Sept. 10, 1963 W. W. HAMMEL, JR 3,103,187

PHOTOCELL CONTROLLED PATTERN ATTACHMENT FOR TUFTING MACHINES

Filed May 29, 1961 4 Sheets-Sheet 1

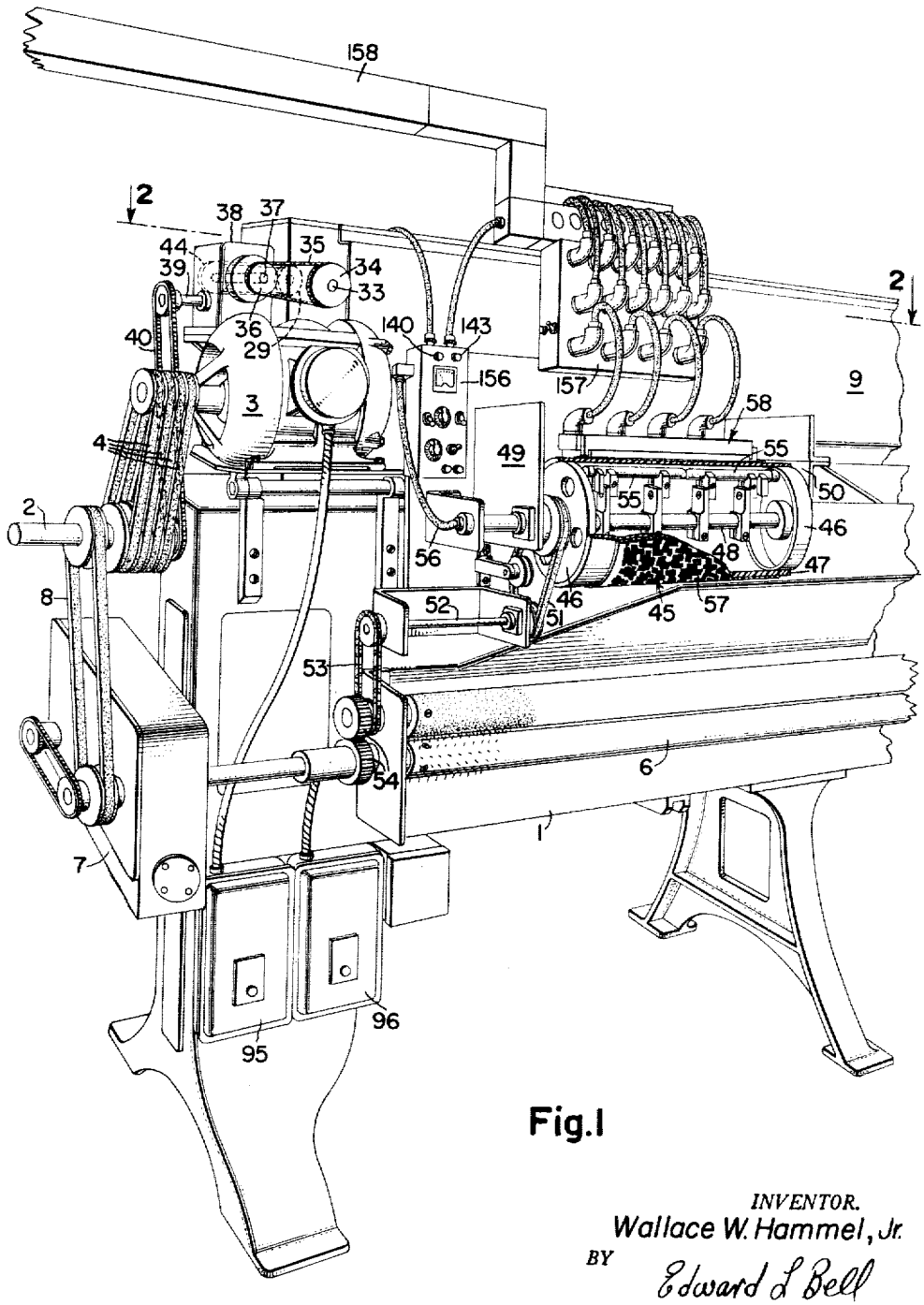



Fig.1

INVENTOR.
Wallace W. Hammel, Jr.
BY Edward L Bell
ATTORNEY

Sept. 10, 1963 W. W. HAMMEL, JR 3,103,187

PHOTOCELL CONTROLLED PATTERN ATTACHMENT FOR TUFTING MACHINES

Filed May 29, 1961 4 Sheets-Sheet 2

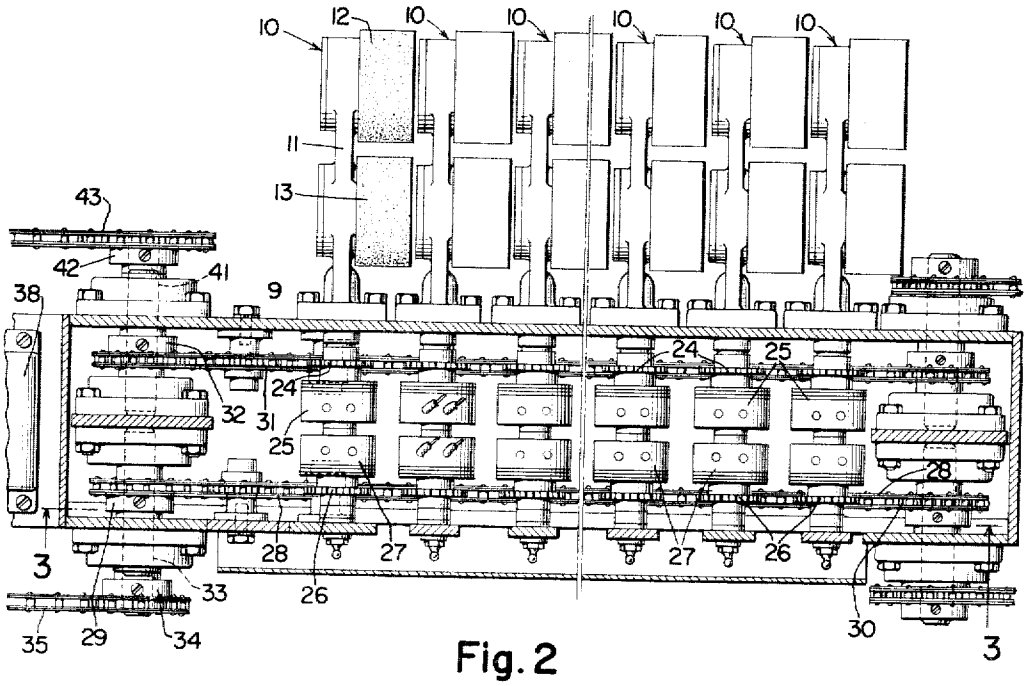



Fig. 2

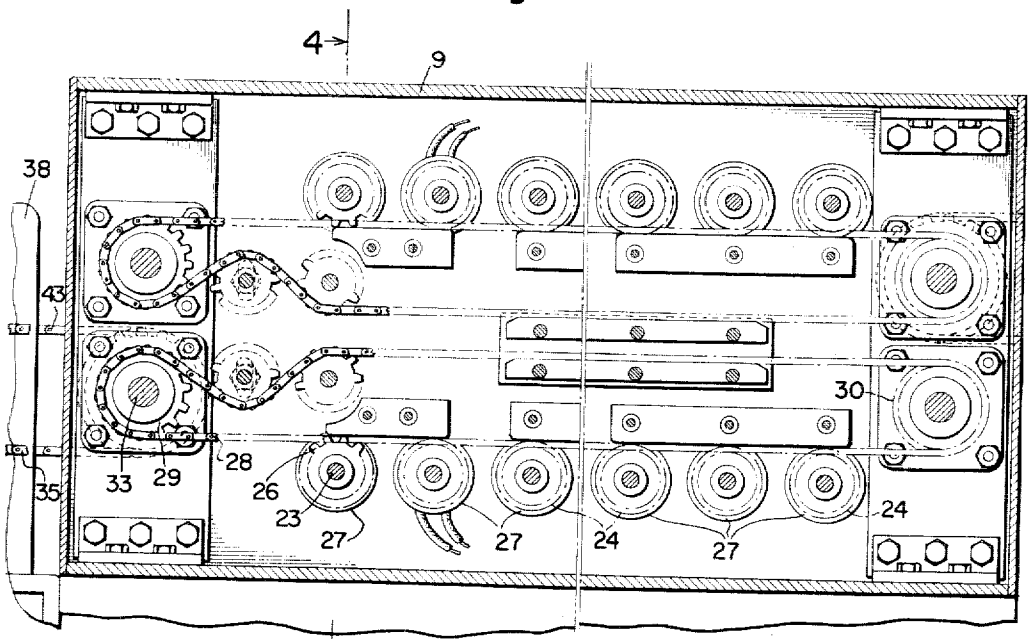



Fig. 3

INVENTOR.
Wallace W. Hammel, Jr.
BY
Edward L Bell
ATTORNEY

Sept. 10, 1963 W. W. HAMMEL, JR 3,103,187

PHOTOCELL CONTROLLED PATTERN ATTACHMENT FOR TUFTING MACHINES

Filed May 29, 1961 4 Sheets-Sheet 3

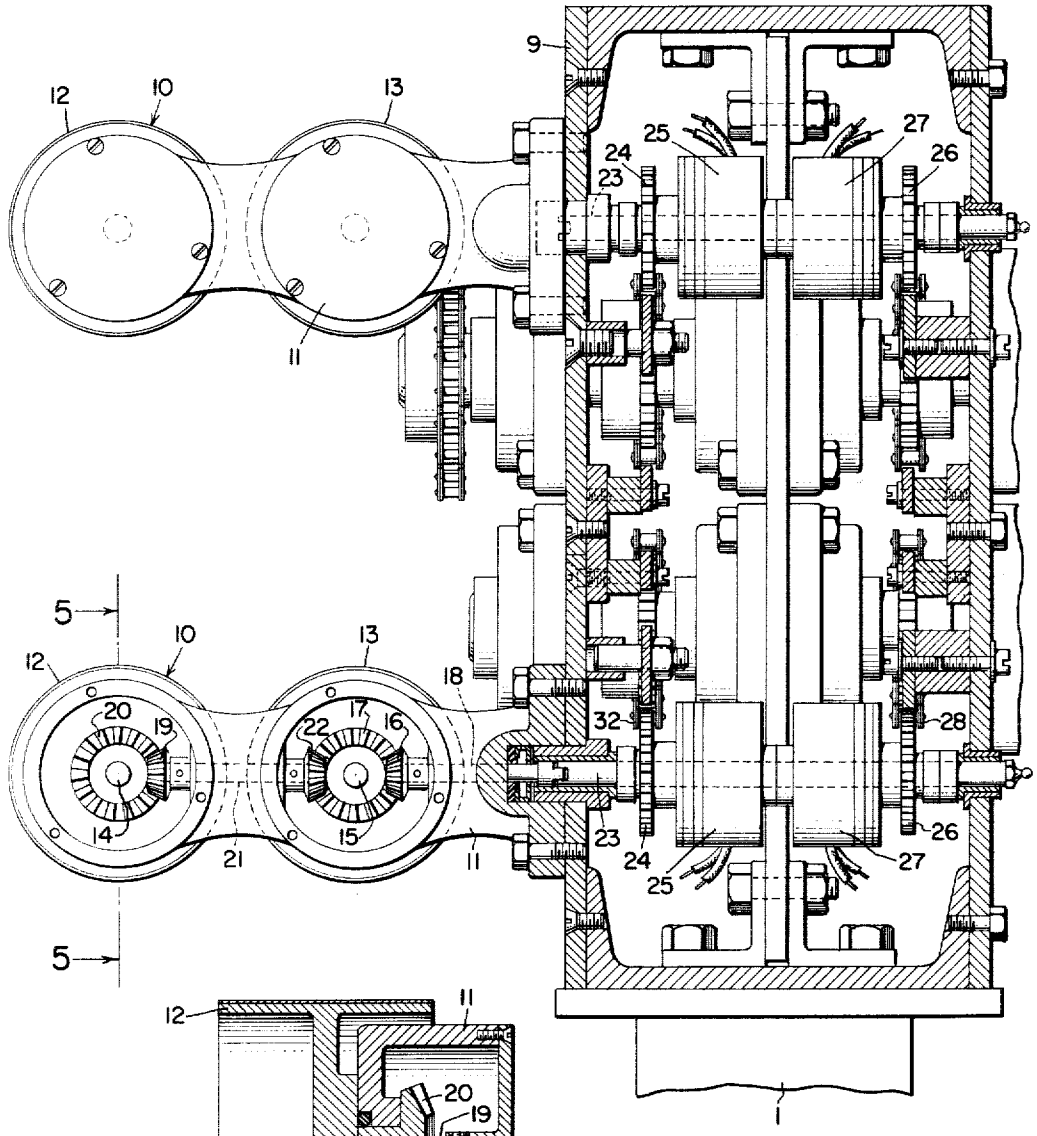



Fig. 4

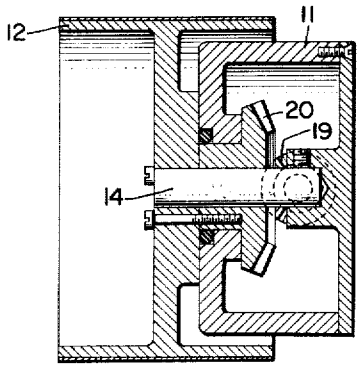



Fig. 5

INVENTOR.
Wallace W. Hammel, Jr.

BY Edward L Bell

ATTORNEY

Sept. 10, 1963 W. W. HAMMEL, JR 3,103,187

PHOTOCELL CONTROLLED PATTERN ATTACHMENT FOR TUFTING MACHINES

Filed May 29, 1961 4 Sheets-Sheet 4

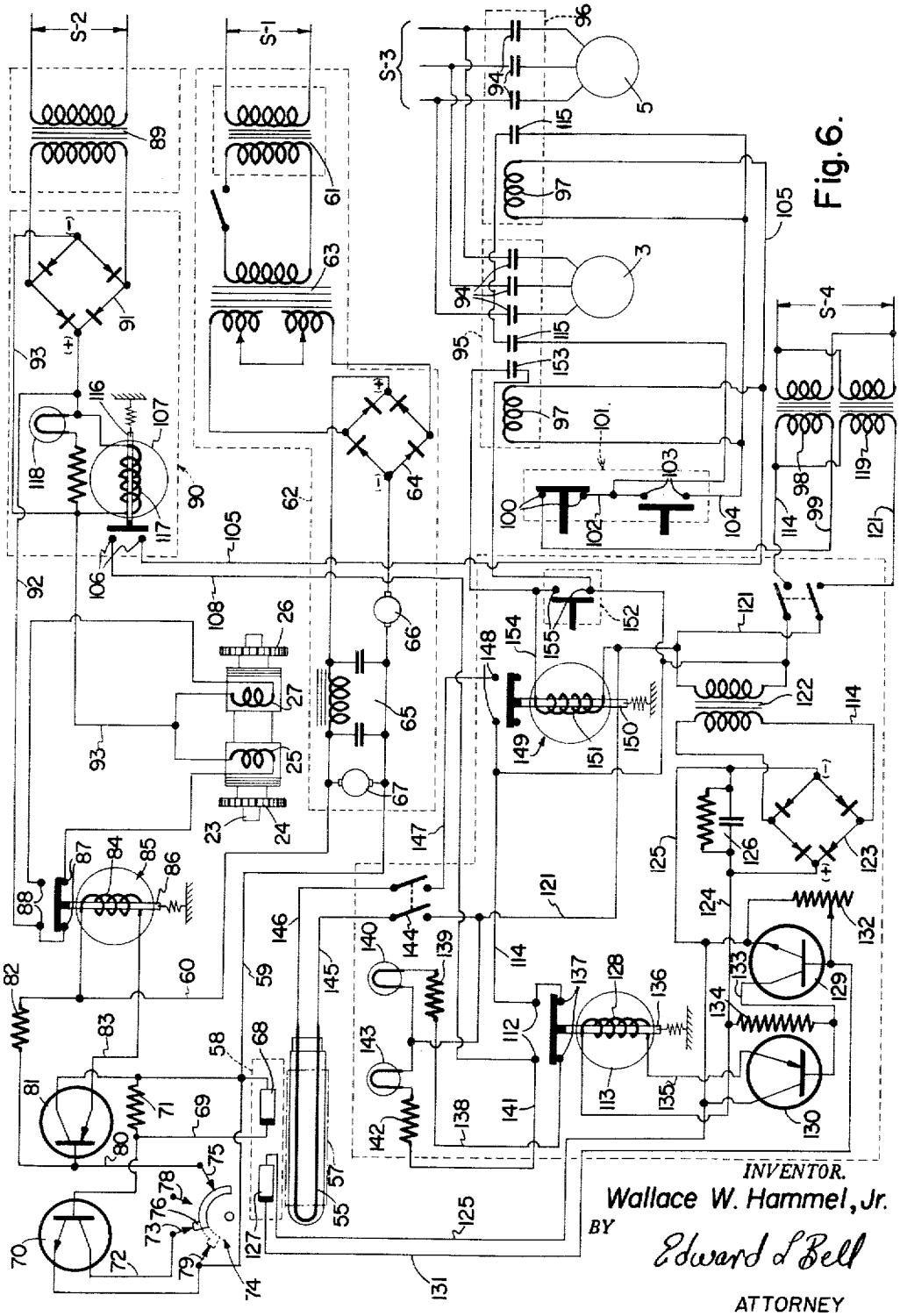


Fig. 6.

INVENTOR.
Wallace W. Hammel, Jr.
BY
Edward L Bell
ATTORNEY

United States Patent Office 3,103,187 Patented Sept. 10, 1963



3,103,187

# PHOTOCELL CONTROLLED PATTERN ATTACHMENT FOR TUFTING MACHINES

Wallace W. Hammel, Jr., Chattanooga, Tenn., assignor to Singer-Cobble, Inc., Chattanooga, Tenn., a corporation of Delaware

Filed May 29, 1961, Ser. No. 113,185
1 Claim. (Cl. 112—79)

The present invention relates to a pattern attachment for tufting machines, or more particularly to a control mechanism for a pattern attachment for a tufting machine, that is, an attachment to adapt the machine for producing a tufted article having a patterned pile surface in which the pattern is defined by variations in the length of the pile.

The object of this invention is to provide a pattern attachment for tufting machines that is capable of producing very intricate patterns in the tufted article and is capable of producing innumerable different patterns. It is also an object of this invention to provide a pattern attachment in which the pattern may be readily and conveniently changed to a different pattern. Further objects of this invention are to provide a pattern attachment that is reliable in operation, durable, efficient and easy to operate, and relatively economical.

Having in mind the above and other objects that will be evident from an understanding of this disclosure, the invention comprises the devices, combinations and arrangements of parts as illustrated in the presently preferred embodiment of the invention which is hereinafter set forth in such detail as to enable those skilled in the art readily to understand the function, operation, construction and advantages of it when read in conjunction with the accompanying drawings in which:

FIG. 1 is a fragmentary perspective view of a tufting machine embodying the present invention.

FIG. 2 is a fragmentary horizontal sectional view taken substantially on the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary vertical sectional view taken substantially on the line 3—3 of FIG. 2.

FIG. 4 is a fragmentary vertical sectional view taken substantially on the line 4—4 of FIG. 3.

FIG. 5 is a detail sectional view taken substantially on the line 5—5 of FIG. 4.

FIG. 6 is a schematic electrical diagram of the control mechanism.

With reference to the drawings, there is illustrated in FIG. 1 the rear right end portion of a tufting machine embodying the present invention. The machine basically is of the type illustrated in the United States patent of Card, No. 2,862,465 to which reference is made. The machine is herein disclosed only insofar as it is necessary for an understanding of this invention. It will be understood that the machine is of the type wherein a backing fabric is fed across a bed plate, a plurality of endwise-moving yarn-carrying needles are passed through the backing fabric and, beneath the bed plate, cooperate individually with hooks that enter a loop of yarn cast by the needle to hold it and form yarn loops as the needle is withdrawn, wherein the lengths of the loops are controlled by providing a yarn feed mechanism for delivering a preselected amount of yarn for each loop to each needle, and wherein a control mechanism is used for automatically varying the actuation of the yarn feed mechanism in accordance with a designed pattern to produce a patterned tufted pile article.



The illustrated machine includes a frame 1 having a main shaft 2 journaled longitudinally thereof. The main shaft 2 is rotated by a motor 3 mounted on the frame 1 and connected thereto by means including belts 4. A similar motor 5 (FIG. 6) is mounted upon the frame 1 at the opposite end of the machine and is connected to the main shaft 2 in the same manner. The various pile forming elements (not shown) are actuated from the main shaft 2. The backing fabric feeding mechanism includes the rear feed roll 6 driven by the transmission 7 attached to the end of the frame 1 and in turn driven by a belt 8 from the main shaft 2.

The pattern attachment comprises a yarn feed mechanism carried by a housing 9 mounted on top of the frame 1 and comprising a plurality of yarn feed roll units generally indicated at 10. Each of the units 10 are identical in construction and comprises a mounting bracket 11 secured to the front of the housing 9 and having a pair of opposed driven feed rolls 12 and 13 journaled therein. The outer roll 12 and the inner roll 13 are mounted respectively upon shafts 14 and 15 journaled in the bracket 11. The shaft 15 is driven by gears 16 and 17 from a shaft 18 and the shaft 14 is driven by gears 19 and 20 from a shaft 21 that is driven by the gear 17 and a gear 22. The shaft 18 is keyed to and driven from a shaft 23 arranged transversely of and journaled in the side walls of the housing 9. Within the housing 9, the shaft 23 has journaled thereon a high speed sprocket 24 and an associated magnetic clutch 25 and a low speed sprocket 26 and an associated magnetic clutch 27. The sprockets 24 and 26 run loosely on the shaft 23 when the associated clutch is de-energized and is adapted to be coupled selectively to the shaft 23 in driving relation when the respective clutches 25 and 27 are energized.

The disclosed machine is designed to include one hundred and twenty yarn feed roll units 10 arranged in two horizontal rows of sixty units each. The low speed sprockets 26 of the lower row of units 10 are driven by a low speed chain 28 extending the width of the machine and entrained at its opposite ends about a driving sprocket 29 and a reversing sprocket 30. The high speed sprockets 24 of the lower row of units 10 are driven by a high speed chain 31 which is in turn driven by a driving sprocket 32. The driving sprocket 29 is mounted upon a shaft 33 upon which is also mounted a sprocket 34 (FIG. 1) connected by a chain 35 with a sprocket 36 upon the driving shaft 37 of a speed reduction unit 38. The driven shaft 39 of the unit 38 is connected by a chain 40 with the main shaft 2 of the machine. The driving sprocket 32 is mounted upon a shaft 41 upon which is also mounted a sprocket 42 connected by a chain 43 with a sprocket 44 on the shaft 37 of the unit 38.

The units 10 in the upper row are driven in the same manner as the units in the lower row but are driven from the opposite end of the machine.

The peripheral or yarn delivering speed of the rollers 12 and 13 is determined by the ratio between the sprockets 34—36, 42—44 and the corresponding sets of sprockets for the upper row of units 10. These sets of sprockets can be varied to provide a desired speed on any one chain and can be selected to provide a different speed for each of the chains 28, 31 and the two corresponding chains for driving the upper row of units 10, thus providing for four pile lengths in the pattern.

In articles such as tufted pile carpets having a patterned surface in which the pattern is defined by variations in the length of the pile, the pattern consists of a

design that is repeated a number of times transversely or across the width of the carpet and also longitudinally of the carpet. The use of one hundred and twenty feed roll units **10** provides for the production of carpet having a transverse repeat comprising one hundred and twenty strands of yarn (eighteen and three-fourths inch repeat with needles on five-thirty-second inch gauge) in which the strands of yarn are all individually controlled. Each of the yarn feed roll units **10** are provided with a number of strands of yarn corresponding to the number of transverse repeats in the article produced, and each of these strands of yarn are delivered to the tufting mechanism to occupy the identical position in each transverse repeat.

The mechanism for controlling the actuation of the clutches **25** and **27**, which is the subject matter of this invention, comprises a drum **45** (FIG. 1) consisting of two end plates **46** and an intermediate cylinder **47** of translucent material. The drum is journaled for rotation on a rod **48** carried by brackets **49** and **50** that are in turn secured to the frame **1**. Rotation is imparted to the drum **45** by means of a belt **51** that is driven from a shaft **52** which is rotated by means of a chain **53** and gears **54** from the feed roll **6** for the backing fabric.

Internally of the drum **45** there is provided a light source consisting of two light bulbs **55** carried by the rod **48** and to which power is delivered by means of wiring **56** that is led internally of the rod **48**. On the periphery of the drum **45** there is mounted a pattern sheet **57** of translucent material and on which the desired pattern is painted with an opaque material. Above the drum **45** is mounted a photocell unit **58** in which is mounted a total number of photocells corresponding in number to the number of yard feed roll units **10** to be controlled, which in this case is one hundred and twenty. While not herein illustrated, the photocells are arranged in a line parallel to the axis of rotation of the drum **45** and in close proximity to the periphery of the drum. Thus, as will be apparent from the following description, the translucent portions of the pattern sheet **57** will permit light from the bulbs **55** to impinge upon the photocells and, alternatively, the opaque surfaces on the pattern sheet **57** will shade the photocells from the bulbs **55**. As the drum **45** rotates, each of the photocells describes a path about the periphery thereof, and the alternate opaque and translucent portions in this path will prohibit or permit light to impinge on that particular photocell. The number of loop forming cycles in one revolution of the drum **45**, which defines the longitudinal repeat in the pattern, depends upon the circumference of the drum **45** and the peripheral speed thereof.

With reference to FIG. 6, direct current electrical power is applied to leads **59** and **60**, the lead **59** being the common. This power, which preferably is in the order of 19 v., may be obtained as illustrated from a 115 v. alternating current source S1 that is connected through a voltage regulating transformer **61** to a D.C. power supply unit **62** that is adapted to provide a low ripple D.C. current and includes a transformer **63**, a full wave bridge-type rectifier **64**, a filter **65**, ammeter **66** and a voltmeter **67**.

A photocell **68** is connected at one end to the common **59** and at the other end is connected by a lead **69** to the base of a "NPN" transistor **70**. A biasing resistor **71** is interposed between lead **69** and common **59**. The emitter of the transistor **70** is connected to the common **59** and the collector is connected by a lead **72** to one contact **73** of a switch **74**. The switch **74** also includes a contact **75** that is permanently in contact with a switching plate **76** that has an ear **77** that is adapted to be moved into engagement with the contact **73** or into engagement with contacts **78** and **79**. The contact **75** is connected by a lead **80** with the base of a "PNP" transistor **81** and through a biasing resistor **82** to the lead **60**. The collector of the transistor **81** is connected to the common **59** and the emitter is connected by a lead **83** to the coil **84** of a relay **85** having an armature **86** and a normally closed set of contacts **87** and a normally open set of contacts **88**.



By means of the above circuit, when light from the bulb **55** passes through the pattern sheet **57** and impinges upon the photocell **68**, the photocell will generate a voltage that is applied to the base of the transistor **70** and will cause an amplified current to flow from the lead **60**, through the resistor **82**, lead **80**, switch **74** (contacts **75** and **73** and switching plate **76**), lead **72**, and through the transistor **70** to the common **59**. This current will place a voltage on the base of transistor **81** which will cause a further amplified current to flow from the lead **60**, through the coil **84** of the relay **85**, lead **83** and through the transistor **81** to the common **59**, thus energizing the coil **84** to close contacts **88** while opening contacts **87**.

The two transistors constitute only a two stage amplifier for amplifying the voltage generated by the photocell **63** sufficient to actuate the coil **84**. It will be seen that when an opaque portion of the pattern sheet **57** is disposed between the photocell **68** and the light **55**, the coil **84** is de-energized and therefore the contacts **87** are closed and the contacts **88** are open. When the translucent portion of the pattern sheet **57** is disposed between the photocell **68** and the light **55**, the coil **84** is energized and therefor the contacts **87** are open and the contacts **88** are closed.

The contacts **87** and **88** of the relay **85** control the application of power respectively to the clutches **25** and **27**. This power preferably is 90 v. D.C. and as illustrated is obtained from a 220 v. A.C. source S2 through a step-down transformer **89** and a power supply unit **90** which includes a full wave bridge type rectifier **91** that is connected to a power lead **92** and a common **93**.

When the switch **74** is positioned to connect the contact **73** with contact **75**, the energization of the clutches **25** and **27** will be controlled by the photocell **68** as above described. When the switch **74** is positioned to connect the contact **75** with the contact **79**, which is connected with the common **59**, the photocell **68** is by-passed and the coil **84** will be continuously energized to close the contacts **88** and thus continuously energize the clutch **27** so that the associated yarn feed roll units **10** will be driven at low speed. When the switch **74** is positioned to connect the contact **75** with the contact **78**, which is a dead contact, the control mechanism is disabled so that the coil **84** cannot be energized and the contacts **87** are thus closed to energize the clutch **25** to drive the associated yarn feed roll units **10** at the high speed.

The motor **3** and **5** receive power from a source S3 through normally open contacts **94** of the respective line starters **95** and **96**, which contacts are adapted to be held closed by coils **97**. Power for the coils **97** is supplied from a source S4 through a transformer **98**, one side of which is connected by a power lead **99** to one side of a normally-closed stop contact **100** of start-stop control box **101**. The other side of the stop contact **100** is connected in the box **101** by a lead **102** to one side of a normally open start contact **103**, the other side of which is connected by a lead **104** to one of the sides of the coils **97**. The other of the sides of the coils **97** are connected by a lead **105** to contacts **106** of a relay **107**, from there by a lead **108** to one side of the contacts **112** of a lamp monitor relay **113**, which are connected at their other side by the common **114** to the other side of the transformer **98**. Thus, with the contacts **106** and **112** closed, manually actuating the start contact **103**, energizes the coils **97** to close the contacts **94** and thereby energize the motors **3** and **5**. The line starters **95** and **96** each include an additional normally open contact **115** which is closed by the coils **97** and are connected in parallel with the start contact **103** so that, when the start contact **103** is once closed.

the coils 97 thereby energized and the contacts 115 closed, the start contact 103 may be released and the coils 97 will be held energized and the machine will operate until the stop contact 100 is manually opened or until one of the contacts 106, 112 are opened.

The contacts 106 are designed to stop the machine in the event that the power supply for the clutches 25 and 27 should fail, in which event neither of the clutches would be operative and there would be no yarn feed. The relay 107 includes, in addition to the contacts 106 which are normally open, an armature 116 and coil 117. One side of the coil 117 is connected to the power lead 92 and the other side is connected to the common 93. A pilot light 118 is interposed between the lead 92 and common 93. So long as there is power in the lead 92 and common 93, the pilot light 118 will be on and the coil 117 will be energized and the contacts 106 closed.

The contacts 112 are designed to stop the machine in the event the the bulb 55 burns out or for any reason fails to provide adequate light to actuate the photocells 68, which would hold the clutch 25 continuously energized regardless of the designed pattern. The monitoring circuit for the bulb 55 is actuated from the source S4 through a separate transformer 119 that is connected at one side to a power lead 121 and at the other side to the common 114. A step-down transformer 122 is connected to the lead 121 and common 114 and is in turn connected to a full wave bridge type rectifier 123 that delivers D.C. power to a power lead 124 and a common 125 between which a filter 126 is interposed. A lamp monitoring photocell 127 is connected at one side to the common 125 and at the other side to the coil 128 of the relay 113 through a transistorized two stage amplifier circuit including transistors 129 and 130, the circuiting of which is the same as that for the transistors 70 and 81. More particularly, the photocell 127 is connected by a lead 131 to the base of transistor 129 which is of the "NPN" type. The lead 131 is connected to the common 125 through an adjustable resistor 132. The emitter of transistor 129 is connected to the common 125 and the collector is connected by a lead 133 through a biasing resistor 134 to the power lead 124. The lead 133 is also connected to the base of transistor 130 which is of the "PNP" type and which has the collector thereof connected to the common 125 and the emitter thereof connected by a lead 135 to the coil 128 of the relay 113. Thus, when light from the bulb 55 impinges on the photocell 127, the coil 128 is energized. The light is designed to impinge continuously upon the photocell 127 so that the photocell will energize the coil 128 except when the light 55 fails. The resistor 132 is adjustable to adjust the sensitivity of the monitoring circuit.

The relay 113 has an armature 136 and a pair of normally closed contacts 137 in addition to the normally open contacts 112. One side of the contacts 137 is connected to the common 114. The other side of contacts 137 is connected by a lead 138 and resistor 139 to one side of a pilot light 140, the other side of which is connected to the lead 121. The pilot light 140 indicates a failure of the light 55. The side of contact 112 opposite from the side connected to the common 114 is connected by a lead 141 and resistor 142 to one side of a pilot light 143, the other side of which is connected to the lead 121. The pilot light 143 indicates proper functioning of the light 55.

Power for the bulb 55 is supplied from the power lead 121 through a lamp switch 144 and lead 145 which is connected to one side of the bulb, the other side of which is connected by lead 146, switch 144 and lead 147 to one side of contacts 148 of a timer unit 149, the other side of which contacts are connected to the common 114. The timer unit 149 which may be of any conventional construction, generally includes an armature 150 and a coil 151 and is of the type which when the coil 151 is energized, instantly closes the contacts 148 and when de-energized will permit the contacts 148 to open only after a pre-selected time interval. The coil 151 may be energized alternatively by a reset switch 152 or by a further set of contacts 153 in the line starter 95 that are closed by energizing the coil 97. Specifically, the coil 151 is connected at one side to the power lead 121 and at the other side to a lead 154 that is connected first to one side of the contacts 155 of the reset switch 152 and a second to one side of the contacts 153, the other side of both of which are connected to the common 114. The purpose of this time delay in the lamp circuit is to keep the lamp 55 in operation for a limited period of time while the machine is shut down, thus permitting correction of any malfunctions, but at the same time, will automatically shut the light 55 off to prevent warping the pattern sheet 57 if the machine is stopped for any extended period of time during which, of course, the heat from the light is concentrated on one portion of the pattern.

Physically, the lamp monitoring the timer elements are mounted in a box 156, FIG. 1. To simplify the electrical connections and to provide for a modular construction where the units may be readily replaceable, there is provided a junction box 157 and a conduit 158 leading to a control panel (not shown) where various electrical components may be mounted. All of the electrical connections from the photocell and to the clutches 25 and 27 are made at the junction box 157.

While FIG. 6 illustrates only a single photocell 68, it will be understood that with a machine having one hundred and twenty feed roll units 10, there are one hundred and twenty such photocells, each being actuated in the same manner as the illustrated photocell. For convenience, the photocells and associated electrical components are arranged in groups of ten and there is provided one power supply such as the transformer 89 and rectifier 91 for each group. Thus, there would be twelve such power supplies for a one hundred and twenty roll machine and the contacts 106 of the relays 107 would be connected in series so that failure of any one circuit would stop the machine and the pilot lights 118 would readily indicate which unit has failed.

Since the power required for actuation of the relays 85 is relatively low, a single power supply unit such as that including the rectifier 64 can service all one hundred and twenty relays of the machine. With the use of two bulbs 55, two photocells 127 would be used, one to monitor each of the bulbs.

Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However, it is to be understood that the present disclosure relates to a preferred embodiment of my invention which is for purposes of illustration only and not to be construed as a limitation of the invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claim.

Having thus set forth the nature of the invention, what I claim herein is:

In a tufting machine having a plurality of needles and cooperating loopers, yarn feeding mechanism comprising a plurality of yarn feeding units for feeding yarns upon each stitch to different ones of said needles, each of said yarn feeding units having means for determining the length of yarn fed upon each stitch and providing for varying the length of yarn fed upon each stitch between a first length for making full height pile and a second length shorter than said first length for making pile of a height less than said full height, and control means for said yarn feeding units for determining the length of yarn fed upon each stitch, said control means comprising a plurality of photocells equal in number to the number of said yarn feeding units, a light source adjacent to said photocells, a pattern member having light transmitting and opaque areas, means for moving said pattern member

between said photocells and said light source, and means for electrically interconnecting each of said photocells individually with one of said yarn feeding units for operation of said yarn feeding unit in response to the presence of a light transmitting or opaque area of said pattern member between said light source and the respective one of said photocells.



**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,173,488 | Tandler et al. | Sept. 19, 1934 |
| 2,225,842 | Page | Dec. 24, 1940 |
| 2,862,465 | Card | Dec. 2, 1958 |
| 2,939,963 | Rideout | June 7, 1960 |