United States Patent [19]

Short

[11] **3,752,094**

[45] **Aug. 14, 1973**

[54] **STRAND DELIVERY MEANS**

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[73] Assignee: **Deering Milliken Research Corporation,** Spartanburg, S.C.

[22] Filed: **July 6, 1971**

[21] Appl. No.: **159,632**

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

[51] **Int. Cl.** **D05c 15/32**

[58] **Field of Search** ..... 112/79 R, 79 A, 266, 112/410; 226/108, 109, 110, 111, 115, 152, 156, 157

[56] **References Cited**

UNITED STATES PATENTS

3,375,797	4/1968	Gaines	112/79 R
2,862,465	12/1958	Card	112/79 A
3,221,683	12/1965	Abelsma	112/79 R
3,605,660	9/1971	Short	112/79 A

Primary Examiner—James R. Boler

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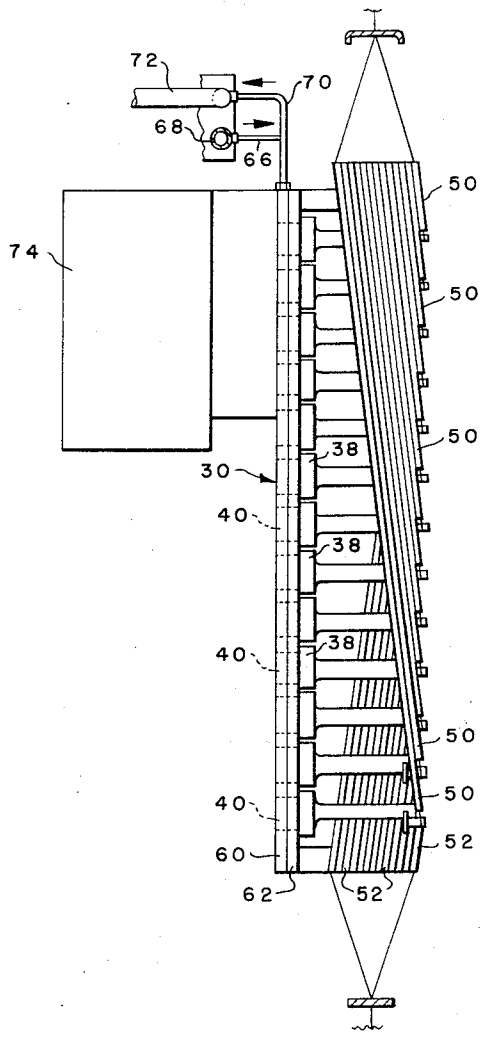
[57] **ABSTRACT**

Apparatus for feeding strands of material to a plurality of closely positioned strand take-up means comprising separate strand-engaging advancing means for each takeup means positioned in closely adjacent rows, with guide means extending between adjacent rows for guiding a strand to and from each advancing means to its corresponding takeup means.

9 Claims, 4 Drawing Figures



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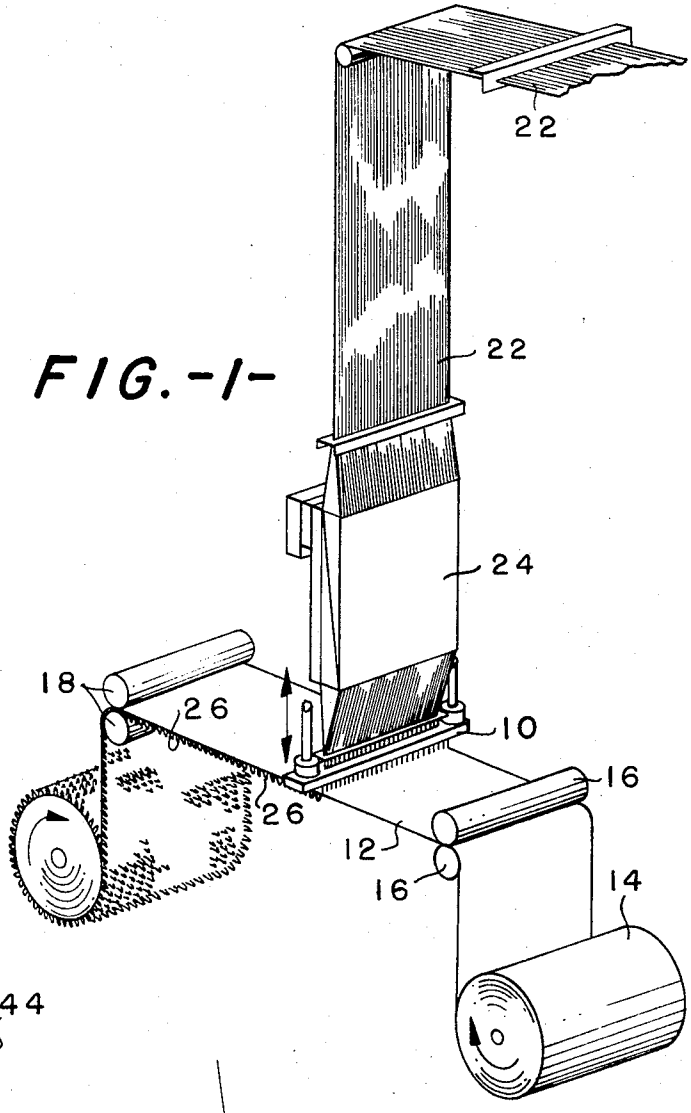

FIG. -1-

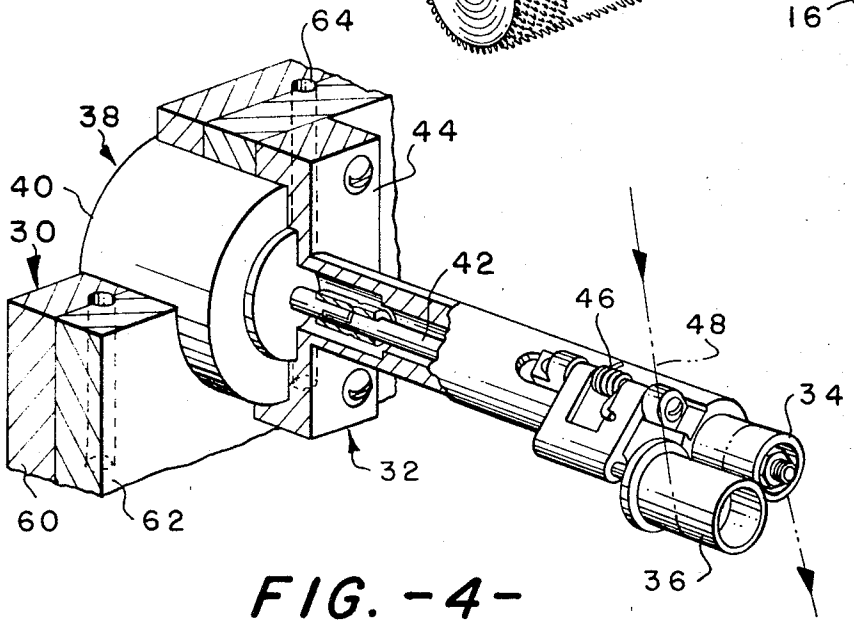

FIG. -4-

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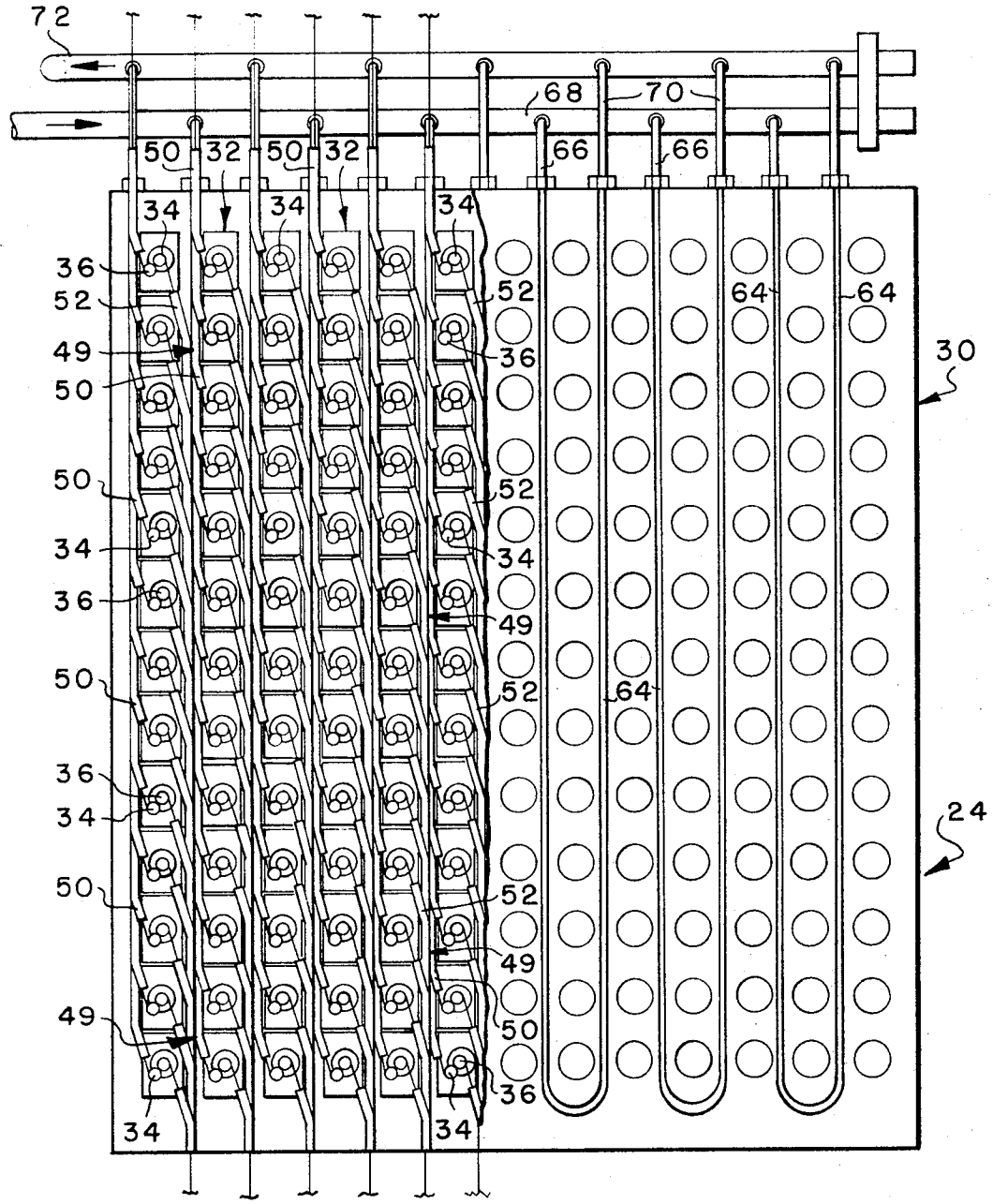

FIG. -2-

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3 Sheets-Sheet 3

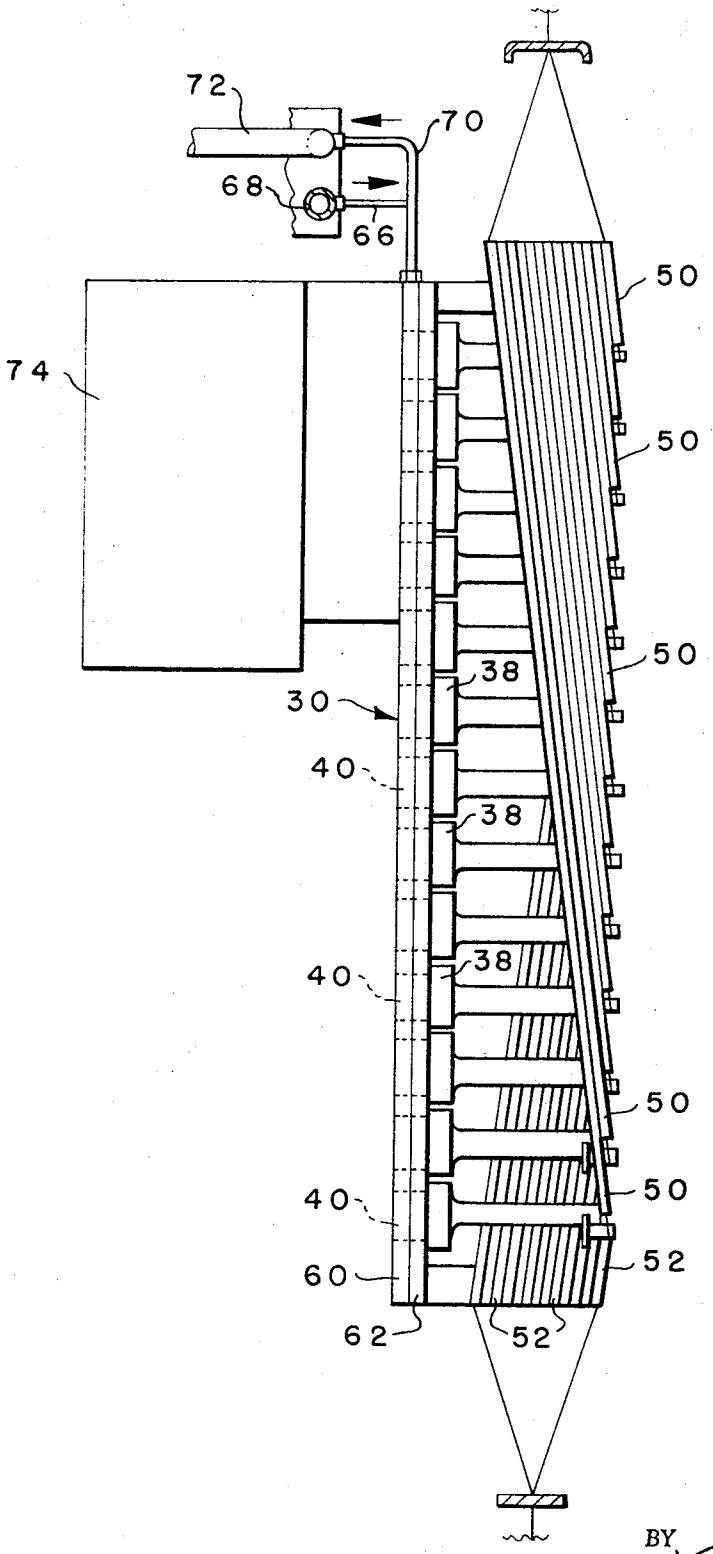

FIG. -3-

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STRAND DELIVERY MEANS

This invention relates to means for delivering strands of material to a plurality of strand take-up means and, more particularly, to improved feed means for delivering yarns at variable rates to multiple needles of a tufting machine employed in production of wide yardage pile fabric, such as carpets.

Tufting machines for producing pile fabrics employ a reciprocating needle bar containing a plurality of needles to which yarns are fed and which are cyclically reciprocated into and out of a perpendicularly moving backing sheet to insert a plurality of yarn loops therein. In one type of tufting machine, each needle in the needle bar has a corresponding looper element disposed on the opposite side of the backing sheet so that the strand carried through the backing sheet in the eye of each needle is engaged by the looper element and held to form a loop when the needle is withdrawn from the sheet. Recently, tufting machines have been constructed with hollow needles and employ a pressurized fluid, such as air, to blow the yarns through the open ends of the needles as they penetrate the backing sheet to form the pile loops, thereby eliminating the need for cooperating looper elements. Such a hollow needle machine is disclosed in my U. S. Pat. No. 3,089,442.

Patterned pile fabrics are produced on tufting machines by selectively varying the rate of feed of the yarn strands to the yarn needles during each tufting cycle to correspondingly vary the height of the pile loops formed in the fabric product. Pattern attachments for selectively varying the yarn feed rates may consist of multiple feed rollers which grip and positively advance the yarn strands to the needles. The rollers are selectively driven at high and low speeds by clutch mechanisms programmed in accordance with a predetermined pattern. Two types of rotatable roller feeding means are described in U. S. Pat. No. 2,862,465 and in U. S. Pat. No. 3,134,529, respectively. The drive shafts of the feed rollers of each of these pattern attachments are generally driven at variable speed rates by high and low speed magnetic clutches which selectively engage the drive shaft in response to activation by a pattern control mechanism, such as a pattern chain, a rotatable pattern drum or other such patterning device well known in the art.

In utilizing such yarn feeding pattern attachments, it is desirable that the point of yarn feed be located as close as possible to the needles in order to provide a short path of yarn travel from the feeding point to the needles. This minimizes pattern irregularities caused by variations in yarn tensions and feed rates resulting from physical variations in the yarns themselves, as well as decreases the chances of entanglement between adjacent yarn strands being fed to the needles. Due to the relatively large size of the pattern attachments and their driving means, and the amount of space consumed thereby, only a limited number of yarn feeding rollers can be located in close proximity to the closely spaced needles of the tufting machine. As an example, pile carpets produced in fifteen foot widths with loops or tufts every one eighth inch require 1440 needles across the needle bar. Because of the limited space for close location of the feeding means, it has been the practice to feed multiple yarn ends on each of the individual feed rollers to provide a yarn end to each of the needles in the needle bar. This obviously limits the pattern capabilities of the tufting machine and requires

that a number of pattern repeats occur across the width of the fabric. It can thus be appreciated that very large patterns or a single overall pattern cannot be produced in a tufted carpet on a tufting machine employing the pattern attachments described.

The present invention is directed to an improved means for feeding plural strands of material to strand take-up means, such as needles of a tufting machine, wherein the rate of feed of the individual strands may be separately and independently controlled, with the strand feeding means located in compact, closely adjacent relation to the takeup means. The individual yarn feeding means employed in the present invention may be of the general type disclosed in copending, commonly assigned U. S. Pat. Application, Ser. No. 17,312, of which I am a co-inventor. Such feeding means comprise electrically operated motors of the pulse-responsive type which are incrementally "stepped" by electrical pulses to rotate by a predetermined amount yarn gripping rollers driven thereby. Depending on the total incremental rotation of the yarn motors and rollers, a desired amount of yarn is fed to the needles in each tufting cycle to provide the yarn loops of desired heights.

The invention will be better understood and explained by reference to the accompanying drawings in which:

FIG. 1 is a diagrammatic perspective view of the principal components of a tufting machine showing the overall arrangement and position of the yarn strand feeding means of the present invention utilized therein;

FIG. 2 is an enlarged front elevation view, with portions broken away, of the yarn feeding means of FIG. 1;

FIG. 3 is a side elevation view of the yarn feeding means of FIG. 2;

FIG. 4 is an enlarged perspective view, with portions broken away and in section, of a single yarn feeding member of the yarn feeding means for directing an individual yarn strand to a tufting needle.

Referring more particularly to the drawings, FIG. 1 is a schematic perspective view of the major components of a tufting machine comprising a needle bar **10** which is vertically reciprocated by suitable means, not shown, to pass the needles thereof repeatedly through a suitable backing sheet **12**. The sheet **12** is supplied from a backing sheet supply roll **14** and is moved past the reciprocating needle bar in the direction of the arrow by rotatable feed rolls **16, 18** which are operated in synchronous manner with the reciprocating needle bar by conventional drive means, not shown.

A sheet of yarn strands **22** is supplied from a creel, not shown, to a yarn feed mechanism or pattern attachment **24** which advances individual yarn strands of the sheet at selected rates to the individual needles of the needle bar **10**. The needles of needle bar **10** may be of the hollow type as described in my U.S. Pat. No. 3,089,442 and pneumatic pressure employed to blow the strands through the open ends of the needles as the needles penetrate the primary backing sheet **12** to form pile loops **26** of yarn therein.

Referring more particularly to the compact yarn feeding mechanism or pattern attachment **24** of the present invention, FIG. 2 is a front elevation of the attachment **24** which comprises a support panel **30** in which are mounted a plurality of rows **32** of yarn strand feeding means. Details of each strand feeding means

are best shown in FIG. 4 and include a pair of strand-engaging nip rollers **34, 36** which are rotatably driven by motor means **38** to advance an individual yarn strand to the strand take-up means or needles of the needle bar. Each motor means includes a main body portion **40** and an elongate drive shaft **42** drivingly connecting the main body portion with the strand advancing roller **36.** As previously mentioned, the motors of motor means **38** are of the electric, pulse-responsive type and the main body portion **40** of each is supportably mounted in an opening of panel **30** and secured therein by a housing **44** attached to the face of the panel. Roller **34** is attached to the end of drive shaft **42** and freely rotatable roller **36** is maintained in nip relation therewith by a spring mechanism **46** so that a yarn strand **48** passing to the advancing rollers is positively gripped thereby.

As best seen in FIGS. **2** and **3,** suitably supported between each of the rows of strand-engaging advancing rollers and their corresponding motor means is a bank **49** of strand guide tubes for directing a yarn strand to each advancing means and from each advancing means to its corresponding needle in the needle bar. Each of the interior banks of strand guide tubes is composed of a first section **50** of stacked entry tubes and a second section **52** of stacked exit tubes secured in back-to-back relation by suitable means, such as welding. As best seen in FIG. **3,** the entry tubes in each section **50** which guide individual yarn strands to their respective strand advancing rollers in an adjacent row of advancing means are angled outwardly, top to bottom, and are stacked in a plane between and generally perpendicular to the spaced parallel planes in which are located the main body portions of the motors and the yarn advancing rollers. In like manner, the exit tubes in each section **52** of exit tubes which guide yarn strands from the other adjacent row of advancing rollers are angled inwardly from top to bottom and are stacked in a plane perpendicular to the spaced parallel planes of the motor means and advancing rollers.

Each needle of the needle bar is provided with a separate pair of strand-engaging advancing rollers and the individual yarn strands are guided to and from the rows of advancing rollers by the compact arrangement of yarn guide tubes disposed therebetween. In this manner the rate of feed of each individual yarn strand may be separately regulated to each of the needles to provide loop-height patterning capabilities far exceeding the ability of the aforementioned yarn feed pattern attachments.

Because of the compact arrangement of the motor means of each advancing means, it is desirable to provide means for cooling the motors. As shown in FIGS. **3** and **4,** the main body portions **40** of the motor means **38** are mounted in openings in the support panel **30.** The support panel **30** is composed of mating sections **60, 62** which are secured by suitable means, such as bolts. The sections are preferably constructed of heat conductive material such as stainless steel, aluminum, or the like, and the inner face of each section **60, 62** is provided with a plurality of recessed U-shaped channels which mate to form a plurality of U-shaped passageways **64** (FIG. **2**) for conveying acooling fluid between the rows of motor means adjacent the main body portions thereof. As seen in FIG. **2,** one open upper end of each U-shaped passageway **64** is connected by a conduit **66** to an inlet manifold **68,** and the other open upper end of each U-shaped passageway is connected by a conduit **70** to an outlet manifold **72.** The inlet manifold **68** is supplied with a suitable cooling fluid, such as water, which may be continuously circulated through the support panel to provide means for cooling the motors.

The operation of each of the pulse-responsive electric motors may be controlled by a patterning device, such as a programmed magnetic tape, operably connected thereto through an electrical control unit **74** indicated schematically in FIG. **3.** In this manner, individual signals may be sent to each pulse-responsive motor and its respective yarn-gripping rollers rotated a desired amount to variably and individually feed each yarn strand to each needle of the tufting machine, as described in commonly assigned U. S. Pat. application Ser. No. 17,312 mentioned above. Further, by locating all of the yarn strand-gripping feed rollers in a common plane in front of the banks of strand guide tubes, the rollers are readily accessible to the operator for thread-up and maintenance of the feed mechanism during use.

From the foregoing, it can be seen that the compact yarn feeding mechanism of the present invention can be installed and employed in close proximity to the needles of a tufting machine to provide selectively variable yarn feed independently to each needle. Although the present invention has been described with specific reference to a tufting machine for manufacturing pile fabrics, it is obvious that the feeding mechanism may be employed in other apparatus wherein it is desirable to maintain individual feed control of strands to closely associated strand take-up means.

That which is claimed is:

1. In a tufting machine including a needle bar containing a plurality of yarn dispensing needles, means for moving a backing sheet past said needle bar, means for producing relative movement between the needle bar and backing sheet to cause cyclical penetration of the needles therethrough to insert loops of yarn therein, and means for feeding yarn strands to each of the needles; the improvement wherein said feeding means comprises separate yarn strand-engaging means for each needle, separate motor means connected to each of said strand-engaging means for independently driving the same to longitudinally advance a strand engaged thereby, means mounting each motor means together with its corresponding strand-engaging means in plural closely adjacent parallel rows positioned close to the needles of said needle bar, and guide means extending between adjacent of said rows and generally parallel thereto for guiding a yarn strand from each of said strand-engaging means to a corresponding one of said needles in said needle bar.

2. Apparatus as defined in claim **1** wherein each of said motor means includes a main body portion and means drivingly connecting said main body portion to the corresponding advancing means to locate said engaging means and said main body portions of said motor means in spaced, generally parallel planes, and said guide means comprising a plurality of banks of strand-guiding tubes positioned generally between said planes.

3. Apparatus as defined in claim **2** wherein each of said engaging means comprises roller means and including a first number of said tubes in at least one of said banks positioned to guide strands from one end of said rows to the roller means in an immediately adja-

cent row, and a second number of said tubes in said bank positioned to guide strands from the roller means in the other immediately adjacent row to the other end of said rows.

4. Apparatus as defined in claim **3** wherein said banks of strand-guiding tubes are stacked generally perpendicular to said spaced planes.

5. Apparatus as defined in claim **1** wherein said means mounting said motor means and feed rollers comprises a support panel, and means associated with said panel for cooling the motor means during operation of the apparatus.

6. Apparatus as defined in claim **5** wherein said support panel has heat conductive properties, said main body portions of said motor means are recessed in said panel, and said cooling means includes means in said panel for conveying a cooling fluid between said rows of motor means.

7. Apparatus as defined in claim **1** wherein each of the needles in said needle bar is hollow for the passage of a yarn strand therethrough.

8. Apparatus as defined in claim **1** wherein each of the needles in said needle bar is substantially solid throughout its length and has an eyelet in its outer end portion for passage of a yarn strand therethrough.

9. A tufting machine as defined in claim **7** wherein each of said strand-engaging means comprise roller means, and said motor means includes means for rotating said roller means to longitudinally advance a strand engaged thereby.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,752,094 Dated August 14, 1973

Inventor(s) Joe T. Short

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the specification, column 4, line 57 (Claim 2, line 4), change "advancing" to --engaging--.

Signed and sealed this 16th day of July 1974.

(SEAL)
Attest:

McCOY M. GIBSON, JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,752,094 Dated August 14, 1973

Inventor(s) Joe T. Short

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the specification, column 3, line 63, delete "acooling" and insert -- a cooling--.

In the claims, Claim 9, first line, delete "7" and insert --1--.

Signed and sealed this 26th day of March 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
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C. MARSHALL DANN
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