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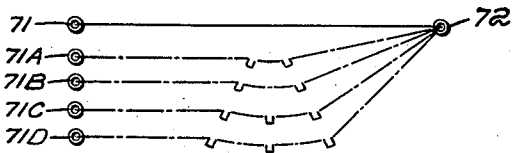
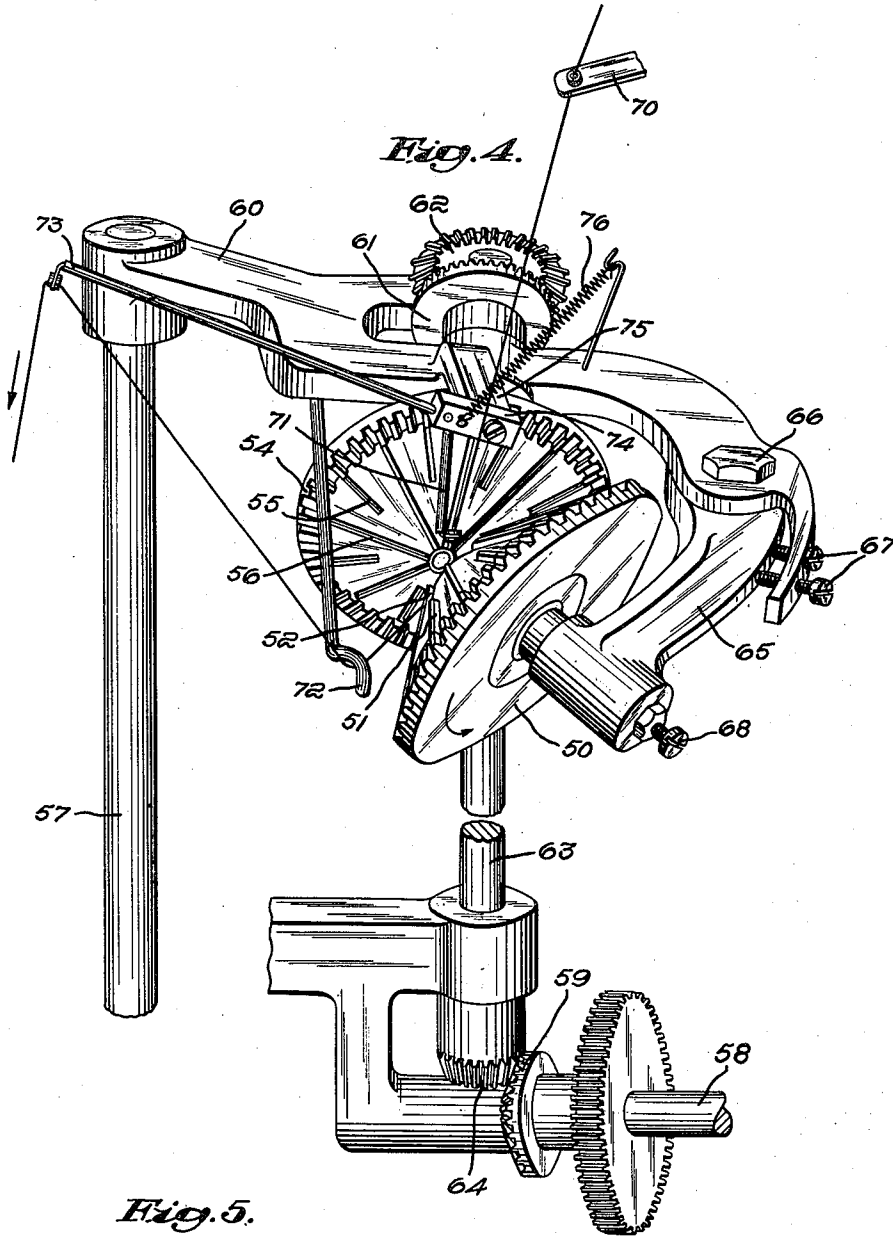
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STRAND FEEDING MECHANISM

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STRAND FEEDING MECHANISM

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This invention relates to strand feeding mechanism for textile machines and particularly to mechanism for controlling the feeding of yarn, elastic thread or other strands to the needles of knitting machines.

Many endeavors have been made in the past to provide strand feeding mechanism for feeding strands at a variable controlled rate, for example, to machines for fashioning garments where the thread demand is interrupted or varied from time to time or at regularly recurring intervals in the operation of the machine. The performance required of such mechanisms is very exacting. They must be capable of feeding the thread effectively at definite predetermined rates over a wide range of speeds, of permitting intervals of interruption when no thread is to be fed and of feeding elastic thread at different rates and intermittently without subjecting it to stretch or tension. The present invention consists in an improved thread feeding mechanism by which the desirable results above set forth may be fully obtained by mechanical means and throughout a wide variation of feeding rates.

Important fields of use for my novel mechanism are in connection with circular underwear machines which require thread feeding at uniform rate, at variable controlled rates with or without interruption periods when no thread is required (in these machines it may likewise be desired to handle elastic thread with or without a stretching device between the feeding mechanism and the needles); in circular hosiery machines with or without a stretching device in which the thread is required to be supplied at a controlled rate of feed broken by intervals of rest; and in flat hosiery or flat underwear machines in which the thread demand ceases at the end of each stroke and in which the thread is supplied either at a uniform rate or at a rate of feed varying in accordance with any predetermined cycle and with or without a stretching or tension device. My invention is herein disclosed as organized for use in these fields but with no intention of limiting it thereto.

As already noted many expedients have been employed in the past in an attempt to arrive at a satisfactory solution of the problem which is now solved by my present invention. Smooth conical feeding surfaces have been tried, but these are not positive in action and a strand can neither be withdrawn nor re-entered conveniently between them, nor shifted rapidly for changing its rate of feed. Toothed and relatively adjustable feeding members are satisfactory in their feeding function but are limited in range. Electrical devices require expert attention of a type not always available in textile mills.

As distinguished from these prior devices the

mechanism of my invention comprises cooperating members rotatable about angularly disposed axes and having conical surfaces intersected by intermeshing teeth and grooves, in combination with a guide movable to direct a strand between the conical surfaces in paths at different distances from their small end or from approximately the point of intersection of the axes of the conical surfaces. Such mechanism may be operated continuously at appropriate and convenient uniform speed and positive feeding movement imparted to the strand by the action of the teeth and grooves and the rate of feed may be varied by shifting the path of the strand with respect to the conical faces. For example, when the path of the strand coincides with the point of intersection of the axes of the conical surfaces, or lies outside that point, no feeding movement is imparted to the strand and the mechanism thus functions in compliance with a condition of no thread demand from the machine. Feeding movement of the strand may be initiated without any perceptible shock to the mechanism by shifting the path of the strand so that the strand is brought into the bite of the teeth which are associated with the conical surfaces. Moreover, the feeding rate may be controllably varied throughout a relatively wide range by shifting the path of the strand away from the small end of the conical surfaces. The intermeshing teeth and grooves positively engage the thread and advance it in bites without noticeable slippage and the teeth are shaped to provide strand-seizing projections facilitating the ready introduction of the thread into feeding position while the teeth facilitate the shifting of its path into the various positions between the conical surfaces. The strand itself is gripped by the conical surfaces located between the teeth and grooves and is advanced thereby, whereas each tooth and groove or group of teeth and grooves deflects the thread and feeds in substantially positive manner a section or bite of the thread varying in its length in accordance with the instantaneous location of its path.

These and other features of the invention will be best understood and appreciated from the following description of two specific embodiments of the invention selected for purposes of illustration and shown in the accompanying drawings in which—

Fig. 1 is a view in perspective of the mechanism shown with such associated parts of a circular knitting machine as are necessary for an understanding of its operation,

Fig. 2 is a fragmentary view in perspective and on an enlarged scale of the apex portions of the two feeding members,

Fig. 3 is a fragmentary sectional view showing the apex portion of one of the cones,

Fig. 4 is a similar view showing a modified form of mechanism,

Fig. 5 is a diagrammatic view illustrating the path of the strand for different rates of feed.

Without in any respect confining myself to the particular textile machine, which has been selected only by way of example, I will proceed to describe illustrative mechanism as organized for feeding two strands of yarn from suitable sources of supply to the needles of a knitting machine. The essential elements of the mechanism are cones or conical disk members 10 and 12 herein shown as arranged to rotate about intersecting axes with their conical surfaces in tangential or rolling relation. The cones are similar in size and shape, both having flat bases, a shallow cylindrical portion and conical surfaces with a base angle of 25° or thereabouts. The cone 12 is herein shown as mounted to rotate about a substantially horizontal axis and is provided in its conical surface with a series of uniformly spaced projecting teeth or ribs 13, substantially rectangular in cross section and having corner edges which are substantially square although not sharp enough to cut the thread. Satisfactory teeth may be formed by inserting strips of hard fibre in a metallic body. The teeth are herein shown as extending substantially uniformly above the conical surfaces although it is within the scope of the invention to vary the length, depth or angle of the teeth as may be desired. The apices of both cones are cut away on a circle of about $\frac{3}{8}$ " in diameter so that an open space is left in and about the locus of the point of intersection of the axes. The inner or convergent end walls of the teeth are substantially parallel to the axis of the disk 12, a characteristic of some importance in the design of the teeth and one which facilitates the reintroduction of the strand into operative feeding position after a period of rest. In fact, the inner ends of the teeth constitute or provide strand-engaging projections acting to carry the strand into feeding range of the teeth as the strand is moved out of neutral position.

The cone 10 is shown as mounted to rotate upon a downwardly inclined axis and is provided with a series of grooves 11 in its conical surface, uniformly spaced and of such dimensions as to receive the teeth or ribs 13 of the disk 12 in intermeshing relation. The grooves 11 have substantially parallel sides and in cooperation with the teeth 13 cause a strand passing between them to take a circuitous path and make substantially positive feeding engagement with the strand. It will be noted that the grooves 11 and the teeth 13 diverge rapidly on account of the flat angle of the cones and their speed of linear movement in the rotating members increases rapidly as they diverge from the apices of the cones.

The cone 12 is mounted on the inner end of a shaft journaled in a bracket 14 and carrying a beveled gear 16. The shaft is provided with thrust bearings 15 located between the bracket 14 and a collar adjacent to the base of the cone 12. The bracket 14 has bearings also for a vertical shaft 17 carrying a beveled gear 18 in mesh with the gear 16 and having a pinion 19 fast to its upper end. The pinion 19 meshes with and is driven by a gear 20 which forms a part of the knitting machine and the bracket 14 is adjustably mounted upon a standard 21 which also forms a part of the knitting machine and upon which the whole mechanism may be adjusted to bring the pinion 19 into mesh with the gear 20. The cone 12 may therefore be conveniently driven about the fixed,

but adjustable axis of its shaft at a constant and appropriate rate of speed for its intended purpose.

Pivotaly mounted in the forward part of the bracket 14 is a supplementary bracket 22 provided with bearings for a shaft 23 carrying at its lower end the cone 10. In the bore of the bracket 22 is provided a compression spring 24 tending at all times to advance the cone 10 and thus maintain it in yielding engagement with the surface of the positively driven cone 12. The compression spring 24 is backed up by an adjustable abutment screw 25 by turning which the pressure of engagement may be regulated and adjusted. The bracket 22 is arranged to swing about the axis of a transverse stud 26 projecting from a portion of a main bracket 14 and the angular position of the bracket 22 may be adjusted about this axis by adjusting screws 27 which pass through a downwardly extending arm of the bracket 22 into threaded engagement or contact with a portion of the bracket 14.

In this way the two cones may be adjusted to occupy the desired tangential relation without requiring excessively precise machining of the parts of the mechanism.

The mechanism is herein shown as provided with guides for directing two strands from separate sources of supply comprising spools 30 to separate tension mechanisms 31 which are elements of the knitting machine.

The main bracket 14 has a forwardly extending arm 32 carrying a horizontal shaft 33 upon which two blocks 34 are mounted to rock freely. From each of these blocks extends a straight guide rod 35 having a thread eye at its inner end which is located approximately in the tangent plane of the contacting elements of the cones 10 and 12. Pivotaly mounted at an intermediate point on each of the guide rods 35 are supplementary upwardly extending guide rods 36 each having a thread eye at its upper end and being initially located so that strands passing from the eyes of the guide rods 36 to the eyes of the guide rods 35 are directed through the open space adjacent to the point of intersection of the axes of the cones and therefore out of feeding range of the rotating cones and the teeth 13 thereon. Guide rolls 37 direct the strands by a convenient path to the eyes of the guide rods 36 and the strands pass directly from the eyes of the guide rods 35 upwardly to the tension mechanisms 31. A transverse pin 39 projecting from the arm 32 acts as a rest beneath the guide rods 36 to determine their initial position, and these rods are guided for movement up and down in an oblique path by a stationary perforated arm 40 projecting transversely from the bracket 14.

The guide rods 35 and 36 are very light in construction and the blocks 34 are counterbalanced so that the weight of the guides is supported by the loop in each strand and is effective to do little more than to straighten the strands so that they run in a straight line from point to point. So long, therefore, as there is no demand for thread and the tension devices 31 remain at rest, the strands are maintained entirely out of range of the cones 10 and 12 although the cones are revolving continuously at a speed calculated for the maximum rate of thread feed. When however, either or both of the tension devices 31 begin to act so that the loop in one of the strands is shortened, the guide rods 35 and 36 are lifted about the axis of the stud 33 and the portion of the thread running between the

thread eyes is shifted upwardly until the thread is caught by the corner edges of the teeth 13 and whipped in between the rolling conical surfaces of the cones.

The initial feeding engagement takes place at the small diameter of the cones, but as increased demand is transmitted by the tension mechanisms 31 the guide rods 35 and 36 are lifted higher and the path of the strand is moved away from the small end of the cones into positions where engagement takes place at progressively larger diameters of the cones. Upon being engaged by a tooth 13 the strand is directed into a circuitous or undulating path by being forced into the grooves 11 of the disk 10. Between the points of engagement by the teeth and grooves the strand lies in a segmental path on the conical surface of the disk 10. The length of these segmental intervals, of course, increases as the strand is shifted toward the base of the cone.

The cooperative effect of the cones with their teeth and grooves is positively to engage a section or bite of the thread and to advance the thread positively. The length of the strand section thus engaged is comparatively short adjacent to the small end of the cones, but increases very rapidly as the strand is shifted toward the large end of the cones. For example, with 4" cones of the general character shown, the feeding rate may be increased more than three times in shifting the strand from near the apex to near the base of the cones. It will be noted, moreover, that while the length of the engaged section varies the character of the contact does not, that is to say, no slippage is introduced, but a positive feeding action is realized throughout its entire range of variation.

To facilitate a more complete understanding of my invention I have shown in Fig. 4 a mechanism embodying the invention differing in some of its details from that shown in Figs. 1-3. Referring to Fig. 4 the mechanism includes cones or conical disk members 50 and 54 arranged as before to rotate about intersecting axes. The cone 50 is provided in its conical surface with short teeth 51 alternating with long teeth 52, that is, the long teeth 52 extend to the cut-off apex of the cone while the short teeth 51 are arranged in the lower half of the conical surface supplementing the longer teeth where the latter diverge widely. The cone 54 is provided with corresponding short grooves 55 alternating with long grooves 56, and both cones are provided with rings of meshing beveled teeth about their bases. Accordingly, the two cones are positively driven in a fixed rotary relation regardless of any driving function on the part of the teeth and grooves, and thus the designer is given more leeway in shaping the teeth and grooves for their strand feeding function.

The strand feeding mechanism is mounted on a standard 57 which constitutes a part of the knitting machine and is driven by a shaft 58 which may also be a part of the knitting machine and which carries a beveled gear 59. Upon the upper end of the standard 57 is adjustably mounted a bracket 60 having journals for a shaft carrying the cone 54 at its lower end and being provided with a beveled gear 61. The beveled gear meshes with a second beveled gear 62 fast to the upper end of a vertical shaft 63 carrying at its lower end a beveled pinion 64 meshing with the beveled gear 59, already mentioned.

The bracket 60 carries an arm 65 adjustably

mounted to swing about a stud 66 and controlled in this position by adjusting screws 67. In the outer end of the arm is journaled the shaft of the cone 50 backed up by a compression spring and adjusting screw 68 as described in connection with the cone 10 of Fig. 1. The two cones are therefore positively driven from the shaft 58 by their geared connection, the cone 53 being yieldingly pressed toward the cone 54, and the cone 54 having a thrust bearing, not shown.

In Fig. 4 the strand is represented as passing from the source of supply, not shown, through an eye in a stationary arm 70, thence downwardly through an eye on the inner end of a guide arm 71, thence between the cones to a stationary guide hook 72, and finally through an eye carried on the outer end of a guide rod 73. The arm 71 and the guide rod 73 project at right angles from a block 74 arranged to swing freely about a horizontal axis provided by an arm 75 projecting from the bracket 60. A tension spring 76 extending between the block 74 and a hook on the bracket 60 counterbalances the weight of the guide rod 73 and maintains the guiding means in such position as to direct the strand initially through the open space at apices of the cones 50 and 54. From the eye in the outer end of the guide rod 73 the strand passes to the tension mechanism of the knitting machine. It will be apparent therefore that when thread demand of the machine draws the strand downwardly from the end of the guide rod 73, the block 74 will be rocked in a counter-clockwise direction and the guide arm 71 will be shifted so as to carry the section of the strand between it and the guide hook 72 into the bite of the teeth of the cones. In Fig. 4 the guide rod 73 is shown as displaced slightly and it will be seen that the path of the strand after leaving the end of the guide arm 71 lies between the contact surfaces of the two cones.

The path of the strand in passing in different positions between the feeding cones is graphically illustrated in Fig. 5 in which the stationary feeding hook 72 is shown on the right hand side of the diagram and the eye of the guide arm 71 is shown on the left hand side of the diagram. The initial path 72-71 is a straight line passing out of range of the teeth of the cone. A displacement of the thread arm to the position 71A, which corresponds substantially to its position as shown in Fig. 4, brings the strand into the range of perhaps two of the long teeth 72 near the apex of the cone 50. These teeth force the strand into the corresponding long grooves 56 of the cone 54 and between the grooves the strand is laid upon the smooth surface of the cone so that the path of the strand is somewhat as indicated by line 72-71A.

As the guide arm 71 is progressively moved to the positions 71A, 71B, 71C and 71D the arc of contact is increased and eventually the short teeth 51 come into play so that the strand is engaged in progressively longer sections and the feeding speed correspondingly increased.

The feeding cones are herein shown as arranged to rotate about intersecting axes but it will be understood that satisfactory results would be secured by employing skewed conical surfaces rotating about angularly disposed but non-intersecting axes.

In the mechanism herein illustrated one of the conical members is provided with projecting teeth and the other with corresponding grooves and while it would be within the scope of the

invention to provide both teeth and grooves upon each of these members the illustrated construction is desirable because adjacent teeth on one member tend to draw the strand more closely into contact with the intermediate conical surface of the groove-carrying cone than would be the case in a mechanism where grooves and teeth were alternately arranged on the same members.

The provision of intermeshing gear teeth in addition to the feeding teeth and grooves, as shown in the mechanism of Fig. 4, is optional and desirable in some cases, but not an indispensable feature of the invention as will be readily understood. The same may be said of the short teeth and short grooves which, as shown in Fig. 4, supplement the longer teeth and grooves toward the base of the conical surfaces. The provision of separate driving gear teeth is desirable when the mechanism is to be operated at high speed. The teeth 13 are herein shown as being of the same height and as disposed radially about the axis of the cones but it would be within the scope of the invention to vary the height of certain teeth or to arrange them upon curves or in skewed relation. While conical surfaces are probably most convenient to employ any two matching surfaces of revolution are to be considered as equivalents.

From the foregoing description it will be apparent that one function of the teeth is to make it easier for the strand to travel along the conical surfaces, transversely to the direction of feed, for the quick and delicate variations in feed required in operation. The guide which controls the entering of the thread feeds it normally, or when uniform feed is taking place, along a path perpendicular to the tangent line of contact of the surface of the cones. As more or less thread is desired the guide pushes or pulls the thread to one side or the other of this normal perpendicular path. The teeth start to mesh with their grooves ahead of the line of contact of the conical surfaces, thus grabbing the thread at a distance from the line of contact. When the thread is directed at an angle other than perpendicular to this line of surface contact, any projection, like the teeth, will grab the thread on one side or the other of the perpendicular and move it across the conical surfaces in steps equal in length to the distance that the thread has been pulled away from its perpendicular path at the point where the teeth mesh. The moving of the thread is thus accomplished in steps and the process of entering the thread is also accomplished in the same manner by the engagement of the teeth with it. The irregularities in the path of the thread caused by the projections and recesses formed as herein shown by the teeth and grooves help to pull the thread with more power when the surfaces are in contact than could be obtained by the same pressure if smooth cones alone were used.

Another important field of use for my novel mechanism is in supplying strands, elastic or otherwise, to winding machines. There the spindle speed is constant but as the cop increases in size the linear speed of the thread demanded may multiply several times. As already explained it is within the range of my novel feeding mechanism to meet such conditions adequately.

Under certain conditions it is contemplated that the driven speed of the mechanism may be increased or decreased in the cycle of operations

where it is employed. For example, if the mechanism is called upon to feed elastic thread at times with no initial stretch and at other times with an elongation of 300% and the rate of thread demand should vary in a ratio of 1 to 4, it is probably more convenient to double the driven speed of the feeding mechanism rather than to design it for a range of 1 to 12 as would be necessary to handle this typical condition.

Having thus disclosed my invention and described two illustrative embodiments thereof, but not in any limiting sense, I claim as new and desire to secure by Letters Patent:

1. Strand feeding mechanism, including in its structure cooperating members rotatable about angularly disposed axes and having conical surfaces provided with intermeshing recesses and teeth providing strand-seizing projections at one end, and a filament guide movable to direct a filament between said conical surfaces in paths at different distances from their small ends.

2. A strand feeding mechanism including in its structure cooperating members rotatable at constant speed about axes intersecting at a fixed angle and having conical surfaces provided with intermeshing recesses and teeth providing strand-seizing projections at one end, and a strand guide for directing a strand in a path which includes substantially the point of intersection of said axes, said guide being movable to determine the path of the strand at different distances from said point between said conical surfaces.

3. A strand feeding mechanism comprising cooperating members having matching conical surfaces and being rotatable at constant speed about intersecting axes, and provided with substantially uniformly intermeshing teeth and grooves which are divergent and spaced to permit a strand to be engaged directly in certain portions of its length by the conical surfaces and also to bite the strand in other portions of its length and thus advance the strand, and guiding means movable to direct a strand in different paths between said members, thus subjecting the strand to feeding bites of correspondingly different lengths.

4. Strand feeding mechanism comprising cooperating members having conical surfaces in rolling contact and intersected by diverging teeth and grooves arranged in intermeshing relation, and a strand guide for directing a strand transversely between said members whereby a section of the strand is forced by the teeth into a path of loops spaced by segmental intervals, the length of the said segmental intervals in the strand being increased as the guide is moved to shift the path of the strand further and further from the apices of the conical surfaces.

5. Strand feeding mechanism comprising cones rotating substantially in tangential relation and having intermeshing projections and recesses, and guides located substantially in the tangent plane of said cones and normally directing a strand to the cones in a path at right angles to their tangent of contact and on opposite sides of the bite of the cones, one of said guides being movable to direct a strand in paths at different distances from the bases of the cones and at acute angles to the said tangent of contact.

6. Strand feeding mechanism for textile machines, comprising a set of rotary members having matching surfaces of revolution intersected by diverging teeth and grooves intermeshing a

substantially uniform amount in operation on a given strand, the teeth providing strand-seizing projections, means for driving said members about fixed axes of rotation, and a strand guide movably supported and operated by machine demand upon variations in strand tension to correct for such variations by correspondingly varying the path of the strand with respect to one end of said matching surfaces.

7. Strand feeding mechanism for textile machines, comprising a set of members having conical faces intersected by divergent teeth and grooves arranged to bite a strand passing between them, said teeth and grooves intermeshing by a substantially uniform amount while feeding a given strand and the teeth providing strand-seizing projections at one end, means for driving said member so long as the textile machine with which it is associated is driven, whether or not the machine demand for thread is interrupted, and guide means delicately responsive to all variation in strand tension, and also to sudden interruption of machine demand for the strand, to vary the path of the strand between the toothed and grooved conical surfaces of the said feeding members and in case of such interruption of machine demand to remove the strand entirely from the range of said teeth and grooves.

8. Strand feeding mechanism for textile machines, comprising a set of rotary members with conical surfaces having intermeshing teeth and grooves for feeding a strand between them, means for driving at least one of said members, the teeth of one of said members having top end walls lying substantially parallel to the axis of the said member to provide strand-seizing corners, and guiding means movable to present a strand to such teeth corners for immediate seizure thereby and consequent immediate feeding by such intermeshing teeth and grooves of said members.

9. Strand feeding mechanism comprising cooperating members rotatable about angularly disposed axes and having conical surfaces in rotary contact, one member having spaced diverging grooves in its conical surface and the other member having corresponding projecting teeth, and guide means for directing a strand transversely between said conical surfaces in a selected path in which the strand is forced by the teeth of one member into the grooves of the other and drawn into contact with the conical surface between said grooves.

10. Strand feeding mechanism comprising cooperating rotatable members having conical surfaces provided respectively with diverging teeth and diverging grooves arranged to engage and feed a strand passing transversely between said surfaces, said members having intermeshing gear teeth distinct from said strand-engaging teeth and grooves, and guiding means arranged to direct a strand in selected paths between said conical surfaces.

11. Strand feeding mechanism comprising cooperating rotary members having conical surfaces one of which is provided with diverging grooves, and the other with projecting teeth arranged to force a strand into the grooves and conform it closely to the intermediate conical surface of the groove-containing members, and feeding means for directing a strand in various selected paths between said conical surfaces.

12. Strand feeding mechanism comprising cooperating rotary members having conical surfaces provided respectively with a series of long grooves, and a corresponding series of long teeth, the grooves and the teeth diverging toward the base of the respective conical surfaces, and a series of short teeth and corresponding short grooves provided on said members between the divergent end portions of the longer teeth and grooves, and strand feeding mechanism movable to direct a strand in selected paths between said surfaces.

13. Strand feeding mechanism comprising cooperating members having rolling conical surfaces intersected by diverging complementary intermeshing teeth and grooves defining between them smooth areas increasing in width from the apices of said conical surfaces, and movable means for guiding a strand between said members, whereby successive and variable lengths of the strand are forced into loops separated by arcuate intervals and positively advanced by the rotation of said members.

14. Strand feeding mechanism including in its structure cooperating members rotatable about angularly disposed axes and having conical surfaces provided respectively with intermeshing projections and recesses, and a guide normally directing a strand in a path perpendicular to the line of contact of said conical surfaces and movable to direct the strand to one side or the other of said perpendicular path, whereby the projections start to grab the strand at a distance from the line of contact of said surfaces and from said perpendicular path and move it in steps across the conical surfaces.

15. A strand feeding mechanism comprising cooperating members having matching conical surfaces and being rotatable at constant speed about intersecting axes, and provided respectively with intermeshing projections and recesses spaced to permit a strand to be engaged directly by the conical surfaces and the projections themselves to bite and advance the strand at a distance from the point where it is engaged by said conical surfaces, and guide means normally directing the strand in a path perpendicular to the line of contact of said surfaces and movable to deflect the strand whereby a projection may bite the strand at one side or the other of its normal perpendicular path.

16. Strand feeding mechanism comprising cooperating members having rolling conical surfaces intersected by teeth and grooves arranged in intermeshing relation, and a strand guide normally directing a strand transversely between said members in a path perpendicular to the line of contact of said surfaces, whereby a section of the strand is forced by the teeth into a path of loops spaced at segmental intervals, the guide being movable to deflect the strand to one side or the other of its normal path, whereby the length of the segmental intervals in the strand is increased as the guide is moved to shift the strand further and further from the apices of the conical surfaces and the teeth act to engage the strand at a point on one side or other of said perpendicular path and thus move it transversely to its general direction of feed.

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