Jan. 4, 1966 W. G. FARRER ETAL 3,227,077

METHOD OF AND MEANS FOR PATTERNING A PILE FABRIC

Filed May 7, 1963 2 Sheets-Sheet 1

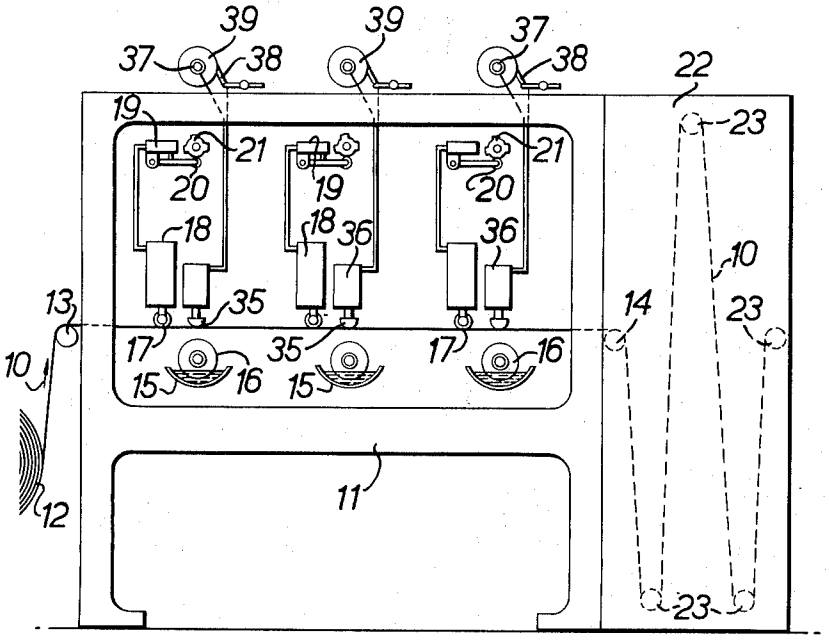


FIG. 1a.

FIG. 1b.

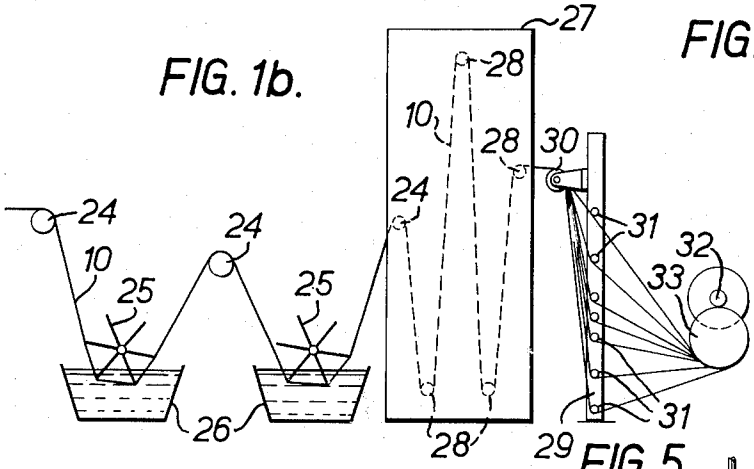


FIG. 5.

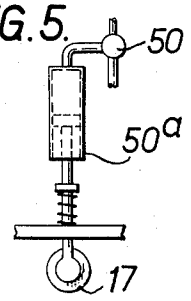


FIG. 4.

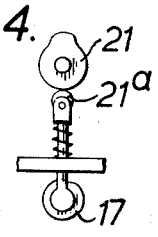
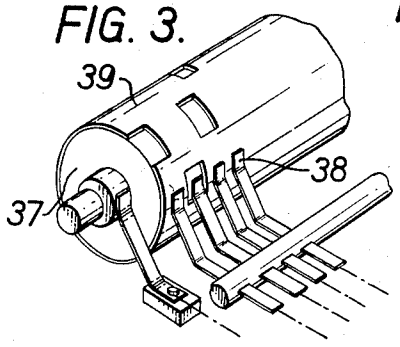


FIG. 3.



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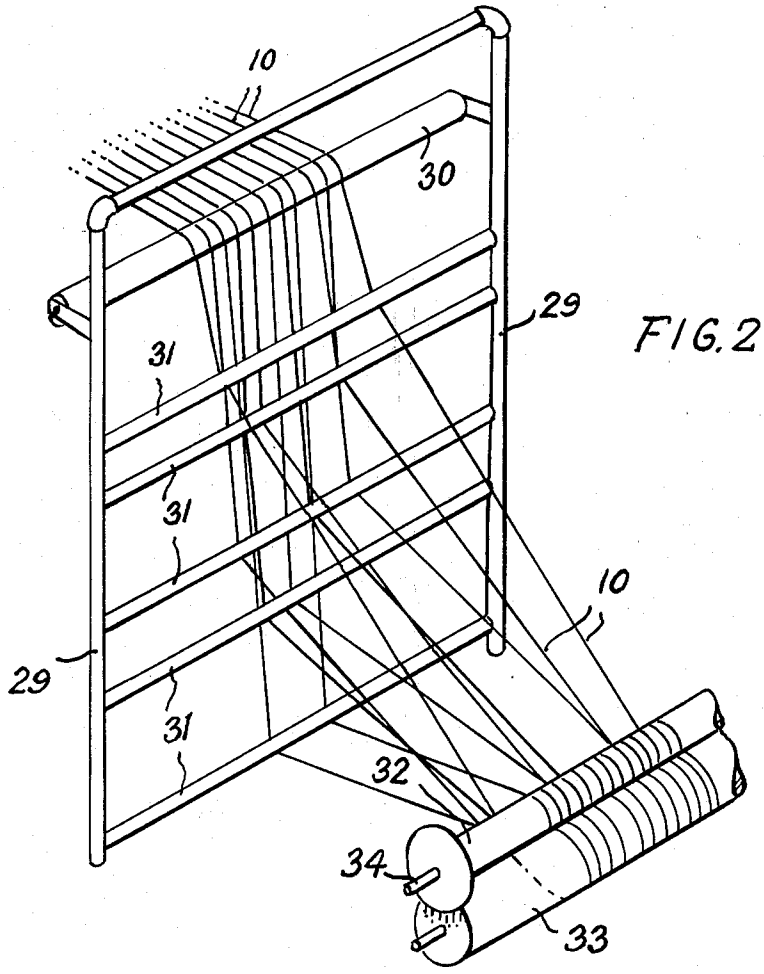


FIG. 2.

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METHOD OF AND MEANS FOR PATTERNING A PILE FABRIC

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This invention is concerned with the patterning of pile fabrics, and particularly of tufted fabrics, an operation which has hitherto usually been carried out by printing the pattern directly upon the pile face of the woven fabric.

In one known method, the fabric is brought into contact with the periphery of a hollow roller having pile-receiving pockets which collectively represent a single repeat of the pattern, each such pocket being defined by a continuous thin upstanding wall and communicating with a colour-box inside the roller.

Another method in use at the present time involves running the fabric in contact with a roller partly immersed in a dye-bath and having an absorbent covering applied as spaced pads, or with spaced cutouts, which collectively form a single pattern repeate.

The satisfactory printing of pile fabrics by these known methods has been found to require considerable care in the design and operation of the apparatus to ensure, on the one hand, that the pile is dyed for its full depth and, on the other hand, that no part of the pattern receives an excess of dye liable to "bleed" into an adjacent part.

Another contingency which requires to be guarded against, with the second method at least, is the accidental marking of parts of the fabric which it is not desired to print, due to the presence of unwanted dye on the roller between the pads, or in the cut-outs, which form the pattern.

Furthermore, in both cases, the printing of fabrics in several colours necessitates a corresponding number of pattern rollers being used, and any relative slippage between rollers and fabric or uneven tension in different parts of the latter may result in faulty registration of the various colours.

The object of the present invention is to provide an alternative method of, and means for, use in the patterning of pile fabrics which will avoid the above-mentioned difficulties and drawbacks of the known processes.

According to this invention, the patterning of a pile fabric is effected by printing each pile-forming yarn, prior to its incorporation in the fabric, with a colour or colours dependent upon the position such yarn will occupy relative to the width of the pattern which the finished fabric is to exhibit, the lengths of any differently coloured sections of such yarn being determined by the number of tufts required in each colour in a single repeat of the pattern lengthwise of the fabric.

Apparatus for carrying the method aforesaid into effect conveniently comprises a beam or separate packages from which the appropriate number of tufting yarns are simultaneously drawn as a sheet across a series of dye-troughs each containing a different colour and a pick-up roller partially immersed therein, means whereby the sheet of yarns is normally supported clear of the several pick-up rollers, and control means operating in accordance with the pattern to be reproduced whereby the yarns can be pressed collectively or individually against any selected pickup roller, or any two or more selected rollers in succession, during their passage through the apparatus to suitable take-up means.

The control means aforesaid conveniently comprise applicators respectively associated one with each of the

several dye-troughs and extending across the whole width of the sheet of yarns, and/or each dye-trough may be associated with a row of applicators each engageable with one particular yarn in such sheet.

Each applicator may be responsive to a control member rotating at a speed dependent upon that of the yarns; for example, a changeable cam or cam section adapted to exert a direct mechanical pressure upon the applicator or to actuate the same by electromagnetic and/or fluid-pressure means or alternatively a conducting drum with a partially-insulated surface adapted to cooperate with a stationary contact to energize a solenoid acting directly or indirectly upon the applicator.

After suitable finishing treatment the printed yarns are preferably wound side-by-side upon a beam for subsequent delivery to a corresponding number of tufting needles, and in a case where the sheet of finished yarns has been printed in differently-coloured full-width sections, it is desirable for such yarns first to pass through a setting frame, which latter comprises a primary roller carrying the whole sheet of yarns and a plurality of secondary rollers mounted at different distances therefrom, consecutive yarns in the sheet being selectively engaged with these secondary rollers so that, on anchorage of their ends to the beam, such yarns will wind onto the latter with their respective coloured sections in the precise positional relationship demanded by the pattern.

In the accompanying drawings:

Figs. 1*a* and 1*b* collectively illustrate in schematic side elevation one form of apparatus for the individual or collective printing of yarns in accordance with the present invention and including the setting frame aforesaid.

FIG. 2 is a perspective view of such setting frame drawn to an enlarged scale.

FIG. 3 is a perspective view of one of the pattern cylinders and associated parts;

FIG. 4 shows one of the cam-operated applicator rollers, and

FIG. 5 shows one of the applicator rollers as operated by fluid pressure.

For convenience the several yarns **10** are shown entering the printing unit **11** from a single beam **12**, but in practice there may be a number of parallel supply beams or alternatively the yarns may be drawn from separate bobbins on a creel.

Rollers **13**, **14** at opposite ends of the printing unit **11** serve to maintain the yarns **10** in parallel coplanar relation, the sheet of yarns thus formed passing above a series of dye-troughs **15** which are arranged transversely thereof and at suitable intervals along the length of the unit. These troughs are charged with different colours corresponding to those called for by the pattern which is to appear on the pile fabric eventually produced.

Each trough **15** contains a partly-immersed pick-up roller **16** (preferably covered with foam rubber) which extends the full width of the sheet of yarns **10** and from the highest part of which the latter are normally spaced by a small amount, such roller being continuously driven so that its exposed surface moves in the same direction as the yarns.

Somewhat in front of each roller **16** and above the sheet of yarns **10** is grooved applicator roller **17** connected to the armature of a solenoid **18**, the latter being so arranged that is energization causes all the yarns **10** to be simultaneously pressed against the roller **16**.

Energization of each solenoid **18** is effected by closure of an individual micro-switch **19** connected in circuit with a source of electrical supply and having its operating lever **20** actuated by a cam **21** which is continuously rotated at a speed dependant upon the linear speed of the yarns **10**. This cam conveniently takes the form

of a disc with a plurality of radial screws spaced equally around its periphery, certain of these screws being allowed to project in varying degress to impart the desired profile.

It will be appreciated that the profile of each cam 21 and the rotational speed thereof controls the lengths of, and the intervals between, the periods during which the yarns 10 are collectively printed by engagement with the adjacent roller 16, and that by a suitable choice of cams the gaps between those sections of the sheet of yarns which are left unprinted by the first roller 16 are printed in one or more different colours by subsequent application to another or other of such rollers.

As an alternative to the electro-magnetic system above described, the arrangement shown in FIGURE 4 can be employed and each cam 21 may act through cam roller 21*a* upon the adjacent roller 17 or it may operate, directly or through the medium of a solenoid, a valve 50 whereby pressure fluid is applied to a piston 50*a* acting on such roller.

After leaving the unit 11, the sheet of printed yarns 10 travels in festoons through a steaming or baking chamber 22 to fix the colours applied thereto, the course of the sheet through such chamber being defined by rollers 23 arranged at upper and lower levels in the latter and such rollers (together with the roller 14 aforesaid) being preferably constructed as winces with the thinnest practicable bars to avoid transference of colour from one printed section to another.

From the chamber 22 the sheet of yarns 10 is passed around further winces or rollers 24 alternating with paddles 25 whereby it is carried through washing troughs 26 and finally traverses a drying chamber 27, in which it is festooned over upper and lower rollers 28 whilst being subjected to the action of hot air.

Immediately adjacent the exit end of the drying chamber 27 is arranged a setting frame 28*a* with upstanding side members 28 at or near whose upper ends a primary roller 30, longer than the overall width of the sheet of yarns 10 issuing from the chamber 27, is mounted for rotation about a fixed horizontal axis.

A suitable number of similar rollers 31 are horizontally mounted in bearings which are adjustable up and down the frame side members 29, all these secondary rollers 31 thus having their axes in a common plane which is parallel to, but does not necessarily contain, the axis of the primary roller 30.

Each individual yarn 10, after passing over the primary roller 30, is led under one or other of the several secondary rollers 31 and thence to the periphery of a beam 32 mounted horizontally and parallel to such roller, preferably first passing beneath a take-up roller 33 upon which the beam 32 rests with its trunnions 34 in suitable guides (not shown). It will be appreciated that, on rotation of the take-up roller 33, the beam 22 is frictionally driven in the reverse direction, winding the individual yarns 10 side-by-side upon itself in the same order as that in which they left the drying chamber 27.

Owing to the manner in which the sheet of yarn 10 is printed, correspondingly coloured sections of several yarns pass simultaneously over the primary roller 30, but the length of any given yarn extending between the latter and the effective periphery of the beam 32 depends upon the position of the particular secondary roller 31 engaged thereby.

Consequently, by leading consecutive yarns 10 under different secondary rollers 31, it is possible to effect a longitudinal offsetting of corresponding colours on such yarns during the beaming thereof.

The selection of the secondary rollers 31 to be engaged by consecutive yarns 10 across the width of the sheet is determined by the pattern to be exhibited by the final tufted fabric.

As an example of a typical setting, to produce a width of pattern represented by 11 consecutive tufting yarns, these latter (reading from left to right) may be engaged with secondary rollers Nos. 1, 3, 4, 5, 2, 4, 3, 5, 2, 3, 1 counting from the top downwards.

The relative longitudinal offset of corresponding colours in any two consecutive yarns 10 will be equal to the difference in the respective lengths of such yarns (measured from the primary roller 30 around the selected secondary roller 31 to the periphery of the beam 32) divided by the tufting ratio of the loom; i.e. the length of yarn (usually between 6 and 10 inches) required to tuft 1 inch length of the finished fabric.

The uprights 29 of the setting frame 28*a* can therefore be calibrated in height units corresponding to suitable increments of colour offset in the final pattern, which will enable the operator quickly to set his secondary rollers 31, and selectively to engage the yarns 10 therewith, at the requisite levels in any given case.

It will be appreciated that, since the wound beam 32 will be mounted in the tufting machine close up to the needles, there is virtually no risk of pattern distortion resulting from differential stretch in the yarns 10 such as would inevitably occur sooner or later if the printed yarns were to be supplied to the needles from separate packages, due to the size of the creel necessary to accommodate the latter and the consequent wide variation in the lead-in lengths of the several yarns.

In order that the carpet pile produced from the printed yarns 10 may exhibit a floral pattern, instead of a mottled effect or so-called "contemporary" pattern such as may be provided for by the full-width printing above-described, each pick-up roller 16 has mounted directly above it a parallel row of grooved pads 35 (or rollers) which are depressible by energization of associated solenoids 36 to apply selected individual yarns 10 to the roller 16.

The solenoids 36 associated with each row of applicator pads 35 (or rollers) are individually connected in circuit with a source of electrical supply, a conducting pattern cylinder 37, and a corresponding number of spring contacts 38 bearing upon the periphery of the latter.

Conveniently each such cylinder 37 has a circumference proportional to the length of one repeat of the pattern and is continuously rotated at a peripheral speed equal to the linear speed of the yarns 10, although to economize space it may be reduced in diameter and driven at a correspondingly lower speed.

Each of the several cylinders 37, which are not necessarily set parallel to the pick-up rollers 16 as illustrated, is provided with an insulating sheath 39 (FIG. 3) such as a layer of varnish, plastic or paper which is scraped or cut away as requisite to expose one or more portions of the conducting surface.

The axial and circumferential dimensions of the (or each) portion so exposed, and their relative positions upon the cylinder 37 if there is more than one, corresponds to the required arrangement of tufts of the particular colour concerned in each repeat of the pattern.

That is to say, according to the dictates of the pattern, any given yarn 10 may be left clear of a particular pick-up roller 16, due to the fact that the spring contact 38 in circuit with the solenoid 36 which controls such yarn's position runs continuously in engagement with an insulated part of the cylinder 37, or on the other hand an appropriate length of the yarn in question may be held against such pick-up roller 16 at least once, and be printed with colour therefrom, as a result of an exposed part or parts of the cylinder 37 passing beneath the contact 38.

Obviously each solenoid 36, instead of mechanically controlling a particular applicator, may operate a valve whereby pressure fluid is applied to a piston acting upon such applicator, or again the latter may be operated mechanically by a suitable follower engaging a pattern drum which replaces the cylinder 37 aforesaid.

It will be appreciated that initially the angular positions of the several pattern cylinders 37 are carefully

adjusted, relatively to one another, so that any parts of a given yarn 10 unaffected by the first printing operation thereon will subsequently be printed in a different colour or colours (as determined by the pattern) during their passage over the appropriate pick-up roller or rollers 16.

After colour-fixing, washing-off, and drying as aforesaid, the individually-printed yarns are set onto a collecting beam such as 32 with the appropriate longitudinal offsets.

For the use in the production of wide widths of patterned carpeting, two or more printing units such as that shown at 11 may be arranged side-by-side, the several yarn-beams 12, 32 being mounted in each case upon a common mandrel and if the pattern repeats itself across the piece, a single cam 21, pattern cylinder 37, or its equivalent may be used to control all the applicator means concerned with a particular colour.

We claim:

1. Apparatus for preparing tufting yarns for use in the production of a patterned pile fabric, comprising supply means from which a number of said yarns equal to the total number of tufts in the width of the pattern to be reproduced can be drawn forward in laterally-spaced coplanar relation, a series of dye-troughts each containing a different colour and a pick-up roller partially immersed therein, means for guiding the sheet of yarns in a path normally clear of said pick-up rollers, printing means for simultaneously printing all of the yarns, separate printing means for printing selected individual yarns, all of such printing means respectively associated with the several pick-up rollers, control means operating in accordance with the pattern to be reproduced to cause said printing means to press said yarns against said pick-up rollers rollers so that each yarn becomes impregnated with at least one colour for a length thereof dependent upon the number of tufts required in that particular colour in a single repeat of the pattern lengthwise of the final fabric, and a beam on which the printed yarns are simultaneously wound for tufting therewith.

2. Apparatus for preparing tufting yarns for use in the production of a patterned pile fabric, comprising, supply means from which a number of said yarns equal to the total number of tufts in the width of the pattern to be reproduced can be drawn forward in laterally-spaced coplanar relation, a series of dye-troughs each containing a different colour and a pick-up roller partially immersed therein, means for guiding the sheet of yarns in a path normally clear of said pick-up rollers, printing means extending the full width of said sheet of yarns and respectively associated with the several pick-up rollers, separate printing means for printing individual yarns control means operating in accordance with the pattern to be reproduced to cause said printing means to press said yarns either collectively or individually against at least one selected pick-up roller so that they become impregnated with the colour carried by said roller for a length thereof dependent upon the number of tufts required in that particular colour in a single repeat of the pattern lengthwise of the final fabric, and a beam on which the printed yarns are simultaneously wound for tufting therewith.

3. Apparatus as claimed in claim 1, wherein said control means take the form of cam members rotating at a speed dependent upon that of said yarns and solenoid-controlled rollers respectively adapted to exert direct mechanical pressure upon the several printing means.

4. Apparatus as claimed in claim 1, wherein said control means take the form of cam members rotating at a speed dependent upon that of said yarns and respectively adapted to cause electromagnetic actuation of the several printing means.

5. Apparatus as claimed in claim 1, wherein said control means take the form of cam members rotating at a speed dependent upon that of said yarns and respectively adapted to actuate the several printing means through the medium of fluid pressure.

6. Apparatus as claimed in claim 1, wherein said control means comprise conducting drums rotating at a speed dependent upon that of said yarns and having partially-insulated surfaces, stationary contacts cooperating with said surfaces, and solenoids energised by completion of electrical circuits through said drums and contacts to cause actuation of the associated printing means.

7. Apparatus as claimed in claim 1, wherein the means for guiding the printed yarns comprises a primary roller carrying the whole sheet of yarns, and a plurality of secondary rollers mounted at different distances from said primary roller, consecutive yarns in said sheet being selectively engaged with said secondary rollers so that, on anchorage of their ends to said beam, such yarns will wind onto the latter with their respective coloured sections in the precise positional relationship demanded by the pattern.

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