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Tannert

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[54] **THREAD FEEDER FOR TEXTILE MACHINES**

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 42,432, June 1, 1970, abandoned.

[52] **U.S. Cl.**..... **242/47.12,** 242/47.01, 242/47.04, 242/47.05, 242/47.07

[51] **Int. Cl.**..... **B65h 21/20,** B65h 51/24

[58] **Field of Search**.....242/47.01–47.13

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Assistant Examiner—Milton S. Gerstein
Attorney, Agent, or Firm—Silverman & Cass

[57] **ABSTRACT**

A thread feeder for textile machines having a winding body or storage spool between a thread supply and a textile machine. Means are provided for winding a plurality of coils of thread onto the winding body to form a store of coils of thread, such means comprising generally a rotating winding eye or frame. The winding in all cases proceeds by virtue of an axial shifting of the coils of said store axially along the winding body from the location where they are laid down to the point where they are removed. The winding body is stationary and various means are provided to effect the axial shifting. The thread passes through the axial center of the winding body, either during the process of laying the coils down in the store or in the process of removing the coils from the store. The speed or activity of the means which wind the coils is controlled by the number of coils in the store which is disposed on the winding body at any time, simple switch means operated by the presence or absence of a certain number of such coils being the medium through which such control is effected.

41 Claims, 15 Drawing Figures

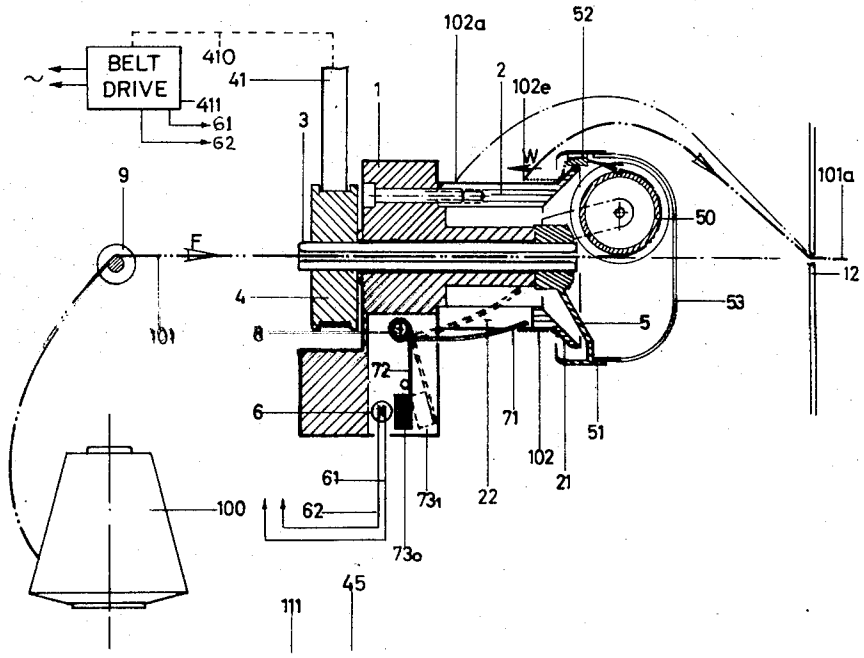
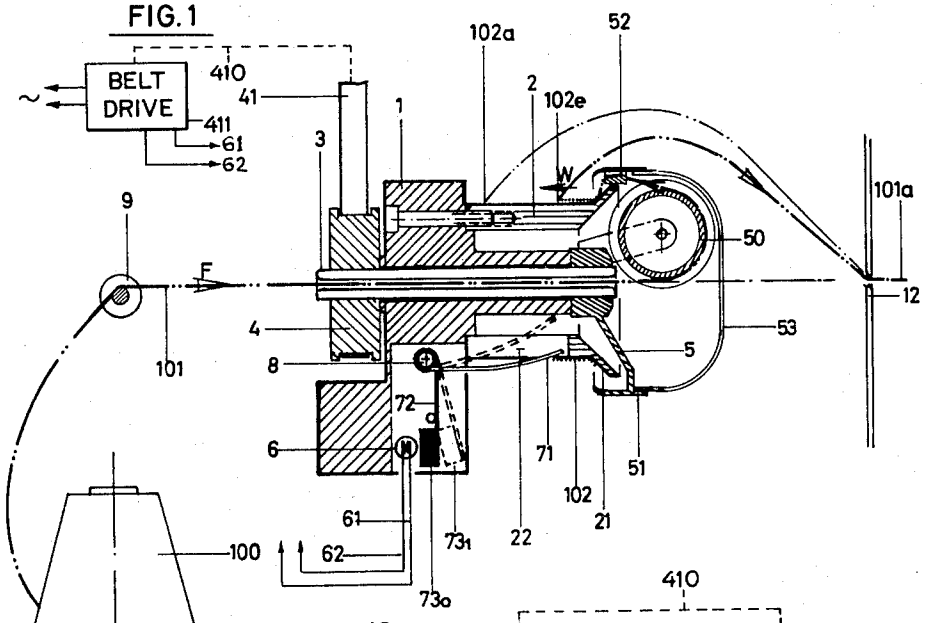


FIG. 1


BELT DRIVE
410
41
411
61
62
1
3
102a
2
102e
52
W
101a
9
F
50
12
4
53
8
5
72
6
71
102
51
61
22
21
100
62
731
730

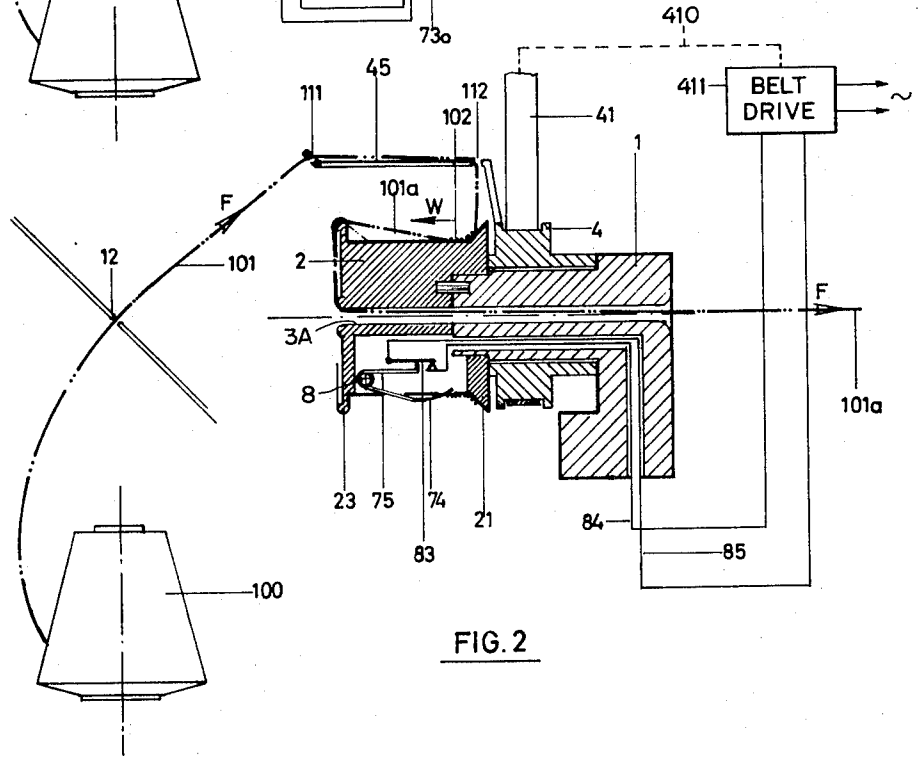

410
45
411
BELT DRIVE
111
112
102
41
1
101a
W
F
4
12
101
2
3A
F
8
101a
23
75
74
21
84
83
85
100

FIG. 2

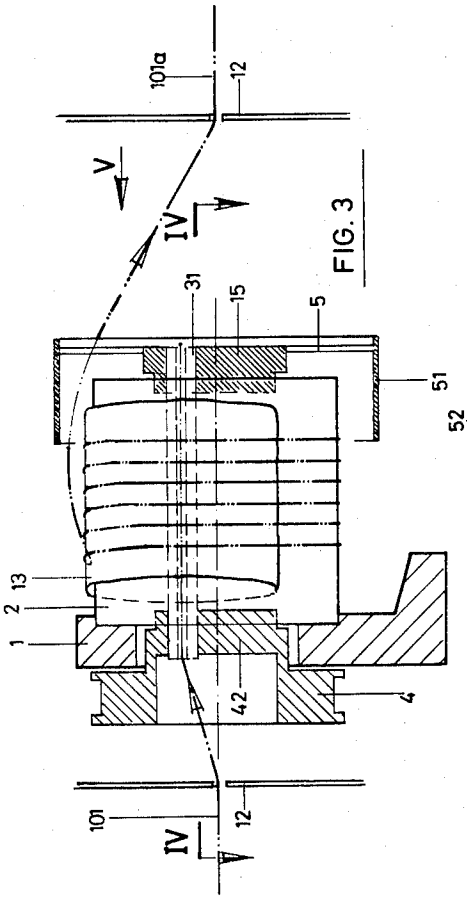


FIG. 3

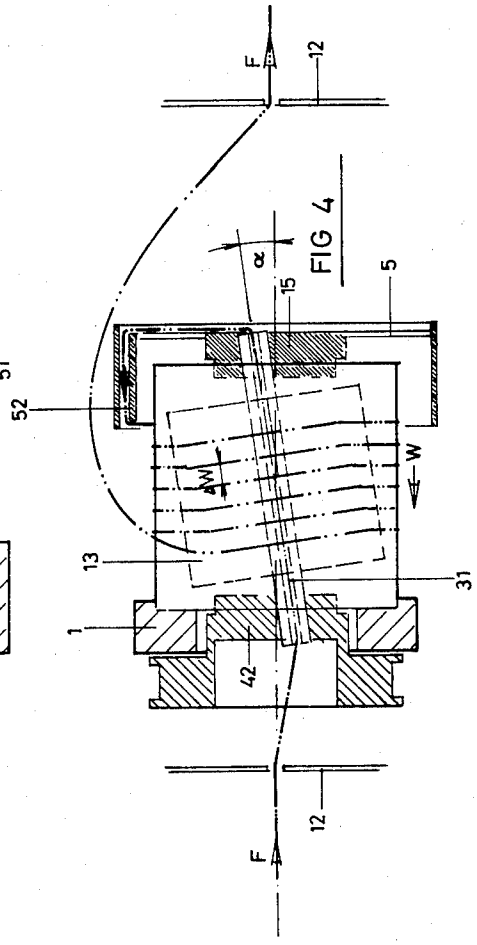


FIG 4

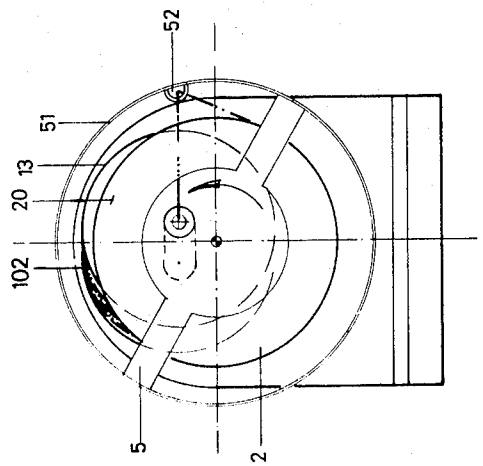


FIG. 5

FIG. 6

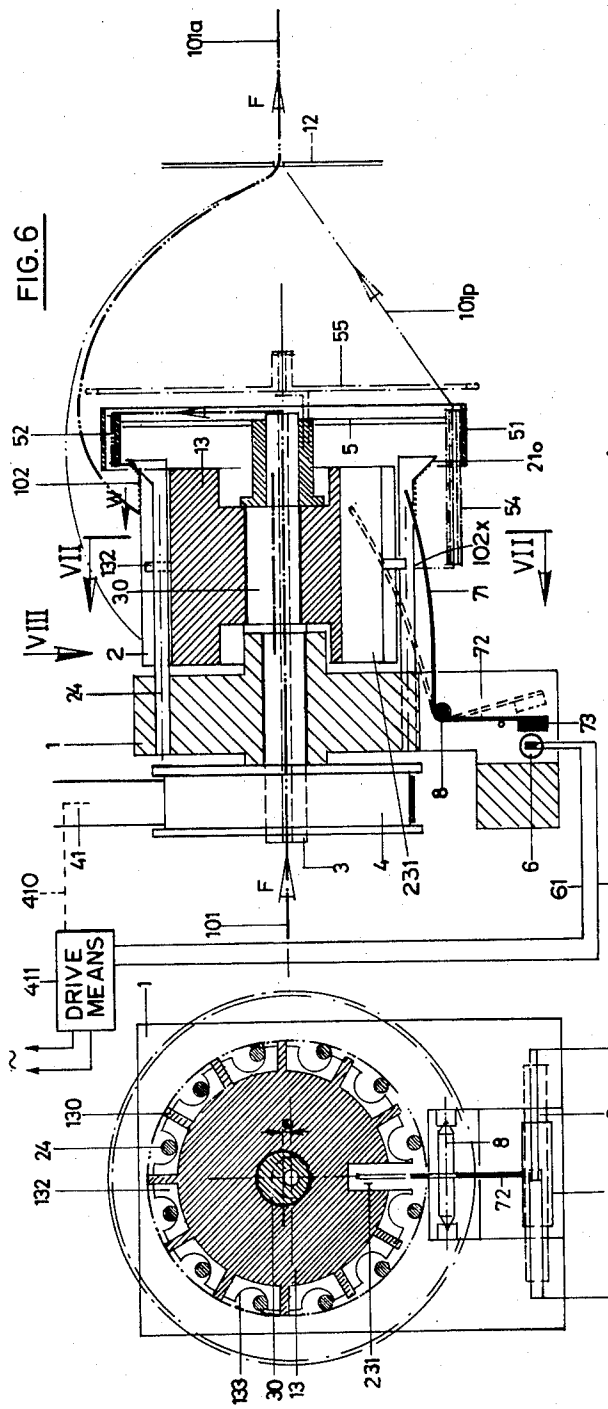
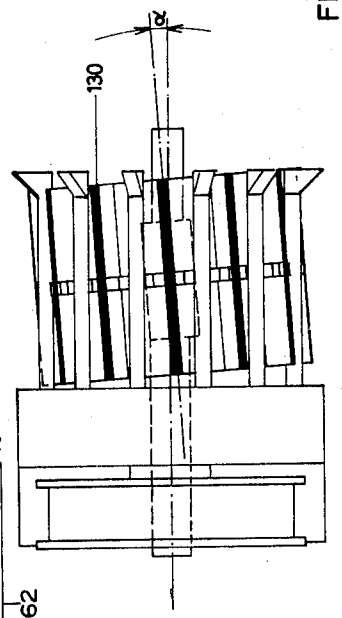


FIG. 7

FIG. 8



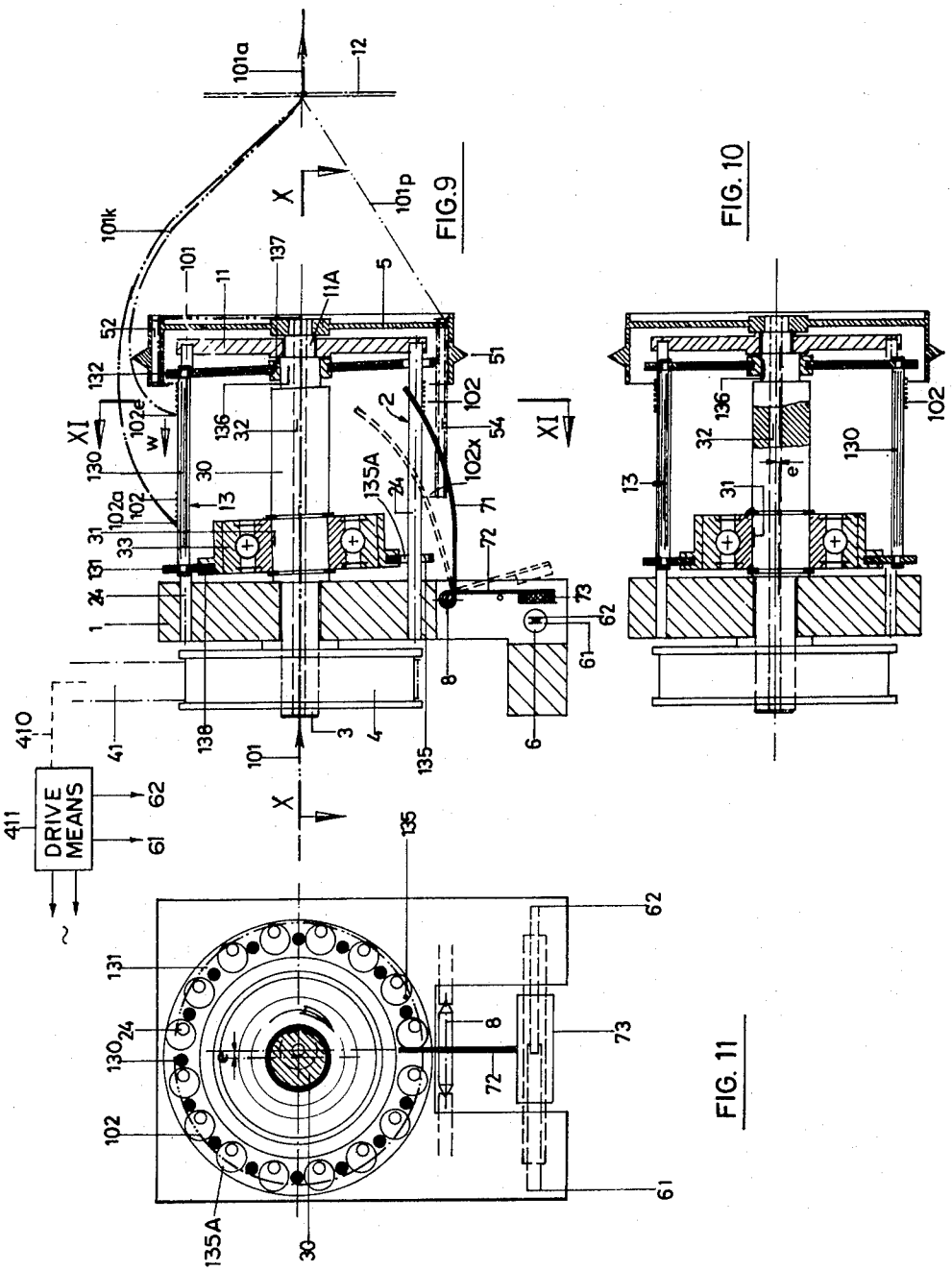


FIG. 9

FIG. 10

FIG. 11

FIG. 12

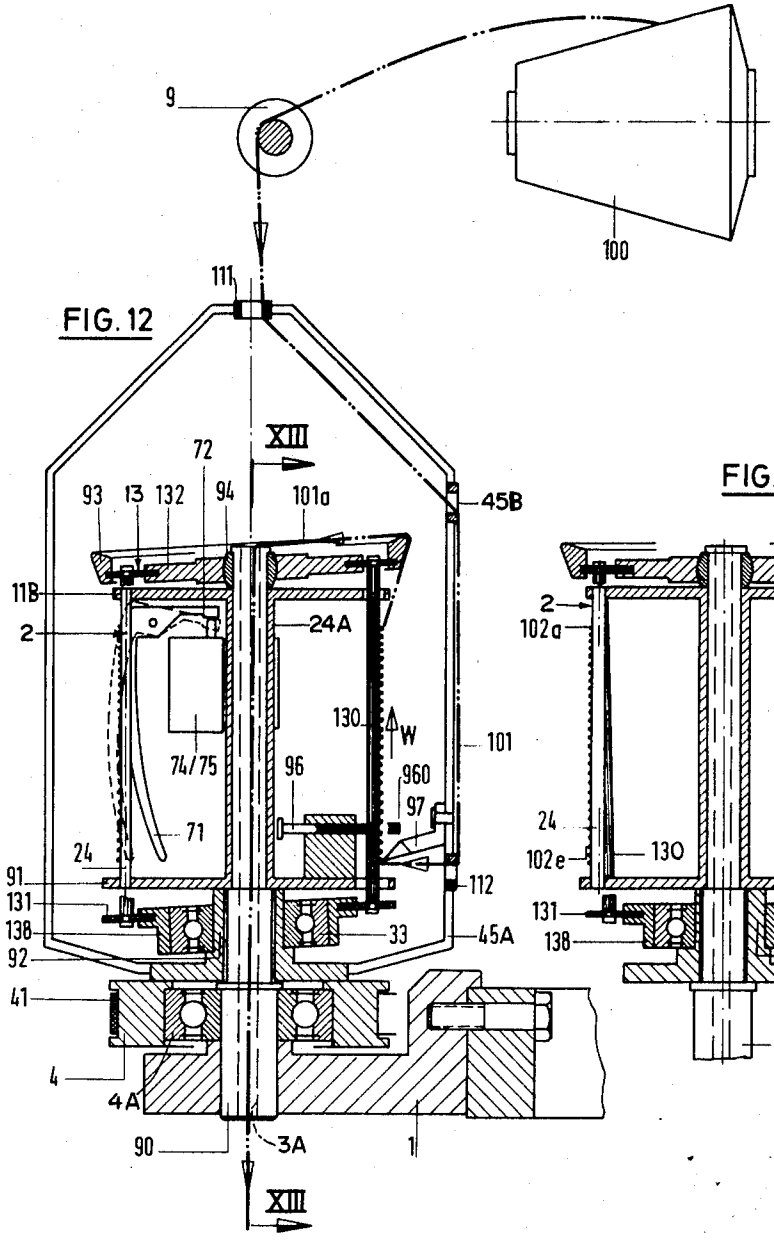

9
100
111
XIII
72
93
13
132
94
101a
45B
11B
2
24A
130
W
101
74/75
96
960
97
71
24
91
131
138
92
112
33
45A
41
4
4A
90
3A
1
XIII

FIG. 13

2
102a
130
24
102e
130
24
13
131
138
92
90

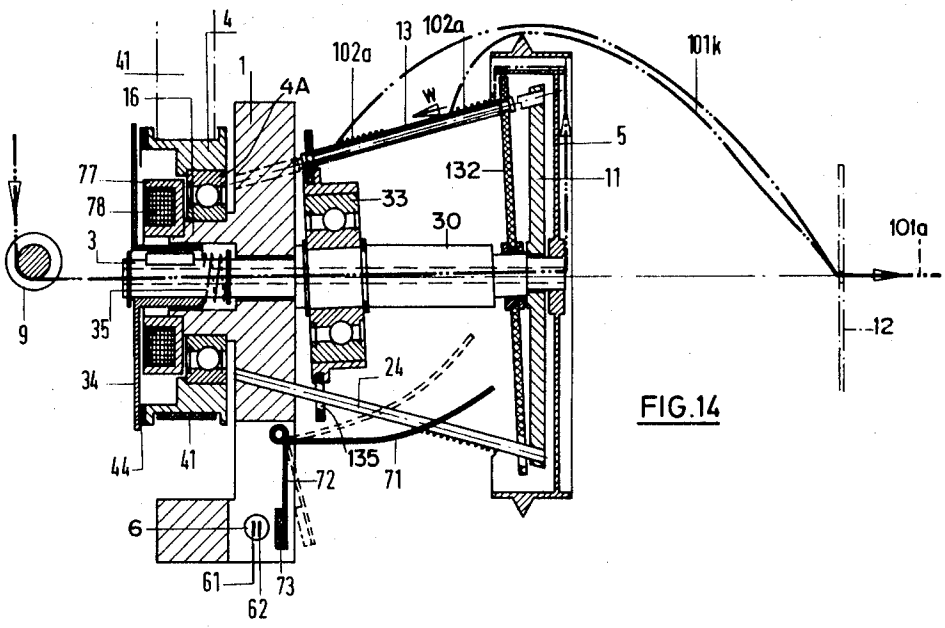

4
41
1
16
4A
102a
13
102a
101k
W
5
77
132
11
78
33
30
101a
3
9
35
12
34
24
44
41
135
71
72
6
61
73
62

FIG.14

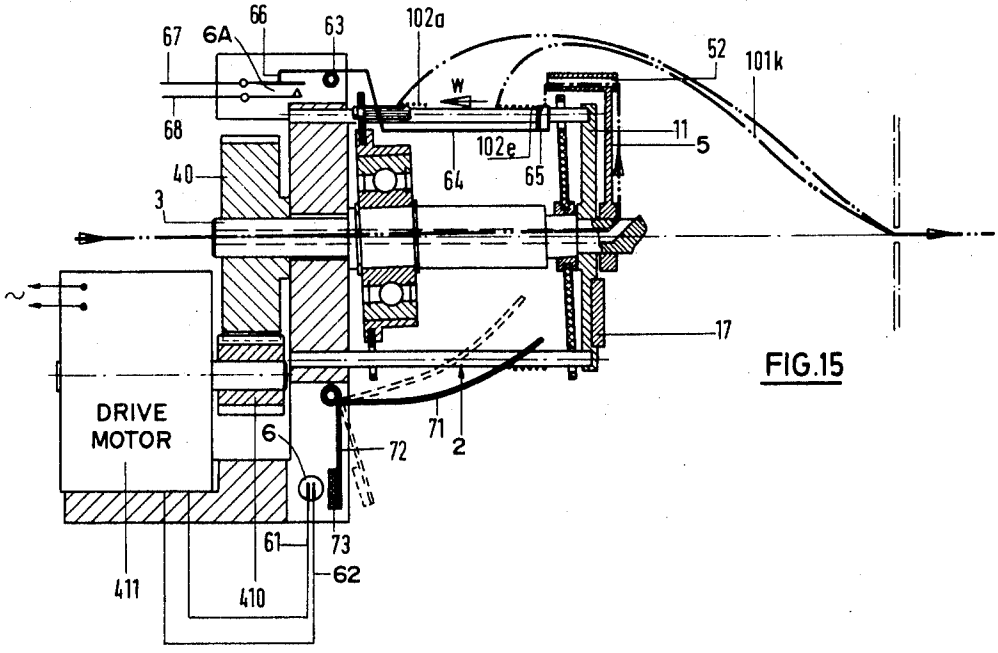

67
6A
66
63
102a
52
101k
W
68
11
5
102e
64
65
40
3
17
DRIVE
MOTOR
71
2
6
72
61
73
62
411
410

FIG.15

THREAD FEEDER FOR TEXTILE MACHINES

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of a co-pending application bearing the same title and filed by the applicant June 1, 1970 and having Ser. No. 42,432 and now abandoned.

BACKGROUND OF THE INVENTION

The invention herein relates to a thread feeder for textile machines and more particularly for weaving and knitting machines, the feeder being operative to form several coils of the thread, yarn or filament to form a store of the same on a coiling or winding body which is located at a point between a thread supply body such as a large spool and the operating point of a machine. The apparatus is capable of forming a single storage coil but normally a plurality of such coils is needed in the store to enable the apparatus to provide the advantages sought.

The thread feeder in all cases is provided with means for axially displacing the coils or windings of the store progressively while the thread feeder is operating so that the thread can be pulled off overhead, that is, over one end of the thread feeder.

Such apparatus is generally known and the primary purpose for the same is to eliminate variations and fluctuations in tension caused by different factors such as thread size, coil size and the like. The end result is to enable the textile machine to receive thread or yarn at a continuous, albeit not necessarily constant, rate without problems occasioned by tension variation, breakage, depletion of the storage spool, and the like. For example, when a storage spool has been emptied, the presence of a number of coils in the store on the thread feeder can in many cases enable the textile machine to continue operating without shutdown until a new spool has been installed and connected with the expiring end of the thread.

The prior art teaches rotating winding bodies which produce complex and expensive mechanisms. In addition other disadvantages arise because of the rotation caused of the thread itself. Rotating winding bodies are difficult to stop quickly without complex and expensive mechanisms. Further, the sensing of signals for controlling the laying down of coils is difficult with rotating winding bodies.

There are also thread feeders whose winding bodies do not rotate but again these structures are complex and expensive.

The problems which are solved by the invention herein are those occasioned by the complexity, expense and lack of reliability of the prior art devices.

According to the invention, the thread feeder thereof is a relatively simple device in which the winding body is stationary, the thread is laid down in coils at one end of the winding body and means are provided for shifting these coils in a reliable and relatively simple manner along the length of the winding body. The textile machine draws the coils off the winding body over the end of the winding body, either through the center of the thread feeder or as coils overhead. In the process of operation the thread passes through the winding body in a longitudinal direction moving against the axial feed direction of the coil, that is opposite to the axial direction in which the coils are shifted as they are laid down upon the winding body.

The prior art required complex and expensive means for controlling the operation of the thread feeder, but according to the invention herein, such control is exerted by the most simplified and yet positive and reliably acting means. Specifically, the rate or speed at which coils are laid down is controlled by the number of coils which remain on the winding body and hence indirectly by the rate at which they are depleted by the textile machine. This provides more flexible and positive control than a type of control which depends directly upon the speed of consumption of thread by the textile machine.

SUMMARY OF THE INVENTION

The invention provides a thread feeder adapted to be interposed between a thread supply and a textile machine and including a plurality of coils forming a store from which the textile machine may draw for its needs, whether continuous or intermittent, these coils of the store being replenished from the thread supply as they are used. The storage coils are wound on a stationary winding body by a rotating thread-laying member or frame and in the process of such winding are shifted axially in one direction by suitable coil shifting means, the coils furthest from the location where they are first laid down being the ones which are drawn off from the winding body by the demands of the textile machine. The rate at which the coils are laid down in the store is controlled at all times by the number of coils which have been laid down, the thread feeder having simple sensing means for sensing the number of coils laid down and as a result thereof controlling the means for driving the rotating thread-laying member or frame. In the operation of the thread feeder, the thread will in the course of its movement pass through the axial center of the winding body in a direction which is opposite to the direction in which the wound coils of the store are shifted along the surface of the winding body. Accordingly, the store is in effect a continually changing one.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a generally diagrammatic view of a thread feeder constructed in accordance with the invention, the view including a median vertical sectional view through the feeder itself and illustrating a symbolic form some of the parts of the system which includes the thread feeder;

FIG. **2** is a modified form of the thread feeder of the invention similar to that illustrated in FIG. **1**;

FIG. **3** is a highly diagrammatic view of a thread feeder constructed in accordance with the invention, this view together with the views of FIGS. **4** and **5** being used in order to explain the construction and operation of the embodiment of the invention illustrated in FIGS. **6, 7,** and **8**; this view being generally a median vertical sectional view through a thread feeder;

FIG. **4** is another highly diagrammatic view of the same thread feeder illustrated in FIG. **3** but in this instance taken as a sectional representation along a horizontal plane defined by the line IV — IV of FIG. **3** and looking in the direction of the arrows;

FIG. **5** is another highly diagrammatic view of the thread feeder of FIGS. **3** and **4**, this view being taken as an end elevation from the right-hand end of FIG. **3** as indicated by the arrow marked V;

FIG. 6 is a vertical section view similar to that of FIGS. 1 and 2 taken through a thread feeder of the construction which is diagrammed in FIG. 3 but in this case more of the details are shown than in FIG. 3 to illustrate more closely a practical example thereof.

FIG. 7 is a vertical sectional view taken through the thread feeder of FIG. 6 along the line VII —VII thereof and in the indicated direction;

FIG. 8 is a top plan view of the thread feeder of FIG. 6 taken generally in the direction indicated by the arrow VIII;

FIG. 9 is a vertical sectional view similar to that of FIG. 6 in this instance illustrating still another modified form of the invention embodied in a thread feeder;

FIG. 10 is a sectional view through the thread feeder of FIG. 9 taken on a horizontal plane defined by the line X — X and in the indicated direction, that is, looking downwards;

FIG. 11 is a vertical sectional view taken on the line XI —XI of FIG. 9 and in the indicated direction;

FIG. 12 is a vertical sectional view taken through another modified form of thread feeder constructed in accordance with the invention;

FIG. 13 is a fragmentary vertical sectional view through the thread feeder of FIG. 12 taken generally on the plane XIII — XIII of FIG. 12 and in the indicated direction, this being 90° displaced from the view of FIG. 12;

FIG. 14 is a vertical sectional view similar to that of FIG. 9 but illustrating a still further modified form of thread feeder constructed in accordance with the invention;

FIG. 15 is a vertical sectional view similar to that of FIG. 9 but illustrating another modified form of thread feeder constructed in accordance with the invention; and

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As previously mentioned, the purpose of the thread feeder is to afford a store for thread as it moves from a supply point such as a spool to a textile machine, providing what is in effect a buffer zone to obviate tension and breakage problems or to smooth demand variations. This is accomplished by producing a continuously replenished plurality of turns of thread which can be drawn from the thread feeder by the textile machine as needed.

Two general types of thread feeders are disclosed and described in detail hereinafter, one type being represented by the simplest form of FIGS. 1 and 2, the other type being represented by the structures of the remaining figures. The structures of FIGS. 1 and 2 are each characterized by a fixed cylindrical winding body in which the thread is wound on the exterior surface of the body and the coils are axially moved along the surface by virtue of axial pressure applied by the newly wound thread being laid on by a winding mechanism. There is a tapered extension of the cylindrical surface which cooperates with the oncoming thread to provide the pressure.

The second type of feeder is characterized by the use of two interdigitating members comprising cagelike structures, wobbling one within the other, but on axes which are offset and skewed relative to one another to impart a combined planetary and slightly axial movement of the inner member with respect to the outer member. The inner member has a peripheral portion of its defined surface protruding somewhat beyond the defined surface of the outer member so that it lifts the turns of thread at the location where it protrudes as the inner member wobbles or oscillates and lays them down a slight distance axially from their first location. This is done around the circumference of the outer member as the inner one moves. In this manner the turns of thread are progressively moved toward an axial end of the outer member. It is understood that the defined surfaces are substantially cylindrical or conical and comprise bars, ribs or rods which are arranged to mesh to enable the interdigitation mentioned.

Referring now to FIGS. 1 and 2, these illustrate the most simplified form of the invention and differ from one another in the principle aspect that the direction of movement of the thread through the center hollow shaft is in opposite directions.

In FIG. 1 a stationary housing 1 is illustrated in section mounted to a textile machine for weaving cloth or the like. The machine is not shown in the drawings, but it is assumed in FIG. 1 that it will consume the thread, yarn or other filaments used in textile machinery that is being transmitted from the storage spool 100 to some location to the right of the apparatus shown. Movement from the storage spool is in the direction indicated by the arrow F. There is a cylindrical winding body or spool 2 that is secured to the housing 1 by suitable fasteners such as illustrated, the winding body or spool 2 having a tapered lip or feed guide 21 integral therewith at its right-hand end. The winding body or spool 2 has a hollow bore which accommodates a rotary hollow shaft 3 having a drive pulley 4 secured to the left or drive end and a rotor 5 secured to the right or head end. The drive pulley 4 is driven by a belt 41 and thus rotates the shaft 3 and the rotor 5. A belt drive 411 connects with the belt 41 by some mechanical coupling 410.

As will be seen, the rotor 5 has several functions. In its rotating mode it serves to feed the thread onto the exterior of the winding body or spool 2 and either rotating or not it shields the head end structure as thread is pulled off that end to be led to the textile machine. The rotor 5 has a hub that is secured to the right-hand end of the shaft 3 and a thin conical disk extends radially outward of the hub terminating in an annular guide hood or protector 51 that has its left-hand edge turned radially inward to cover at least a portion of the tapered lip or feed guide 21. A winding eye 52 is provided connected to the guide hood 51 on the interior thereof so that thread may pass inside of the hook and down upon the feed guide 21. The winding eye 52 may be in the form of a small tube carrying the thread or a loop of wire soldered in place. The rotor web is suitably slotted radially to accommodate the reversing idler wheel 50 and its support, this wheel acting as a reversing guide for the thread and rotating bodily with the rotor 5 while at the same time adapted to be rotated on its one shaft in a plane that passes through the axis of the wheel 50. The idler wheel 60 picks up thread coming through the right-hand end of the hollow shaft 3 and feeds it through the winding eye 52 so that it can be laid down upon the feed guide 21. A cup-shaped cover member or cap 53 is frictionally engaged to a suitable portion

of the guide hood **51** to enclose the head end of the thread feeder.

The winding body or spool **2** has a radially extending slotted recess **22** along a substantial portion thereof which is adapted to be covered by the turns of the thread as they are formed and axially pushed along the cylindrical surface. The stationary housing **1** has a radial slot provided with a transverse spindle or stub shaft **8** that mounts a two-armed lever having the arms **71** and **72.** For example, a simple wire with one or two loops formed in its center could be used to form this lever, the loops forming a bight to be traversed by the spindle **8.** The arm **71** is arranged to enter the recess **22** while the arm **72** swings in the radial slot of the housing, such latter arm **72** having a permanent magnet **730** secured to its end. A small magnet-actuated switch **6** is disposed in the radial slot of the housing **1** with electrical leads **61** and **62** extending out of the housing **1** to control the operation of the mechanism **411** drives the belt **41** in accordance with the number of turns of thread which is present on the cylindrical surface of the spool **2.**

The two-armed lever **71–72** serves as a sensing member to sense the number of coils or turns of thread in the store on the cylindrical surface. The arm **71** engages on the interior of the slotted recess **22** beneath the thread coils **102** and when just a few turns are present, the arm **71** is disposed in the solid line position of FIG. **1** while the arm **72** is also disposed in its solid line position. In this latter position, the arm **72** is engaged against a stop member which is located in the radial slot of the stationary housing **1.** The switch **6** is closed under these circumstances, the drive for the belt **41** energized and thread laid onto the cylindrical surface of the spool **2.** When the turns laid down form a store which extends from **102**e to **102**a, the arm **71** assumes the dotted line position shown in FIG. **1** while the arm **72** assumes its dotted line position. This carries the permanent magnet to the location 73_1 which is far enough from the switch **6** to cause the contacts of the latter to open. The belt **41** is thereafter no longer driven and no further windings of thread are laid down upon the surface of the spool until the lever **71–72** is returned to the solid line position of FIG. **1.** In the meantime, the turns of thread between position **102***a* and **102***e* are stripped off the spool **2** overhead by the textile machine as explained below. This decreases the number of coils in the store.

The thread **101** is to be supplied to the textile machine from a storage spool shown at **100.** It is led through a thread brake **9** which assures reasonable tension for the thread in passing through the feeder apparatus and traverses the hollow shaft **3.** It will be understood that when the belt **41** is being driven the shaft **3** is also driven and the thread **101** is moving through the shaft **3.** On the other hand when the belt **41** is not driven, there is no feeding of thread **101** through the hollow shaft **3.**

As it emerges from the head end of the hollow shaft **3,** the thread **101** takes a reverse turn around the idler wheel **50** which is grooved to guide the thread, passes through the winding eye **52** and is laid down upon the tapered lip or feed guide **21.** At this point, the tension of the thread **101** and the sliding movement of the coils being formed on the feed guide **21** keep pulling the turns of thread being executed because of rotation of the rotor **5** and forming the tight coils **102** of said store on the cylindrical surface of the spool **2.** These coils are continuously being added to by additional coils being formed with the result that the coils of said store formed at **102** are shifted continuously to the left in the axial direction designated by the arrow W. It is to be understood that the lever **71–72** is in the solid line position during this period of time and the belt **41** is being driven.

This action continues until the entire spool is filled from the point **102***e* to the point **102***a.* At this point, the lever **71–72** is in its dotted line position in FIG. **1** and the switch **6** is opened so that the belt **41** is no longer driven. This stops the rotation of the rotor **5** and thread coils are no longer produced at **102.**

In the meantime, the textile machine has been stripping thread off the spool **2** over the head end. If the thread feeder apparatus had succeeded in filling the spool to the point **102***a* and then stopped adding coils at **102,** the stripping by the textile machine would commence from the point **102***a* as shown by the lighter upper dot-dash line in FIG. **1** and terminate at the point **102***e* as shown by the darker lower dot-dash line in FIG. **1.** The thread is stripped off over the head end more likely at locations quite close to the guide hood or protector **51** and because of the construction of the latter will not catch or interfere with the structure of the head end whether it is rotating or quiescent. It passes through the thread guide **12** as shown at **101***a* on its way to the mechanism of the textile machine.

Since magnetic switches generally require a greater flux for establishing a connection than for breaking a connection the switch will remain closed and effect the driving of the belt **41** for the better part of the time that the spool **2** is filled up with coils of thread from the point **102***e* to the point **102***a.* In the opposite direction, however, that is for the period of time occupied while thread is being stripped off from the point **102***a* to the point **102***e,* the switch **106** will remain open and will once more close only when the magnet is at the position **730.**

It will be appreciated that the demands of the textile machine are continuous and that even while thread is being laid onto the spool **2** it is at the same time being stripped off by the textile machine. The mechanism is thus arranged to keep a number of coils in the store always present on the spool **2** available for the textile machine and the speed at which the spool **2** is filled with turns should be slightly greater than the speed at which the turns are stripped off so that the textile machine is never able to deplete the turns from the thread feeder.

According to the invention, it is immaterial as to the type of drive mechanism **411** which is controlled by the switch **6.** Thus, variable or direct drive motors, magnetic clutches, etc., could be used to achieve the functions which have been explained. It is understood by those skilled in this art that the thread feeding apparatus may be supplemented by thread monitoring systems for sensing breaks, knots and the like before and after the described thread feeding apparatus and by tension controlling devices such as brakes at suitable locations. It is not deemed necessary to illustrate such means.

In FIG. **2** there is illustrated a modified form of thread feeding apparatus which differs essentially from that of FIG. **1** in the direction in which the thread passes through the center of the apparatus. Similar

components generally carry the same reference characters in this view as in FIG. 1.

The stationary housing 1 has a winding body or spool 2 connected thereto, the housing 1 and the spool 2 having aligned hollow passageways which together form a central guideway 3A which is equivalent to the hollow center of the shaft 3 of FIG. 1. As will be seen, there is no rotating shaft in the structure of FIG. 2 and neither the housing 1 nor the spool 2 rotates. There is a drive pulley 4 which is journalled on a suitable cylindrical bearing formed on the housing 1 and held in place by the securement of the spool 2 to the housing 1. A belt 41 drives the pulley 4. An L-shaped thread-laying arm 45 is connected to the pulley 4 and rotates therewith, the arm having a slightly upturned perforated end comprising a thread eye 111 and a second perforation near its bend which serves as another thread eye 112.

The spool 2 has a tapered lip or feed guide 21 at its right-hand end and the thread eye 112 is located such that the thread 101 emerging from the thread eye 112 will be laid directly upon the tapered surface of the feed guide 21 to form the turns of thread that constrict and engage the cylindrical surface of the spool 2 and provide the coils 102 that are accumulated in the store and moved to the left in FIG. 2 as indicated by the arrow W. In this structure, the thread is stripped off the end of the storage spool 100, passes through a guide 12 in the direction indicated by the arrow F. Instead of being stripped off the spool 2 over the end at which they are being laid down as in FIG. 1, the coils of the store are stripped off the left-hand end over the bead-like edge 23 integrally provided on the spool 2 and pass into the central guideway 3A. The thread 101a passes out of the central guideway 3A in the direction indicated by the arrow F to the textile machine.

In this structure there is an electric switch 83 that is disposed in a radially extending recess provided in the body of the spool 2 that connects by way of the electrical leads 84 and 85 extending through the housing 1 with drive 411 for controlling the drive of the belt 41. A two-armed lever 74–75 mounted on the shaft 8 is arranged to be manipulated by the coils of thread of the store to make and break the contacts of the electrical switch 83. When just a few coils are disposed on the cylindrical surface of the spool 2 as shown in FIG. 2 at 102, the arm 74 is located outwardly of the recess but interior of the coils and the other arm 75 is disposed to permit the switch contacts 83 to remain in engagement. When the store of coils of thread commence to build up along the spool, pressure radially inwardly is exerted on the arm 74 and in turn on the arm 75. It may be assumed that the contacts of the switch 83 are biased to remain in closed position and that the pressure exerted to open them is not achieved until a substantial number of coils in the store has been laid upon the cylindrical surface of the spool 2. Then the switch 83 is opened and the belt 41 is no longer driven so that no more coils are being laid down in the store upon the surface of the spool 2. The stripping of the turns or coils from the left-hand end of the spool 2 continues in the manner as explained in connection with the stripping of turns from the spool of FIG. 1 and when enough turns have been removed from the store to permit the lever 74–75 to regain the condition shown in FIG. 2 the L-shaped arm 45 again commences to rotate and lay down more turns of thread in the store.

The remaining structures described hereinafter differ from those of FIGS. 1 and 2 in the manner in which the several coils of the thread of the store carried on the spool or winding body are moved axially. Instead of depending upon the shifting effected in FIGS. 1 and 2 brought about by laying the oncoming thread against a tapered lip or feed guide 21 so that the formed coils of the store are pressed axially along the cylindrical surface of the spool 2 end to end, another scheme is used. In FIGS. 3 to 16 the coils of the store are shifted by bodily lifting them from one location on the winding body and moving them in a group axially toward one end of the winding body.

This action, which will be described in detail, is effected by providing a pair of generally cylindrical cage-like members one within the other, each cagelike member having its exterior surface defined by a plurality of bars, ribs or rods or the equivalent thereof, but the rods of one cagelike member being located between the rods of the other cagelike member. The inner cagelike member moves in a wobbling type of motion that is best defined as planetary while at the same time axial relative to the other cage-like member. A portion of the surface defined by the rods of the inner cagelike member thus moves from the inside to the outside of the outer cagelike member but does this in a progression around the circumferences of the cagelike members, at the same time also moving slightly axially. The bars of the inner cagelike member interlace with the bars of the outer cagelike member while this is going on in a function which is called "interdigitation." The action as stated lifts a plurality of coils progressively around the fixed cage and moves them slightly axially. This is repeated at a rapid rate as the inner cagelike member shifts rotatively in its peculiar wobbling movement so that all of the coils of the store are continuously moved axially in the same direction toward the second end of the store.

There are three types of structures which will be described, and in order to provide a good understanding of the description, the three types are (1) the feed body or spool is represented by a substantially solid body as in FIGS. 3 to 8, inclusive; (2) the feed body is formed as a cage with rods quite similar to the planetarily moving structure as in FIGS. 9 to 11, inclusive; and (3) a structure illustrated in FIGS. 12 and 13 which provides a movement afforded through the use of a spherical bearing.

Keeping in mind the general principals of a cage wobbling within a cage and the inner protruding through the outer in a progressive circumferential action while moving slightly axially, it is easy to visualize the desired function and its results. Importantly, it should be realized that as the protruding portion of the inner cage passes radially outwardly of the outer cage it moves radially outward (lifting the coils only at that location) and slightly axially (moving the affected portions of the coils axially) but that same protruding portion recovers from these movements, including an axially reverse movement after it has retracted inwardly of the outer cage, leaving the coils it lifted and shifted in the position that it moved them.

The invention combines the actions described with structures for guiding and feeding the thread and controlling the operation of the thread feeder apparatus to the end that such apparatus is ideally suited for use with textile machines.

Looking now at FIGS. 3 to 8 inclusive, FIGS. 3 to 5 are simplified mechanical diagrams of the same views shown in FIGS. 6 to 8 respectively. FIGS. 3 to 5 are intended only to assist in an understanding of the operation of the apparatus of FIGS. 6 to 8.

The views of FIGS. 3 to 5 make no attempts to show the rods or bars or other structure which enable the one cage to wobble inside of the other in a planetary movement but it is to be understood that such rods, bars, etc., must be present in order to permit of such movement. The respective views are repeated, but illustrating the practical embodiment, in FIGS. 6 to 8.

There is a stationary housing 1 in FIGS. 3 to 5 which is connected to a textile weaving or the like machine having a stationary winding body or the equivalent of the spool 2 previously mentioned, the winding body being secured to the housing 1. Such winding body 2 is generally solid but has a structure on its exterior which provides parallel, axially extending bars or rods to be described. There is sufficient space between the rods and interior of the cylindrical surface defined by the outermost extent of the rods to accommodate a hollow cage which is for the most part disposed interior of the cylindrical surface defined by said outermost extent of the rods.

In FIGS. 3 to 6, the geometric cylindrical figure defined by the winding body and its rods is designated 2, and the geometric cylindrical figure defined by the inner cage is designated by the reference character 13. It is understood that bars or rods on the one member will interdigitate with bars or rods on the other member to achieve the desired functions. The planetary and axial wobbling movement of the member 13 relative to the member 2 is the essential feature of this construction.

The shaft 31 in FIGS. 3 to 5 is the equivalent of the shaft 3 of FIGS. 1 and 2. It is hollow and is fixed to the central trunnion 42 of the drive pulley 4 to rotate therewith in the direction of the arcuate arrow shown in FIG. 5. Said shaft 31 is located off-center relative to the axis of the drive pulley 4 and the winding body 2, that latter two being concentric, but in addition, is skewed at an angle designated α in FIG. 4 relative to the axis of the pulley 4. The trunnion 15 of the rotor 5 which carries the guide hood 51 is disposed parallel to the coaxial with the trunnion 42 so that notwithstanding the off-center and angular disposition of the shaft 31 which is also fixedly secured to the trunnion 42, when the drive pulley 4 is rotated the rotor 5 and its guide hood 51 will rotate coaxially with the pulley 4 and the winding body 2.

By examining the illustrations of FIGS. 3 to 5 it can be seen that as the pulley 4 rotates it causes the shaft 31 to execute a rotational movement in which the off-center and skewed disposition is retained. The inner cage member or body 13 is mounted on the shaft 31 for free rotation relative thereto, but the said inner cage member 13 is restricted from rotational movement relative to the winding body 2 in a manner which will be explained in connection with FIGS. 6 to 8. Accordingly, there will be a planetary wobbling movement of the member 13 relative to the body 2. There is substantially no relative tangential movement between the two members 2 and 13, but the cage member 13 penetrates the outermost defined cylindrical surface of the winding body 2 in a progressive movement around the periphery of the winding body 2. If the axis of the shaft 31 were only offset from the axis of the winding body 2 this would result in a simple planetary movement of the member 13 relative to the body 2 so that the penetrating portion in the area 20 would progressively move around the circumference of the body 2 and merely lift and then lay down any coils of thread of the store carried on the body 2. These coils would not move axially in one direction or another.

Inasmuch as the shaft 31 also is skewed relative to the axis of the drive pulley 4 and hence relative to the axis of the winding body 2, as the inner cage 13 penetrates the outer circumference of the geometric figure defined by the outermost extent of the bars of the winding body 2 and returns to the interior thereof in its planetary movement, it does not do so in a pure radial movement. It also does so on a path which is at an angle relative to the axis of the winding body 2 measured in an axial direction. Thus, it lifts up the coils at one location and lays them down at another location displaced axially from the first location. Thus, it is possible to achieve movement without rotation of the winding body 2 or the inner cage 13, the latter functioning as feed member. Furthermore, by adjustment of the amount of off-center location and the angle α one can control the distance between the turns of thread and precisely maintain that distance which is designated ΔW in FIG. 4, the direction of shifting the turns being indicated by the arrow W. In other words, the pitch of the turns is precisely established depending upon the geometry of the apparatus.

In this instance, the thread 101 passes through the guide eye 12 from a storage supply (not shown) moves in the direction of the arrow F into the hollow bore of the shaft 31, emerges from the right-hand end of the shaft 31 and passes through a guide tube or eye 52 connected to the hood 51 and is laid upon the outer circumference of the geometric figure defined by the winding body 2 and its rods. It is stripped off the left-hand end of the winding body 2 and moves through the eye 12 as shown at 101a to the mechanism of the textile machine.

The practical equivalent of the apparatus of FIGS. 3 to 5 is shown in FIGS. 6 to 8 inclusive.

The thread feeder apparatus of FIGS. 6, 7 and 8 includes the stationary housing 1 which is in the form of a disklike member 1 having a plurality of circumferentially arranged rods 24 secured to the right-hand surface thereof. The right-hand ends of the rods are provided with respective feed bevels 21o to serve generally the function of the feed guides 21 of FIGS. 1 and 2. These guides are not essential for the operation of the structure of FIGS. 6, 7, and 8. The outermost extent of the rods 24 define a cylindrical geometric figure which is the equivalent of that shown at 2 in FIGS. 3 to 6. In fact, the rods comprise the feed body 2 of this structure. The coils of thread 102 of the store will be carried primarily on these rods 24.

The disc-like member comprising the housing 1 has the shaft 3 journalled therein, this shaft carrying on its left end the drive pulley 4 which is connected to the belt 41 driven by the drive mechanism 411. At its right-hand end, the shaft 3 has the hub of the rotor 5 secured thereto for rotation therewith, the rotor 5 having the peripheral guide hood 51 and the thread tube or eye 52 to lead the thread onto the beveled feed guides 21o.

In the center of the apparatus, there is a cylindrical member which comprises the inner cage or so-called

feed member **13**, equivalent to the member **13** of FIGS. **3** to **5**. This feed member has a central solid portion and a plurality of radially extending, longitudinal, axially parallel ribs **130**, the number of ribs **130** being the same as the number of rods **24** of the winding body **2**. A central annular flange or wall **132** is mounted on the member **13**, this flange having a plurality of arcuate recesses giving rise to sprocketlike teeth **133**. The number of recesses is also equal to the number of rods **24** and they are spaced between the ribs so that they receive and confine the rods and thereby prevent any shifting between the members **2** and **13** while maintaining substantial centering of the one relative to the other during the operation of the apparatus.

In this structure the outermost diameters of the member **2** and the member **13** are equal but as in the case of the structure of FIGS. **3** to **5**, the mounting of the member **13** relative to the axis of the member **2** is offset and skewed. Thus, the feed body **13** is staggered relative to the stationary body **2** by a small distance *e* which is indicated in FIG. **7**. It is also skewed by the angle α as shown in FIG. **8**. An eccentric shaft section **30** provides for this geometric departure from coaxial, the body of the member **13** being freely rotatable relative to the section **30** to give the desired planetary wobbling movement described in connection with FIGS. **3** to **5**.

The member **13** is equivalent to the inner cage previously mentioned because the thread turns **102** are laid down upon the outer periphery defined by the outermost extent of the rods **24** and as the shaft **3** rotates the member **13** moves in a planetary and wobbling action, penetrating the member **2** in an interdigitating manner. That is to say, the ribs **130** move in between, outside and then inside of the rods **24** when a penetration is effected. This penetrating effect travels around the periphery of the member **2** the total angular extent of penetration being about 180° at any point but of varying radially over this sector.

Again, as in the case of the structures described in FIGS. **3** to **5**, the feed body **13** does not itself rotate but serves in the rotation of the shaft **3** to lift the turns **102** from one location and return them to another location which is displaced slightly axially, in this structure in the direction indicated by the arrow W by an amount determined by the degree of eccentricity *e* and the angle of skew α.

In operation the thread member **101** derives from a storage location in the direction F and enters the hollow bore of the shaft **3**, passing through and out at the right-hand end (FIGS. **6** and **8**). The thread moves radially outward within the hood **51** and out through the tube or eye **52** and onto the outer periphery of the member **2**. Rotation of the shaft **3** lays down more turns to the store while continuously shifting them to the left to fill the cylindrical shape defined by the rods **24**. In the meantime, the textile machine's demands strips the thread from the left-hand end of the member **2** pulling from coils from the store over the hood **51** and through the eye **12** in the direction F as shown at **101***a*.

As in the case of the other structures described, there is a radial recess or slot **231** in the body of the member **13** adapted to be entered by one arm **71** of the lever **71–72**. The operation of the lever **71–72** in connection with the magnetic switch **6** and its electrical leads **61** and **62** should be understood from previous explanations.

As previously mentioned, the feed function of the beveled ends **21***o* is not needed to shift the coils. Instead these beveled ends cause the last-formed loop to impact with a greater lateral distance against the preceding winding in the conical feed zone. This prevents the winding following in each case from crowding and adhering against the preceding winding. The rolling of the winding on the beveled ends brings protruding fibers closely into engagement with the thread and makes eventual stripping of thread less likely to be impeded due to adjacent thread loops adhering.

The thread-feeding apparatus thus far described accomplishes the purposes of feeding thread from a storage location to an operating point of a textile machine where the demands of the machine are intermittent or variable albeit continuous. With slight modification, however, it can also be used to provide a positive thread supply if the thread is delivered directly from the thread feeder instead of being stripped off overhead. In such case a second unwinding eye or tube **54** is mounted on the rotating hood **51** and picks up the thread at the point **102***x* and feeds same to the textile machine in synchronism with the rate at which it is being wound onto the member **2**. It will always deliver a maximum number of threads which in the case of nonelastic threads is determined by the number of revolutions of the winding body.

In textile machines with several operating points having identical thread requirements, this condition is most easily met by directly driving a plurality of thread feeders being of identical size and driven by one joint drive element. Such element could be for example, a sprocket wheel, drive belts, cog belts and the like. In this example, the drive may also be infinitely variable.

Even if the individual operating points have unequal thread requirements, the thread feeders can nevertheless be driven from a single drive member. A clutch in coupling **410** would be provided for each thread feeder arranged between the drive pulley **41** and the rotor drive **411** which can be controlled by the individual sensing elements **71** and switches **6**.

Referring now to FIGS. **9**, **10**, and **11**, there is illustrated therein a further embodiment of the thread-feeding apparatus with a stationary winding body. Again there is provided a stationary housing **1** in the form of a disc-like member having the hollow shaft **3** journalled therein. The hollow shaft **3** mounts the drive pulley **4** on its left-hand end, the drive pulley being connected by the belt **41** to a rotating device **411**. The housing **1** has a plurality of bars or rods **24** mounted therein, protruding from its right-hand surface and arranged in a circle circumferentially equally spaced apart. These bars or rods **24** and the housing **1** comprise a cagelike member, the rods **24** defining the equivalent winding body or spool **2** previously described. For stability of the winding body **2**, its right-hand end is provided with a cylindrical plate **11** and each of the right-hand ends of the bars or rods **24** is secured to said plate **11**. The plate is journalled on a short section of the hollow shaft **3** at **11A** for support.

The so-called inner cagelike member or feed body **13** is formed likewise with two end plates and intervening bars or rods **130**. Thus, there is a left-hand disk **131** which is secured in the slotted flange **138** of the outer race of a ball bearing **33** which has its inner race connected to the bearing seat **31** of the enlarged section **30** of the shaft **3**. The center of the right-hand disk **132** is

provided with a bearing **137** that is journalled on the seat **136** provided at the right-hand end of the enlarged section **30** of the shaft **3.** The disks **131** and **132** are mounted eccentric relative to the axis of the winding body **2** (which is also the axis of the straight portion of the shaft **3**) by the degree indicated at *e* in FIGS. **10** and **11.** The seat **31** for the disk **131** is oblique. This arrangement gives the wobbling motion required, consisting of the planetary movement accompanied by a slight axial movement of the winding body or cagelike member **13** within the outer cagelike member **2.** The rods or bars **24** are disposed between the rods or bars **130** and there are identical numbers. The planetary wobbling movement will produce the interdigitation of the bars **24** with the bars **130.** The disks **131** and **132** have aligned perforations **135A** which result in webs **135** between perforations. The respective bars or rods **24** pass through these perforations and hence are radially confined during the wobbling movement to assure the precise manner of the radial movement of the inner cagelike member **13.**

In the course of the motion described, the feed body or inner cagelike member **13** of FIGS. **9** to **12** would require longitudinal deformation of the rods or bars **130** due to the manner in which the disks are mounted. The deformation occurs during the axial movement led by the disk **131** while the planetary movement is occurring. In order to compensate for this stress, the disks **131** and **132** may be made of some resilient material to enable flexing of the same. An alternate manner of compensating for this type of movement is to embed the ends of the bars or rods **130** in their respective disks elastically so that they may afford limited axial oscillation during the wobbling movement.

The remainder of the structure of thread feeder or FIGS. **9** to **111** is not substantially different from that described in connection with other embodiments. The center of the shaft **3** is hollow as shown at **32** and thread **101** enters from a storage point (not shown) in the direction of the arrow, passing through the bore **32** and emerging beyond the hub of the rotor **5** which is fixed to the right-hand end of the shaft **3.** The periphery of the rotor **5** is provided with a hood **51** in which there is secured a thread eye or tube **52.** The thread passes radially outwardly from the center of the rotor **5,** through the eye **52** and is laid down forming a store of coils **102** on the winding body **2.** As the inner cagelike member **13** wobbles during the rotation of the drive pulley **4** and the rotor **5,** the coils **102** of the store shift to the left in FIGS. **9** and **10** and commence to build up along the length thereof. The pitch of the coils or windings is controlled by the geometry of the apparatus as determined by the offset distance *e* and the skew angle of the bearing **33.** The coil area of the store extends primarily between **102e** and **102a,** the thread **101k** being stripped off overhead, passing over the hood **51** at the head end of the thread feeder apparatus.

The operation of the sensing device comprising the lever **71–72,** permanent magnet **73,** switch **6** and leads **61** and **62** are the same as previously described in connection with other embodiments. A positive feed arrangement can be made using the tubular thread eye **54** rotating with the hood **51** and the rotor **5,** picking up the thread axially spaced from the point **102***a* at the point **102***x*, as explained in connection with FIG. **6.** The resulting thread strand **101***p* is then fed directly to the textile machine through the guide **12** as shown at **101***a*.

FIGS. **12** and **13** illustrate a modified form of the invention which is shown arranged vertically and utilizing a spherical bearing and a method of advancing the thread which is not substantially different from that of the structure of FIGS. **9** to **11.** In addition, the direction of movement of the thread is similar to that of FIG. **2,** namely, in a direction emerging from the hollow shaft in the direction of the driven end (downwardly in FIG. **12**).

The vertically arranged column or shaft **90** is frictionally engaged to a carrier **1** which is the equivalent of the housings **1** previously mentioned. A stationary winding body **2** or outer cagelike member is formed in the manner of a hollow tube spool, comprising the upper disk **11B,** the lower disk **91,** connecting rods or bars **24** and the hollow tube **24A** connected with and fixed to the central portion of the shaft **90.** It will be appreciated that this winding body **2** is separated from the carrier **1** but nevertheless is stationary since it is connected thereto by way of the shaft **90.** The drive pulley **4** in this case is connected to the outer race of a ball bearing **4A** whose inner race is secured to the shaft **90** so that the belt **41** driving the pulley **4** will rotate the same independently of the shaft **90.** The pulley **4** is attached to a flanged bushing **92** that rotates with the pulley **4** and also carries with it the thread laying frame **45A** that is attached to the flange portion of the bushing **92.** This bushing **92** is eccentric and also has a skewed shoulder so that the ball bearing **33** whose inner race is connected to the bushing and engaged against the shoulder will execute the wobbling motion needed to effect the thread feeding of the type which has been described.

Again, as in the structure illustrated in FIGS. **9** to **11,** there are end disks **131** and **132** with the bars **130** being disposed between the bars **24** to achieve the desired interdigitation. The bottom disk **131** is mounted on a flange **138** provided on the outer race of the bearing **33** to impart to the inner cagelike member **13** the desired wobbling movement.

The wobbling movement of the feed body **13** of this thread feeder is not the same over its entire length. Instead the axial movement effected by the bars **130** is greater adjacent the bottom of the feed body **13** than adjacent the top. This produces a variable pitch in the coils of thread, the pitch being greatest at the point **102***e* and least at the point **102***a*. This is accomplished by mounting the center of the upper disk **132** on a spherical bearing bearing **94** located on the axis of the winding body **2,** instead of eccentrically relative thereto. Thus, a larger amount of thread may be accommodated by this thread feeder than by others which have the same pitch throughout.

With respect to the other components of the apparatus of FIGS. **12** and **13,** for the most part they are readily understood. Thread is removed from the storage spool **100** at the top of the apparatus, passes over a guide or brake **9** which provides uniform tension thereafter, passes through the eye **11** provided at the upper end of the thread-laying frame **45A,** through the side eye **45B,** down the side of the frame **45A** to the eye **112** and then radially inwardly to be laid onto the outer circumference of the winding body **2.** The store of thread coils are formed and shifted axially along the member **2** in the direction indicated by the arrow W of FIG. **12** and are stripped off by the demands of the textile ma-

chine (not shown) drawing the thread through the hollow center 3 of the shaft 90. An annular beaded ring 93 is connected to the periphery of the disk 132 to guide the thread 101*a* to the hollow center guideway 3A.

The sensing member 71–72 operates as explained before, in this case in connection with an electric switch indicated by the block 74–75.

Adjacent to the starting location of the first coil there is shown in FIG. 12 a movable bolt 96, its inner position being such that its radially outer end is clear of the cylinder defined by the outermost extent of the bars 24. Its outermost position is shown at 960. This movement can be effected either manually or automatically. Under these circumstances it serves as a stop member to prevent movement of the first few coils axially until the action of the apparatus proceeds. Thereafter the bolt 96 is withdrawn inwardly and it no longer blocks movement of the coils axially upwards.

The wedgelike deflection member 97 shown connected to the thread-laying frame 45A is disposed immediately above the thread eye 112 and its purpose is to deflect the free ends of any knots which may enter under the coils, preventing these knots from being caught under turns ahead of that turn being formed and jamming the apparatus or causing breakage of thread.

FIG. 14 illustrates in a sectional view a modified form of the invention especially intended for feeding threads of an elastic variety such as for example manufactured from synthetic fibers. The basic structure of FIG. 14 follows the constructional details of the device of FIGS. 9 to 11 and operates for the most part in the same functional manner except that the feed body 13 of FIG. 14 is conical instead of substantially cylindrical. The said feed body 13 tapers from its wider diameter at the head end (on the right) to its narrower diameter at the driven end (to the left). Another difference between the two structures is exemplified by the use of a magnetic clutch in FIG. 14, such a clutch having been mentioned previously.

The need for a thread feeder especially in connection with feeding elastic threads or filaments to a textile machine is somewhat more important in many respects than in connection with nonelastic threads. The normalization or relaxation of elastic threads during the process of removing the same from a storage spool or the like requires considerably more time than would be occupied in passing from the storage spool directly to the machine. This time is of the order of several seconds; hence the delay provided by the thread feeder is beneficial. The textile machine otherwise is capable of consuming thread traveling from the storage spool within a fraction of a second.

For the most part the reference characters of FIG. 14 can be identified as to construction and function from previous views. The difference lies principally in the use of a magnetic clutch that is operated by the switch 6. The drive pulley 4 is mounted for rotation independently of the shaft 3 on the outer race of a ball bearing 4A whose inner race is fixed to the housing 1. The belt 41 drives the pulley 4 as in the other versions of the invention. The outer axial end surface of the pulley 4 has an annular friction lining 44 adhered thereto, this lining adapted to cooperate with the friction plate 34 that is formed of iron and is mounted on the shaft 3 with a sliding connection to enable it to rotate with the shaft while capable of movement axially relative to the shaft 3. A spring 35 urges the plate 34 to the left out of engagement with the friction lining 44.

The housing 1 has a central annular extension 16 coaxial with the shaft 3 and mounts thereon an electromagnet 77 whose energizing winding 78 is adapted to be electrically connected to a suitable source of electricity (not shown) by the switch 6 and its connecting leads 61 and 62. The operation of the switch 6 is in accordance with explanations given above. When the winding 78 is not energized the spring 35 urges the disk 34 out of engagement with the friction lining 44 and hence it can be seen that the pulley 4 may be rotating continuously.

The structure of FIG. 15 is again a modified form of that of FIGS. 9 to 11.

As in the case of previously described embodiments, the sensing means 71–72 with attached magnet 73 cooperate with the magnetically actuated switch 6 to open and close the circuit of the two electrical leads 61 and 62. In this instance, the drive for the shaft 3 is provided by an electric motor 411 energized from a suitable source of electricity by the closing of the switch 6, the motor 411 being coupled to the shaft 3 by way of the gears 40 and 410.

A mechanism shown in FIG. 15 for detecting the breakage of a thread and stopping the operation of the apparatus includes an arm 64 also serving as sensing means having a scanning end 65 that scans the thread coils 102 from the inside thereof but only at the infeed range 102e. This arm 64 is pivoted at 63 and has an opposite extension end 66 that will open the contacts of the switch 6A when the arms 64 and 66 swing clockwise and close these contacts when the arms swing counterclockwise. A spring (not shown) will urge the slight rotation of the arms 64 and 66 when a broken thread permits the end 65 to swing upwards as viewed in FIG. 15. The closing of the contacts of switch 6A completes the circuit through the conductors 67 and 68 to a relay (not shown) that will shut off the drive for the textile machine. The thread feeder may also be deenergized at the same time, if desired.

There are thread break shutoffs known for textile machines but this has the advantage that there is no requirement to lead the thread through an additional device besides the thread feeder.

What it is desired to secure by Letters Patent of the United States is:

1. A thread feeder adapted to be interposed between a supply source and a textile machine in which the thread feeder is adapted to accumulate at least several coils of thread for storage purposes axially along a winding body, said coils of thread forming a store of coils, the thread feeder being constructed to add coils at one end of the store from the supply source and the textile machine adapted to strip coils from the second end of the store, the thread feeder adapted to have the coils shifted in the direction from the one end of the store to the second end thereof, said thread feeder comprising:

A. a support for mounting on a textile machine,

B. a winding body being fixed to said support and being stationary relative thereto and adapted to have coils of thread wound thereon to form a store of coils extending side by side along the length of said winding body, the winding body being elongate and generally circular in cross section and the store forming a geometrical arrangement symmet-

rically about and coaxial with the axis of said winding body,

C. a rotating thread-laying guide mounted on said support for rotation coaxially with the axis of the winding body, the thread adapted to be fed from the supply source to said thread-laying guide, said thread-laying guide being located to lay a coil of thread onto said winding body at a location constituting the beginning and one end of said store, said location remaining fixed at all times during operation of said thread feeder,

D. means for axially shifting said coils in a direction away from said location while said thread-laying guide is rotating to form said store, the coil furthest from said location comprising the second end of said store, the number of coils in the store and hence the position of said second end being variable,

E. means for driving said rotating thread-laying guide,

F. a control device for controlling said driving means and operated in response to the length of said store, and

G. a passageway through said winding body approximately at the axis thereof and means for guiding said thread during the operation of said thread feeder to move through said passageway in a direction opposite to the direction in which said coils are shifted.

2. The thread feeder as claimed in claim **1** in which said control device includes a sensing element mounted for movement relative to the axis of said winding body and movable on the interior of said coils of said store to at least two different control conditions by said coils in accordance with the number of coils in the store.

3. The thread feeder as claimed in claim **2** in which said control device includes a magnetic switch adapted to be opened and closed at said two different control conditions respectively.

4. The thread feeder as claimed in claim **2** in which the winding body and store are cylindrical.

5. The thread feeder as claimed in claim **2** in which the winding body and store are frustoconical.

6. The thread feeder as claimed in claim **1** in which the means for driving the rotating thread-laying guide includes a hollow shaft journalled for rotation on said support and extending through the center of said winding body, a rotary drive member coupled to one end of said shaft and said thread-laying guide being coupled to the other end of said shaft, the said passageway comprising the hollow center of said shaft.

7. The thread feeder as claimed in claim **1** in which means are provided for enabling the incoming thread to traverse the said passageway prior to being fed to said thread-laying guide and the coils adapted to be freely stripped from the second end of said store and the thread of said stripped-off coils pulled over the end of said winding body having said location of the beginning of said store on its way to said textile machine.

8. The thread feeder as claimed in claim **7** in which means are provided for deflecting the thread of said stripped off coils from the thread-laying guide during its being pulled over said end.

9. The thread feeder as claimed in claim **1** in which the thread from said supply source is adapted to be fed directly to said thread-laying guide and enters said passageway after being stripped off said winding body.

10. The thread feeder as claimed in claim **9** in which the structure forming said passageway is fixed to said support.

11. The thread feeder as claimed in claim **1** in which the coils of thread are stripped from said store in the same direction as said coils of said store are shifted in the forming of said store and bead-like means are provided to guide the thread of said stripped-off coils into said passageway on the way to said textile machine.

12. The thread feeder as claimed in claim **1** in which said means for axial shifting of said coils comprise a positive axial feed device coupled with said means for driving the said thread-laying guide.

13. The thread feeder as claimed in claim **1** in which the means for axial shifting of said coils comprise structure lifting the coils of said store slightly from said winding body in a sector of the circumference thereof less than the whole of said circumference while simultaneously moving said lifted coils slightly along said winding body exterior axially toward the second end of said store, said lifting and moving action being effected progressively around the circumference of said winding body.

14. The thread feeder as claimed in claim **13** in which the pitch of the coils in the store resulting from the axial shifting is constant along the length of said store.

15. The thread feeder as claimed in claim **13** in which the pitch of the coils in the store resulting from the axial shifting decreases from the beginning of the store to the end of the store.

16. The thread feeder as claimed in claim **13** in which said means for axial shifting said coils is coupled with said driving means for operation in synchronism with said thread-laying guide.

17. The thread feeder as claimed in claim **16** in which the means for axial shifting of the coils comprise elongate circumferentially spaced bars on the exterior of said winding body and defining the outer effective surface thereof and a feed member having the same outer geometric configuration as the winding body and provided with similarly spaced bars defining its said outer geometric configuration, the feed member being mounted on the interior of said winding body for a non-rotative but wobbling movement on an axis close to but not coaxial with the axis of said winding body and positioned with its bars alternating with the bars of the winding body, the wobbling movement producing an interdigitation of the feed member bars and winding body bars axially to shift and lift said coils as aforesaid.

18. The thread feeder as claimed in claim **17** in which the diameter of the feed member is substantially the same as that of the winding body.

19. The thread feeder as claimed in claim **17** in which said winding body is comprised of a generally cylindrical disklike solid member having one end of each of its said bars engaged in a face of said solid member and the other end free and forming a first cagelike structure, the feed member and its bars forming a second cagelike structure spaced from said face of said solid member.

20. The thread feeder as claimed in claim **19** in which said feed member has an annular flange for confining relative movement between the bars of the feed member relative to the bars of the winding body during said wobbling movement.

21. The thread feeder as claimed in claim 17 in which said feed member includes end disks supporting said bars and said disks are journalled for wobbling motion but not rotation relative to said support.

22. The thread feeder as claimed in claim 21 in which one end disk is mounted in a manner to provide at least substantially less wobbling action at that end of said feed member than the other end whereby to vary the pitch of the coils of said store from one end thereof to the other as they are laid down.

23. The thread feeder as claimed in claim 22 in which the coils of thread are stripped from said store in the same direction as said coils of said store are shifted in the forming of said store and bead-like means are provided to guide the thread of said stripped-off coils into said passageway on the way to said textile machine, said support carrying a shaft fixed thereto and having a hollow center comprising said passageway, said disks being journalled to said shaft.

24. The thread feeder as claimed in claim 22 in which said one end disk is mounted on a spherical bearing.

25. The thread feeder as claimed in claim 21 in which said disks and bars of said feed member are connected in a relatively flexible assembly permitting axial displacement of said bars notwithstanding somewhat different wobbling action of the respective disks.

26. The thread feeder as claimed in claim 21 in which the disks are flexible.

27. The thread feeder as claimed in claim 1 in which the winding body and store are cylindrical.

28. The thread feeder as claimed in claim 1 in which the winding body and store are frustoconical.

29. The thread feeder as claimed in claim 1 in which the means for driving the rotating thread-laying guide includes a hollow shaft journalled for rotation on said support and extending through the center of said winding body, a rotary drive member coupled to one end of said shaft and said thread-laying guide being coupled to the other end of said shaft, the said passageway comprising the hollow center of said shaft and means are provided for enabling the incoming thread to traverse said passageway prior to being fed to said thread-laying guide and the coils are adapted to be freely stripped from the second end of said store and the thread of said stripped-off coils pulled over the end of said winding body having said location of the beginning of the store on its way to said textile machine.

30. The thread feeder as claimed in claim 29 in which the means for axial shifting of said coils comprise structure lifting the coils of said store slightly from said winding body in a sector of the circumference thereof less than the whole of said circumference while simultaneously moving said lifted coils slightly along said winding body exterior axially toward the second end of said store, said lifting and moving action being effected progressively around the circumference of said winding body.

31. The thread feeder as claimed in claim 30 in which said means for axial shifting and lifting said coils is coupled with said shaft for actuating thereby in synchronism with said thread-laying guide.

32. The thread feeder as claimed in claim 31 in which the means for axial shifting of the coils comprise elongate circumferentially spaced bars on the exterior of said winding body and defining the outer effective surface thereof and a feed member having the same outer geometric configuration as the winding body and provided with similarly spaced bars defining its said outer geometric configuration, the feed member being mounted on the interior of said winding body for a non-rotative but wobbling movement on an axis close to but not coaxial with the axis of said winding body and positioned with its bars alternating with the bars of the winding body, the wobbling movement producing an interdigitation of the feed member bars and winding body bars axially to shift and lift said coils as aforesaid.

33. The thread feeder as claimed in claim 31 in which the diameter of the feed member is substantially the same as that of the winding body.

34. The thread feeder as claimed in claim 31 in which said winding body is comprised of a generally cylindrical disklike solid member having one end of each of its said bars engaged in a face of said solid member and the other end free and forming a first cagelike structure, the feed member and its bar forming a second cagelike structure spaced from said face of said solid member.

35. The thread feeder as claimed in claim 31 in which said feed member includes end disks supporting said bars and said disks are journalled for wobbling motion but not rotation relative to said support.

36. In a thread feeder for feeding thread from a supply source to a textile machine and which includes a support, a winding body carried on said support, means for winding a plurality of coils on said winding body to form a store of axially arranged side by side coils connected between the supply source and the textile machine, means for progressively shifting the coils of said store from one end thereof to the second end thereof, the coils at the second end adapted to be freely stripped off from said end in a direction passing over the said one end of said store, the invention herein comprising:

A. the winding body being fixed to said support and being stationary,

B. said winding means including a hollow shaft arranged in the center of the winding body and having

i. driven means at one end of the shaft for rotating the same and driving means for operating said driven means,

ii. a rotating thread-laying guide at the other end of the shaft for laying thread in coils onto said winding body to form said store, the stripped off coils adapted to pass over said guide also while the thread thereof is passing to said textile machine,

C. control means for controlling the operation of said driving means in response to the length of said store, and

D. means for guiding the thread arriving from the supply source to pass through said hollow shaft in a direction opposite to that in which the coils are shifted and to pass thereafter to said thread-laying guide.

37. The invention as claimed in claim 36 in which said control means include a sensing element mounted for movement toward and away from the axis of said winding body and movable on the interior of the coils of said store to at least two different control conditions by said coils in accordance with the number of coils in the store.

38. The thread feeder as claimed in claim **37** in which the means for axial shifting of said coils comprise structure lifting the coils of said store slightly from said winding body in a sector of the circumference thereof less than the whole of said circumference while simultaneously moving said lifted coils slightly along said winding body exterior axially toward the second end of said store, said lifting and moving action being effected progressively around the circumference of said winding body.

39. In a thread feeder for feeding thread from a supply source to a textile machine and which includes a support, a winding body carried on said support, means for winding a plurality of coils on said winding body to form a store of axially arranged side by side coils connected between the supply source and the textile machine, means for progressively shifting the coils of said store from one end thereof to the second end thereof, the coils at the second end adapted to be freely stripped off from said second end in the direction that the coils are being shifted, the invention herein comprising:

A. the winding body being fixed to said support and being stationary,

B. said winding means including

i. driven rotating means journalled on said support and driving means for operating said driven means,

ii. a rotating thread-laying guide coupled with said driven means and rotated thereby for laying thread onto said winding body to form said store,

iii. means for leading thread from said supply source to said thread-laying guide,

C. control means for controlling the operation of said driving means in response to the length of said store

D. means fixed relative to said support and winding body forming a passageway passing through the winding body axially of the coils forming said store, and

E. bead-like means for guiding the thread being stripped off said second end of the store to pass through said passageway in a direction opposite the direction in which the coils are shifted and thereafter to pass to said textile machine.

40. The invention as claimed in claim **39** in which said control means include a sensing element mounted for movement toward and away from the axis of said winding body and movable on the interior of the coils of said store to at least two different control conditions by said coils in accordance with the number of coils in the store.

41. The thread feeder as claimed in claim **40** in which the means for axial shifting of said coils comprise structure lifting the coils of said store slightly from said winding body in a sector of the circumference thereof less than the whole of said circumference while simultaneously moving said lifted coils slightly along said winding body exterior axially toward the second end of said store, said lifting and moving action being effected progressively around the circumference of said winding body.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,796,386 Dated March 12, 1974

Inventor(s) KARL TANNERT

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the Introductory Data, insert the following: --[30] foreign application B.R.D. P 19 28 040.1 filed June 2, 1969 and B.R.D. 19 42 062.3 filed Aug.19, 1969--; Column 2, line 47, "a" should read --in--; and Column 13, line 37, "111" should read --11--.

Signed and sealed this 8th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents