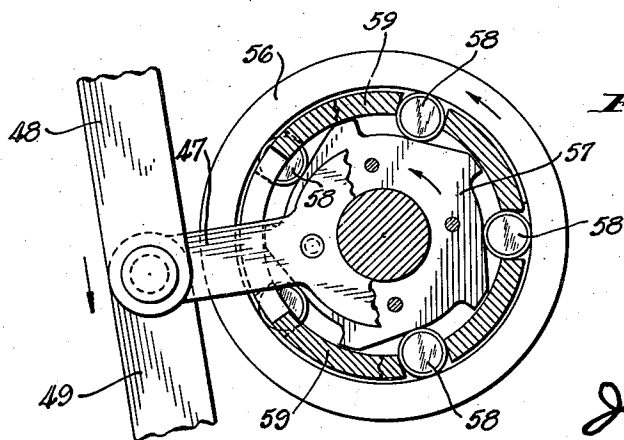


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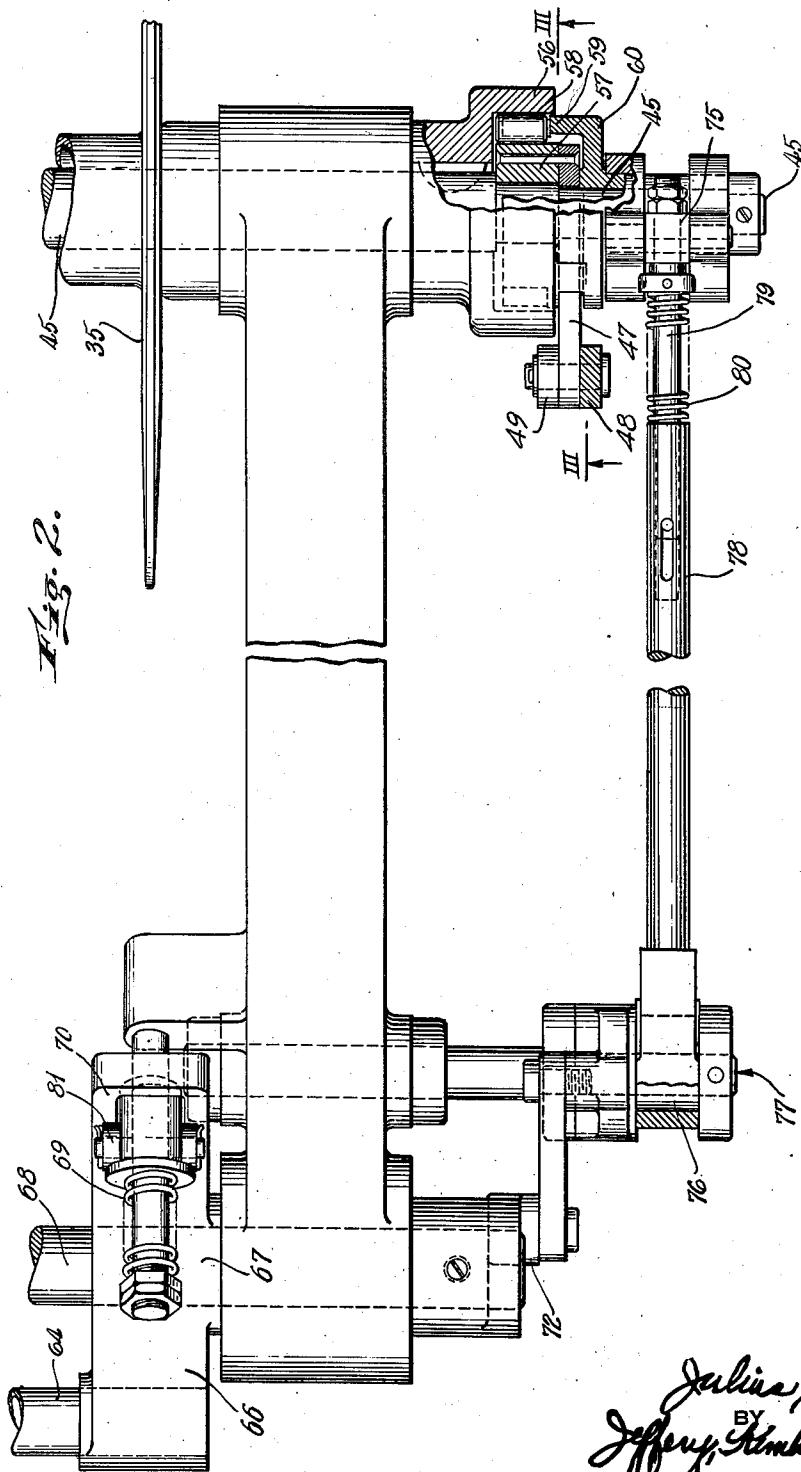
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THREAD AND YARN FEEDER

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THREAD AND YARN FEEDER

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My invention relates to the feeding of the yarns from the spools in the manufacture of fabrics. The term "yarn" is used herein as including thread and other filaments of all kinds that can be worked into a fabric. The term "spool" is used as including cops, beams and all other carriers that may be used to supply the yarn for the fabric.

The invention provides a feed device for this purpose that delivers the yarns under such conditions that the finished fabric, throughout its length, shows a minimum amount of variation in structure, even though the individual stitches may be very small. It is particularly adapted for use with warp knitting machines, that is to say, knitting machines in which all of the yarns run in the general direction of the length of the fabric, but it may be used in other situations also.

Briefly, I provide mechanism to turn the yarn spool or spools in a direction to supply the yarn therefrom, and between the spools and the point where the fabric is formed I pass some or all the yarns, in something like a loop, over a member which is movable as an excessive rate of feed of yarn permits the loop to enlarge and as an insufficient feed rate makes the loop smaller. I use the movements of this member to control the rate of feed from the spool or spools. Additionally, I at least prefer to hold this member against the yarn by as nearly a constant pressure as reasonably possible regardless of the position of the member, so that its movements will be as proportional as possible to any excess or insufficiency in the feed rate, for accuracy of control, and also hold the yarns under as constant a tension as possible in order that all stitches may be formed under the same conditions. The result is that the feed of the yarns is controlled by the momentary relative rates of supply and consumption of the yarn rather than by changes in the tension on the yarn, and the structure of the fabric is substantially uniform.

The feed from a spool may be an intermittent step-by-step feed. In such cases I preferably avoid the use of ratchets and the like to step the spool ahead, for greater accuracy. In such cases too I preferably advance the spools a step for each formation of a row of stitches, and preferably make each advance in an interval when no stitches are actually in process of formation.

The accompanying drawings illustrate the preferred form of my invention applied to a warp knitting machine. Fig. 1 illustrates the same in end view, but almost entirely diagrammatically. Fig. 2 is a plan view, partly in section and to a

larger scale, of the connection between one of the tension members of the machine and the driving mechanism of the spools which it serves. Fig. 3 is a sectional view of the clutching device of this driving mechanism, taken substantially at the line III—III of Fig. 2.

In Fig. 1 the essential elements of the warp knitting machine will be recognized. Its various operating parts are actuated by cams on a rotating cam shaft shown in dotted lines at 1 and the axis of which is at 2. As customary the needle bar 3 carries a line of needles 4, which here are spring beard needles; this needle bar 3 is carried by and oscillates around a rod 5 as directed by a roller bracket 6, the rollers 7 of which bear on the opposite sides of a cam 8 on the cam shaft 1. The sinker bar 11 carrying sinkers 12 between which the needles 4 operate, oscillates around a bar 13 as directed by a roller bracket 14, the rollers 15 of which bear on the opposite sides of a cam 16 carried by the cam shaft 1. The customary presser bar 19 oscillates around a bar 20 as directed by the roller bracket 21; the rollers 22 of this bracket bear on the opposite sides of a cam 23 on the cam shaft 1. A line of yarn guides 25, in number substantially corresponding to the number of needles 4, is mounted in a guide bar 26 which swings about its supporting bar 27, and is arranged to be moved back and forth along the needle line, for limited distances, as will be understood from customary practices. In the present instance the machine has a second line of yarn guides 28 mounted on the second guide bar 29 which also may be carried by and oscillated about the rod 27. The invention is not concerned with the number of lines of guides however. The guides 25 and 28 may also be rocked by a cam or cams on the cam shaft 1 or otherwise, but their driving connections have been omitted from the drawings for clarity. It will be understood of course that Fig. 1, being an end view, shows only one needle 4, and only one yarn guide 25 or 28 in each of the guide bars and one sinker 12, whereas in reality there are a great many needles, sinkers and guides in the machine. The yarns 32 and 33, generally one for each yarn guide, are taken from large spools or lines of spools 34 and 35. In accordance with a common practice, the completed cloth 36 passes under a loose roll 31 and thence is wound up on a cloth beam 38 as indicated at 39, the beam 39 being driven customarily in such a manner as to maintain as uniform a tension on the cloth 36 as possible.

The operation of the warp knitting machine as

so far described may be in accordance with prior practices. Briefly (omitting feed of the yarns from the spools 34 and 35) it is about as follows: In Fig. 1 the yarn guides 25 and 28 have wrapped yarns for new loops around the projected needles 4, and these needles are about to be drawn downwardly. As they are drawn downwardly (by rotation of the cam shaft 1) the presser bar 19 is moved against the needle beards so that these beards are closed and thereby their ends are caused to enter the previously drawn loops of yarn hanging on the needles. As the needles continue to descend, the presser 19 retracts, and ultimately the descent of the needles casts off the previous loops over the needle ends as completed stitches. As the bearded ends of the needles pass below the top edges of the sinkers 12, they draw the newly wrapped yarn into loops, and the distance these ends pass below the top edges of the sinkers measure the lengths of the new loops and accordingly the length of yarn to be consumed in the formation of the next row of stitches. The needles 4 then start upwardly again and the sinker bar 11 moves forward to catch the edge of the finishing fabric in notches in the sinkers 12, so that this edge is held down in order that the needles 4, in moving upwardly, will slide through the newly-drawn loops; ultimately the sinkers are drawn back again. One or both the yarn guides 25 and 28 having been moved a short distance or short distances lengthwise of the needle line, they are swung across the needle line as the needles are again at or approach their highest positions, and then back again in such a manner as to wrap further yarn around various needles. This completes a cycle of operations and the needles are now ready to start down again to complete another row of stitches and draw new loops of the yarns.

The rows of spools 34 and 35 which supply the yarns to the needles, are fixed on the shafts or yarn beams, so called, 44 and 45, so that by rotating the beams the spools are rotated to feed off their yarns; ordinarily the attachment of the spools to the beams is such that empty spools can be removed readily and full spools substituted for them. At 46 and 47 the mechanisms for rotating the two beams receive their driving power from the rods or links 48 and 49 which are reciprocated (once for the formation of each row of stitches in the present instance) by an eccentric 50 on the cam shaft 1 and the strap 51 of which is connected to the rods 48 and 49 by means of link 52 and rocker 53. These driving arrangements are only matters of mechanical convenience however.

The mechanisms which rotate the two beams, embody the invention in the same form and accordingly a description of that at beam 45 will suffice. A ring 56 (Fig. 2) is keyed to one end of the yarn beam 45, and internally of this ring 56 a cam member 57 is mounted concentrically with the ring but so as to turn independently of the ring. The eye 47 which is connected to the reciprocating driving rods, is connected to this cam 57 so that the latter oscillates as the rods reciprocate. On its outer edge the cam 57 is provided with preferably a number of inclined planes or non-tangential surfaces, and a series of rollers 58 is interposed between these non-tangential surfaces and the outer ring 56 so that the cam, when it turns in one direction (namely when the eye 47 is rocked downwardly, Fig. 1) grips the ring 56 and turns the ring and beam 45 with

it. The rollers 58 however are held between arms of a roller cage 59 carried by a bracket 60 which also is mounted to turn freely concentrically with the ring 56, for example on the extended shaft of yarn beam 45. The function of this cage is to control, i. e., determine, the distance the beam, and hence the spools on it, are turned with each oscillation of the cam member 57. The eccentric 50 oscillates the eye 47 and cam member 57 a given distance with each rotation of the cam shaft 1 of course, and hence tends to turn the beam a certain fixed distance with each oscillation. The cage 59 however, by holding the rollers 58 at one point or another along the inclined planes of the cam member 57 at the start of any oscillation, can require the cam member to turn a greater or lesser distance before it grips the ring 56 through the rollers, and thus can cause the beam to be moved throughout only a lesser or greater part of the total stroke of the cam member. As desired, the spaces for the rollers in the cam member 57 may be made relatively long, so that the cage can exercise a correspondingly considerable degree of control, and even to the extent of permitting no movement of the beam at all. Ordinarily I prefer a friction type of drive to the beam of which the foregoing is an example, rather than one operating in definite steps like a pawl and ratchet, because I find that the friction type gives more accurate control as before pointed out. As will be understood, a, say, friction brake (not shown) may be attached to the beam to prevent the beam turning except as turned by the cam member 57 and to only the extent of the effective throw of that cam member.

The positioning of the roller cage 59, or at least the extent of turning of the beam 45 or the rate at which it is turned to feed off yarn, is determined by a bar 64 over which some or all the yarns from this beam pass. This bar may extend the full length of the machine and preferably all of the yarns 33 from the spool or spools 35 are passed over it. A similar bar 65, similarly mounted and related to the yarns 32, serves the same functions for the yarn beam 44 and its spools 34. The bar 64 (commonly called a tension bar because it can determine the tension on the yarns 33 also as hereafter explained) is so disposed that the yarns 33, in passing over it, are deflected away from straight line paths from the spools to the needles; i. e., as stated before, the yarns are drawn into something like loops in passing over the bar 64. This permits the portion of each yarn between its guide and its spool to not only increase if the feed rate at the spool is greater than the rate of consumption of yarn in the formation of the fabric, but also permits the lengths to decrease if the yarn is fed from the spools too slowly. The bar 64 is movably mounted however, and pressed against its yarns, so that it changes its positions as the portions of the yarns between the yarn guides and the spools increase and decrease in length. For example, the bar 64 may be (and preferably is) carried by arms 66 of brackets 67 which are free to turn on a supporting bar 68 carried by the frame of the machine, and one or more springs 69 may bear on an arm 70 of one or more of the brackets 67 to thrust the tension bar 64 against the yarns 33. This permits the tension bar 64 to oscillate as the yarns increase and decrease in length. In the present instance the spring or springs 69 also determine the tension under which the yarns are held, as will be seen, and this tension can be changed and

adjusted from time to time as desired, for example by the nut and thread arrangement illustrated at the spring 69 and which will be understood.

Whatever this construction may be however, I desire that the tension on the yarns do not change as the bar 64 moves with any increase or decrease in the lengths of the portions of the yarns 32 between the yarn guides and the spools. However, the pressure of such a spring as 69 increases as the spring is compressed by swinging of the tension bar 64 in one direction, and falls as the spring elongates with the swinging of the tension bar in the opposite direction, as is well known. Desirably therefore I compensate for this in some manner. For example, this can be done (and preferably is done) by permitting the end or follower roll 81 of each spring to move along its arm 70 as its bracket rocks, and so disposing each spring arm 70 that the end or follower roll 81 of each spring works entirely at one side of that radius of the axis of the respective bracket 67 which is at right angle to the direction of the spring movement, as indicated in Fig. 1. By such an arrangement, the effective length of each arm 70 (i. e., the distance from the end 81 of the spring to the axis of its bracket 67) becomes longer as the spring expands and becomes weaker (note the position of the end of spring 69 on arm 70 in Fig. 1), and becomes shorter as the spring is compressed and therefore exerts greater pressure (note the position of the end of spring 69^a relatively to the axis of its bracket, Fig. 1). By arranging and disposing the parts in this manner properly consonant with the characteristics of the spring used, the tension bar 64 can be pressed against its yarns 32 with substantially the same pressure in all positions of the bar, as will be understood.

To form a connection between the tension bar 64 and the driving mechanism of the yarn beam 45 (specifically, a connection to the eye 75 connected to the roller cage 59) it is usually convenient to provide one of the brackets 67 with an additional arm 72; obviously this arm 72 swings with the tension bar 64. Instead of connecting the bar 64 (or its related arm 72) to the cage directly however, I prefer to interpose between the two a device such that, while it causes the cage to respond rather promptly and substantially proportionally to a change in position of the bar, permits the bar 64 to make a relatively large movement in bringing about a small change in the yarn feed rate; e. g., in bringing about a small change in the position of the cage 59. This usually produces better results, and can be effected by connecting the arm 72 to an eccentric 76 or the like (the center of rotation of this eccentric is at 77), and connecting the strap or abutment of the eccentric to the cage eye 75 by a connecting rod 78. I have found however that devices which transmit each displacement of the tension bar to the roller cage quickly usually operate better than those which transmit the displacements more slowly; eccentrics and sliding and rotating cams are illustrative of quick-acting devices; threaded devices (e. g., a nut on a threaded bolt) are examples of slower acting devices that are not quite so accurate in some instances.

It will be observed of course that the roll cage 59 must turn through a small arc each time its yarn beam is advanced a step, and then must return to about its starting position unless the tension bar 64 has changed its position noticeably in the meantime. To permit this oscillat-

ing motion of the roll cage 59 without disturbance, the connection between the tension bar and the cage can include an arrangement permitting such a degree of independent motion of the cage. For example, a spring can be included in the connection between the two. Thus the connecting rod 78 may include a telescoping extension 79 connected directly to the cage eye 75, the two parts of the rod being pushed apart by an interposed spring 80 (see Fig. 2 particularly).

As before mentioned, I prefer to cause the yarns to be fed (i. e., the yarn beams 44 and 45 to be turned) in a particular time relation with respect to the movement of the needles 4; preferably too with respect to the movement of the yarn guides 24 and 25. Namely, I prefer to so relate the driving mechanisms (e. g., by the positions of the various driving cams angularly about the cam shaft 1 and the shaping of the clutch cam 57) that the yarn beams 44 and 45 are actually turned to feed yarn at times other than when the lengths of the stitches are being measured; in the present instance this measuring is when the needles are descending as before indicated. Such time relation permits the stitches or fabric tightness to be measured against the tension on the yarns alone and in all instances, and this conduces to uniformity in the fabric. Also preferably, although somewhat secondarily, I so time and arrange the parts that the yarn beams 44 and 45 are actually turned to feed yarn while the yarn guides 25 and 28 are moving from back of the needles (their positions in Fig. 1) to the front of the needles, and usually complete each advance of each yarn beam just before the yarn guides 24 and 28 reach their extreme positions in front of the line of needles (i. e., on the opposite side of the needles from that shown in Fig. 1). Preferably accordingly, with the knitting machine illustrated, I so arrange and time the parts that the yarn beams are turned while the needles are at or have nearly reached their upper positions and to that end so dispose the beam driving eccentric 50 with respect to the needle bar cam 8, that each forward step of the yarn beams is completed shortly before the needles reach their highest positions.

It will be understood that the details of construction and operation described above and shown in the accompanying drawings are subject to considerable changes and that my invention as described can be embodied in various forms of apparatus. My invention accordingly is not limited to the details of construction and operation described and shown except as appears hereafter in the claims.

I claim:

1. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, a driven device coupled in a fixed relation to said spool, a driving device, an element engageable with both said driven device and said driving device through which the driving device drives said driven device and therewith the spool, a member over which the yarn passes out of a straight line path between the spool and the fabric-forming instrumentalities, said member being movable as the length of the yarn between the spool and said instrumentalities changes, and means connecting said member to said element through which the position of said member determines the action of the element.

2. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, a driven device coupled in a fixed relation to said spool, an oscillating driving member, an element engageable with both said driven device and said driving member in one direction of the oscillation through which the driving member drives said driven device and therewith the spool, a controller to control the engagement of said element with said driving member and said driven device, a yarn member over which the yarn passes out of a straight line path between the spool and the fabric-forming instrumentalities, said yarn member being movable as the length of the yarn between the spool and said instrumentalities changes, and means connecting said member to said controller through which the position of said yarn member determines the positioning of the controller and therewith the action of said element.

3. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, a driven device, a driving device, an element engageable with both said devices through which the driving device drives the driven device and therewith the spool, a member over which the yarn passes out of a straight line path between the spool and the fabric-forming instrumentalities, said member being movable as the length of the yarn between the spool and said instrumentalities changes, and means connecting said member to said element through which said member moves said element to change the action between the driving and driven devices.

4. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, driving mechanism to rotate the spool to feed yarn therefrom, a controller to control the rate of rotation of the spool by said driving mechanism, a member over which the yarn passes out of a straight line path between the spool and the fabric-forming instrumentalities, said member being movable as the length of the yarn between the spool and said instrumentalities changes a spring and lever arm to thrust said member against the yarn, said spring engaging said lever, at all times, at one side of the line passing through the lever arm axis at right angles to the direction of pressure of the spring on the arm and said spring being movable along said lever arm so as to engage the arm at a point farther remote from the lever arm axis as the pressure of the spring on the arm falls, and means connecting said member to said controller through which movement of said member responsive to a shortening of said yarn length adjusts said controller to increase the rate of yarn feed by said driving mechanism and vice versa.

5. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, driving mechanism to rotate the spool intermittently to feed yarn therefrom in intervals between the completion of the measuring of the length of said yarn consumed in the formation of one row of stitches and the beginning of the measuring of the length of said yarn to be consumed in the formation of the next succeeding row of stitches, a controller to control the distance said driving mechanism turns the spool in individual spool-turning operations, a member over which the yarn passes and which is movable as the length of the yarn between said spool and said instrumentalities changes, and means connecting said member to

said controller through which said member moves said controller to different positions.

6. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, driving mechanism to rotate the spool intermittently to feed yarn therefrom, said driving mechanism being timed to terminate each spool-turning operation prior to the beginning of the measuring of the length of yarn to be consumed in the formation of a row of stitches, a controller to control the beginning of each spool-turning operation by said driving mechanism, a member over which said yarn passes and which is movable as the length of yarn between said spool and said instrumentalities changes, and means connecting said member to said controller through which said member moves said controller to determine the length of the interval between the completion of the measuring of the length of said yarn consumed in the formation of a row of stitches and the beginning of a spool-turning operation that will stop prior to the measuring of the yarn for the next succeeding stitch row.

7. For a fabric-forming machine having fabric-forming instrumentalities and a spool to supply yarn thereto, a bar over which said yarn passes and oscillatable as the length of the yarn between the spool and said instrumentalities changes, a driving device movable around the spool axis, a device driven by said driving device to rotate this spool, a controller oscillatable around the spool axis to effect a driving connection between said driving and driven devices, and means connecting said bar and controller to position the controller in accordance with the position of the bar to control the rate of spool rotation.

8. The combination with the subject matter of claim 7, of means operating on the bar to press the bar against said yarns with substantially the same pressure in all positions of the bar and to tension said yarn.

9. The subject matter of claim 7, characterized by the fact that said driving device is of the friction clutch type.

10. The combination with the subject matter of claim 7, of means operating on the bar to press the bar against said yarns with substantially the same pressure in all positions of the bar and to tension said yarn, the said means connecting said bar and controller shifting said controller substantially proportional to but distances less than the distances the bar moves.

11. For fabric-forming machines having fabric-forming instrumentalities and a yarn beam, an oscillatable bar over which yarn from the beam passes and oscillating as the length of said yarn between the beam and said instrumentalities changes, a friction clutch comprising a driven member connected to the yarn beam, an oscillating driving member and at least one member-coupling element interposed between said members, a controlling member to position said element with respect to said driving member, and means connecting said bar and controlling member through which the position of the bar determines the position of said member-coupling element.

12. The subject matter of claim 11, characterized by the fact that said member-coupling element is a rolling element.

13. The subject matter of claim 11, characterized by the fact that said connecting means includes an eccentric connected to said bar and an

eccentric strap connected to said controlling member.

14. The subject matter of claim 11, characterized by the fact that spring means are provided to press the bar to said yarns, said spring means working against an arm of variable length to maintain the pressure of the bar substantially constant as the bar oscillates.

15. The subject matter of claim 11, characterized by the fact that means are provided to oscillate said driving member at such times that each oscillation of the driving member, in the driving direction, is terminated subsequent to the completion of the measuring of the length of yarn consumed in the formation of a row of stitches and prior to the beginning of the measuring of the length of said yarn that is to be consumed in the formation of the next succeeding row.

16. For fabric-forming machines having fabric-forming instrumentalities and a yarn beam,

an oscillatable member over which yarn from the beam passes and which oscillates as the length of said yarn between the beam and said instrumentalities changes, a friction clutch comprising a driven member operatively connected to the yarn beam, an oscillating driving member, at least one of the last two mentioned members having at least one inclined surface, and at least one member-coupling element at said inclined surface to couple said driving member to said driven member on oscillation of said driving member in one direction, a controlling member to position said element with respect to said inclined surface, and means connecting said oscillatable member and controlling member through which the position of the oscillatable member determines the position of said member-coupling element.

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