United States Patent

[11] **3,568,614**

[72] Inventors **Stanley Shorrock;**
Norman Ian Buckley, Blackburn, England

[21] Appl. No. **762,961**
[22] Filed **Sept. 26, 1968**
[45] Patented **Mar. 9, 1971**
[73] Assignee **Said Buckley assignor to said Sharrock**
[32] Priority **Sept. 26, 1967**
[33] **Great Britain**
[31] **47876/67**

[54] **MACHINE PATTERN FOR A TEXTILE TUFTING MACHINE**
12 Claims, 5 Drawing Figs.

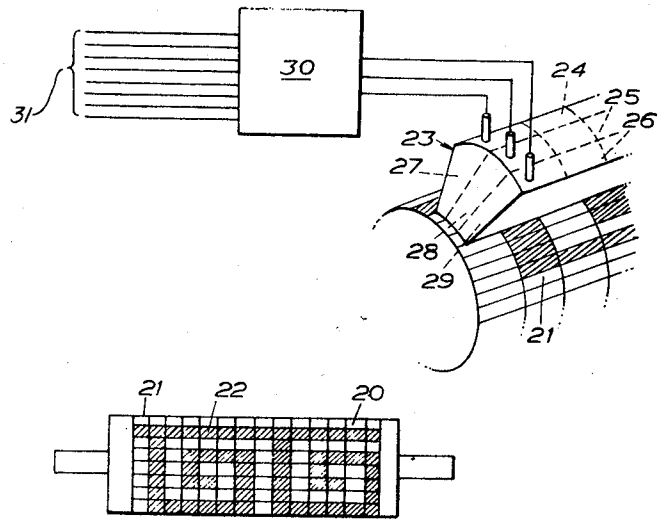
[52] **U.S. Cl.** **112/79**
[51] **Int. Cl.** **D05c 15/26**
[50] **Field of Search** 112/79, 79.5, 79.6

[56] **References Cited**
UNITED STATES PATENTS

3,247,814	4/1966	Polevitzky	112/79
3,247,815	4/1966	Polevitzky	112/79
3,433,188	3/1969	Pickles	112/79
3,459,143	8/1969	Ellison et al.	112/79
3,103,187	9/1963	Hammel	112/79

Primary Examiner—Patrick D. Lawson
Assistant Examiner—Geo. V. Larkin
Attorney—Sughrue, Rothwell, Mion, Zinn & MacPeak

ABSTRACT: A textile tufting machine is controlled by a pattern produced by applying a grid to an artist's pattern equal to the number of tufts in the pattern then making a binary coded machine pattern gridded corresponding to the colors of the artist's pattern when gridded, sensing and decoding the machine pattern and thereby controlling the tufting machine needles accordingly. The pattern itself has a number of unit areas consisting of a number of rows and columns of binary coded information with the columns equal to the number of needles in the tufting machine and the rows equal to the number of needle strokes in a pattern.



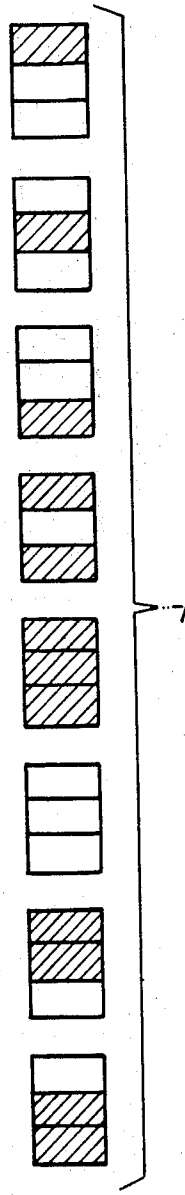


FIG. 1

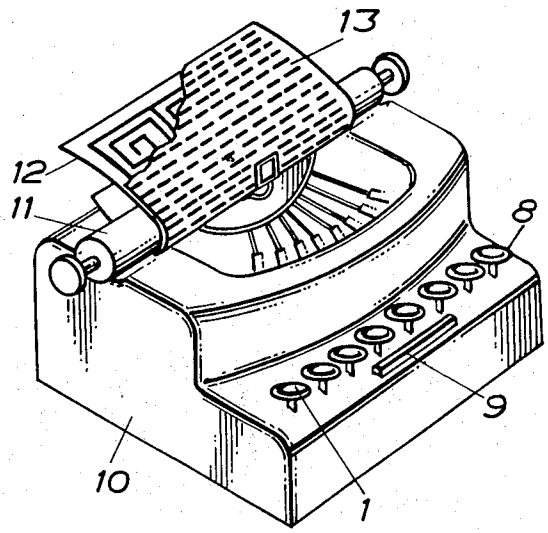


FIG. 2

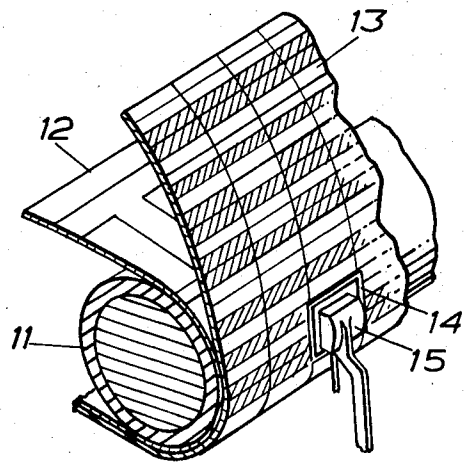


FIG. 2A

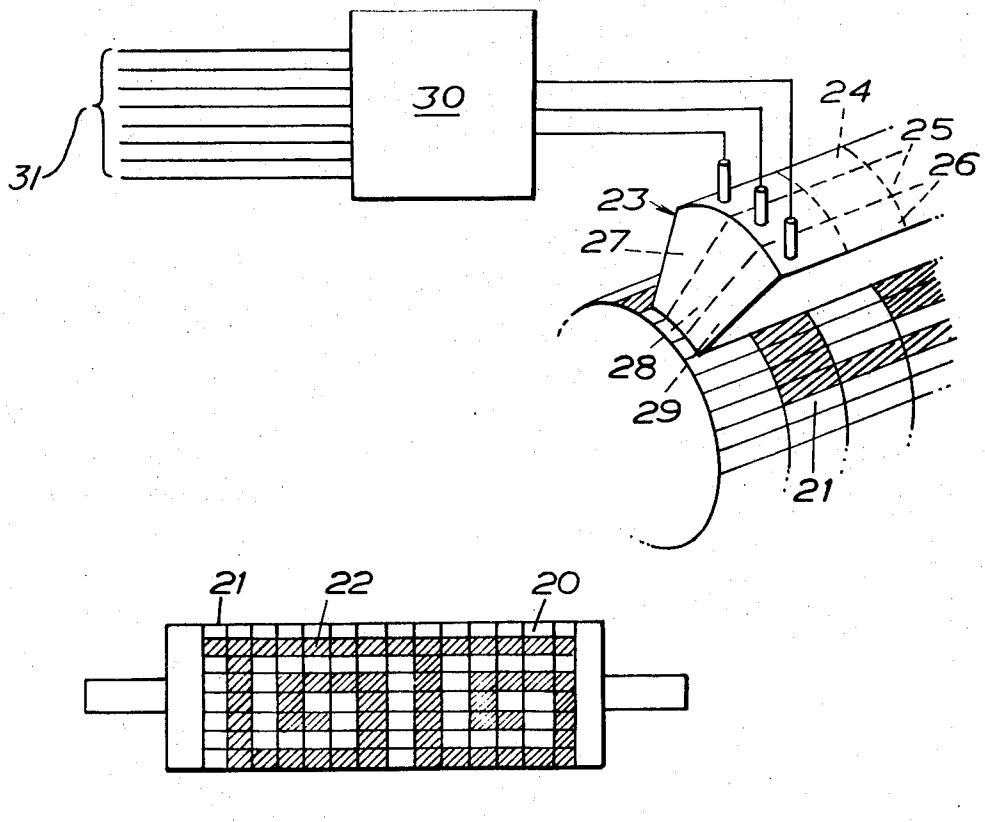


FIG. 3.

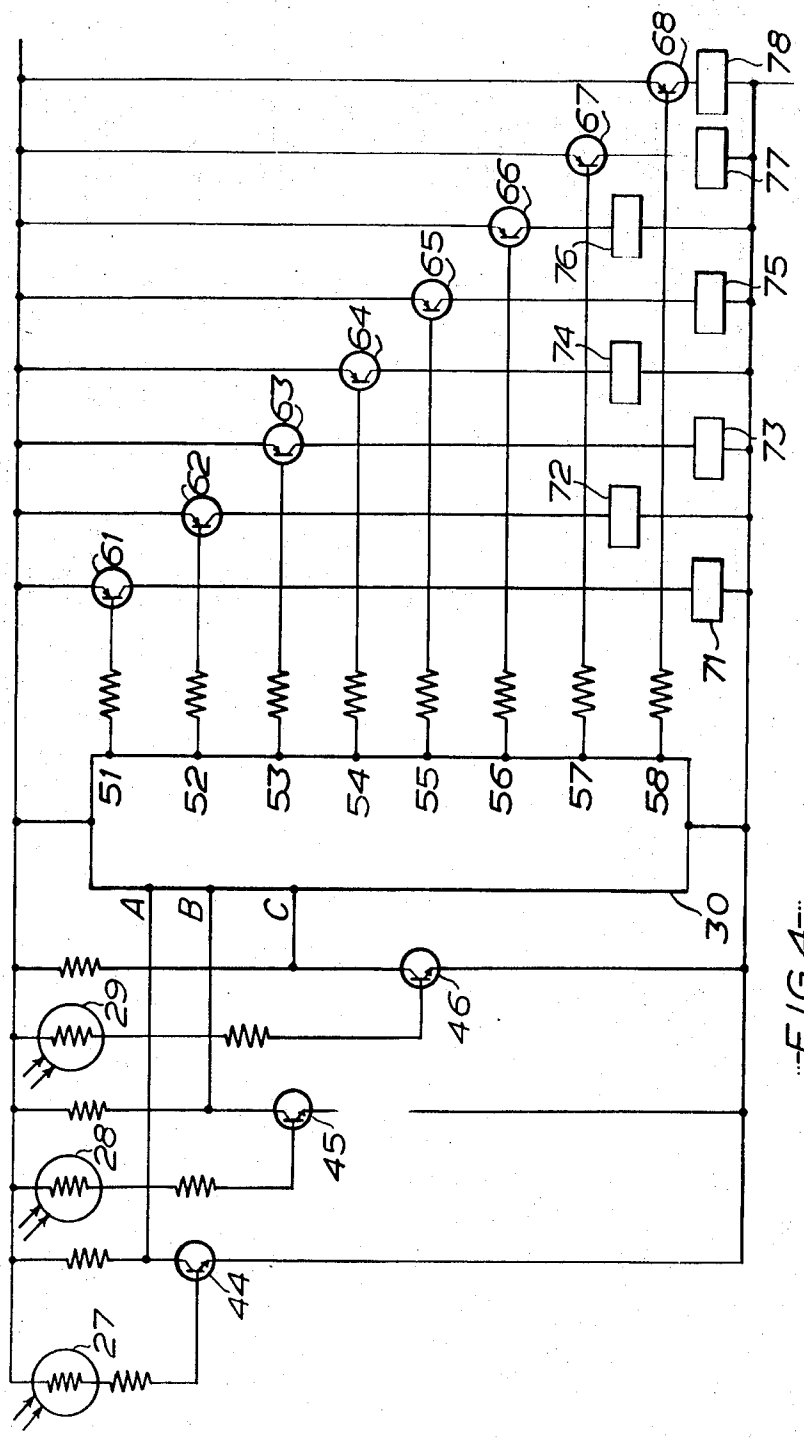

68
78
67
77
66
76
65
75
64
74
63
73
62
72
61
71
51
52
53
54
55
56
57
58
30
A
B
C
46
29
45
28
44
27

FIG 4

MACHINE PATTERN FOR A TEXTILE TUFTING MACHINE

Our invention relates to the production of a pattern to be copied by a machine, the pattern concerned being more particularly suitable for controlling a textile machine such as a tufting machine, capable of producing a textured or colored carpet.

Patterns are known which control, for example, the pile height produced in such a machine, by forming an opaque design on a transparent base, illuminating the pattern from one side and deriving pattern information from the other by photocell pickups. Whilst this is effective to distinguish between one of two states e.g. high or low pile, it is not suitable to produce piles of several lengths or colors since, more particularly in the latter case, some kind of color discriminating means is necessary in connection with the pattern, and such means are usually complicated and expensive.

We have devised a form of machine pattern in which the pattern is divided into a number of units, each unit corresponding to a particular tuft to be applied to a backing material by a tufting machine. In each unit we apply a marking determining the tuft length or color, and the marking is such that any one of several tuft lengths or colors may be chosen.

In one form of our invention, in order to provide a machine pattern which is capable of producing a patterned fabric either of tufts of varying length without color discrimination in the machine, or varicolored tufts, we arrange for an artist to produce a basic pattern. This pattern is then placed beneath a screen which is divided into a number of horizontal rows and vertical columns, the columns being equal to the number of yarns to be applied across each pattern or pattern repeat on the base fabric, and the number of rows being equal to the number of cycles of the machine during the completion of a single lengthwise pattern or pattern repeat. The artist pattern, beneath a ruled transparency, is then transferred to a typewriter type mechanism, and the operator presses a key for each particular artist pattern part seen through each transparency division or unit area. The typewriter mechanism then applies blanking stripes to each unit of the transparency in a code representing the information seen by the operator through the division. Thus for example each color could be represented by three parts of each unit; each part may either be left transparent or blocked out, so that a combination of 2^3 choices of color can be dealt with by three parts. If only four colors are required, then only two parts in each unit need be provided. The transparency contains means at its edge for synchronizing it with the movement of the base fabric and the yarn supplies of the machine, and such means may consist either of a series of bars printed on the transparency edge, or punched holes, or any other similar synchronizing means. Alternatively a punched-card-type mechanism could be employed.

When the transparency is applied to the machine, it is wrapped round a transparent drum, and illuminated from the inside along a line corresponding to a row of tufts to be applied to the base fabric. Each unit of the pattern is provided with three photocells, and the combination of photocells illuminated by each unit determines via a computer-type apparatus the color selected or the tuft height. Optical means may be provided on the tufting machine for magnifying the machine pattern so as to enable the reproducing photocells to be spaced adequately apart and screened from one another.

If necessary, a pair of synchronized coded machine patterns may be employed, one pattern code determining the color, and the other the length, of each tuft.

Alternatively the machine pattern may be produced on a machine remote from the operator's position and the pattern may be punched, not marked, as by placing a machine pattern base beneath the artist pattern, and punching both. In the case of the remote machine, the pattern produced may be the same size as the original or different, and the impressions may be delayed so as to enable the operator to correct a mistake.

Reference should not be made to the accompanying drawings in which:

FIG. 1 shows the various ways in which each unit of a machine pattern can be marked,

FIG. 2 shows a typewriter mechanism adapted for producing a machine pattern from a colored original,

FIG. 2A is an enlarged view of a portion of FIG. 2,

FIG. 3 shows the method of deriving information from the machine pattern in order to control the colors applied to a carpet by a tufting machine, and

FIG. 4 shows the circuit of a decoding apparatus as used in conjunction with the machine pattern.

Referring now to FIG. 1, eight units of a pattern are shown. Each unit consists of a rectangle, which is divided into three parts. Each part can be white (or transparent) or black (or opaque). It therefore follows that since the number of ways in which the parts can be filled in is 2^3, each unit of pattern with three separate parts can control eight different colors of yarn. The choice of unit parts filled in and the associated colors are of course entirely arbitrary, and is predetermined for any particular group of colors to be used. Although a unit divided into three parts is shown, more or less parts could be used, in which case more or less colors of yarn could be controlled.

Each machine pattern is composed of a large number of units, there being rows and columns of units. Since each rug or carpet to be made would in all probability consist of pattern repeats both across and along the fabric, we arrange that the number of columns is equal to the number of needles used across each pattern repeat on the base fabric, and the number of rows are equal to the number of cycles of operation of the machine during the completion of a single lengthwise pattern repeat. To produce the number of pattern repeats required across the fabric, the needles are grouped and each group is connected to its adjacent neighbor, so that one machine pattern controls several groups of needles.

FIGS. 2 and 2A show the method of making a machine pattern. We provide a modified typewriter mechanism as shown in FIG. 2, and assuming that eight color variations are required, eight color keys are provided, together with a carriage return key. Depression of any one key applies a blanking pattern to the unit concerned, and transfers the pattern one unit row crosswise. A depression of the carriage return key moves the pattern up one column, and returns it to a start position.

In the drawings, the color keys are denoted by the numbers 1 to 8, and the carriage return key is 9. The typewriter mechanism has a body 10, on which there is the usual platen roller 11. On the latter is placed a colored pattern 12 as designed by an artist, the artist pattern constituting one section of a pattern repeat to be worked into a carpet or rug. On top of the pattern is placed a translucent machine pattern sheet 13, and there is a fixed window 14 located at the center of the machine opposite the machine pattern 13. The latter is divided into a grid consisting of a number of units equal to the product of a number of columns and rows in one pattern repeat, and the machine is designed so that on depression of one of the keys 1 to 8, a blanking action takes place through the window 14 whereafter the patterns move one column width, with the roller 11.

In action, an operator inserts the artist's and machine patterns in the body 10 as shown in FIG. 2. She then brings the first unit of the pattern beneath the window and observes the color, thereafter depressing the appropriate color key. This applies a blanking or blackening material to a required number of divisions of the pattern unit concerned, and moves the roller and the two patterns one column space along, on restoration of the key. Observation of the second portion of the pattern through the second unit space now occurs, and the blanking action is repeated. This continues to the end of a line of columns, whereupon the carriage return key 9 is depressed, and the two patterns and roller are returned to the start of the next row. This action continues until the whole of the artist's pattern has been transferred to the machine pattern. FIG. 2A shows a part of a machine pattern in which the units have been blanked or blacked-out in various manners. One of the blanking or blackening keys is shown at 15, and the blacking-out

may be effected either by inking each key before it moves into contact with the machine pattern, or by the use of a typewriter ribbon.

In this connection it should be noted that although FIGS. 2 and 2A show the preparation of the machine pattern whilst in contact with the artist's pattern it should be recognized that this is not necessarily the only method of performing the process of the invention. This particular method of preparing the pattern would provide a machine pattern which would be equal in size to that drawn by the artist. If however a very considerable amount of color information is required on a machine pattern, it may be necessary to make this larger than the pattern drawn by the artist. In this case, a separate machine pattern producing device is employed. This consists of marking arrangements similar to that shown in FIG. 2, but whereas in the previous arrangement the actual machine copy was made on the artist's pattern, in the modified arrangement, only a unit grid is applied to the artist's pattern. As before the operator depresses keys in accordance with the colors seen through the unit grid, the difference being that electromagnetic hammers or punches produce a machine pattern remotely from the machine operated by the operator. This machine pattern can be smaller, larger or the same size as that of the artist's original sketch as determined by the dimensions of the machine pattern producing device.

In order to ensure synchronization between the machine pattern and the needle movements of the machine, the machine pattern is provided with synchronizing marks or holes along at least one edge, and these marks may either actuate photocells or may cooperate with cogs or spikes on the pattern drum of the tufting machine.

When the machine pattern has been produced, and it is required to use this pattern to control a tufting machine, the machine pattern is applied to a transparent drum which is mounted on a tufting machine, and the drum is illuminated from inside. Alternatively the pattern may be opaque and each unit consist of white and black reflecting spaces, in which case the pattern is illuminated from the outside. In FIG. 3 there is shown a machine pattern 20 on a drum 21, one column of the pattern 22 being devoted to synchronizing dots as shown. When placed in position on the machine, the pattern drum rotates synchronously with the movement of the backing fabric.

Above the pattern is an arrangement of photosensitive cells 23, three such cells 27, 28, 29 being provided for each pattern unit area. The cells are arranged in rows 24, 25, 26, across the width of the pattern. In use, each cell is energized or not by light from its own part of the unit instantaneously below it. The outputs of each group of three cells are connected to a computer device 30, which decodes the information to a mark or energization on one of eight leads 31. There is a counter for each group of photosensitive cells i.e., for each needle in a pattern repeat. Photoresistive cells are used i.e. cells whose resistance falls when light, infrared or ultraviolet radiation falls on them.

The computer itself the circuit of which is shown in FIG. 4 consists of an integrated circuit with computer amplifiers, and will be described later. Each of the wires 31 is connected to a different yarn feed, each wire being adapted when energized to feed its own particular color to its associated needle. On energization of one of the wires 31, appropriate control mechanism which does not form part of the present invention supplies a length of colored yarn to its particular needle so that the machine repeats at each needle the color information derived from the associated pattern unit via the photocells and computer. After the appropriate colored yarns have been supplied to all the needles, the latter are driven through the backing fabric leaving the colored tufts in position, and the needles are retracted, whereupon the backing fabric and the pattern move one row along and the process is repeated until the whole of the carpet or rug has been produced. Note that since the drum 21 is substantially endless, a strip of carpeting can be made of any particular length required, provided the number of repeats of the pattern across the width thereof remains constant. If necessary, border attachments may be added in order to provide sides or borders to the carpet of a uniform color.

FIG. 4 shows the control circuit for each group of three photoresistive cells and the associated needle. The photocells are numbered 27, 28 and 29, and each photocell is connected to the input of an associated amplifier transistor 44, 45 or 46 respectively. The outputs of these transistors are connected to the input terminals A, B and C respectively of an integrated circuit decoder of known type, the decoder operating so as to provide an output potential on one of the output terminals 51 to 58 for each input code. These output terminals are connected via isolating resistors to further amplifying transistors 61 to 68, and each transistor operates a relay or control mechanism 71 to 78 which either directly supplies a colored yarn or operates a supply and cutoff mechanism of known type to do so. In view of the extremely small dimensions and relatively low cost of the parts concerned, it is quite feasible to supply this quantity of apparatus per needle, seeing that the result is the production of a multicolored patterned tufted carpet in a relatively cheap and straightforward manner, and using a machine pattern which is readily changeable to another pattern should this be desired.

Although the machine pattern has been described as consisting of a transparent sheet consisting of a number of units of which parts may be blocked out, it should be understood that each unit may consist of an area in an opaque sheet, and that portions of the area may be punched out instead of blacked out, in which case feelers or means other than photocells may be employed in order to sense the punched-out portions. As a still further alternative, the machine pattern may be made by photographic means, the pattern itself consisting initially of a sheet of photosensitive material on which the machine pattern is projected, unit by unit, under control of the operator, so as to expose some or all of the spaces in each unit. The pattern is then developed and fixed by normal methods. This avoids the use of typewriter mechanisms and blanking ink.

It should be realized that production of a pattern consisting of a series of binary coded units of this character is eminently suitable for purely electromechanical control of the machine; in addition such a binary coded pattern may be connected directly to a computer which may assess the amount of materials required for a given carpet, its cost, and other details.

We claim:

1. A machine pattern for a textile tufting machine comprising a base divided laterally into a number of columns equal to the number of needles in the machine to be individually controlled, and longitudinally into a number of rows equal to the number of needle strokes in a pattern on the finished carpet, the result being a number of unit areas of pattern equal to the product of the said rows and columns, and a plurality of binary signalling parts in each unit.

2. A machine pattern as recited in claim 1, wherein said base is transparent and flexible with the parts of each unit area carrying a binary code of markings adapted alternatively to transmit or block radiation.

3. A machine pattern as recited in claim 1, wherein said base is reflective and flexible, the parts of each unit area carrying a binary code of markings adapted alternatively to reflect or absorb radiation.

4. A machine pattern as recited in claim 1, wherein said base is opaque and flexible, the parts of each unit area carrying a binary code punched through said base.

5. A machine pattern as recited in claim 1, including a synchronizing means carried on at least one side thereof, the said means being periodically recurring signalling areas.

6. A method of producing and using a machine pattern as recited in claim 1, including the steps of producing an artist's pattern, applying a grid to said artist's pattern, said grid consisting of a number of unit areas equal to the product of the number of tufts in each row of a tufted carpet pattern to be produced, and the number of columns of stitches in said pat-

tern, producing a machine pattern consisting of a like number of unit areas containing binary coded information corresponding to said artist's pattern, passing said machine pattern past a plurality of sensing devices each of which senses the binary code of a unit area at one time, decoding the outputs of said sensing devices, and applying each decoded results to control the supply of yarn to one needle of a tufting machine.

7. A method as recited in claim 6, including the steps of producing a colored artist's pattern, placing said grid with said pattern in an adapted typewriter mechanism, applying a binary code to the unit areas of said grid by means of said mechanism, and using said coded grid to control the colors of yarns fed to the needles of said tufting machine to produce a tufted carpet with a pattern of tufts colored to correspond with said artist's pattern.

8. A method as recited in claim 6, including the steps of producing a colored artist's pattern, placing said grid with said pattern in a primary adapted typewriter mechanism, placing a machine pattern blank in a secondary mechanism synchronously operated with said primary mechanism, actuating said primary mechanism so as to produce a series of binary coded unit areas on said machine pattern blank, and controlling the supply of colored yarns to the needles of said tufting machine by means of said coded machine pattern.

9. A method as recited in claim 6, characterized in that said machine pattern is transparent, with a binary code thereon of opaque parts, and including the steps of providing an illuminating means and a plurality of photosensitive devices equal to the number of tufting machine needles to be controlled, and passing said machine pattern between said illuminating means and said photosensitive devices.

10. A method as recited in claim 6, wherein said machine pattern is reflective, with a binary code thereon of radiation absorbent parts, and including the steps of providing an illuminating means and a plurality of photosensitive devices equal to the number of tufting machine needles to be controlled, illuminating one side of said pattern by said illuminating means, and sensing the radiation reflected from the reflecting parts thereof by means of said photosensitive devices.

11. A method as recited in claim 6, wherein said machine pattern is an opaque sheet, and including the steps of punching said sheet in said unit areas with a plurality of holes to produce a said binary codes.

12. A method as recited in claim 6, wherein said sensing devices are photoresistive cells, an integrated circuit and a transistor amplifiers connections from said cells to said amplifiers and integrated circuit, said integrated circuit decoding the combination of signals received from said photoresistive cells to apply a potential to one of a plurality of output leads, the lead energized determining the color of yarn to be fed to the associated tufting machine needle.