April 2, 1968 W. M. GAINES 3,375,797

PATTERN ATTACHMENT FOR TUFTING MACHINES

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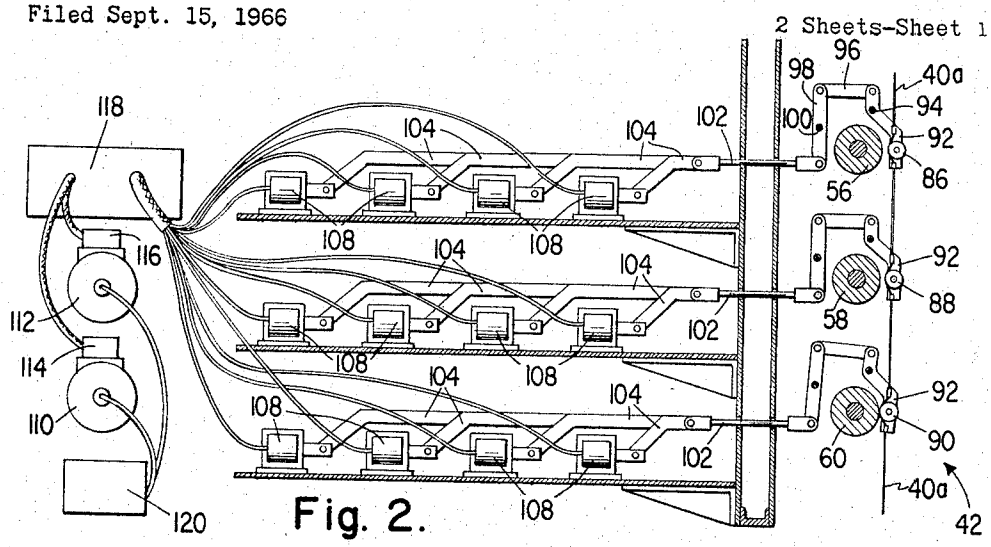

Fig. 2.

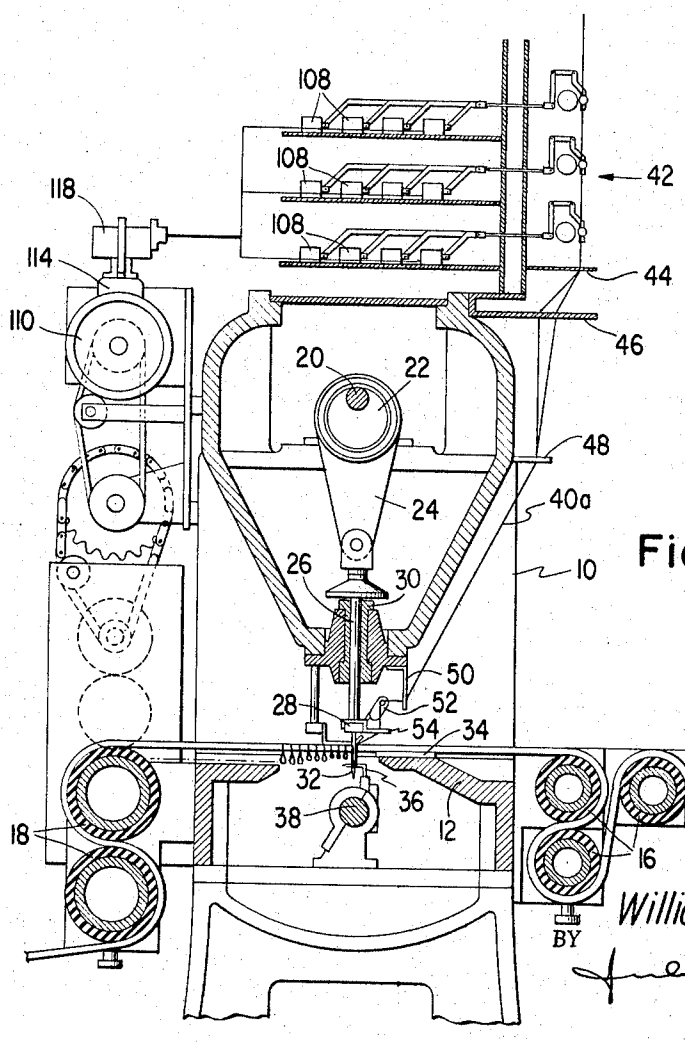

Fig. 1.

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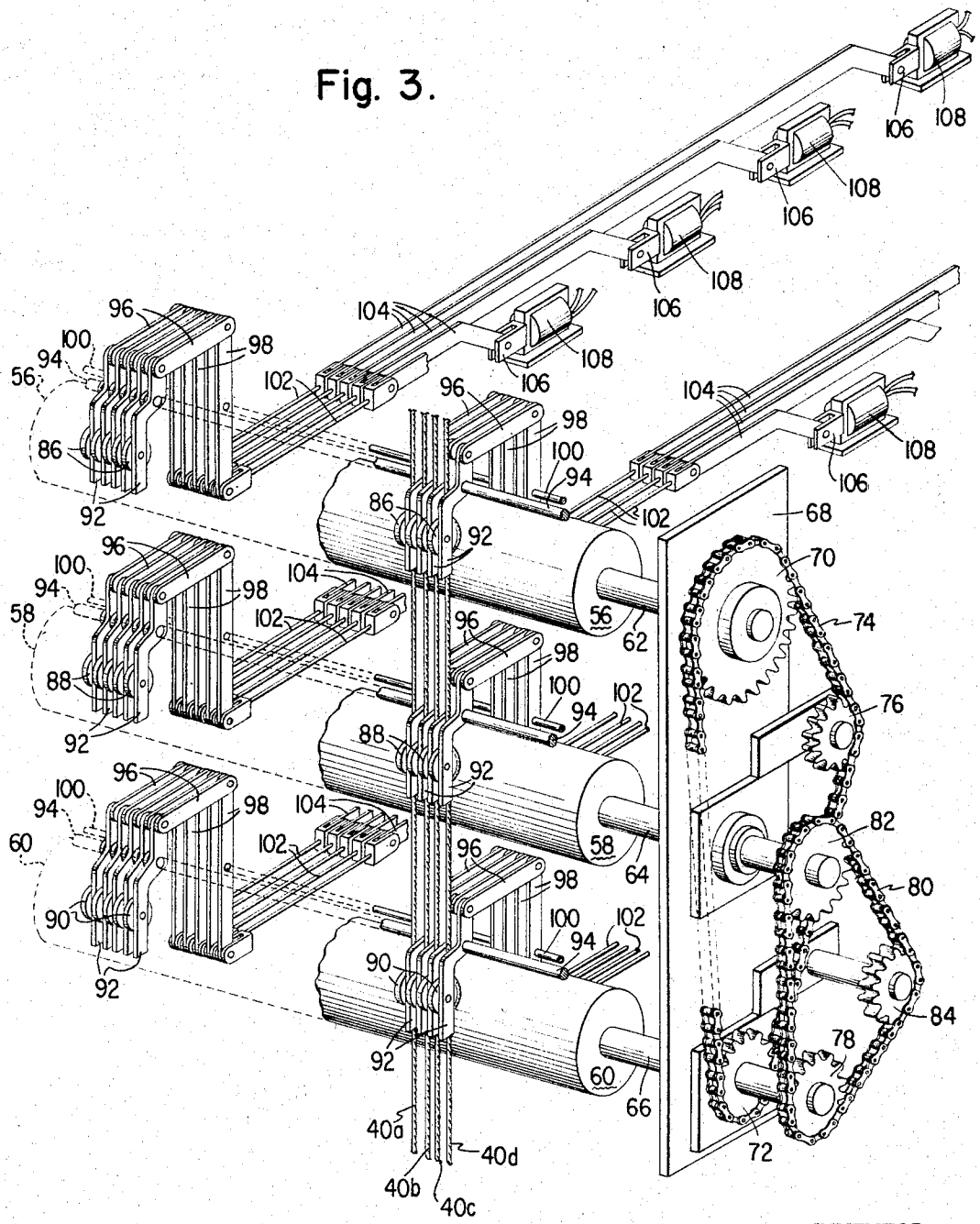
Fig. 3.



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PATTERN ATTACHMENT FOR TUFTING MACHINES

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This invention relates to means for producing variations in the pile height of tufted fabrics and is particularly directed to a pattern attachment for controlling the yarn feed in tufting machines.

It is a prime purpose of the invention to provide a pattern attachment for tufting machines which is capable of relatively simply and efficiently producing a plurality of selected pile heights from each yarn strand so that fabric can be produced having relatively intricate patterns. It is known in the tufting art that variations in the pile height can be brought about by varying the length of the yarn being fed to a needle during its penetration stroke so that, for example, if the length of yarn is decreased on a particular stroke of the needle, the previously formed loop or tuft will be shortened by backrobbing of the yarn from said previously formed loop. The previously known mechanisms for producing variations in pile height have not been entirely satisfactory in that they have been somewhat limited in the number of different heights of pile that can be obtained.

In accordance with the present invention, a pattern attachment means is provided for selectively controlling the speed at which each strand of yarn is fed to the needle so that by selectively varying the yarn feed a plurality of different heights of pile may be produced in response to predetermined pattern selections. The invention is generally carried out by providing a plurality of feed rolls, each being rotatable at a different speed from each other feed roll and each being capable of feeding yarn to a needle at a speed determined by its speed of rotation. A plurality of yarn control rollers are disposed adjacent to each feed roll for each yarn strand. The control rollers for each yarn strand carry the associated yarn strand in spaced relationship with the feed rolls and, in response to a predetermined pattern signal, selectively bring their associated yarn strand into engagement with a feed roll for positively feeding the yarn at a speed determined by the speed of the associated feed roll. A pattern control mechanism is provided through which a desired fabric pattern can be duplicated by generating control signals for actuating the control rollers in response to the predetermined control signals. As will be apparent from the detailed description following below, through the construction of the pattern attachment of the present invention, the speeds of yarn feed that may be selected for each yarn strand are substantially unlimited so that a wide variation of pile height can be obtained.

Accordingly, it is one object of the invention to provide a novel and improved pattern attachment for a tufting machine which is capable of producing a relatively wide variety of pile heights.

It is a further object of the invention to provide a novel and improved yarn feed mechanism for a tufting machine wherein a plurality of speeds of yarn feed may be individually selected for each yarn strand.

It is an additional object of the invention to provide a novel and improved pattern attachment for a tufting machine wherein a plurality of speeds of yarn feed may be obtained by providing a separate means for actuating the feed mechanism for each yarn strand for a particular speed of yarn feed desired.

Other objects and advantages of the invention will be best understood upon reading the following detailed description of a preferred embodiment of the invention with the accompanying drawings in which:

FIG. 1 is a partial sectional view showing a tufting machine embodying the invention;

FIG. 2 is an enlarged side view of the pattern attachment of the invention with parts thereof shown in section; and

FIG. 3 is an enlarged fragmentary perspective view showing the yarn feed attachment of the invention.

Referring to FIG. 1, there is shown therein a portion of a tufting machine comprising a frame **10** and including thereon a bed plate **12** for supporting a backing fabric **14** which fabric moves relative to the bed plate **12** by means of a plurality of backing fabric feed rolls **16**, which feed the fabric to the machine from a suitable source (not shown), a plurality of take-up rolls **18** at the output side of the machine. A main shaft **20** is journalled in frame **10**, and is suitably driven by a motor (not shown) in a well known manner. The shaft **20** has an eccentric **22** supported thereon in driving relationship and a connecting rod **24** is disposed in surrounding engagement with the eccentric **22** so that rotary motion provided by the shaft **20** and the eccentric **22** will result in a substantially reciprocating motion of the connecting rod **24**. A rod **26** is pivotally connected to the connecting rod **24** at one end and to a needle bar **28** at its other end with the rod **26** passing through a bushing **30** in the frame **10** so that the rod **26** and the needle bar **28** will reciprocate relative to the frame **10** and the bed plate **12** as a result of the motion imparted by the shaft **20**, eccentric **22** and the connecting rod **24**.

The needle bar **28** supports a needle **32** therein for reciprocating said needle through the backing fabric **14** and a needle plate **34** on the bed plate **12** which supports the backing fabric **14** against the thrust of the needle **32**. A hook **36** is supported beneath the bed plate **12** and is oscillated by a shaft **38** in a known manner for operating in cooperation with the needle **32** as said needle pierces the backing fabric **14** and carries a loop of yarn therethrough for forming the tufted pile. As further illustrated in FIG. 1, a yarn strand **40***a* is supplied from a suitable source (not shown) through a pattern attachment mechanism generally indicated at **42** and is guided to the needle **32** by suitable yarn guide means **44**, **46**, **48** and **50**, over a yarn thread jerker bar **52** and through a further yarn guide **54** carried by the needle bar **28** and is then threaded through the needle **32**. Although only one needle **32** and its associated driving mechanism and one hook **36** are shown in the drawings, it will be understood that, as it conventional in tufting machines, a plurality of needles and hooks are preferably provided and only one of each of said elements has been shown for purposes of clarity of illustration.

As briefly explained above, the pile height in tufted fabrics can be varied through controlling the amount of yarn fed to the needle during its reciprocating stroke relative

to the backing fabric so that, if the yarn feed is decreased during a needle stroke, the needle, which has a constant stroke, will rob yarn from the previously formed loop as it penetrates the fabric to form the succeeding loop. This action is termed backrobbing and can be utilized to obtain variations in the loop size and thus the pile height. In accordance with the present invention, means are provided for selectively varying the length of each yarn strand that is fed to the needle during a particular needle stroke so that the needle will backrob from a previously formed loop in an amount determined by the relative amount of yarn fed during the succeeding needle stroke. By varying the amount of yarn fed, the amount of yarn backrobbed from a previously formed loop will be varied and thus the different size loops will be formed.

In order to control the length of the yarn fed for each needle stroke, a yarn feed mechanism is provided which includes a plurality of feed rolls, there being three such feed rolls **56**, **58** and **60** shown in FIG. 3. As illustrated in FIG. 3, each of the yarn feed rolls **56**, **58** and **60** is journalled for rotation relative to one another and each is provided with a shaft **62**, **64**, **66**, respectively, journalled by bearings in frame member **68**, there being only one such frame member shown in FIG. 3. The rolls may be driven in any suitable manner as through a conventional motor and transmission means (not shown) such as, for example, a drive mechanism connected to the main driving motor for the machine or by a separate motor for the yarn feed mechanism itself. Preferably the feed rolls **56**, **58** and **60** are covered with a material having relatively high friction characteristics, such as rubber or the like, to aid in gripping the yarn when it is brought into feeding contact with said feed rolls.

Assuming for purposes of explanation, that the feed roll **60** through its shaft **66** is directly driven through a suitable motor and gear reduction means, the shaft **66** of the feed roll **60** is provided with a first sprocket **72**, which is connected to a sprocket **70** through a drive chain **74** supported in fixed relationship to the shaft **62** of the feed roll **56**. An idler sprocket **76** is suitably supported for rotation and also serves as a tensioning means for the chain **74** as illustrated in FIG. 3. The shaft **66** of the feed roll **60** also carries a second sprocket **78** which through a chain **80** is connected in driving relationship with the sprocket **82** fixedly carried by the shaft **64**. A sprocket **84** is engaged with the chain **80** and serves an idler sprocket and tensioning means for said chain **80**. It will be seen that the shaft **66** through its sprockets **72** and **78** will drive the shafts **62** and **64** of the feed rolls **56** and **58**. Further, the driving sprockets for each of the respective shafts **62**, **64** and **66** are of different sizes or ratios from one another so that each of the feed rolls will be driven at a different speed from each other feed roll. As shown in FIG. 3, the shaft **66** carries the relatively smallest drive sprockets **72** and **78**, the shaft **64** carries the next largest sprocket **82** and the shaft **62** carries the relatively largest sprocket **70** so that the feed roll **66** will rotate relatively faster than each of the feed rolls **56** and **58**, the feed roll **58** will rotate the next fastest, and the feed roll **56** will rotate relatively slower than the other two feed rolls **58** and **60**. For convenience of explanation, the feed rolls **60**, **58** and **56** may be referred to as the fast, medium and slow feed rolls, respectively.

Again referring to FIG. 3, as shown therein, a plurality of yarn supporting mechanisms or yarn control rollers **86** are provided for carrying the strands of yarn and for bringing the yarn strands into feeding engagement with the feed rolls **56**, **58** and **60** in a manner which will be explained more completely hereinafter. For purposes of explanation, only four yarn strands **40***a*, **40***b*, **40***c* and **40***d* are shown in FIG. 3, although it should be understood, as is well known in the art, a relatively large number of yarn strands are normally provided for tufting fabric such as carpet or the like. A plurality of yarn control rollers **88** and **90** are also respectively disposed adjacent to feed rollers **58** and **60** for engagement therewith with each yarn control roller **88** and **90** carrying a yarn strand in the same manner as the control rollers **86**. It will be apparent from FIG. 3, that each yarn strand is provided with a control roller disposed adjacent to each of the feed rolls **56**, **58** and **60** so that a yarn strand may be brought into positive feeding engagement with a selected feed roll whereby the yarn strand will be positively fed to the needle at a speed determined by the speed rotation of the associated feed roll operably engaged with the yarn strand.

Further in accordance with the invention, means are provided for selectively and individually bringing a yarn strand into operative feeding engagement with a feed roll so that the amount of yarn fed to the needle can be controlled in accordance with the desired loop height to be produced. Each of the yarn control rollers **86**, **88** and **90** is supported by a generally S-shaped lever **92**, which lever **92** is in turn supported for pivoting action about a pivot shaft **94** which shaft **94** extends axially across the machine and through each of the levers **92**, as illustrated. A connecting link member **96** connects the levers **92** at one end thereof and a lever **98** at its other end which lever **98** is supported for pivoting action about pivot shaft **100**, disposed in a similar manner as pivot shaft **94**. A rod **102** is connected to the opposite end of each of the levers **98** in a suitable manner which permits the lever **98** and the rod **102** to pivot relative to one another. Each rod **102** is further connected to an arm or link member **104** which is in turn suitably connected to the armature **106** of a solenoid **108**. As will be apparent hereinafter, each of the solenoids may be selectively energized to cause relative movement of its armature with resulting selective engagement of its associated control rollers **86**, **88**, **90** with a preselected feed roll to feed the yarn in accordance with the manner described above.

As best shown in FIG. 3, one solenoid **108** and an associated linkage mechanism is provided for each control roller so that the control rollers may be selectively and individually actuated. As will be further explained below, means are provided for selectively energizing the solenoids **108** in response to a control signal which is generated in accordance with a preselected desired pattern.

Assuming for purposes of explanation that one of the solenoids **108** is energized, the solenoid **108** is operative to draw its armature **106** toward the solenoid body in a direction away from the associated feed roll and will move arm **104** and the rod **102** to the right as viewed in FIG. 3. Lever **98** will be caused to pivot in a counter-clockwise fashion about shaft **100** thereby moving connecting link **96** toward the left to pivot lever **92** in a counter-clockwise direction about the pivot shaft **94** and thereby bring its control roller and the associated yarn strand into engagement with the associated preselected feed roll. A length of yarn will thereby be positively fed out by the feed roll to provide an amount of yarn to the needle determined in accordance with the speed of the particular feed roll engaged. As soon as the control signal is cut off so that solenoid **108** is no longer energized, the armature will be returned to its original position in a known manner, which thereby results in the control roller being drawn out of engagement with the associated feed roll so that this feed roll will no longer control the amount of yarn fed to the needle.

As mentioned above, means are provided for selectively energizing each of the solenoids, in accordance with a preselected pattern. The pattern control mechanism includes a pair of pattern rolls **110** and **112**, shown in FIG. 2, which are preferably disposed in coaxial relationship, although shown one above the other in FIG. 2 for purposes of illustration. Pattern rolls **110** and **112** comprise cylindrically shaped drums having a peripheral surface which is preferably transparent or translucent so that light may be passed through the drum. A preselected pattern sleeve is provided on the peripheral surface of each of the pattern

rolls which pattern sleeves have opaque and light transmitting portions determined in accordance with the pattern desired for the particular tufting operation. A light source, such as elongated fluorescent tube, is provided inside the pattern rolls or drums to provide a source of light which passes through the light transmitting portions of the pattern drum and sleeve. Photosensitive means, such as photocell devices diagrammatically illustrated at **114** and **116**, are provided in operative relationship with each of the pattern drums **110** and **112**, as illustrated in FIG. 2. The photosensitive devices preferably comprise a plurality of photocells which distinguish light passing through the peripheral surface of each drum or the absence of light caused by the opaque portions on the sleeves and accordingly, respond to generate an electrical signal which is transmitted through an associated cable to a relay control center **118**. Relay control center **118** contains a relay for each solenoid **108** which relay is in turn electrically connected to an associated individual photocell in the photocell mechanisms **114** and **116** so that, when a photocell responds to a light signal or absence thereof, the relay will provide a voltage to its associated solenoid **108**.

Two pattern drums are preferably provided for producing relatively intricate patterns and the pattern for the selected tufting operation may be distributed between the two pattern drums in a manner wherein drum **110** may provide control signals for producing high pile and low pile while the drum **112** may provide control signals for producing high and medium pile. It will be understood that the pattern may be divided among as many drums as is necessary in accordance with the intricacy of the selected pattern to be produced in the fabric. The pattern drums **110** and **112** are preferably continuously rotated during operation and may be driven from the main motor through a suitable gear drive or belt drive, as illustrated in FIG. 1. Reference may be made to U.S. Patent No. 3,103,187, issued on Sept. 10, 1963, to W. W. Hammel, Jr., for a more complete description of a type of photocell control pattern attachment which may be embodied in the invention. Insofar as the present invention is concerned, other types of pattern control means may be provided such as a mechanically responsive pick-up, or a pattern mechanism which is responsive to reflected light, as for example, from the drum surface, instead of passing light through a drum surface as described above. A light source control box **120** is also preferably included for providing a power source for the electrical light source inside the drums **110** and **112** and the light control box mechanism may also include means for automatically shutting off the light when the machine is not in use.

During operation of the machine, the photocell units **114** and **116** continuously scan the pattern upon the surface of the rotating drum **112**. In accordance with the predetermined pattern, the photocell units will be individually energized to provide control signals to the relay associated with the particular photocell whereby a voltage will be supplied to the associated solenoid **108** which will in turn actuate a control roller to move into engagement with the appropriate feed roll. It will be seen, therefore, that by providing an individual actuating mechanism for each control roller and by providing a number of different feed rolls which rotate at different speeds, various patterns may be produced including a plurality of different loops or pile heights. In the embodiment illustrated, at least three different pile heights can be produced through the three feed rolls rotating at different speeds. However, it should be understood, it is within the scope of the invention to provide other speeds for the yarn feed, such as, for example, by permitting the needle to pull yarn from the source with positive engagement of a control roller with a feed roll or wherein more than one control roller for each yarn strand is engaged with associated feed rolls so that an intermediate speed between the speeds of the two engaged rollers will be provided.

While the invention has been described in detail in its preferred embodiment, it will be understood by those skilled in the art that various modifications and changes may be made therein without departing from the spirit and scope of the invention as defined in the appended claims. It is aimed in the appended claims to cover all such modifications.

I claim:

1. In a tufting machine; yarn feed means for feeding a plurality of yarn strands including a plurality of feed rolls disposed for rotation relative to one another; means for rotating each feed roll at a different speed from the speed of each other feed roll; a plurality of individually movable yarn supporting mechanisms, there being a yarn supporting mechanism for each yarn strand disposed adjacent to each feed roll for operable engagement therewith so that, when a yarn supporting mechanism operably engages an associated feed roll, yarn will be fed at a speed determined by the speed of rotation of said feed roll; actuating means for moving said yarn supporting mechanisms relative to said feed rolls, said actuating means including a separate actuator mechanism for each yarn supporting mechanism; and control means for selectively and individually initiating movement of each said actuator mechanism to move a yarn supporting mechanism relative to its associated feed roll in accordance with the selection of said control means such that a plurality of different individual lengths of yarn can be selectively provided by said yarn feed means through selective operable engagement of said yarn supporting mechanisms with said feed rolls.

2. In a tufting machine as recited in claim **1** wherein each said actuating mechanism includes an electromagnetic actuator operably connected to a yarn supporting mechanism for moving said yarn supporting machanism relative to a feed roll associated with said electromagnetic actuator and said yarn supporting mechanism.

3. In a tufting machine as recited in claim **1** wherein said control means includes scanning means for scanning a preselected pattern, said scanning means being responsive to distinctive portions on said preselected pattern to produce control signals for initiating movement of selected actuator mechanisms.

4. In a tufting machine as recited in claim **3** wherein said scanning means comprises a photosensitive means capable of producing an electrical control signal and said preselected pattern includes selected portions operable for transmitting light from a source of light to said photosensitive means for inducing said photosensitive means to produce control signals in accordance with the light transmitted from said pattern portions.

5. In a tufting machine as recited in claim **1** wherein said actuating means is responsive to electrical signals for moving said yarn supporting mechanisms and said control means being operable for providing selected predetermined electrical signals to each actuating mechanism whereby each yarn supporting mechanism will be moved relative to its associated feed roll in accordance with the selected predetermined electrical signal produced by said control means.

6. In a tufting machine as recited in claim **1** wherein the number of different individual lengths of yarn which can be selectively provided by said yarn feed means is at least equal to the number of feed rolls.

7. In a tufting machine as recited in claim **6** wherein said yarn feed means includes at least three feed rolls.

8. In a tufting machine as recited in claim **1** wherein said feed rolls are supported with their axes in substantially parallel relationship and said yarn supporting mechanisms disposed adjacent each feed roll are supported for movement toward and away from a plane including the axes of said feed rolls.

9. In a tufting machine as recited in claim **1** wherein each yarn supporting mechanism comprises a yarn con-

trol roller supported for pivotal movement toward and away from its associated feed roll.

10. In a tufting machine as recited in claim **9** wherein each said actuating mechanism comprises an electromagnetic actuator and each yarn control roller being operably connected to an electromagnetic actuator so that individual pivotal movement of each yarn control roller can be initiated whereby each yarn strand can be individually and selectively pivoted into feeding engagement with a selected feed roll for feeding yarn in accordance with the relative speed of rotation of the selected feed roll.

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