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Hammel, Jr.

[11] **3,847,098**

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[54] **YARN FEED MODULE FOR TUFTING MACHINE**

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[73] Assignee: **Card & Co., Inc.**, Chattanooga, Tenn.

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

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

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

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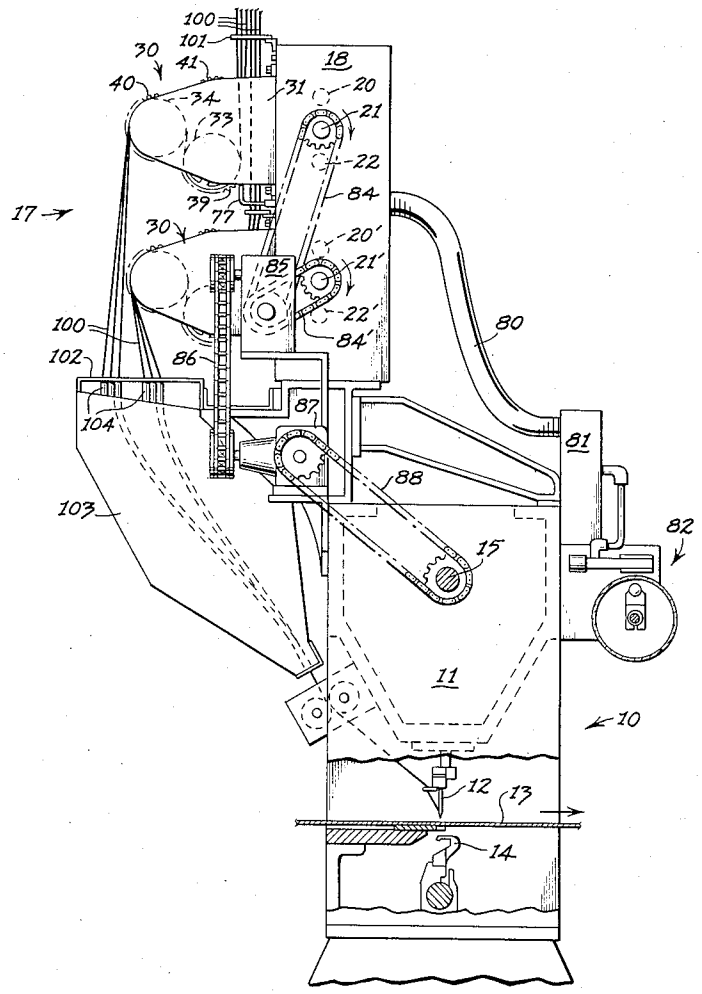
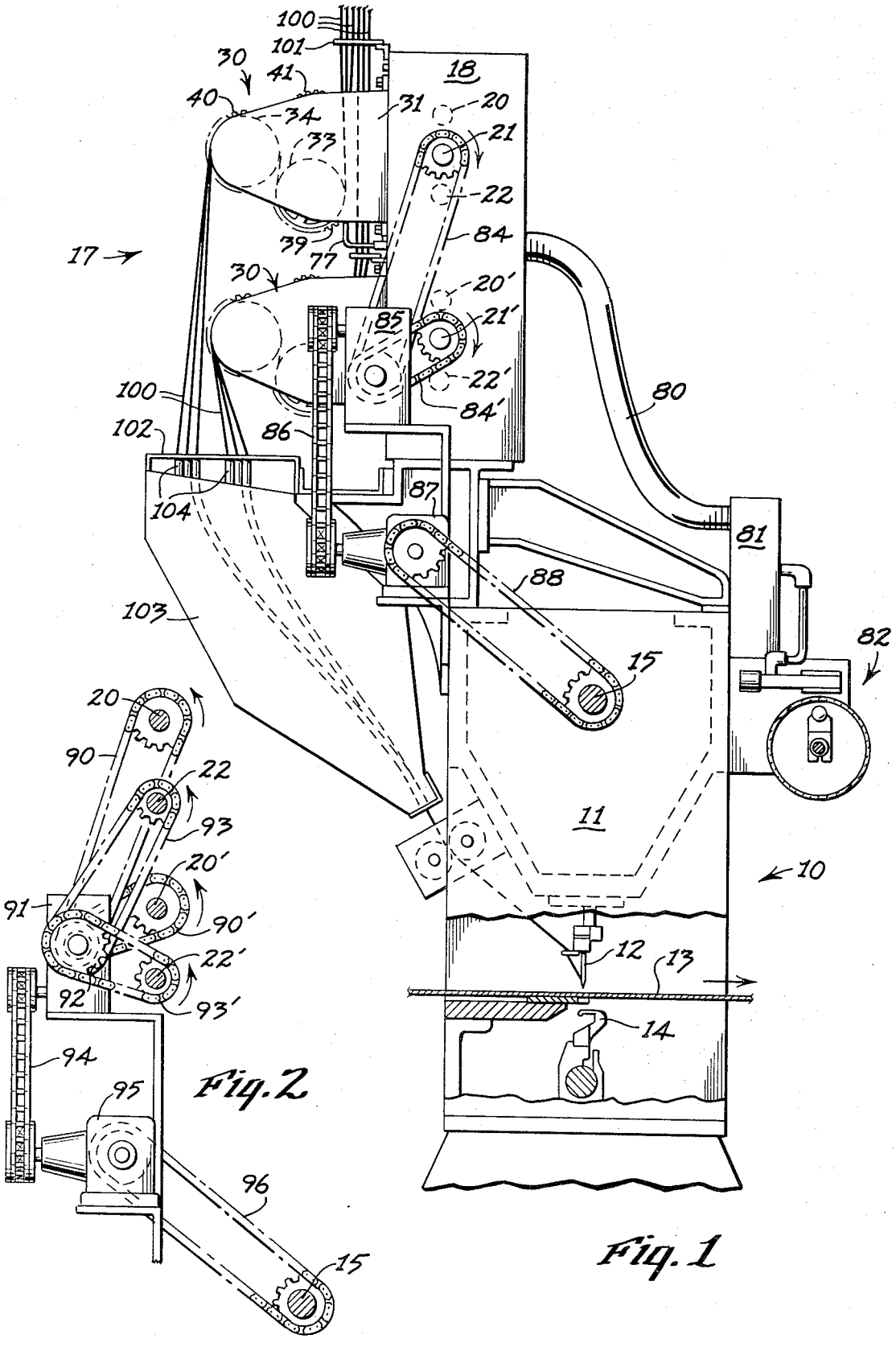
Attorney, Agent, or Firm—Harrington A. Lackey

[57] **ABSTRACT**

A yarn feed mechanism for a tufting machine having a plurality of needles for tufting yarns through a moving base fabric. The feed mechanism includes a module supporting a yarn feed roll, rotary clutches and drive transmission, detachably secured to a drive housing for drive coupling with at least two drive shafts in order to selectively drive the feed roll at different speeds.

9 Claims, 7 Drawing Figures




100
101
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20
21
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20'
85
21'
22'
84'
100
102
86
80
104
87
81
88
103
15
82
11
10
12
13
14

Fig. 1

20
90
22
93
20'
91
90'
22'
92
93'
94
95
96
15

Fig. 2

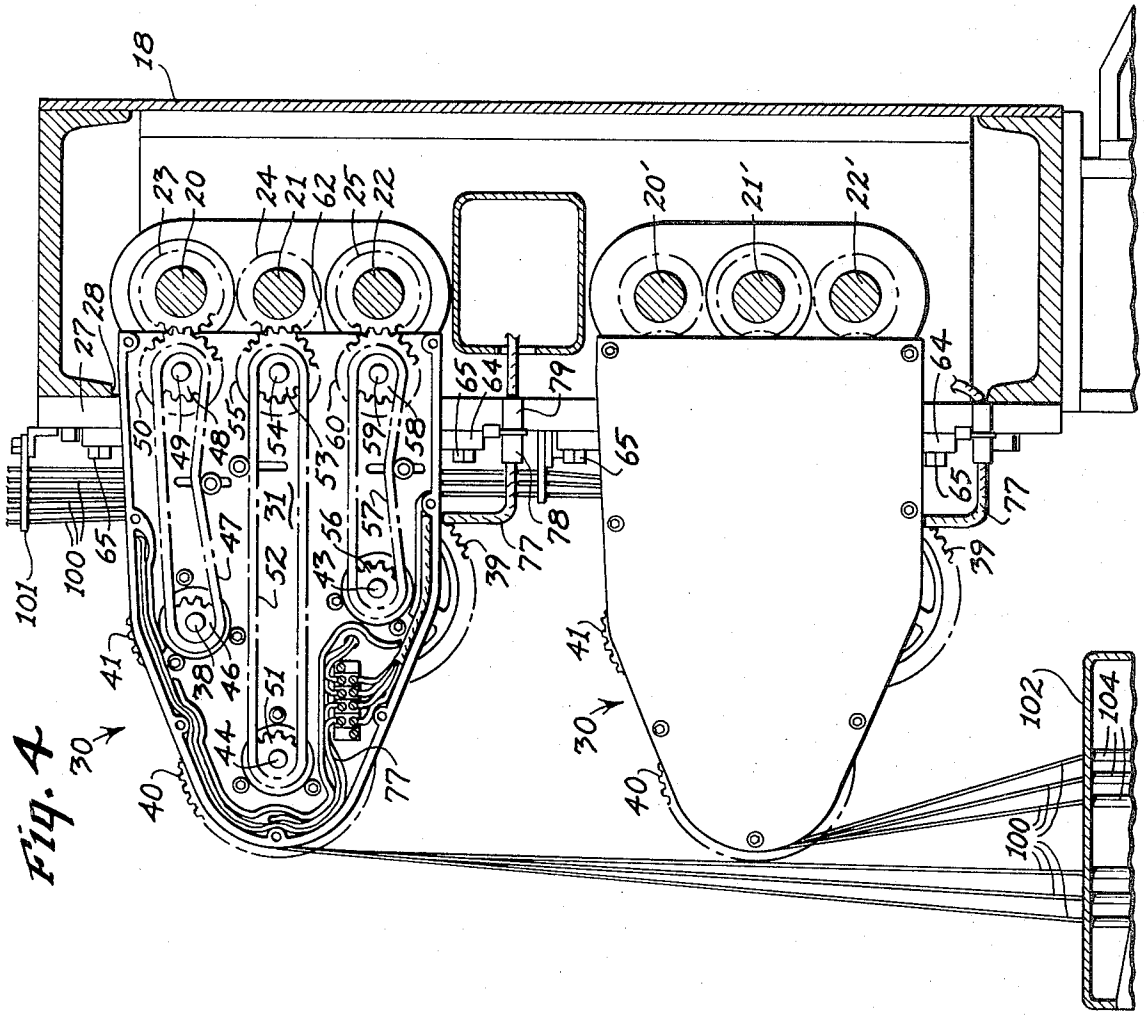

Fig. 4

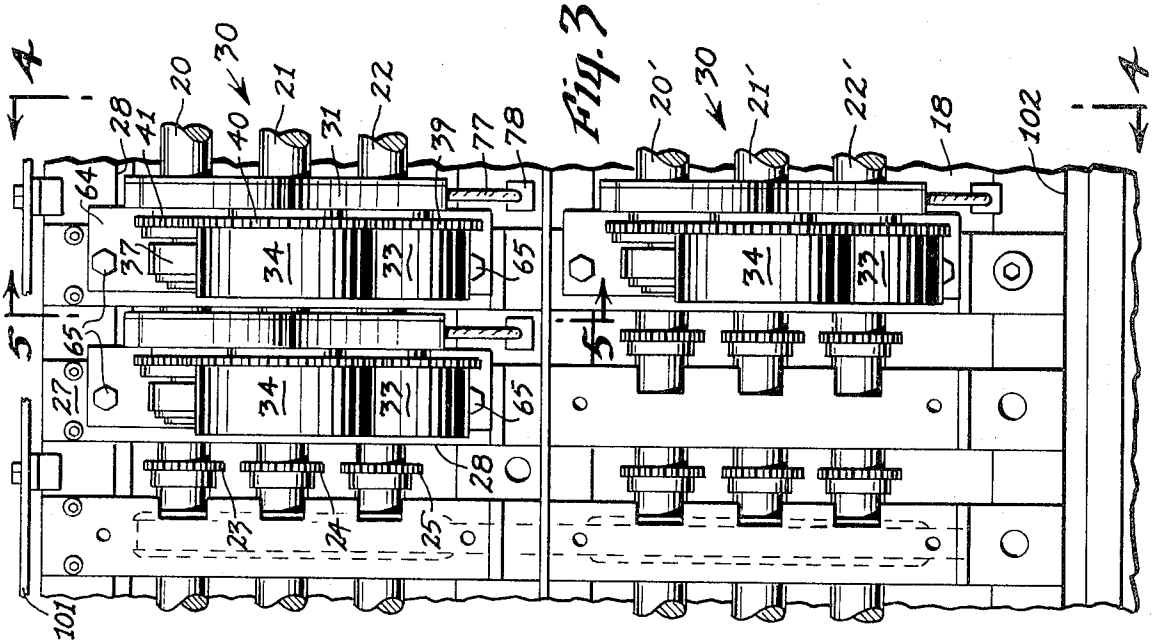

Fig. 3

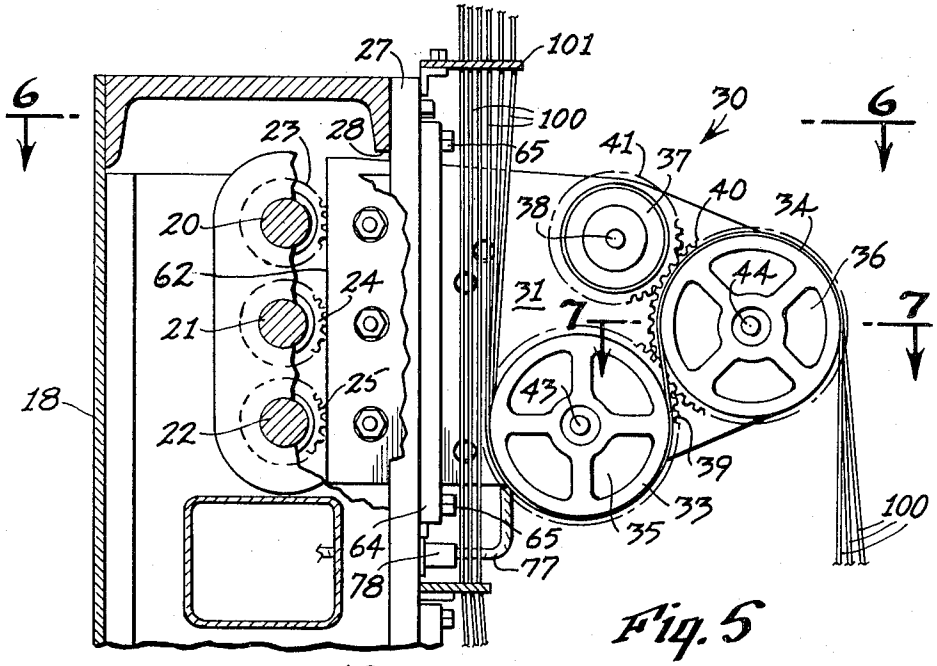

Fig. 5

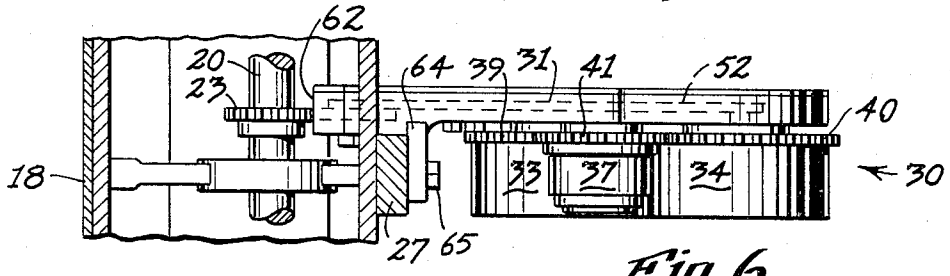

Fig. 6

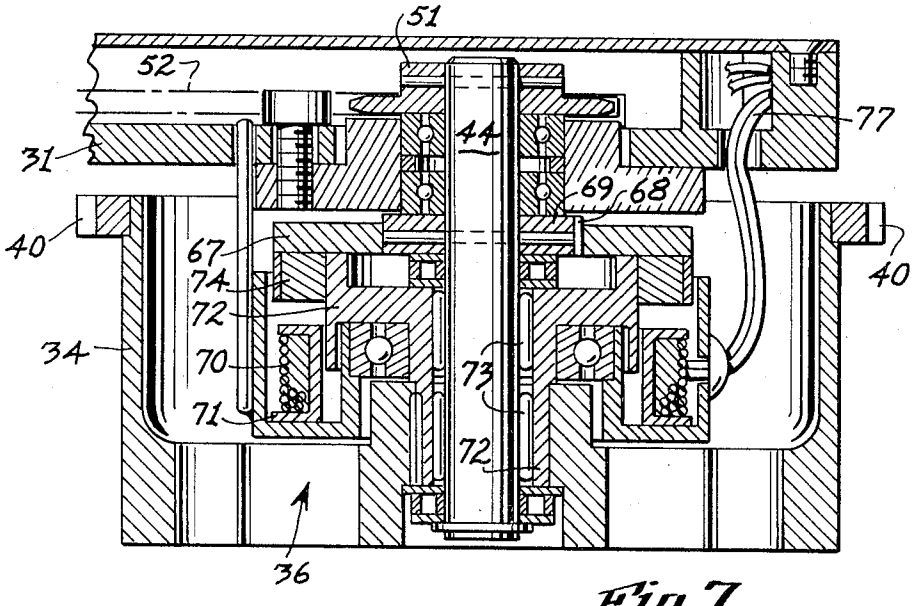

Fig. 7

YARN FEED MODULE FOR TUFTING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to a tufting machine, and more particularly to a yarn feed mechanism for a tufting machine.

In U.S. Pat. No. 2,862,465 of J. L. Card, issued Dec. 2, 1958, a yarn feed mechanism is described in which a plurality of yarn feed rolls are individually clutch controlled by a pattern control mechanism so that each of the plurality of feed rolls is driven at different speeds, independently of any of the other feed rolls. Each roll is adapted to control the speed of a yarn to a particular row of stitching within a repeat pattern, in order to effect the tufting of a rather intricate pattern in high and low nap tufted fabrics. However, each feed roll is mounted upon a shaft extending perpendicularly to the row of needles, and each shaft carries a high speed clutch and a low speed clutch. All of the high speed clutches are driven by chain and sprocket mechanisms from a high speed shaft, while all of the low speed clutches are driven by another chain and sprocket mechanism from a low speed shaft.

In the operation of the above described J. L. Card tufting machine, the electromagnetic clutch members wear out or become defective before the other moving parts. In order to repair or replace such clutch members, considerable disassembly of the drive mechanism for the yarn feed must be carried out before the clutches can be replaced. Accordingly, the "down-time" of such a machine is excessive, sometimes being as great as a half a day or a day.

One attempt to reduce this down-time resulted in a "Clutch-in-Roll" yarn feed mechanism described in British patent 1,126,410, Aug. 14, 1967 of Singer-Cobble Limited. The "Clutch-in-Roll" improvement included at least two drive shafts driven at different speeds, each of which carries for rotation independently of the drive shaft a yarn feed roll, the yarn feed rolls being coupled together for simultaneous rotation by meshing ring gears. Electromagnetic clutches within the yarn feed roll are selectively energized, one at a time, to create operative engagement between one feed roll and its corresponding shaft. However, a plurality of the feed rolls and their clutch members are mounted on a single shaft section, the shaft sections being coupled end-to-end, so that a shaft section may be removed for inspection, repair or replacement. Even though the British mechanism reduces the down-time, nevertheless problems still arise in handling such large numbers of feed rolls and clutch mechanisms on a single shaft section. For example, if after the shaft section is removed and replaced by another shaft section, the clutch mechanism in the middle feed roll of the shaft section is defective, then all of the remaining feed rolls and clutch members between the defective unit and the end of the shaft section must first be removed before the problem can be diagnosed and remedied.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a yarn feed mechanism for a tufting machine incorporating a plurality of modules, each of which supports only a single feed roll, or a single set of feed rolls, for detachable driving engagement with a permanent drive mechanism.

It is another object of this invention to provide an improved yarn feed mechanism incorporating clutch modules for individual feed rolls in which the modules may be so rapidly replaced that the down-time is insignificant.

The yarn feed mechanism made in accordance with this invention includes a drive housing incorporating a number of parallel drive shafts, equal to the number of desired speeds, extending the entire width of the machine parallel to the line of needles. Upon each drive shaft is fixed a drive coupling member, such as a drive gear, there being one drive gear on each shaft for each module. Detachably secured to the face of the housing is a clutch module or module frame supporting at least one yarn feed roll and at least two clutch members, preferably electromagnetic clutches, one of which is preferably incorporated within the yarn feed roll. Each clutch member is driven by its own drive transmission mounted on the clutch module and including a driven coupling member, such as a driven gear at the rear end of the module which is in registry with and adapted to be drivingly engaged by the corresponding drive gear on the corresponding drive shaft in the drive housing, when the module is inserted in operative position. The electromagnetic clutches are energized one at a time by a pattern control mechanism so that the yarns carried by the set of yarn feed rolls on each module are driven at one of several speeds, but independently of the speed of the yarn feed rolls of any other module.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a fragmentary right end elevation of a tufting machine incorporating the yarn feed mechanism made in accordance with this invention;

FIG. **2** is a fragmentary sectional elevation of the drive transmission at the left end of the machine, looking in the same direction as in FIG. **1**;

FIG. **3** is an enlarged fragmentary front elevation of the yarn feed mechanism, with some of the clutch modules removed;

FIG. **4** is a section taken along the line **4—4** of FIG. **3**, with the cover plate of the upper clutch module removed;

FIG. **5** is a section taken along the line **5—5** of FIG. **3**;

FIG. **6** is a fragmentary section taken along the line **6—6** of FIG. **5**; and

FIG. **7** is an enlarged section taken along the line **7—7** of FIG. **5**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings in more detail, FIG. **1** discloses a typical multiple-needle tufting machine **10** including a frame **11**, supporting a plurality of needles **12** disposed in a line transversely of the machine **10** for vertical reciprocal movement through a base fabric **13** moving longitudinally through the machine **10** in the direction of the arrow. Each needle **12** cooperates with a looper or hook **14** for forming the tufted stitches through the base fabric **13**. The needles **12** and loopers **14** are synchronously reciprocated, in a manner well-known in the art, from the needle shaft **15**.

The yarn feed mechanism **17** made in accordance with this invention includes a drive housing **18** mounted on top of the front portion of the machine frame **11**.

Although two or more drive shafts may be rotatably supported in the drive housing **18**, two sets of three drive shafts are illustrated in the drawings. The upper set includes a top low speed shaft **20**, a middle, intermediate speed shaft **21** and a bottom, high speed shaft **22**. The lower set of three drive shafts **20'**, **21'** and **22'** are identical to the upper set.

Fixed upon each drive shaft **20**, **21** and **22** are drive gears **23**, **24** and **25**, respectively. The drive gears **23 – 25** are arranged in vertical sets, and as shown in the drawings, are of equal size.

Formed in the front wall **27** of the drive housing **18** is a vertical slot **28** adapted to register with each set of vertically spaced drive gears **23 – 25**.

Adapted to be received within each vertical slot **28** is a clutch module **30** including a vertically disposed frame or plate **31**. Mounted for rotation on the left side of the frame **31** and about axes parallel to the drive shafts **20 – 22** is a set or pair of yarn feed rolls, including the front feed roll **34** and the rear feed roll **33**.

Mounted concentrically within each feed roll **33** and **34** respectively, is a low-speed, electromagnetic clutch member **35** and an intermediate-speed, rotary electromagnetic clutch member **36**. A third or high-speed, rotary electromagnetic clutch member **37** is also rotatably mounted on shaft **38** on the left side of the module plate **31**.

Yarn feed rolls **33** and **34** carry fixed ring gears **39** and **40** which intermesh with each other, so that both yarn feed rolls **33** and **34** are always driven at the same speed. Ring gear **40** also intermeshes with a ring gear **41** carried by the high-speed magnetic clutch member **37**. Thus, when any one of the magnetic clutches **35**, **36** or **37** is energized, it controls the speed of the yarn feed rolls **33** and **34**. When the magnetic clutch **35** is energized, it is adapted to clutch or couple the yarn feed roll **33** to its driven shaft **43**. When the magnetic clutch **36** is energized, it is adapted to clutch or drivingly couple the yarn feed roll **34** to its driven shaft **44**.

As best disclosed in FIG. **4**, the upper driven shaft **38** is journaled in the module plate **31** and has its right end fixed to a driven sprocket **46** carrying an endless chain **47** trained about a drive sprocket **48** fixed to a shaft **49** carrying a driven gear **50**. The shaft **49** is rotatably mounted adjacent the rear end of the module frame **31**.

In a similar manner, driven shaft **44** is fixed to driven sprocket **51** driven through endless chain **52** from drive sprocket **53** fixed on rotary shaft **54** carrying the driven gear **55**.

Also in a similar manner, driven shaft **43** carries sprocket **56** carrying endless chain **57** trained about drive sprocket **58** on rotary shaft **59** fixed to driven gear **60**.

All of the driven gears **50**, **55** and **60** are preferably equal in size, vertically spaced and in vertical alignment in such a manner that the gear teeth project rearward past the rear edge **62** of the module frame **31**.

Spaced forward of the rear edge **62** and fixed to extend vertically and laterally from the left side of the frame **31** is a retainer flange **64**. The spacing between the retainer flange **64** and the rear edge **62** defines a tongue portion of the frame **31** and is of such dimension that when the retainer flange **64** is flush against the front wall portion **27** and the tongue portion projects through the slot **28**, all of the driven gears **50**, **55** and **60** perfectly intermesh with the teeth of the drive gears **23**, **24** and **25**, respectively. The module **30** is held in its fixed operative position in driving engagement with the drive shafts **20**, **21** and **22** by securing means, such as bolts **65** extending through registering bolt holes in the flange **64** and the front wall section **27**.

The magnetic clutches **35**, **36** and **37** may be of any conventional type. One specific type of electromagnetic clutch **36**, which can be incorporated in the yarn feed mechanism **17**, is best disclosed in FIG. **7**. The electromagnetic clutch **36** includes a disc-shaped clutch armature **67**, splined at **68** to hub **69**, which is fixed to the driven shaft **44** by a pin or other securing means, so that the armature **67** may move axially of the shaft **44** and yet rotate with the shaft **44**. The electromagnetic coil **70** is held in fixed position in a bracket **71** fixed to the frame **31**. The clutch rotor **72** is fixed to the feed roll **34** and journaled in bearings **73** for relative independent rotation about the shaft **44**. The clutch rotor **72** may be provided with an annular frictional surface **74** for engagement with the armature **67**. As illustrated in FIG. **7**, the armature **67** is engaging the clutch rotor **74** while the coil **70** is energized. When the coil **70** is de-energized, the armature **67** disengages the rotor **72** to permit the feed roll **34** to rotate independently of driven shaft **44**.

Electrical current is supplied to the coil **70** through leads **77** terminating in detachable electrical connector **78**. The connector **78** is adapted to electrically engage a cooperating connector **79** fixed to the front wall **27** of the drive housing **18**. The connector **79** in turn is connected through the cable **80** to the switches in the switch box **91**, which in turn is controlled by the pattern control mechanism **82**.

FIGS. **1** and **2** illustrate the drive train for the drive shafts **20 – 22** and **20' – 22'**.

As best disclosed in FIG. **1**, the intermediate-speed drive shafts **21** and **21'** are connected through respective chain-and-sprocket transmissions **84** and **84'** to a gear box **85**, driven by chain-and-sprocket transmission **86** from a right-angle gear box **87**, which in turn is driven from the needle shaft **15** by chain-and-sprocket transmission **88**.

The low-speed shafts **20** and **20'** and the high-speed shafts **22** and **22'** are driven at the left end of the machine **10** as best disclosed in FIG. **2**. The low-speed shafts **20** and **20'** are driven through respective chain-and-sprocket transmissions **90** and **90'** from a smaller sprocket, not shown, on the opposite or left side of the gear box **91**. The high-speed shafts **22** and **22'** are driven from the right side of the box **91** by a larger sprocket **92** through chain-and-sprocket transmissions **93** and **93'**. The input to the gear box **91** is produced through chain-and-sprocket transmission **94** from right-angle gear box **95**, which in turn is driven by needle shaft **15** through chain-and-sprocket transmission **96**.

In the operation of the tufting machine **10**, all of the clutch modules **30** are inserted into the respective slots **28** and retained in operative position by each retaining flange **64** and bolts **65**. All of the driven gears **50**, **55** and **60** then intermesh with the corresponding drive gears **23**, **24** and **25**. Yarns **100** are fed from any source of supply, not shown, such as an overhead creel, down through the yarn guide **101**, beneath the lower yarn feed roll **33**, up between the feed rolls **33** and **34** and over the feed roll **34**, and thence down through the upper guide **102** of the tube bank **103**. The yarn tubes

104 then distribute the respective yarns 100 to corresponding needles 12 in the various repeat groups in the same manner that they are supplied to needles in the tufting machine disclosed in the Card U.S. Pat. No. 2,862,465.

After the machine is started to drive the needle shaft 15, and thereby reciprocate the needles 12 and loopers 14, the drive shafts 20 – 22 and 20′ – 22′ are driven at their respective low, intermediate and high speeds. Because of the drive couplings with the drive gears 23, 24 and 25 through the various chain-and-sprocket transmissions 47, 52 and 57, respectively, the shafts 38, 44 and 43 are driven also at corresponding low, intermediate and high speeds. The pattern control mechanism 82 is so designed that only one electromagnetic clutch 35, 36 or 37 is energized at any one time, in order to engage the corresponding feed roll 33, 34 or high-speed clutch member 37 with corresponding shafts 43, 44 and 38. If the high-speed clutch 37 is actuated, then the clutches 36 and 35 will be de-actuated so that the feed rolls 33 and 34 rotate independently of their respective shafts 43 and 44. However, the feed rolls 33 and 34 are driven together at the same speed by the high-speed clutch member 37 through the intermeshing teeth of the ring gears 41, 40 and 39. Thus, the yarn 100 will be fed to the needles at high-speed to form high tufted loops or cut pile.

By selectively energizing or actuating the other magnetic clutches, the yarn 100 will be fed at the corresponding low, intermediate, or high-speed to the needles 12.

Should one of the clutch members 35, 36 or 37 fail to function properly, only the module 30 upon which the defective member is mounted is removed from its corresponding slot 28. This removal is effected quite rapidly by merely removing the bolts 65 and slipping the entire frame out through the slot 28. A spare module 30 is then inserted into the empty slot 28 and attached by bolts 65 in a matter of minutes. The defective module 30 may then be worked on independently of the functioning of the tufting machine 10.

Thus, by incorporating the yarn feed mechanism 17, including the clutch modules 30 in the tufting machine 10, and having on hand a few spare modules 30, the down-time of the machine 10 is appreciably reduced and production correspondingly increased.

What is claimed is:

1. In a tufting machine having a plurality of reciprocal needles operative to stitch yarns through a base fabric, a yarn feed mechanism comprising:

a. a drive housing of substantial length having a front wall portion,

b. at least two drive shafts rotatably mounted in said housing,

c. a rotary drive coupling member driven by each of said drive shafts at a speed proportional to the speed of said corresponding drive shaft,

d. a plurality of module frames, each module frame having front and rear end portions and a width substantially less than the length of said drive housing,

e. a yarn feed roll rotatably mounted on each of said module frames,

f. at least two rotary clutch members mounted on each of said module frames,

g. means operatively coupling said rotary clutch members to said yarn feed roll for selective driving of said feed roll,

h. means for selectively actuating only one clutch member at a time,

i. at least two rotary driven coupling members mounted on the rear end portion of each of said module frames, each of said driven coupling members being adapted to register with and drivingly engage a corresponding drive coupling member, in operative position, and to drivingly disengage said drive coupling member in inoperative position,

j. drive transmission means on each of said module frames drivingly connecting each of said driven coupling members to a corresponding clutch member,

k. detachable securing means on each of said module frames for attaching the rear end portion of each of said module frames to the front wall portion of said drive housing for driving engagement of each of said driven coupling members with a corresponding drive coupling member, in operative position, and for detaching the rear end portion of said module frame from said front wall portion for driving disengagement of the driven coupling members on said module frame from said corresponding drive coupling members, in inoperative position, and

l. means for driving each of said drive shafts at a different speed so that each of said rotary clutch members in a module frame is driven at a corresponding different speed.

2. The invention according to claim 1 in which the front wall portion of said drive housing has a slot therein aligned with said drive coupling member, the rear end portion of said module frame comprising a tongue portion supporting said driven coupling member and being adapted to be inserted through said slot, and means on said module frame for limiting the entry of said tongue portion into said slot to said operative position in which said drive coupling member and driven coupling member drivingly engage.

3. The invention according to claim 2 in which said means for limiting the entry of said tongue portion comprises a flange projecting laterally from said module frame spaced forward of the rear end of said frame and adapted to fit flush against said front wall portion in operative position.

4. The invention according to claim 1 in which each clutch member is an electromagnetic clutch, and said means for selectively actuating said clutch members comprises an electrical pattern control means electrically connected to said electromagnetic clutches.

5. The invention according to claim 1 in which the rotary axes of said rotary clutch members are parallel to the rotary axis of said feed roll, and said feed roll and said clutch members are operatively coupled by intermeshing gears.

6. The invention according to claim 5 in which each of said drive transmission means comprises a driven sprocket coaxially fixed on said drive coupling member, a drive sprocket coaxially fixed on one of said rotary clutch members and a chain coupling said driven and drive sprockets.

7. The invention according to claim 5 in which said clutch members and said feed roll are in substantial

alignment in a front-to-rear vertical plane on each of said module frames.

8. The invention according to claim **7** in which said module frame is substantially a planar frame member lying in a front-to-rear vertical plane, said clutch members and feed roll being mounted on one side of said frame member and said drive transmission means being mounted on the opposite side of said frame member.

9. The invention according to claim **1** in which each of said drive coupling members and driven coupling members is a gear, said corresponding drive and driven gears being adapted to drivingly intermesh in operative position.

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