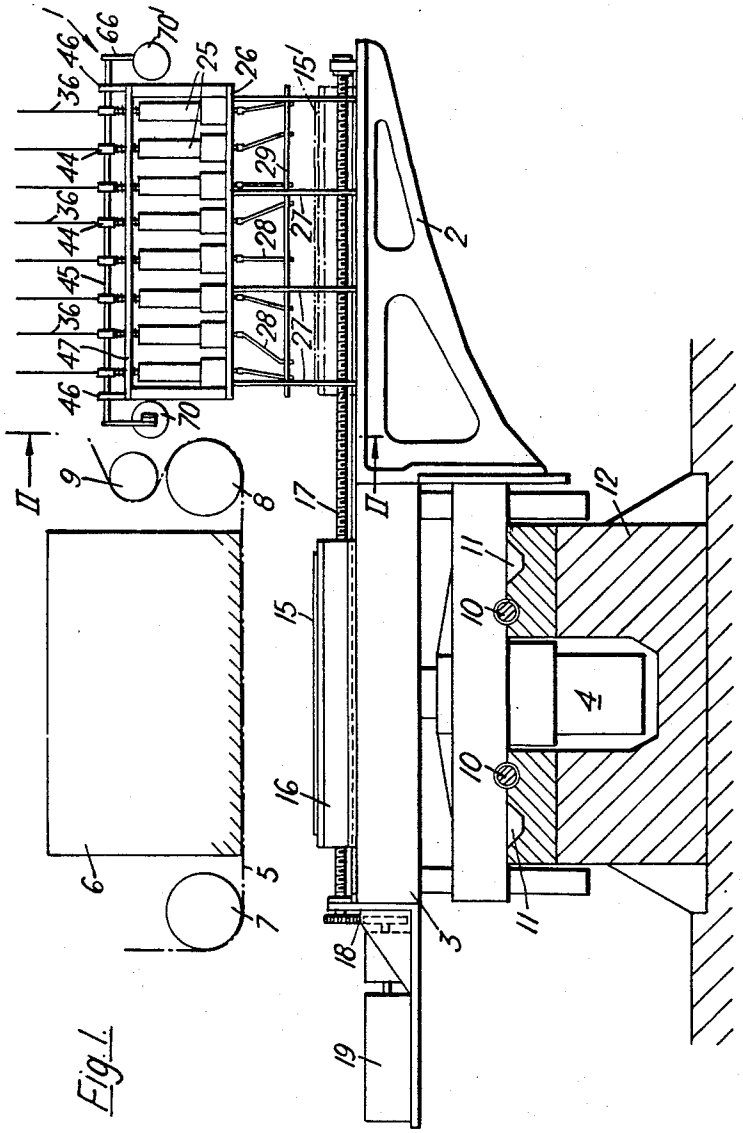


Fig. 1.

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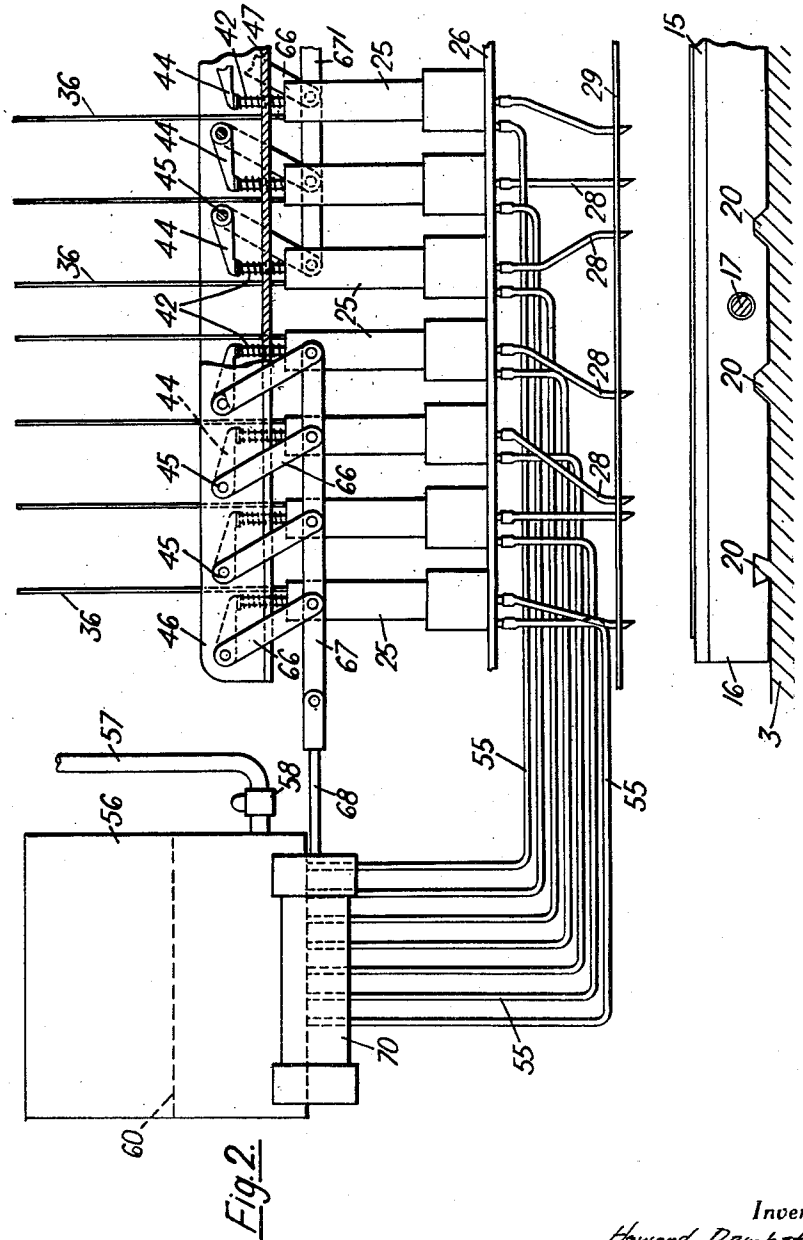


Fig. 2.

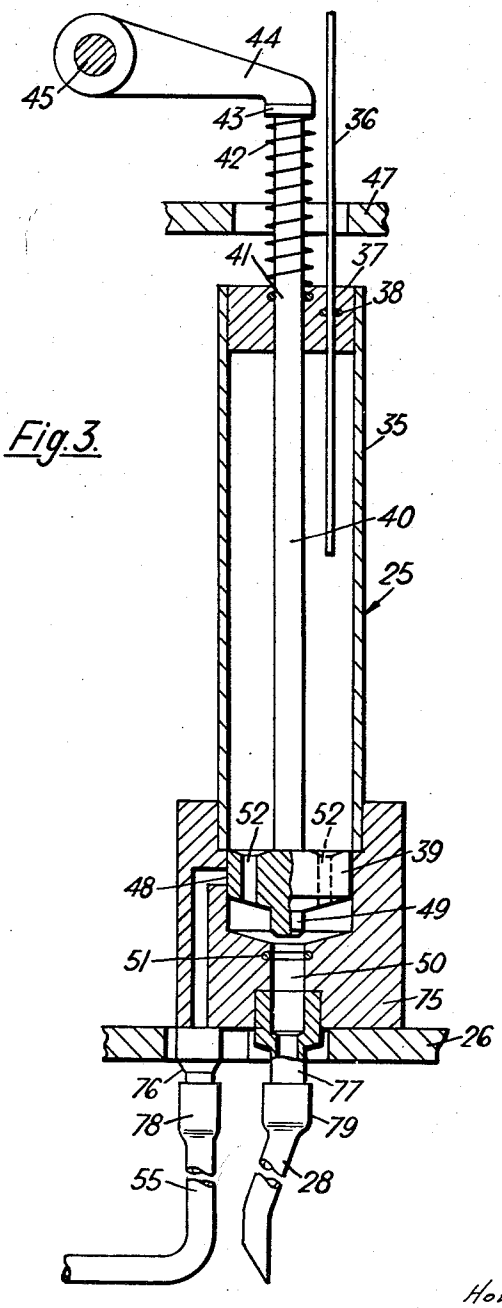
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DYEING OF PILE FABRICS

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Fig. 3.



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United States Patent Office 3,185,084 Patented May 25, 1965

3,185,084

DYEING OF PILE FABRICS

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Filed Oct. 19, 1962, Ser. No. 231,776
Claims priority, application Great Britain, Oct. 25, 1961, 38,240/61
7 Claims. (Cl. 101—115)

This invention relates to the dyeing of pile fabric particularly carpet and is concerned with the application of coloured designs as set out in U.S. Patents Nos. 2,816,811 and 2,984,540.

These specifications describe the use of a printing form comprising a number of flat receptacles separated by thin upstanding walls which define the designs or pattern to be applied to the carpet. Colouring agent is supplied to each receptacle and the pile of the carpet is then caused to enter the receptacles, the absorption of the colouring agent being assisted by the compression of the pile as described in the second specification.

According to the present invention colouring agent is supplied to the receptacles from above by means in pipes, each leading from a separate metering device connected to a source of the respective colouring agent. Each receptacle is filled by means of one or more such pipes according to its area and this with the appropriate adjustment of the metering devices enables each receptacle to be supplied with a volume of colouring agent proportional to its area. By filling the receptacles from above in this way the need for openings in the bottoms of the receptacles is avoided thus simplifying the construction of the printing form. Before the carpet or other pile fabric may be brought into engagement with the printing form the filling pipes must, of course, be removed from immediately above the form. Preferably this is achieved by moving the form laterally until it is clear of the filling pipes after which the fabric may be pressed into contact with the form.

Thus apparatus for carrying out the method in accordance with the invention includes an assembly of downwardly directed pipes mounted above a support for the form and in order to produce the necessary lateral movement of the form a horizontally reciprocating slide is arranged beneath this assembly of pipes. Once the form has been charged with colouring agent it is moved away from the filling pipes and is then pressed into engagement with the pile fabric which is arranged above it. Most simply the fabric itself is stationary during this step and the form is raised into engagement with it by mounting the apparatus as a whole on a vertically movable table. Consequently when the form is in position beneath the fabric the table carrying the form, the reciprocating slide and the arrangement of filling pipes is raised in a vertical direction to press the form against the fabric which is backed by a stationary platen.

As mentioned originally each filling pipe has its own metering device and since a relatively large number of such pipes is required, for example, 500 in an area of one square yard it is necessary that the metering devices should be small and simple. For this purpose each metering device may comprise a piston valve having a body which is closed except for an upwardly extending capillary tube and movement of the piston in one direction allows colouring agent to flow under gravity from a reservoir into the body of the valve until it reaches a level which is pre-set by the position of the bottom of the capillary tube while movement in the other direction discharges the colouring agent into the respective receptacle of the printing form. A group of piston valves may then be operated

simultaneously by common mechanism. Such a construction provides a very simple but nevertheless effective form of metering device since the quantity of colouring agent is determined solely by the position of the bottom of the capillary tube. As mentioned above the body of the valve is otherwise completely closed and as soon as the liquid level rises to the bottom of the tube entry of air through the tube is cut off and thereafter the only additional liquid to flow from the reservoir is that necessary to raise the level in the capillary tube to that of the liquid in the reservoir. For practical purposes the volume of liquid held by the capillary tube may be ignored so that the effective volume of colouring agent is held by the valve body is limited by the position of the bottom of the tube. By adjusting the level of the bottom of the tube so the quantity of colouring agent may be adjusted.

A construction of apparatus in accordance with the invention will now be described with reference to the accompanying drawings in which:

FIGURE 1 is an elevational view of the apparatus as a whole;

FIG. 2 is a fragmetary view in vertical section taken on line II—II of FIG. 1 with the portion of the apparatus illustrated being drawn to a slightly larger scale than FIG. 1; and

FIG. 3 is a vertical section view illustrating one of the metering devices employed in the apparatus illustrated in FIGS. 1 and 2, but being drawn to a larger scale than FIGS. 1 and 2.

The apparatus shown in FIGURE 1 corresponds largely to that of FIGURE 10 of the copending application No. 193,669 filed May 8, 1962 except in the filling arrangements for the printing form. In the construction of the earlier application the printing form is filled from below and the arrangements for this are not illustrated in detail. According to the present invention the printing form is filled from above by means of a filling arrangement indicated generally as **1** which is supported by a bracket **2** from a table **3** capable of movement in a vertical direction under the control of a hydraulic ram **4**. Generally speaking, the present invention may be utilized in conjunction with the application of dyes or colouring agents to a pile fabric as described in detail in the copending application just mentioned and for present purposes it is sufficient to say that the carpet or other pile fabric to be dyed **5** is led beneath a stationary platen and is passed around rollers **7**, **8** and **9**. The table **3** is arranged to be traversed across the width of the carpet by means of lead screws **10**, moving on guides **11** on a base **12**. As the table **3** is moved in both a horizontal and a vertical direction so the complete filling apparatus **1** is moved with it.

The printing form **15** is supported on a horizontally reciprocating slide **16** which is driven by means of a lead screw **17** turned by gearing **18** from an electric motor **19**. The slide **16** is guided on the table **3** by means of guides **20** seen in FIGURE 2.

In operation the receptacles of the printing form **15** are filled by means of the apparatus **1** while the form is occupying the position shown in dotted lines as **15'**. As soon as the receptacles are full the slide **16** is moved to the left into the position shown in full lines and as soon as this position is reached the table **3** is raised under the control of the ram **4** to press the form **15** against the underside of the carpet **5** which is arranged with its tufts downwardly. The table **3** is then lowered, the slide **16** returned to the filling position and the process repeated for successive areas of the carpet as described in the earlier application. The apparatus **1** for filling the receptacles of the printing form constitutes the main subject matter of the present invention and will now be described in more detail.

The apparatus comprises a number of metering de-

vices in the form of piston valves **25**. As mentioned previously a considerable number of such devices is required, for example, 500 over an area of one yard square. For simplicity only a smaller number of such device is illustrated in the drawings which show eight rows of eight devices, i.e. a total of sixty four such devices. These are all supported on a plate **26** carried by legs **27** extending upwardly from the bracket **2**. Each metering device **25** has a filling pipe **28**, the lower end of which is located by means of a perforated plate **29** supported between the legs **27**. The pipes **28** are flexible and by the provision of numerous perforations in the plate **29** the discharge points of the pipes **28** can be adjusted as required to suit the design of the receptacles of the form **15**. In other words the filling apparatus may be adapted to suit any variation of printing form with a minimum of trouble and without the need to alter the position of the metering devices **25** themselves in any way. Depending on the area of each receptacle so it may require to be filled from two, three or more of the metering devices but there is no difficulty in adjusting the filling pipes **28** in a corresponding manner. All that is necessary is to adjust the metering devices themselves so that the total quantity of colouring agent which is metered corresponds to the area of the receptacle in question.

In order to permit the ready adjustment of each metering device it is constructed as shown in more detail in FIGURE 3. Each device comprises a cylindrical body **35** which is completely closed except for a capillary tube **36** which is slidably mounted in an upper closure **37**, being fitted with a small sealing ring **38** to prevent any leakage. The valve has a piston **39** operated by a piston rod **40** which is fitted with a sealing ring **41** and which is biased upwardly by a compression spring **42** acting between the closure **37** and an enlarged end piece **43** on the end of the rod **40**. The rod is moved downwardly against the effect of the spring **42** by means of a tappet **44** mounted on a rod **45** turning between a pair of flanges **46** extending upwardly from a plate **47**.

The inlet to the valve is through the side of the body at **48** and in the uppermost position of the piston the inlet is closed as shown in FIGURE 3. The piston **39** has a downwardly extending spigot **49** which seals the outlet from the valve **50** which is fitted with a sealing ring **51** cooperating with the spigot **49**. In addition the piston **39** is formed with a pair of axial passages **52**. When the piston **39** is in its lowest position the upper edge of the piston lies just below the lower edge of the inlet **48** so that the latter is unobstructed and colouring agent is able to flow into the body of the valve through a pipe **55**. As best seen from FIGURE 2 each pipe **55** leads to a reservoir **56** for the colouring agent which in its turn is supplied by way of a pipe **57** through a constant lever valve **58**. As many reservoirs **56** are fitted as there are colours in the design which is to be applied to the tufted fabric. Only one such reservoir is shown in FIGURE 2 but successive reservoirs may be mounted behind that shown in the drawing and for simplicity all of these are omitted from FIGURE 1.

Consequently when the piston **39** is in its lowest position colouring agent is able to flow from the reservoir **56** and into the valve body **35**, the displaced air passing upwardly along the capillary tube **36**. When the level of colouring agent reaches the bottom of the capillary tube the air above this level is trapped and as a consequence the liquid level in the body of the valve does not rise by any appreciable amount. A very small quantity of additional colouring agent therefore flows into the valve body until the capillary tube **36** is filled to a level corresponding to the level **60** of liquid in the reservoir **56**. For all practical purposes this additional quantity of colouring agent which flows into the capillary tube can be ignored and the overall result is that the valve is supplied with a quantity of coluring agent which is determined by the level of the bottom of the capillary tube. By adjusting the capillary tube **36** in a vertical direction so the quantity of colouring agent can be varied correspondingly.

As soon as all the metering devices **25** are filled the apparatus as a whole is ready to discharge metered quantities of colouring agent to the printing form **15**. This is achieved under control of the tappets **44** which allow the springs **42** to raise the piston **39** to the position shown in FIGURE 3. As the piston **39** rises the inlet **48** is progressively closed but owing to the length of the spigot **49** the outlet **50** is not opened until the closing of the inlet is complete. At that stage the charge of colouring agent held in the body of the valve flows downwardly through the passages **52**, through the outlet **50** and then down the pipe **28** into the respective receptacle on the printing form.

As can be seen from FIGURE 1 each rod **45** extends across the width of the filling apparatus between the flanges **46** and consequenlty controls the tappets **44** for a complete row of metering devices **25**. As seen from FIGURE 2 each rod **45** is connected by a crank arm **66** to an operating link **67** which in its turn is connected to the rod **68** of a pneumatic cylinder **70**. The rods **45** are divided into two groups, that on the right side of FIGURE 2 being controlled by a link shown as **67'** operated by a pneumatic cylinder **70'** seen in FIGURE 1. The two pneumatic cylinders **70** and **70'** are operated independently of one another and by operating only one cylinder only one group of metering devices is operated to fill a corresponding proportion of the printing form. If the printing form is constructed with a wall dividing it into two equal halves it thus becomes possible to fill only one half of the form and thus to dye half a repeat of the pattern on the fabric. As previously described the form is normally one yard square permitting the dyeing of carpets having widths which are multiples of one yard but by filling only half the form as just described carpets of intermediate widths such as 7½ or 10½ feet can be dyed equally easily.

Returning to the details of the metering devices as shown in FIGURE 3 it will be seen that each has a solid base portion **75** secured to the plate **26** and within which is formed the outlet **50** and also the inlet **48**. The latter after passing through the side of the body of the valve then extends vertically downwardly to its connection with the pipe **55**. The respective joints are formed between male portions **76** and **77** extending downwardly from the part **75** through openings in the support plate **26**. These male portions fit into enlarged end pieces **78** and **79** respectively of the pipes **55** and **28** to form readily releasable connections and thus to facilitate assembly of the apparatus as a whole.

We claim:

1. In an apparatus for dyeing pile fabric wherein a length of pile fabric with the pile facing downwardly is supported above a printing form having an upwardly facing printing surface and a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the combination which comprises:

(*a*) a support positioned beneath said length of pile fabric;

(*b*) a slide movably mounted on said frame and carrying a printing form having upwardly facing open receptacles thereon;

(*c*) said slide and the printing form being movable on the support in a horizontal plane from a first position beneath the length of pile fabric to be dyed to a second position where the printing form is removed from beneath the fabric and the open receptacles thereon are in a position to be filled from above with measured quantities of coloring agents,

(*d*) a plurality of metering devices corresponding in number to the number of receptacles on the printing form positioned above the printing form at said second position of the form,

(e) each of said metering devices being connected to a source of a coloring agent, and

(f) conduit means leading from each of the metering devices to a point immediately above one of the open receptacles on the printing form.

2. In an apparatus for dyeing pile fabric wherein a length of pile fabric is supported with the pile facing downwardly above a printing form having an upwardly facing printing surface and a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the combination as defined in claim 1 whrein:

(a) each of the metering devices is individually adjustable for delivery of a measured quantity of the coloring agent therefrom proportioned to the area of the receptacle to be filled therefrom.

3. In an apparatus for dyeing pile fabric wherein a length of pile fabric is supported with the pile facing downwardly above a printing form having an upwardly facing printing surface and a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the combination as defined in claim 1 wherein:

(a) the conduit means leading from each of the receptacles comprises a flexible pipe having an end which is movable to different positions relative to the printing form.

4. In an apparatus for dyeing pile fabric wherein a length of pile fabric is supported with the pile facing downwardly above a printing form having an upwardly facing printing surface and a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the combination as defined in claim 1 which includes

(a) means for selectively operating the metering devices in delivery of measured quantities of the coloring agents therefrom to selected groups of the receptacles on the printing form.

5. In an apparatus for dyeing pile fabric wherein a length of pile fabric is supported with the pile facing downwardly above a printing form having an upwardly facing printing surface and a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the combination as defined in claim 1 which includes:

(a) means for selectively operating the metering devices in delivery of measured quantities of the coloring agents therefrom to selected groups of the receptacles on the printing form, and

(b) means for adjustably positioning the conduit means relative to the printing form at said second position thereof.

6. In an apparatus for dyeing pile fabric wherein a length of pile fabric is supported with the pile facing downwardly above a printing form having an upwardly facing printing surface with a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the combination as defined in claim 1 wherein:

(a) each of the metering devices comprises an upright cylinder having an inlet and an outlet at a lower end thereof and a closed upper end,

(b) a piston movable mounted in said cylinder and being movable between an inlet opening and outlet blocking position and an inlet blocking and outlet opening position,

(c) a capillary tube extending through said closed upper end of the cylinder and being adjustable lengthwise relative to the cylinder.

7. In an apparatus for dyeing pile fabric wherein a length of pile fabric is supported with the pile facing downwardly above a printing form having an upwardly facing printing surface and a plurality of open receptacles for containing coloring agents formed thereon by thin upstanding walls defining a design to be applied to the fabric, the improvement which comprises:

(a) a support located beneath said length of pile fabric,

(b) a slide movably mounted on said support and carrying the printing form;

(c) said slide with the printing form carried thereon being movable on the support between a first position beneath the length of pile fabric to be dyed and a second position where the printing form is removed from beneath the fabric and the open receptacles thereon are in a position to be filled with measured quantities of coloring agents,

(d) a plurality of metering devices corresponding in number to the number of receptacles on the printing form supported above the printing form at said second position of the form,

(e) each of said metering devices being individually adjustable and being connected to a source of a coloring agent,

(f) conduit means leading from each of the metering devices to a point immediately above one of the open receptacles on the printing form at said second position thereof, and

(g) means for moving the printing form into and out of printing engagement with the fabric at said first mentioned position of the form.

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