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Brown et al.

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[54] **CYCLIC BEAM TUFTING MACHINE**

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[73] Assignee: **Keystone Limited**, New Providence, Bahamas

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[52] **U.S. Cl.** ..... **112/79 A**

[51] **Int. Cl.** **D05c 15/12**

[58] **Field of Search** ..... 112/79 R, 79 A, 266, 112/410, 221; 66/1 R

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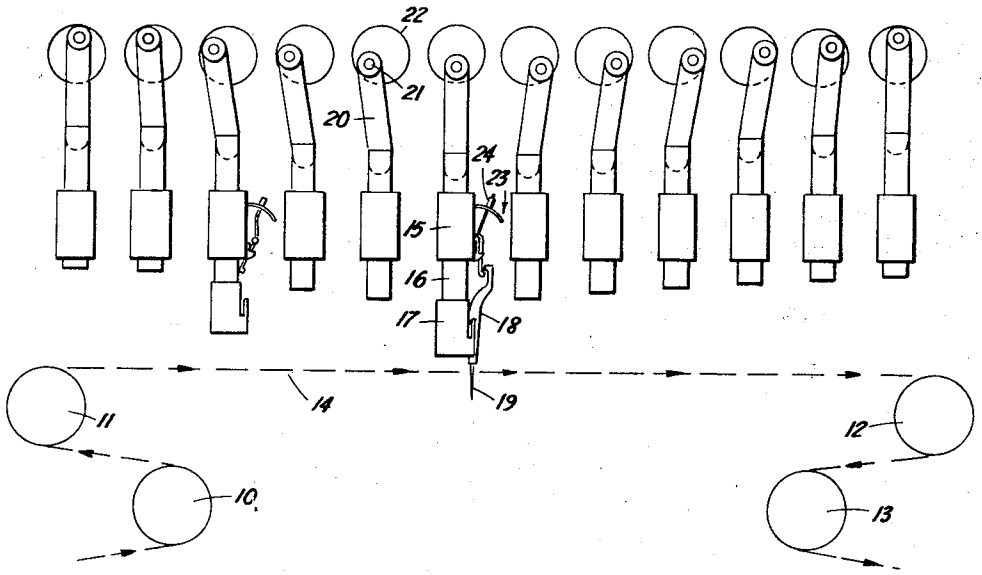
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[57] **ABSTRACT**

A tufting machine has a number of rows of needles, one row for each yarn colour to be tufted, and individual reciprocating beams for each row for driving the needles into a backing to tuft. Each needle can be individually latched to its associated beam in accordance with a programmer so that a predetermined pattern can be formed from the yarn tufts on the backing. The beams are reciprocated in a cycle so that at any one time the needles of at least one beam are engaged in the backing.

11 Claims, 6 Drawing Figures



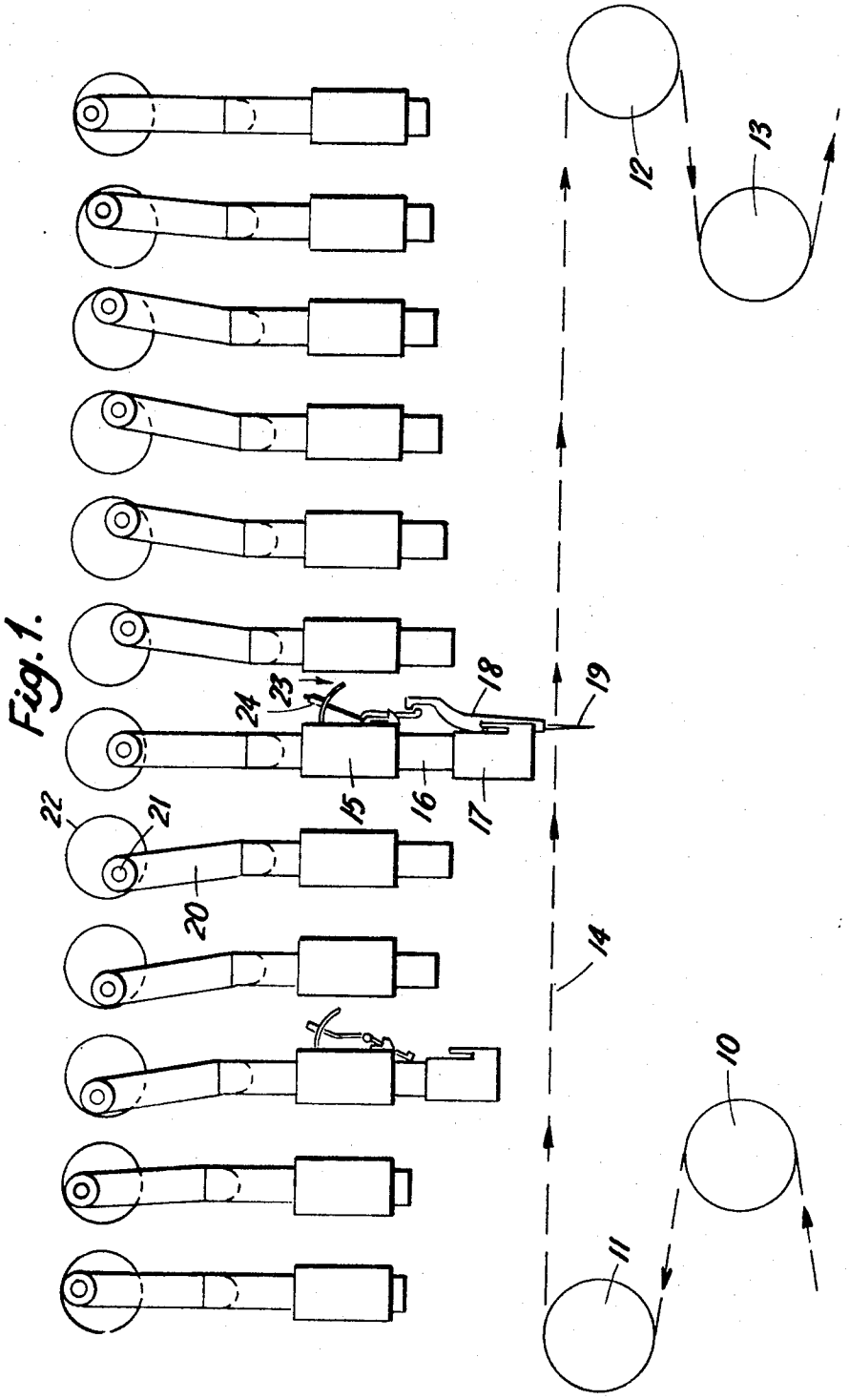


Fig. 1.

Fig. 2.

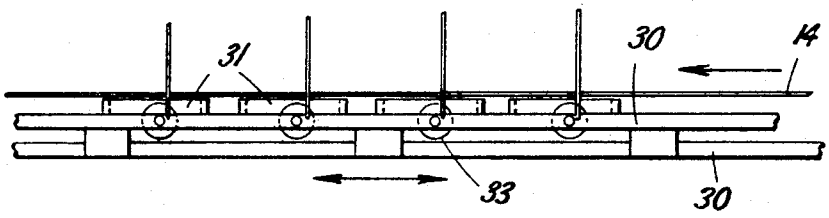


Fig. 3.

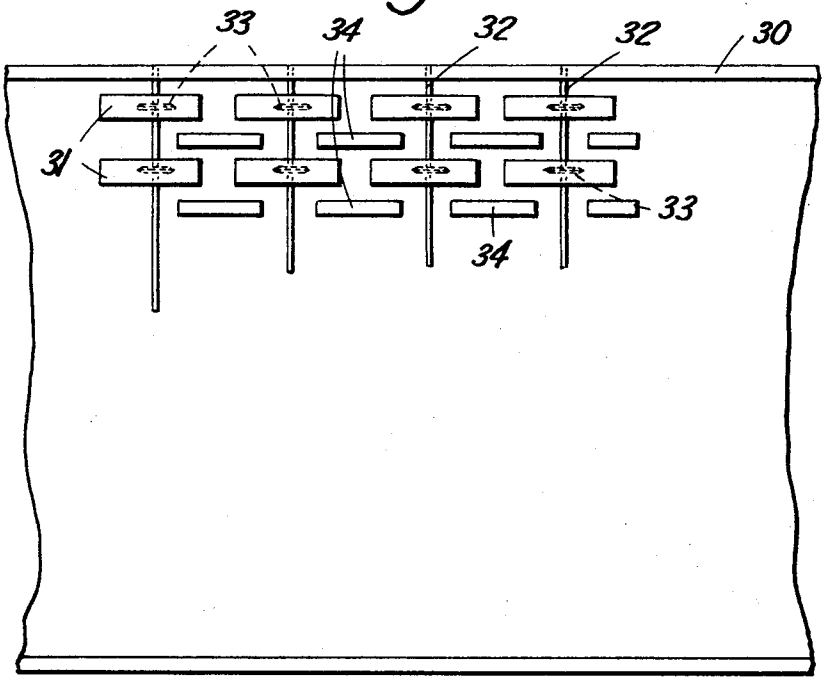
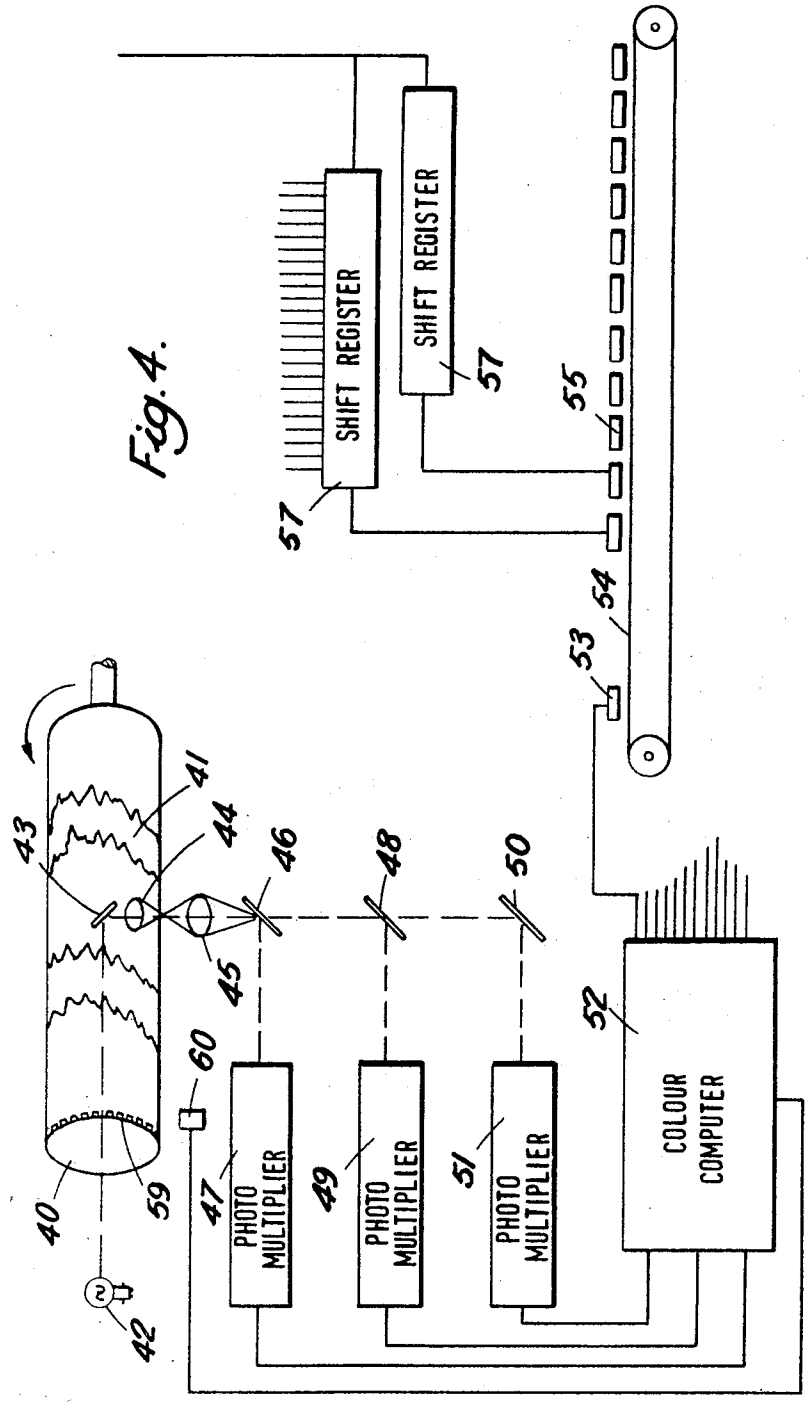


Fig. 4.


SHIFT REGISTER
SHIFT REGISTER
57
55
57
54
53
41
43
44
46
48
50
45
52
COLOUR COMPUTER
60
PHOTO MULTIPLIER
PHOTO MULTIPLIER
PHOTO MULTIPLIER
47
49
51
40
59
42

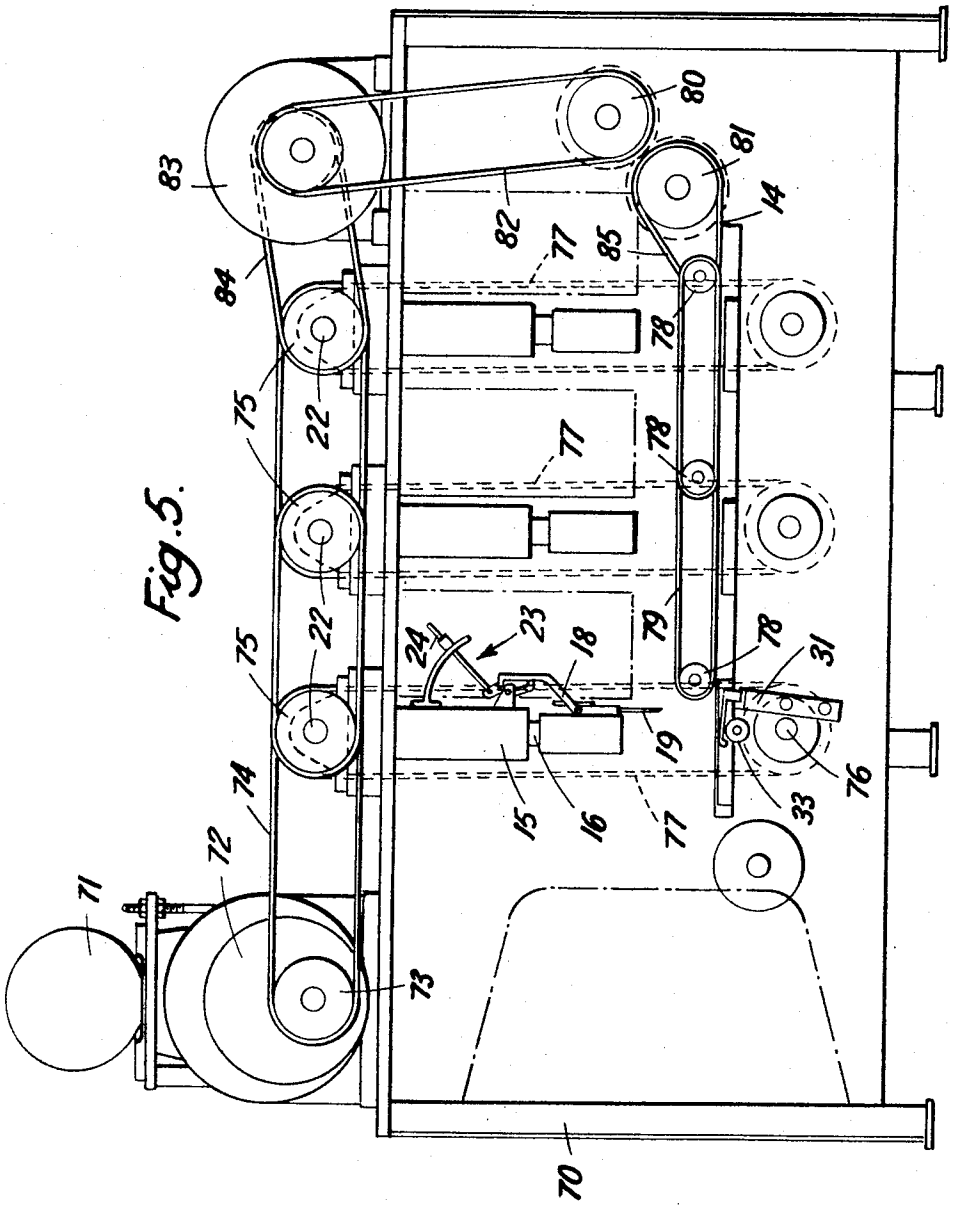
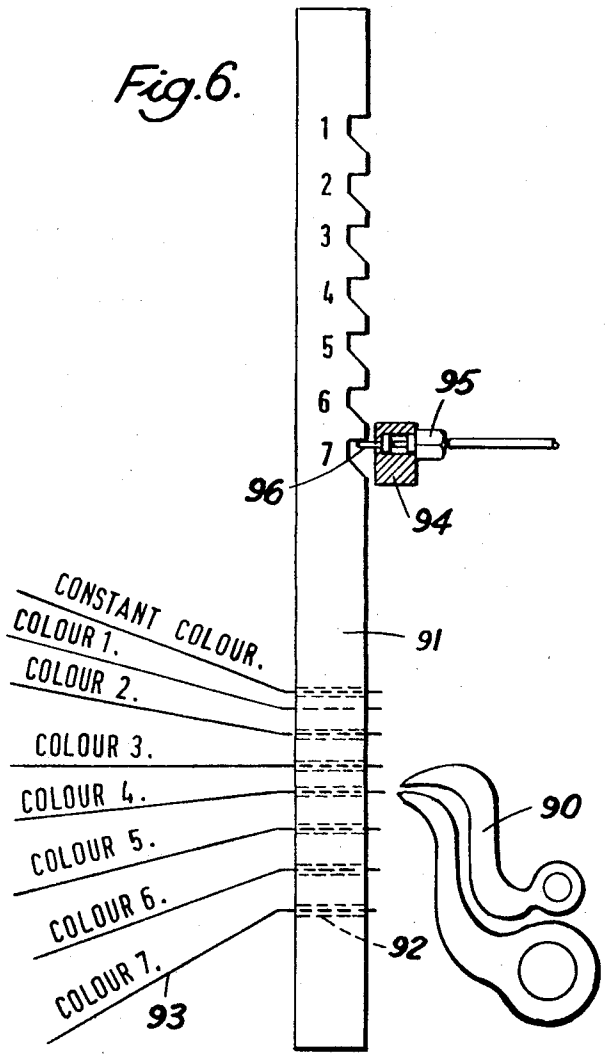

80
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83
14
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Fig. 5.

Fig.6.



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CYCLIC BEAM TUFTING MACHINE

This invention relates to fabrics such as tufted carpets.

The invention provides tufting machine comprising a number of rows of needles, means for moving a backing to be tufted along a path extending transversely to the rows of needles, a needle driving member for each row of needles which members are reciprocable towards and away from said path of the backing, means individual to each needle for engaging the needles with their associated driving members, a programmer for controlling the needle engaging means and means for reciprocating the needle driving members in staggered relation towards and away from the path of the backing so that the needles of different rows selected by the programmer perform tufting operations at different times. All the driving members may be staggered in their reciprocal movements with respect to one another. The driving members may be equally staggered with respect to one another.

Said driving means may include a rotatable shaft for each driving member which shaft has an eccentric which is linked to the driving member so that rotation of the shaft reciprocates the driving member and power drive means drivably connected to all the shafts.

The needles may be engaged with their associated driving members by a latching mechanism controlled by the programmer.

The latching mechanism may be constructed as described in Patent specification No. 9986/69.

Reciprocating loopers may be provided on the opposite side of said path for the rows of needles which loopers move into and out of the paths of travel of the needles to engage yarns in the needles which penetrate the backing so that when the needles are withdrawn loops of yarn are formed on the backing.

Yarn cutters may be provided for cutting the loops of yarn thus formed.

The yarn cutters may be rotatably driven discs, one disc being provided for each looper.

The loopers and yarn cutters may be mounted on a platform which is reciprocable parallel to the path of movement of the backing material whereby the loopers are moved into and out of the paths of travel of the needles.

The platform may be provided with guide members extending parallel to said paths to engage on either side of the lines of tufts formed on the backing to prevent lateral movement of the backing.

Guide members may be provided on the side of the path of travel of the backing remote from the loopers to prevent the backing material from lifting away from the loopers.

The following is a description of a specific embodiment of the invention reference being made to the accompanying drawings in which:

FIG. 1 is a diagrammatic side elevation of part of a tufting machine;

FIG. 2 is a diagrammatic view of a further part of the machine;

FIG. 3 is a plan view of the part of the machine shown in FIG. 2;

FIG. 4 is a diagrammatic view of a programmer for the machine; and

FIG. 5 is a diagrammatic elevation view of an alternative form of tufting machine.

Referring firstly to FIG. 1 of the drawings there is shown a tufting machine having guide rolls **10, 11, 12** and **13** which guide a backing material to be tufted al'ng a horizontal path indicated at **14.** Extending above and across the path **14** are twelve parallel spaced fixed beams **15** one beam being provided for each colour to be used in producing a tufted carpet. Each beam **15** has a vertical slideway extending through it in which a slide **16** is located. Mounted at the lower end of the slide **16** is a needle carrying beam **17** along which there are spaced a number of tufting needle holders **18** in which tufting needles **19** are mounted. The upper end of the slide **16** is connected by a link **20** to an eccentric **21** on a shaft **22.** All twelve shafts are connected to a common drive mechanism (not shown). Mounted on the right-hand side of each beam **15** is a needle selection device indicated at **23** which is operated by a pneumatic ram **24** incorporating a solenoid controlled valve The needle selection device, pneumatic ram solenoid controlled valve, needle holder and beams **15** and **17** are constructed as described in Patent specification No. 9986/69 and yarn is fed to the needles by the system described in Patent specification No. 40253/68. As the beam starts to rise a switch is operated which sends a cancelling signal to a solenoid operated valve connected in a mains air supply to all the rams to cause the rams to retract. Rotation of the shaft **22** raises and lowers the needle carrying beam **17** and, depending on whether a needle holder has been latched the tufting needles **19** are driven by the beam **17** through the backing material to bring yarns in the tufting needles into engagement with loopers (not shown) so that when the beams **17** are raised loops of tufting yarn are left in the backing material.

The eccentrics **21** on the shafts **22** are arranged at different rotational positions with respect to one another so that the needle carrying beams **17** are reciprocated sequentially. Thus at any given time there will always be some needles **19** penetrating the backing material. The needles **19** thus hold the backing material in correct registration for the needles about to make tufting operation. As the needles are withdrawn from the backing material by the beam **17** the needle holders are unlatched and this allows the needle holders and needles to swing in anti-clockwise directions thus permitting the backing material to be advanced in the direction of the arrows.

Located below the path **14** of the backing material is a platform which is shown diagrammatically in FIGS. **2** and **3** of the drawings. The platform **30** extends below all the needle carrying beams **17** and is reciprocated by a mechanism (not shown) in a direction extending parallel to the direction of the path of travel of the backing material. The platform carries a number of loopers **31** which are brought into engagement with the tufting yarns in the needles **19** which have penetrated the backing material when the platform is reciprocated. Extending across the platform are a number of motor driven shafts **32** which carry cutter discs **33.** The discs **33** sever the loops of yarn caught by the loopers. Between the loopers and cutter discs guide members **34** are located which guide the tufts of yarn on the backing material formed by previous tufting operations to prevent the backing material from being displaced laterally between the loopers.

Reference is now made in FIG. **4** of the drawings in which a programmer for controlling the aforesaid sole-

noid controlled valves of the latching devices is shown. A hollow motor driven transparent cylinder **40** carries a translucent coloured pattern **41** which is to be reproduced, the pattern being arranged so that lines extending across the pattern extend circumferentially around the cylinder. A light source **42** is spaced axially from one end of the cylinder and is arranged to direct a beam of light onto an angled mirror **43** located within the cylinder. Light reflected from the mirror **43** is focussed to a point on the surface of the cylinder by a lens **44**. Light passing through the cylinder is collected by a lens **45**. The cylinder is rotated in the direction of the arrow in synchronism with the operation of the tufting machine and the mirror **43** and lenses **44** and **45** are simultaneously moved axially along the cylinder to traverse the helical path on the pattern.

Light from the lens **45** is focussed onto a dichroic filter **46** which reflects blue light from the beam into a first photo-multiplier **47**. Light other than blue is transmitted by the filter **46** to a second dichroic filter **48** which reflects red light into the photo-multiplier **49** and transmits the remaining yellow light to a reflector **50** which reflects the yellow light into a photo-multiplier **51**. The photo-multipliers produce electrical signals the magnitude of which depends on the intensity of the light beam received.

The photo-multipliers are connected to the input side of a colour computer **52** which has twelve outputs. The outputs from the computer are for electrical signals corresponding to dark and light versions of each of the colours red, yellow, blue, purple, orange and green. The computer analyses the signals simultaneously received from the three photo-multipliers and directs an output signal into the appropriate one of its outputs. The cylinder has, in addition to the pattern **41**, a circumferential line **59** of white dots which dots correspond to the needles in the row of needles on the aforesaid beams. A photosensitive device **60** is mounted opposite the line of dots so that as the dots pass the device pulses of electricity are generated in the device. The device is connected to the colour computer and the pulses used to modify the output signals so that they are converted into pulses of the same frequency.

The outputs are connected respectively to a number of recording heads **53** past which a twelve-channel magnetic tape **54** is moved. The recording heads **53** are arranged side by side across the tape over the channels on the tape. After passing the recording heads the tape passes twelve pick-up heads **55**, one for each channel, which are staggered by distances corresponding to the distances between the tufting beams and in the same colour sequence.

Each pick-up head **55** is connected to the input of a shift register **57** having a number of outputs corresponding to the number of solenoid control valves for the latching devices. Each shift register is triggered by a switch operated by the reciprocating beam **17** when the beam reaches the upper limit of its travel and the latching devices are then operated for the next tufting operation.

Alternatively the signals from the colour computer **52** can be stored in a magnetic core or like storage system and released by suitable switching mechanism colour by colour to a single shift register which is connected consecutively in the appropriate order to each of the tufting beams when they are at the appropriate positions in their cycles. In a modification of this arrangement there may be a shift register for each beam connected directly to the storage system.

It will be appreciated that instead of a translucent pattern on the drum, the pattern may be opaque in which case the light source would be outside the drum and the drum itself can then be opaque.

FIG. **5** shows an alternative form of tufting machine which is similar to that shown in FIGS. **1** to **3** and like parts have been alloted the same reference numerals. In this case however the machine has only three needle carrying beams and only three rows of needles. The apparatus has a supporting structure **70** in which the various components are mounted. At one end of the structure an electric motor **71** is mounted which is connected to a gear box **72**. The gear box has an output shaft on which a pulley **73** is mounted. The pulley **73** is connected by a belt **74** to pulleys **75** on each of the shafts **22** for driving the needle-carrying beams whereby the shafts are rotated.

A row of pivotally mounted loopers **31** is provided for each row of needles which loopers are reciprocated towards and away from the paths of travel of the needles to engage the yarns in the needles **19** which penetrate the backing material from a drive shaft **76** to which the loopers are eccentrically connected. The shafts **76** are connected by belts **77** to the respective shafts **22** for each row of needles whereby the shafts **76** are rotated.

The set of loopers for each row of needle bars is timed to be operated in relation to the reciprocation of the needle-carrying beam for the row of needles so that the loopers are operated after the selected needles have penetrated the backing material.

Three pin rollers **78** driven by a belt **79** are provided above the path of the backing material for feeding the material under the needle driving beams and for maintaining registration of the material with the needles. The backing material after passing under the last beam passes between two co-operating pin-rollers **80, 81** one of which is driven by a belt **82** and a gear box **83** the input of which is driven by a belt **84** from the shaft **22** for the last beam and the other of which is driven by a belt from the adjacent pin-roller **78**.

It will be appreciated that in this case a programmer having only three output channels for the three rows of needles **19** is required.

Referring now to FIG. **6** of the drawings there is shown part of a yarn end selection system for a gripper Axminster carpet loom. Gripper Axminster looms have a row of swannecked grippers extending across the loom for inserting tufts of yarn in the weave as it is formed. Each gripper oscillates between a position in which it receives a tuft of yarn selected from one of a number of differently coloured yarn ends and a position in which it lays the tuft in the weave so that a patterned carpet is produced. The selector system for presenting the appropriate yarn into the grippers will now be described.

For each gripper, one of which is illustrated at **90**, there is a vertically reciprocable selection bar **91** which is guided in a slideway (not shown). The selector bar **91** is formed with eight vertically spaced apertures **92** towards its lower end and eight differently coloure of types of yarn ends **93** are fed through the apertures. The yarn ends are supplied from spools (not shown). The selector bar **91** is located adjacent a vertically reciprocating lift bar **94**. The lift bar extends across the

full width of the loom and a pneumatic ram **95** is mounted on the bar **94** opposite each of the selector bars **91.** The pneumatic ram has a plunger **96** and the ram is mounted on the bar so that the plunger can be fired towards the bar. The side of the bar adjacent the lift bar **94** is formed with seven spaced notches **97** into which the plunger **96** can be fired, so that when the plunger is fired into a notch the selector bar **91** rises and falls with the lift bar. The height which the selector bar **91** is raised to is determined by which of the notches the ram is opposite when the ram is fired. The height to which the bar is raised determines which of the seven lower yarns is taken by the gripper. If the ram is not fired at all the selector bar **91** is not raised at all and the uppermost yarn in the bar is then taken by the gripper. The manner in which the gripper **90** operates in taking the yarn end and the severing of the yarn end is identical to conventional gripper Axminster looms.

The air supply to the pneumatic ram **95** is controlled by a solenoid controlled valve and the solenoid is controlled by a programmer which will now be described.

A tape reader reads pre-recorded signals from a magnetic tape. The tape is pre-recorded with sets of signals spaced along the tape. Each set of signals comprises seven groups of signals i.e. one less the number of notches on each selector bar **91.**

Each group comprises a number of separate signals corresponding to the number of selector bars **91** which determine whether or not the solenoid controlled valves are energized.

The signals are fed from the reader which converts the signals into electrical pulses into a shift register having a number of outputs equal to the number of selector bars **91.** The shift register discharges a group of pulses automatically when the register is full and the tape is timed with respect to the lifting bar so that the register discharges each group of pulses just before the rams on the lifting bar reaches the appropriate notches in the selector bars. The outputs of the shift register are connected to the solenoid controlled valves. Thus the pulses sent to the solenoid controlled valves determine which valves are opened and thus which selector bars are lifted at that point in the movement of the lifting bar. This is repeated as the lifting bar rises up the selector bars for each group of signals recorded on the tape.

When the lift bar **94** reaches the top of its travel the loom operates as described earlier and the bar operates a mains air valve connected to all the rams to cause the rams to retract.

The loom could be controlled by the programmer shown in FIG. **4** as descirbed earlier or the modifications thereof described.

We claim:

1. A tufting machine comprising a number of rows of needles, means for moving a backing to be tufted along a path extending transversely to the rows of needles, a number of needle driving members one for each of said rows of needles, which members are reciprocable towards and away from said path of the backing, means for engaging the needles with the driving members, which needle engaging means are adapted to be controlled by a programming means and means for receiprocating the needle driving members in staggered relation towards and away from the path of the backing so that the needles of different rows selected by the programmer perform tufting operations at different times.

2. A tufting machine as claimed in claim **1** wherein all the driving members are staggered in their reciprocal movements with respect to one another.

3. A tufting machine as claimed in claim **2** wherein the driving members are equally staggered with respect to one another.

4. A tufting machine as claimed in claim **1** wherein said driving means includes a rotatable shaft for each driving member which shaft has an eccentric which is linked to the driving member so that rotation of the shaft reciprocates the driving member and power drive means drivably connected to all the shafts.

5. A tufting machine as claimed in claim **1** wherein the needles are engaged with their associated driving members by a latching mechanism controlled by the programmer.

6. A tufting machine as claimed in claim **1** wherein reciprocating loopers are provided on the opposite side of said path for the rows of needles which loopers move into and out of the paths of travel of the needles to engage yarns in the needles which penetrate the backing so that when the needles are withdrawn loops of yarn are formed on the backing.

7. A tufting machine as claimed in claim **6** wherein yarn cutters are provided for cutting the loops of yarn thus formed.

8. A tufting machine as claimed in claim **6** wherein the yarn cutters are rotatably driven discs, one disc being provided for each looper.

9. A tufting machine as claimed in claim **7** wherein the loopers and yarn cutters are mounted on a platform which is reciprocable parallel to the path of movement of the backing material whereby the loopers are moved into and out of the paths of travel of the needles.

10. A tufting machine as claimed in claim **9** wherein the platform is provided with guide members extending parallel to said paths to engage on either side of the lines of tufts formed on the backing to prevent lateral movement of the backing.

11. A tufting machine as claimed in claim **10** wherein guide members are provided on the side of the path of travel of the backing remote from the loopers to prevent the backing material from lifting away from the loopers.

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