June 24, 1958 M. M. BEASLEY 2,840,019

BACKING FABRIC FEED MEANS FOR TUFTING MACHINE AND METHOD

Filed Aug. 29, 1955

2 Sheets-Sheet 1

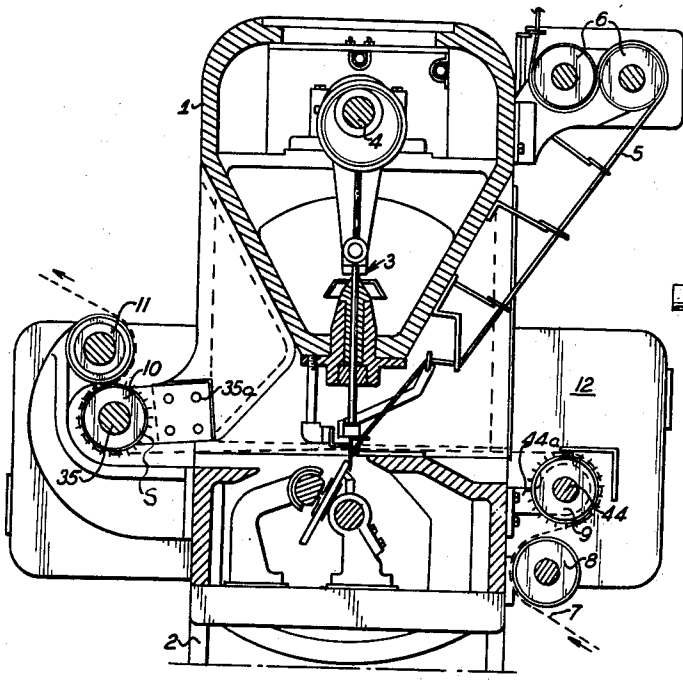


Fig. 1

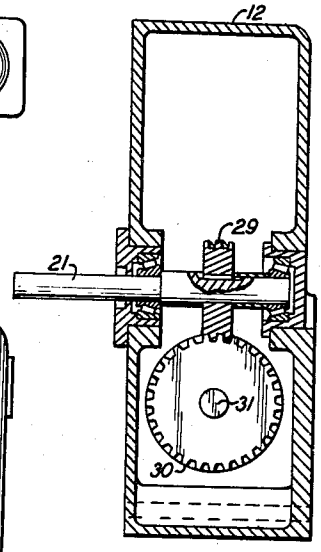


Fig. 4

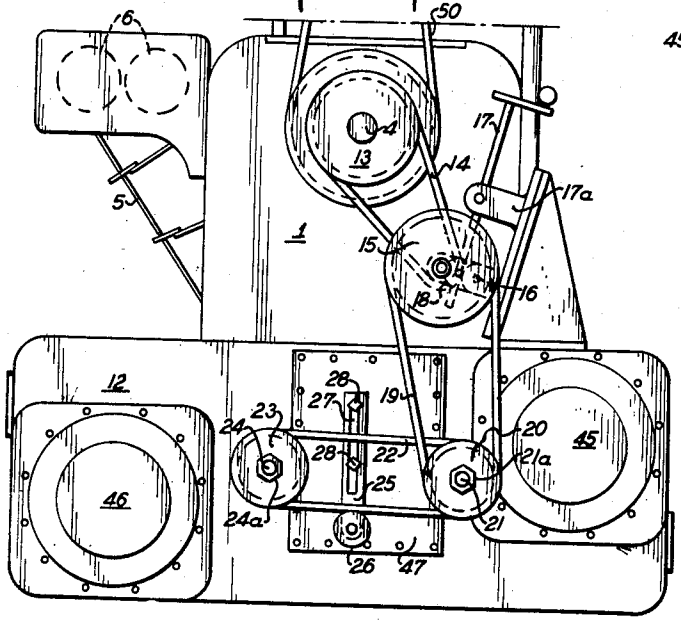


Fig. 2

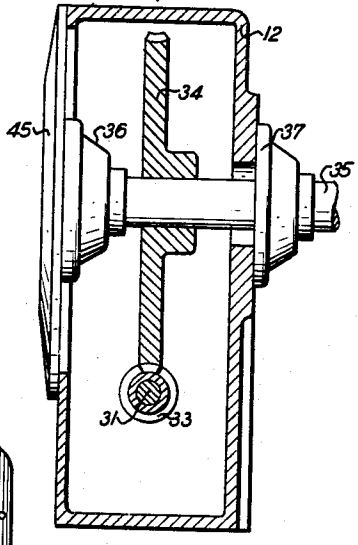


Fig. 5

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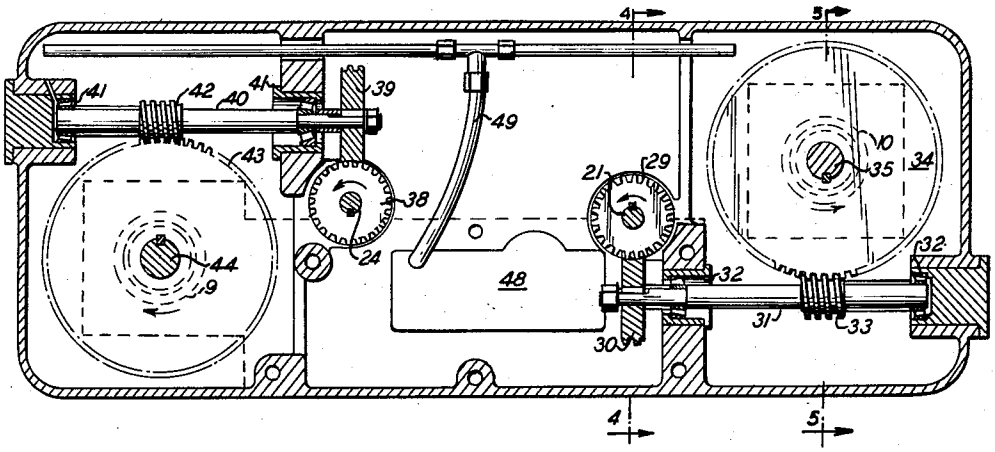


FIG. 1

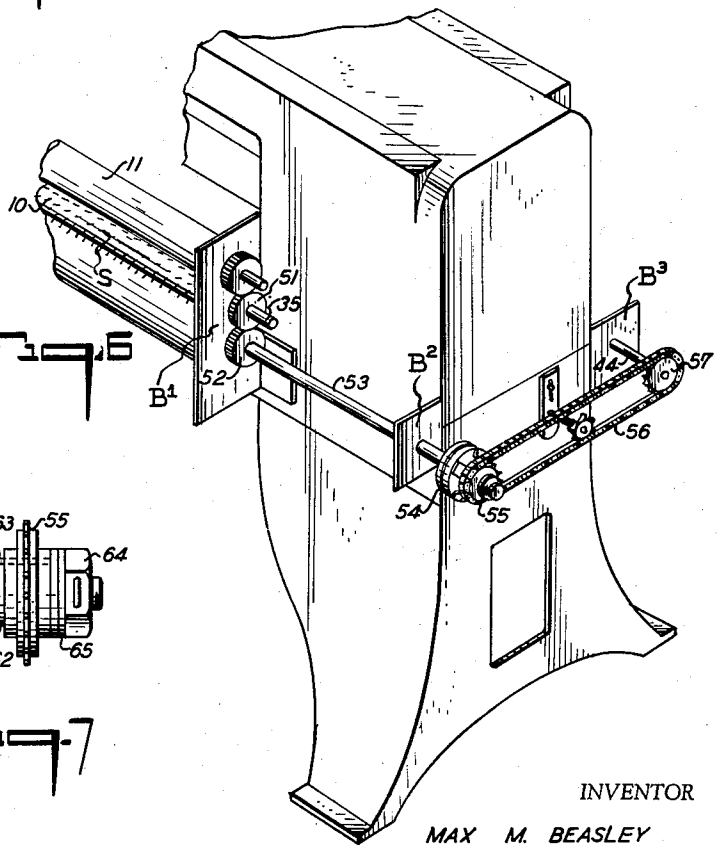


FIG. 6

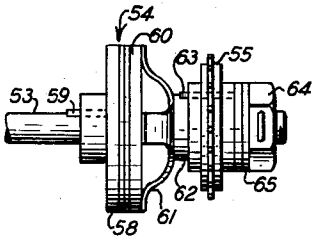


FIG. 7

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2,840,019

BACKING FABRIC FEED MEANS FOR TUFTING MACHINE AND METHOD

Max Marion Beasley, Chattanooga, Tenn.

Application August 29, 1955, Serial No. 531,107

9 Claims. (Cl. 112—79)

This invention is a drive mechanism for the feed rolls by which backing fabric is fed through a multiple needle tufting machine and is an improvement on similar apparatus shown and described in my co-pending application, Serial No. 456,995, filed September 20, 1954.

In the past, considerable difficulty has been occasioned in the operation of multiple needle tufting machines when engaged in producing yardage goods such as carpets, bedspreads, and the like, by the appearance of "stop marks" in the finished fabric as a result of the inertia of the roll of backing fabric from which the machine is supplied, when starting up the machine, and/or by the acceleration and deceleration of machine parts during stopping and starting periods of the machine after a "run" has been initiated. These "stop marks" extend transversely of the finished fabric and are occasioned by a variation in the length of stitches formed by the machine due to variations in the rate of feed of the backing fabric resulting from the above-recited causes, and constitute blemishes in the product which result in appreciable loss to the manufacturer.

The present invention has for an object the provision of means for feeding the backing fabric to the needle mechanism so that there will be no deviation in the rate of feed of the fabric due to acceleration and deceleration of the machine during stopping and starting periods of the machine, and/or to the inertia of the supply roll from which backing fabric is being fed into the machine.

In my co-pending application, Serial No. 456,995, I have described a method and apparatus for accomplishing these purposes by developing a controlled tension in the base fabric as it is passed through the needle mechanism, said tension being of sufficient magnitude to eliminate backlash in separate gear trains employed to drive feed rolls placed fore and aft of the needle mechanism. The tension is developed by driving the aft feed roll at a slightly higher rate of speed than the speed of the fore feed roll while maintaining the fabric and feed rolls in substantially non-slipping engagement. In this arrangement tension in the base fabric, in effect, "loads" the fore and aft feed rolls over and above the fabric feeding load thereon, with the result that the gear teeth of the feed roll driving trains are maintained in contact at all times and thus all backlash in these gear trains is eliminated. To enhance these results, the gear trains each include worm gears which are self-locking against reverse or retrograde movement.

While the arrangement proposed in my co-pending application, Serial No. 456,995, is effective in eliminating "stop marks" in the finished fabric by precluding all movement of the base fabric except when the main shaft, which drives the feed rolls, is in operation, the arrangement is subject to the objection that it requires frequent change and adjustment of the relative speed of the fore and aft feed rolls, since the desired degree of tension in the base fabric is dependent upon such variable factors as the texture of the base fabric and/or its width. Thus, when the tension in the base fabric alone is relied upon

to eliminate backlash in the driving gears, speed adjustments may become troublesome when changes in the types and width of the base fabric are frequent. Furthermore, such adjustments at times require delicate manipulation of the speed controls to maintain proper tension in the cloth to meet operational demands.

In my co-pending application, the total tension force developed in the base fabric may be considered as comprising two components, i. e., the tension force necessary to insure a smooth even feed of the base fabric, and a greater tension force necessary to eliminate backlash in the driving gears. With these facts in mind, the present invention proposes to develop within the base fabric by means such as described in my co-pending application, Serial No. 456,995, only that amount of tension that is necessary to insure a smooth even feed of the fabric when the needles are in operation, and to provide other means, operable to eliminate backlash in the gear trains, the latter means operating without regard to the amount of tension prevailing in the base fabric as it passes through the needle mechanism.

One object of the invention is to provide drive means for the feed rolls of the base fabric which includes means for driving feed rolls at the rear of the needle mechanism at a slightly greater rate of speed than feed rolls in front of the needle mechanism are driven, while maintaining a substantially non-slip driving relation between the feed rolls and the fabric to thereby develop tension in the fabric as it is passed through the needle mechanism, and while loading the feed rolls independently of the fabric feed load to eliminate backlash in the gear trains which drive the rolls.

Another object of the invention is to drive the fore and aft feed rolls through separate gear trains operatively connected respectively to the feed rolls and arranged to drive the aft feed roll at a predetermined speed slightly exceeding the speed of the fore feed roll and wherein said feed rolls are otherwise drivingly interconnected by means tending to drive the aft feed rolls from the fore feed rolls at a speed greater than said predetermined speed.

Another object of the invention is to provide fore and aft feed rolls separately driven by gear trains which maintain the aft feed roll at a predetermined speed which is greater than the speed of the fore feed roll while concurrently loading the rolls over and above the normal feed load thereon by drivingly connecting the rolls so that the fore feed roll tends to drive the aft feed roll at a speed greater than the predetermined speed while compensating by a slip clutch the speed differential between the two driving means for the aft feed roll.

Another object of the invention is to provide a transmission mechanism for the feed rolls which will eliminate entirely or reduce to a negligible minimum the backlash in the transmission mechanism and thereby preclude "stop marks" in fabric due to irregular movement of the base fabric with respect to the needle mechanism, i. e., "over run" and/or reverse movement, as a result of stopping and again starting the machine after a yardage "run" has been initiated.

These and other objects of the invention will become apparent from a consideration of the following specification read in connection with the accompanying drawings wherein a preferred modification of the invention is shown and wherein

Fig. 1 is a vertical sectional view of a multiple needle tufting machine embodying the present invention,

Fig. 2 is an end elevation of a tufting machine equipped with the present invention,

Fig. 3 is a vertical sectional view through the transmission housing,

Fig. 4 is a transverse sectional view through the housing taken on the line 4—4 of Fig. 3, and

Fig. 5 is a transverse sectional view taken on the line 5—5 of Fig. 3,

Fig. 6 is a perspective view of the opposite end of the machine shown in Fig. 2 and showing the loading means,

Fig. 7 is a detailed view of one form of slip clutch.

Referring more particularly to the accompanying drawings, Fig. 1 shows a typical multiple needle yardage tufting machine designed for making carpets, bedspreads, and the like. It includes a suitable framework **1** supported on a suitable base **2** (shown broken away) and includes a needle mechanism indicated generally by the reference character **3**, the needle mechanism being driven by an overhead shaft **4** which may be driven by any conventional means (not shown). Thread or yarn **5** is fed to the needle mechanism from a source (not shown) by yarn feed rolls **6**. The base fabric **7**, which is provided with pile tufts or loops by the needle mechanism in a well-known manner, may be drawn from the supply roll (not shown) over stationary roll **8** by the front fabric feed roll **9**. At the rear of the machine there are provided the fabric feed roll **10** and stripper roll **11**. The feed roll **10** draws the base fabric **7** through the needle mechanism of the machine and the needles project the pile tufts or loops through the fabric in a well-known manner. The fore and aft feed rolls **9** and **10** are positively driven by drive mechanism housed within the transmission casing **12** secured to the machine frame **1** by any suitable means. The drive mechanism within the casing **12** is driven from the overhead shaft **4** by means clearly shown is Fig. 2.

The drive means for the transmission mechanism housed within the casing **12** comprises a V pulley **13** secured to shaft **4** and driving a V belt **14** which operatively drives one pulley of a multiple V pulley change speed device indicated generally by the reference character **15**. The change speed pulley device **15** is of conventional form and includes an intermediate axially movable sheave which in response to belt tension in the belts on opposite sides thereof will shift axially on the pulley spindle to increase the effective diameter of one belt pulley and simultaneously and correspondingly decrease the effective diameter of the other belt pulley in a well-known manner. The tension on the belt **14** may be varied by rocking the pulley device **15** about the mounting spindle **16** by manipulation of the threaded rod **17** which has one end rotatably connected to an arm **18** which in turn is operatively connected to the pulley device **15**. The threaded portion of the rod **17** passes through a threaded sleeve or nut supported for rocking movement between arms **17***a* as shown in Fig. 2. Thus, as the threaded rod **17** is rotated, the pulley device **15** may be rocked clockwise or counterclockwise about the pivot **16** to increase or decrease respectively the diameter of the pulley to which the V belt **14** is connected and simultaneously to correspondingly decrease or increase the effective diameter of the pulley to which the V belt **19** is connected. The V belt **19** drives a multiple expansible V pulley **20** mounted on a shaft **21** and the pulley **20** drives through a V belt **22** an expansible V pulley **23** mounted on shaft **24**. The V pulleys **20** and **23**, as shown in Fig. 2, are of the expansible type and in response to adjustment of the nuts, **21***a* and **24***a*, the space between the pulley sheaves may be made greater or less and thus vary the effective diameter of the respective pulleys. A belt guide and tension device **25** for the belt **22** is shown, carrying an idle pulley **26** and the latter is adjustable on the gear casing **12** by means of a slot **27** and bolt members **28** to maintain suitable tension on the belt **22** in all positions of adjustment of the pulleys **20** and **23**.

The shafts **21** and **24** are mounted in suitable bearings in the walls of the gear casing **12**, and project therefrom

at one end to receive the V pulleys **20** and **23** respectively, as clearly shown in Fig. 2 of the drawing. Within the gear casing **12** the shaft **21** carries a helical gear **29** which is operatively engaged with a mating gear **30** mounted upon a shaft **31** journaled in suitable bearings **32** and carrying a worm **33**. The worm **33** is operatively engaged with a worm gear **34** which is splined to a shaft **35** which extends across the rear of the machine, generally parallel to the bank of needles **3** and is suitably journaled in bearings **35***a*, carried by the machine frame **1**. The shaft **35** carries the rear feed roll **10** and one end thereof projects into the gear casing **12** through guide bearings **36** and **37** and is driven by the gear **34** as shown.

Shaft **24** is similarly supported for rotation by bearings in the walls of the gear casing **12** and has splined thereto within the casing a helical gear **38** which meshes with a gear **39** splined to a shaft **40** journaled in suitable bearings **41** and carrying a worm **42**. The worm **42** meshes with a worm wheel **43** splined to shaft **44** which extends across the front of the machine generally parallel to the bank of needles **3** and is mounted for rotation in suitable brackets **44***a* carried by frame **1**. The shaft **44** carries the fore feed roll **9**, and one end of this shaft projects into the housing **12** and is driven by gear **43** as shown.

The details of the gear casing **12** are unimportant, but the casing may be provided with suitable removable closure plates **45**, **46**, **47**, and **48** to provide access to the gear elements of the transmission. Suitable lubrication may be provided within the casing **12** by any convenient means including ducts **49** for delivery of lubricant to the bearing elements of the transmission mechanism.

As shown in Fig. 1, the rolls **9** and **10** are provided with fabric-penetrating spikes S to insure non-slipping feed of the fabric.

In operation, the main shaft **4** of the machine is driven by any suitable source of power such as an electric motor (not shown), by V belt **50**. As previously described, the transmission mechanism for driving the feed rolls **9** and **10**, is driven from the main shaft **4** of the machine so that the feed rollers are driven in timed relation to the needle mechanism. The length of the stitches looped into the base fabric is of course dependent upon the rate of feed of the base fabric, and this in turn may be controlled by adjusting the speed pulley device **15** as desired. Thus, if the effective diameter of the pulley to which V belt **14** is engaged is increased, the speed of the feed roll transmission mechanism is increased, and vice versa. Generally speaking, a speed change of about 2½ to one may be effected by the pulley drive **15** as shown, and this will yield a range of stitch lengths of approximately from 4 to 10 stitches per inch. If greater range of variation is desired, a change in the size of sheaves in the pulley drive **15** may be readily made. Any change in speed of the feed roll transmission mechanism due to adjustment of the pulley drive **15** has no effect upon the relative speed difference in the shafts **21** and **24** since the percentage of speed difference in the latter shafts is determined by the adjustment of the expansible V pulleys **20** and **23**. Thus, for any given adjustment of the pulley speed change device **15**, the expansible pulleys **20** and **23** may be relatively adjusted to give any desired percentage of speed difference between these shafts to thereby drive feed rolls **9** and **10** at relative speeds such as to create a desired tension in the base fabric **7** as it passes through the needle mechanism.

It should be noted that while I have described a change speed drive means between shafts **21** and **24**, this while desirable, is not necessary where separate means are provided to eliminate backlash by loading the feed roll shafts over and above the fabric feed load thereon as fully described hereinafter. Thus, for the change speed belt and pulley drive **20**—**22**—**23** provided between shafts **21** and **24**, I may use a fixed ratio drive of any desired form such as a chain and sprocket drive (not shown)

designed to drive the aft roll (or shaft) at a slightly higher speed than the fore roll (or shaft). Experience has shown that when the tension in the fabric is relied on only to provide a smooth even feed through the needle mechanism a speed differential between the fore and aft feed rolls of approximately 2 percent is usually sufficient.

It will be noted that each feed roll **9** and **10** is driven by a separate train of gearing; the roll **9** by the gear train **38—39—42—43**, and the roll **10** by the gear train **29—30—33—34**. In each instance the last two gears in the respective train are high reduction worm gears which are self-locking in response to any tendency of the respective rolls **9** and **10** to move in reverse. This reduces backlash to a minimum. The ratio of reduction between the gears **42—43** and **33—34** is not critical, but it should be high and preferably of the order of 80:1 or greater.

Although any tension in the fabric between the rolls **9** and **10** will tend to reduce backlash in the gear trains which drive the feed rolls, it is not always desirable to develop sufficient tension in the fabric to eliminate completely this lost motion in the gears as proposed in my co-pending application, Serial No. 456,995. I, therefore, propose to provide separate means for controlling backlash in the gears and in Fig. 6 I have shown such means operatively associated with the feed rolls **9** and **10**. Thus the fore feed roll shaft **44** and the aft feed roll shaft **35** may be extended beyond the end of the machine opposite that shown in Fig. 2. The extension of shaft **35** may be supported in any suitable bracket B′ and may have a gear **51** secured thereto. The gear **51** is meshed with a gear **52** carried by a jack shaft **53**, the latter being supported in any convenient manner by bracket members B′ and B^2. The jack shaft **53** extends beyond the end of the machine and is then provided with a slip clutch indicated generally by the reference character **54**. The slip clutch may be of conventional design such as shown in Fig. 7 and in practice a 6 inch Hilliard No. 311 clutch has proved quite satisfactory.

The slip clutch **54** may include a friction element **58** secured to the shaft **53** by a key **59** and cooperating with the friction element **58** is a second friction element **60**, the latter being connected by spring arms **61** to a hub **62** rotatably mounted on shaft **53**. On the hub **62** is secured a sprocket **55** as by a key **63**. A nut **64** threaded on the end of the shaft **53** bears against a thrust collar **65** to urge the friction element **60** resiliently into engagement with the friction element **58** to thereby regulate or adjust the degree of slip between the elements **58** and **60**. The sprocket **55** is connected by a sprocket chain **56** to a sprocket gear **57** secured to the extended end of shaft **44** which carries the fore feed roll **9**. The extension of shaft **44** may be suitably supported in a bracket B^3. The sprockets **55** and **57** are designed to provide a speed differential between shafts **44** and **53** of approximately 5 to 7 percent with the shaft **44** tending to rotate the shaft **53** at the higher speed. Obviously, due to the separate gear trains which drive the rolls **9** and **10** at the opposite ends thereof, namely **38—39—42—43** and **29—30—33—34** respectively, the sprockets **55** and **57** and the sprocket chain **56** are not effective to relatively alter the speed of the rolls **9** and **10** as determined by said separate gear trains, so that the slip clutch **54** is provided to compensate the speed differences between the drive members connected to opposite ends of the feed roll shaft **35**. This clutch functions, in effect, to load the roll shafts to an extent sufficient to eliminate substantially all backlash in said gear trains while a desired light tension of the fabric is maintained between the rolls as the fabric passes through the needle mechanism. The degree to which the roll shafts are loaded may be controlled and determined by adjusting the degree of "slip" of the clutch **54** by the nut **64** in a known manner.

It should be noted that while I have described a continuous drive for the feed rolls and associated gearing, either in the form of a fixed ratio drive or a change speed drive as by the belt and pulley means **13—14**, **15—19**, and **20**, any desired form of intermittent drive means, such as a Ferguson roller gear drive, may be employed between the drive shaft **4** and the shaft **21** without sacrificing any of the effectiveness of my invention in preventing "stop marks" in the resulting fabric. It is well known in the art to drive the base fabric intermittently in timed relation to needle movement, and it is to be understood that where the terms "drive means" or "drive mechanism" are used herein and in the appended claims, said terms comprehend either a continuous drive means or an intermittent drive means.

Having thus described my invention it is apparent that by providing loading means for the roll shafts separate from the means for developing tension in the base fabric, I am able to eliminate backlash in the gear trains which drive the rolls while maintaining only that degree of tension in the base fabric as is necessary to insure a smooth even feed thereof through the needle mechanism of the machine. This precludes any difficulty such as deflection of the needles due to excessive tension in the fabric while insuring a smooth even feed of the fabric and a uniform operation of the machine which together produces a finished fabric entirely free of stop marks.

It will be understood that while I have shown a preferred embodiment of my invention, those skilled in the art will appreciate that various changes may be made in size and proportion of the parts without departing from the spirit of the invention which is set forth more particularly in the appended claims.

I claim:

1. In a multiple needle tufting machine including needle mechanism and fabric feed rolls positioned fore and aft with respect thereto, separate drive means for the feed rolls operating to drive the aft feed roll at a speed that is greater than the speed of the fore feed roll and means drivingly interconnecting the feed rolls and tending to drive the aft feed roll at a speed greater than said first mentioned speed thereof.

2. The apparatus described in claim 1 wherein the means drivingly connecting the feed rolls includes means for compensating the speed differential between said first mentioned speed of the aft roll and the speed at which said interconnecting means tends to drive it.

3. The apparatus described in claim 2 wherein said speed compensating means includes a slip clutch.

4. The apparatus described in claim 2 where means are operatively associated with said separate drive means for the feed rolls for relatively varying the speed of the fore and aft rolls and wherein said speed compensating means includes means for variably loading the fore and aft feed rolls over and above the fabric feed load thereon.

5. In a tufting machine, feed rolls mounted fore and aft of the needle mechanism thereof, separate gear trains connected to the respective feed rolls for driving the rolls at different speeds, the aft feed roll being driven at a greater speed than the fore feed roll to develop tension in the fabric fed by said rolls, and means for loading the feed rolls over and above the fabric feed load thereon to thereby eliminate backlash in the gear trains driving the said rolls.

6. The apparatus described in claim 5 wherein the loading means comprises means drivingly interconnecting the feed rolls and tending to drive the aft feed roll at a speed greater than that imparted to said feed roll by the gear train connected thereto, and speed compensating means operatively interposed between the aft feed roll and the means drivingly interconnecting it with the fore feed roll.

7. The apparatus described in claim 6 wherein the speed compensating means comprises a slip clutch.

8. In a tufting machine, fabric feed rolls fore and aft

of the needle mechanism, a first drive means comprising separate gear trains operatively connected to the respective feed rolls at one end thereof and arranged to drive the aft feed roll at a speed greater than the speed of the fore feed roll, and a second drive means comprising means drivingly interconnecting the opposite ends of the feed rolls and tending to drive the aft feed roll at a speed greater than the speed imparted thereto by said first drive means, and speed compensating means operatively interposed between the aft feed roll and said second mentioned drive means therefor.

9. The apparatus described in claim 8 wherein said

speed compensating means comprises a slip clutch including means for adjusting the percentage of slip thereof.

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