United States Patent

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Rottenburg/Necker, Germany
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[33] **Germany**
[31] **P 20 03 760.9**

[54] **THREAD SUPPLY APPARATUS FOR TEXTILE MACHINERY**
30 Claims, 17 Drawing Figs.

[52] **U.S. Cl.** **242/47.01,** 242/47.12
[51] **Int. Cl.** **B65h 51/20**
[50] **Field of Search** 242/47.01, 47.02, 47.03, 47.05, 47.08, 47.09, 47.12, 47.13, 128, 147; 66/132

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Primary Examiner—Stanley N. Gilreath
Assistant Examiner—Werner H. Schroeder
Attorney—Flynn & Frishauf

ABSTRACT: A cylindrical nonrotating element has a spirally progressive track formed therealong. A forked member has two tines extending on either side of the cylindrical element, and rotatable therewith, as well as being axially movable. Thread is threaded around the forked member, engaging in the spiral track, and then delivered to a using station, such as a knitting position. Upon rotation of the forked member, the thread will engage in the spiral grooves; the spiral grooves will cause spacing of the thread along the tines until an end position is reached at which point, if too much thread is wound along the tines, the thread will bunch up, causing increased axial pull, moving the forked member from the rotating thread supply; when a sufficient number of threads have been taken off the tines so that the axial pull will be overcome by a counteracting spring, the tines will again engage, causing rotation of the forked thread supply member to wind more thread on the tines. The drive can be external, or internal of the cylindrical member by individual motors, the tines can be supported from the bottom, or top of the cylindrical member and various constructions are shown.

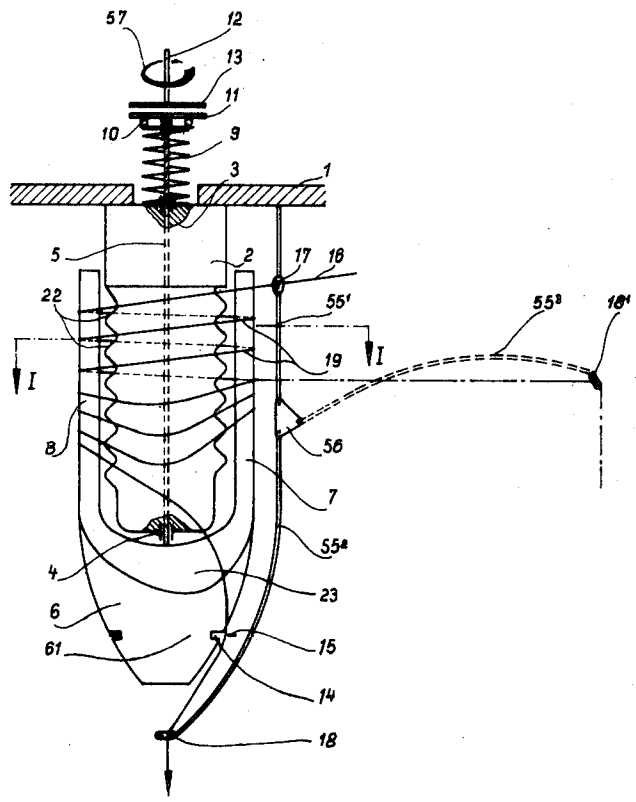

Fig. 2

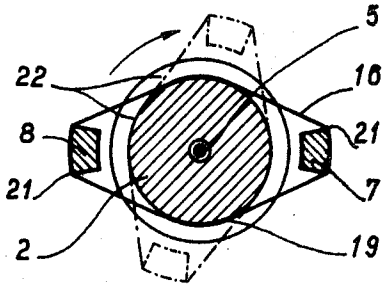
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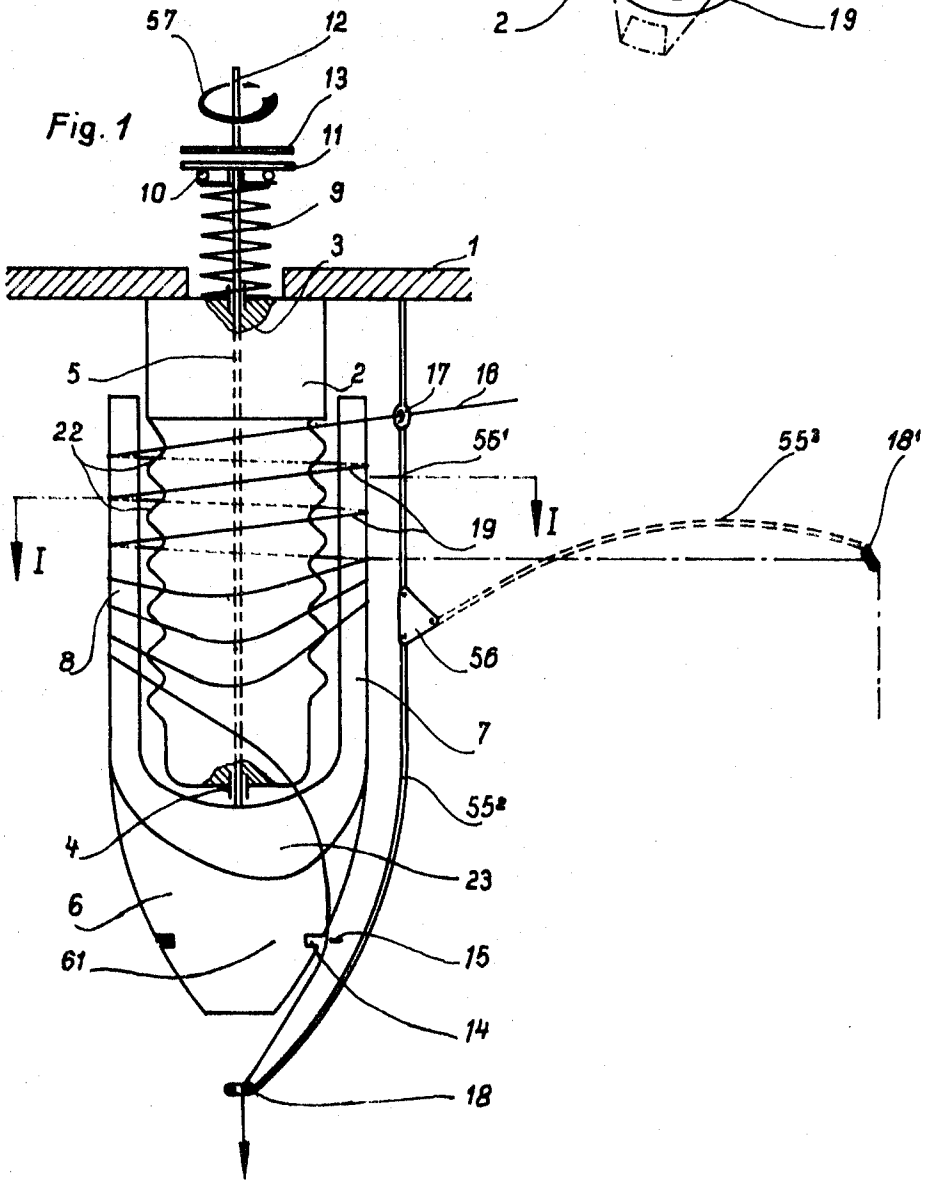
Fig. 1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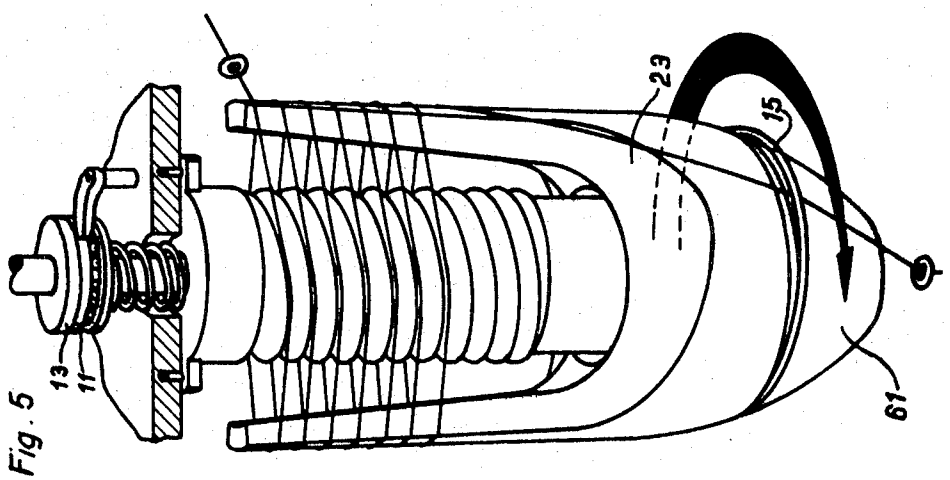
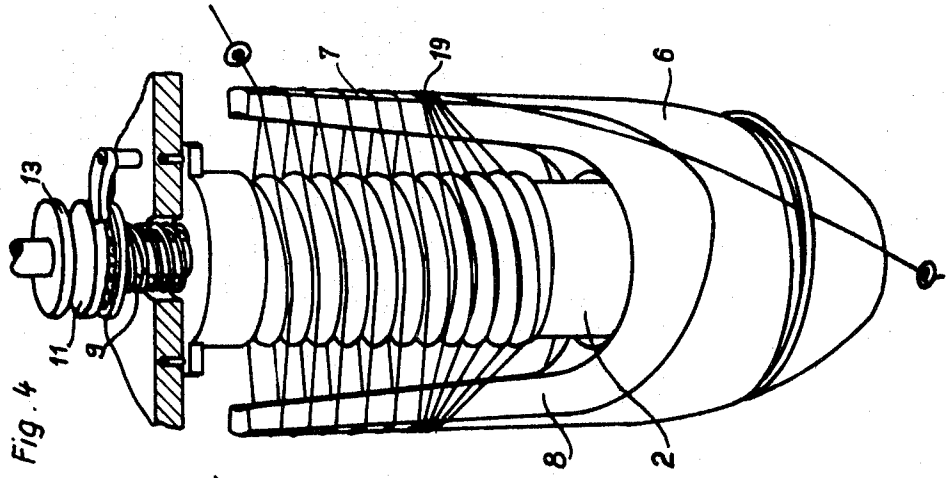


Fig. 5



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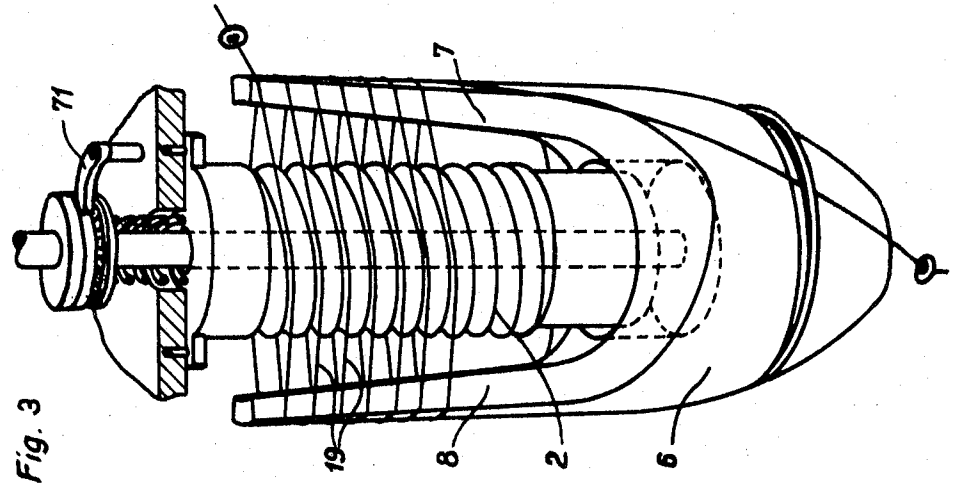

Fig. 3

Fig. 6

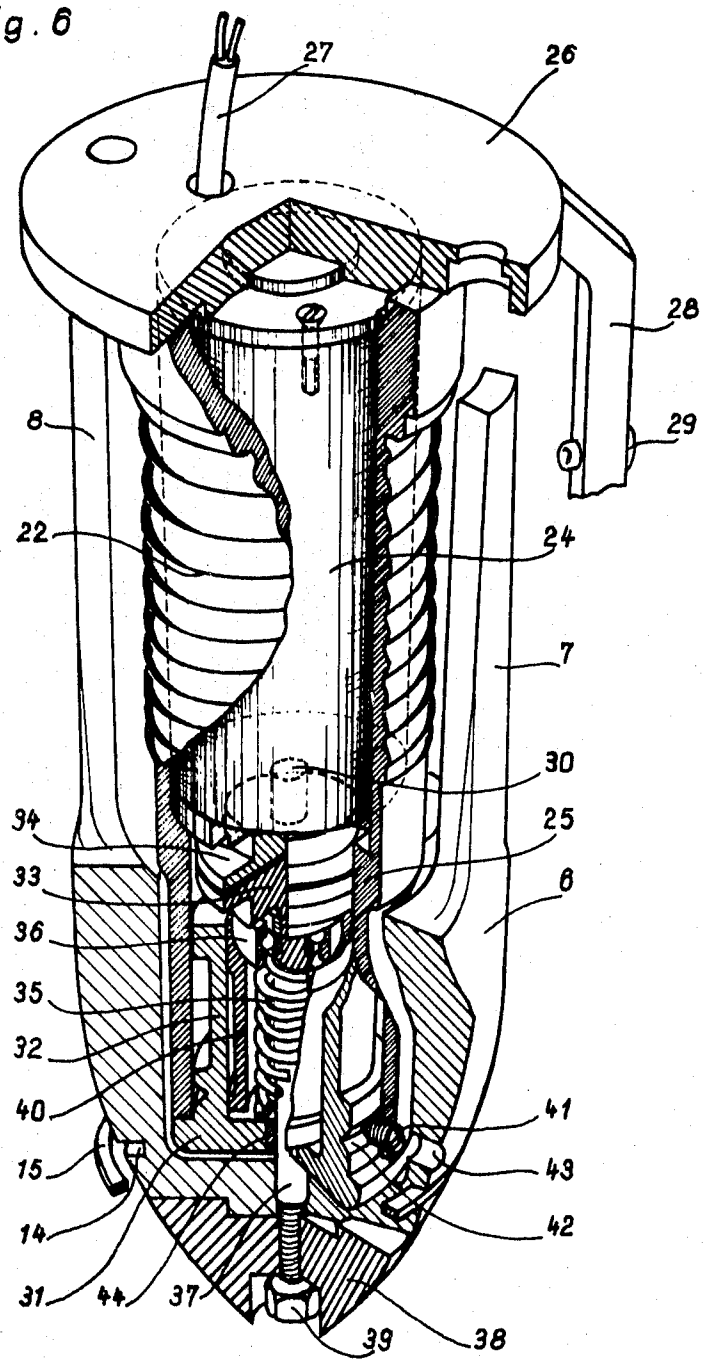
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Fig. 7

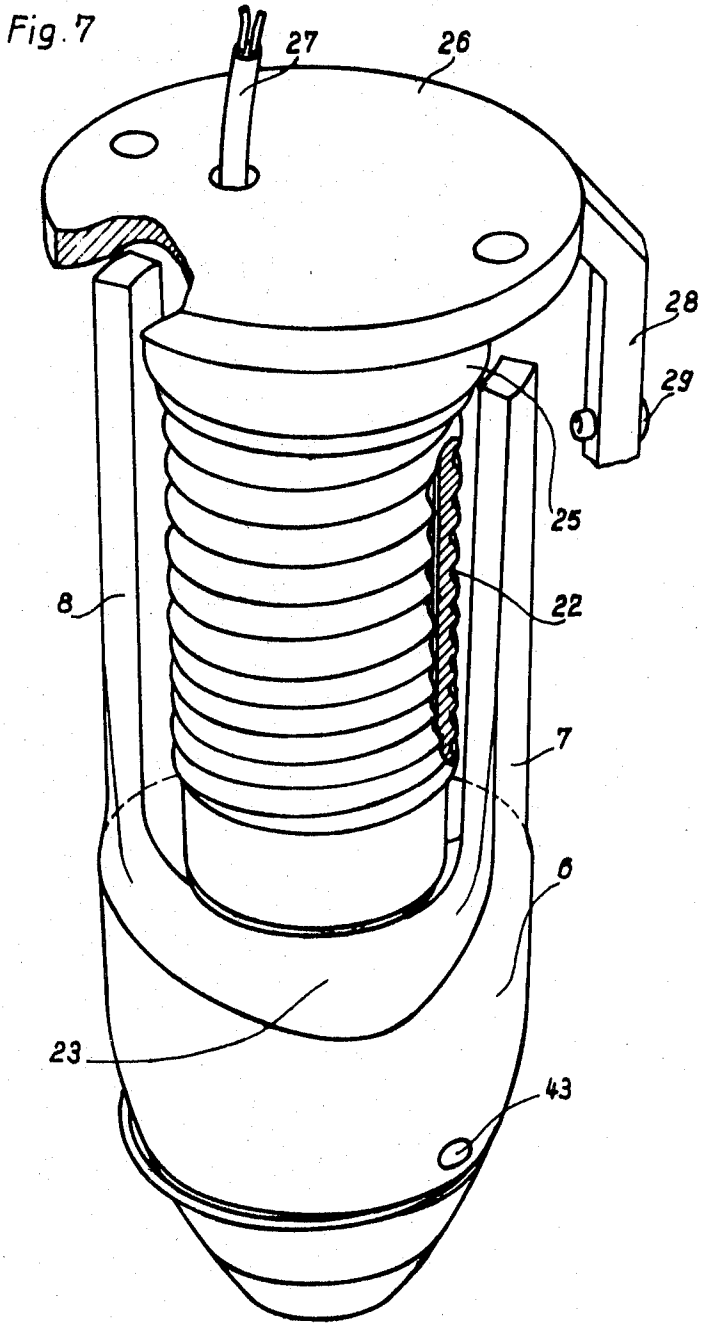


Fig. 8

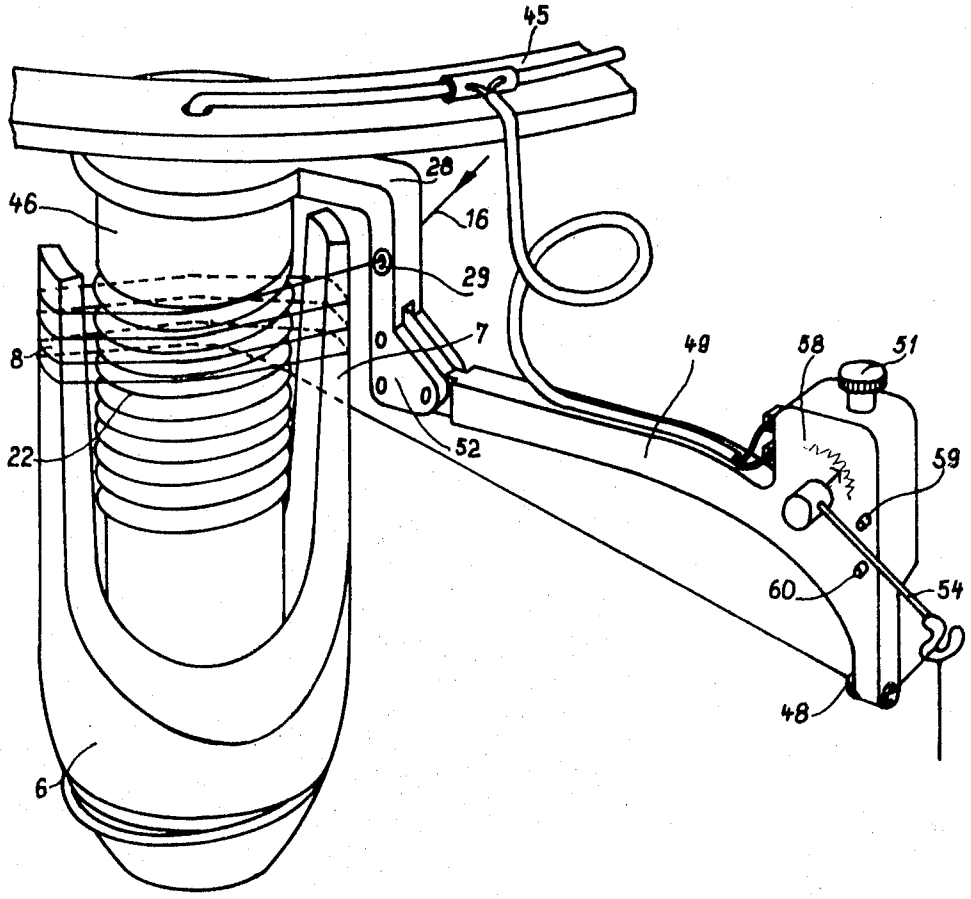


Fig. 9

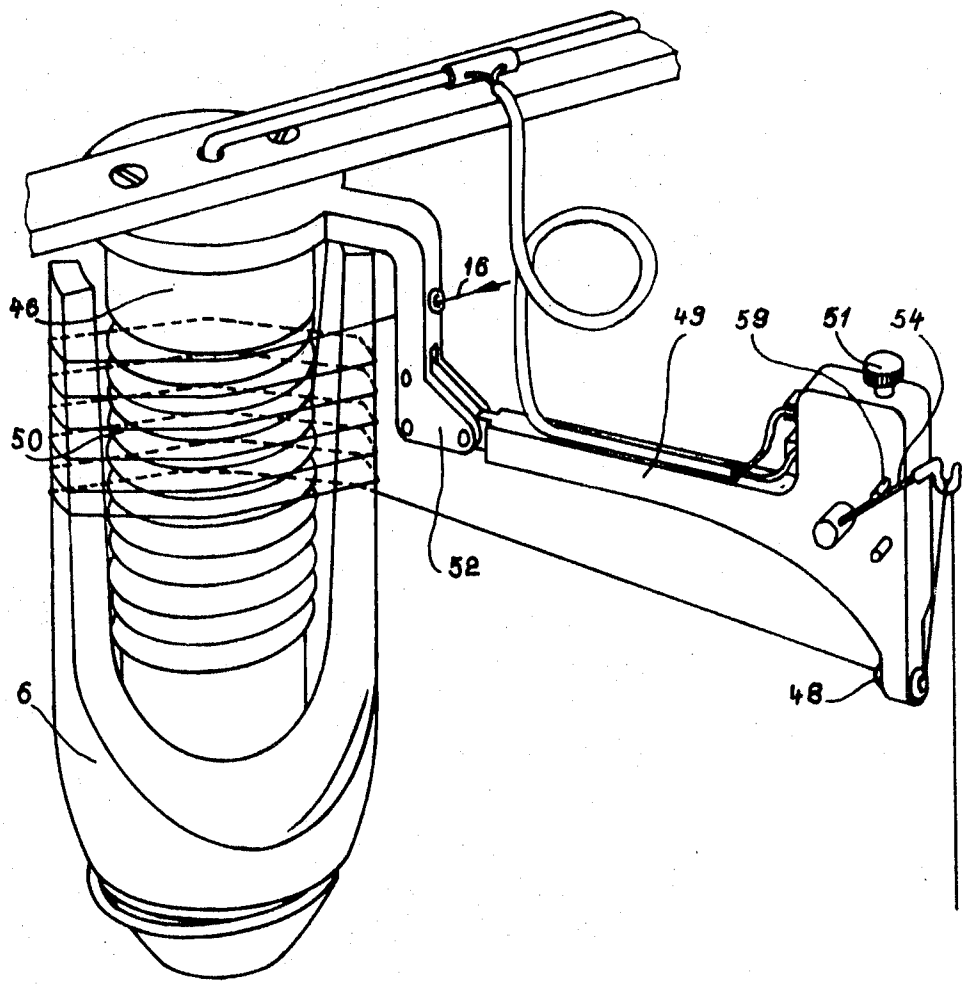


Fig. 10

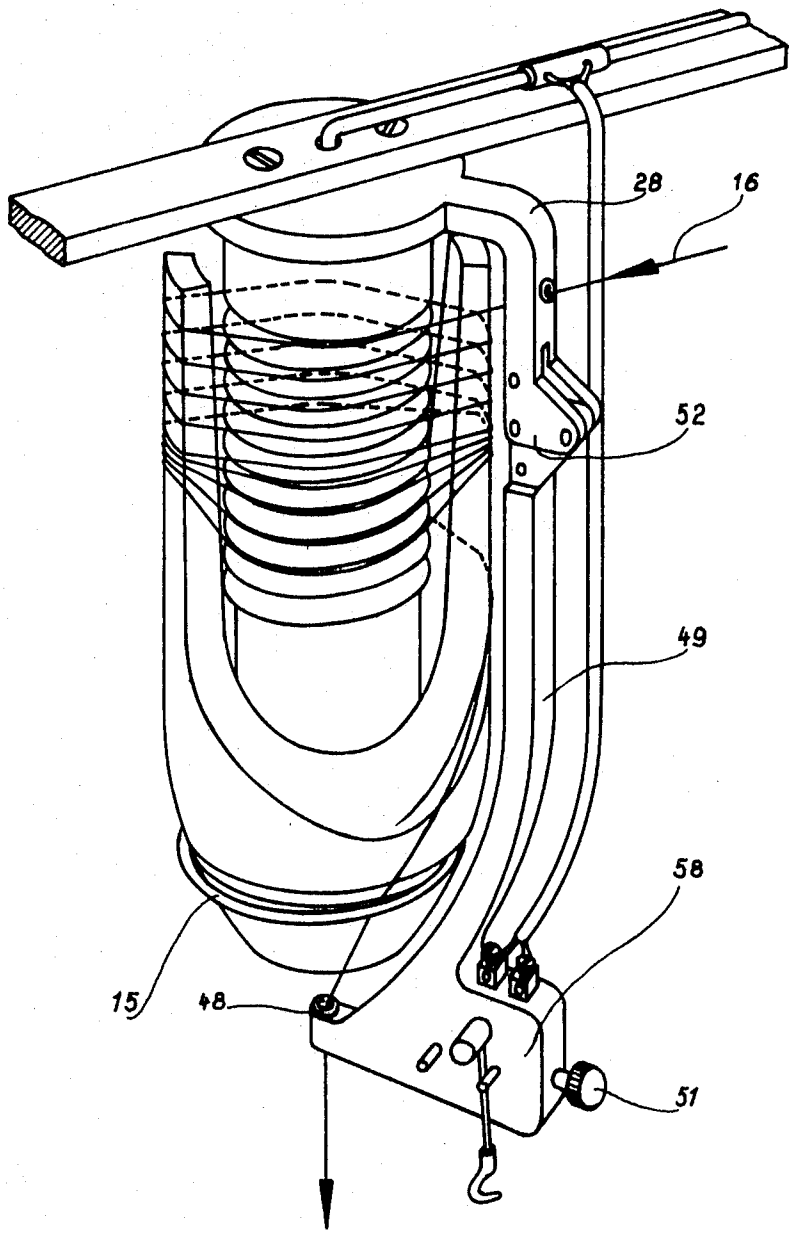
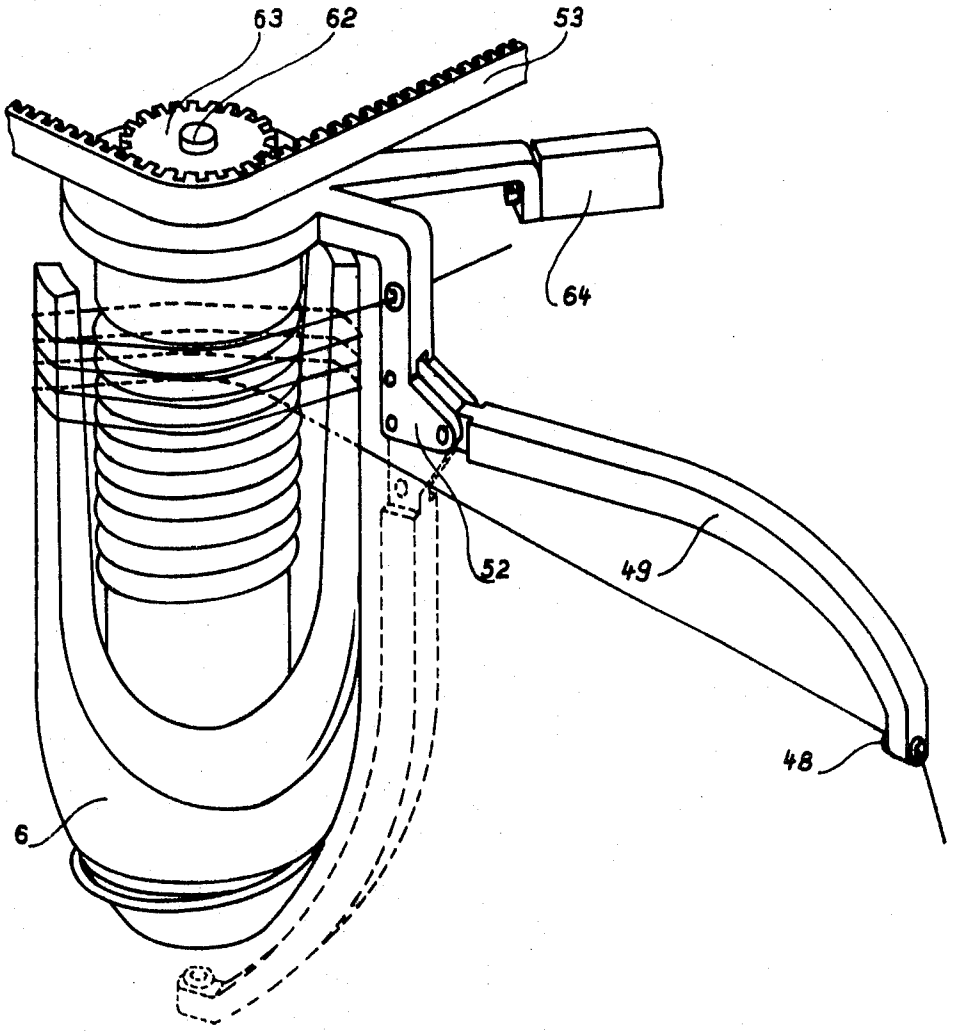


Fig. 11



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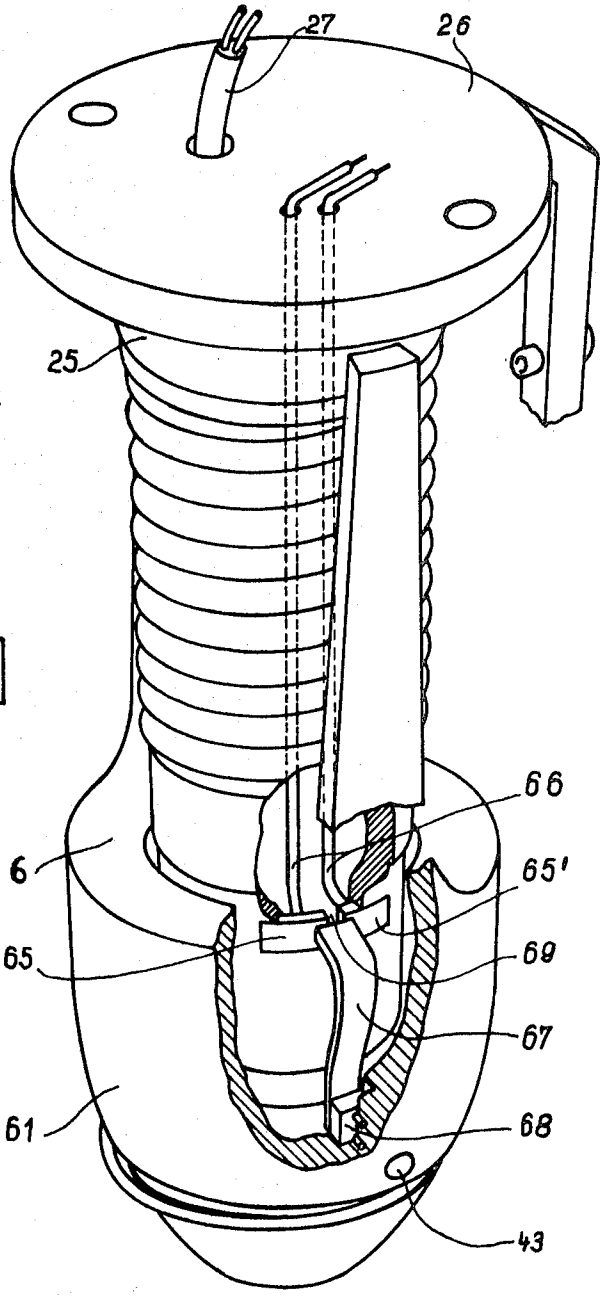
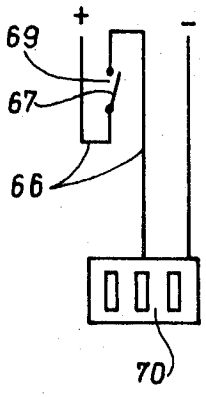


Fig. 13



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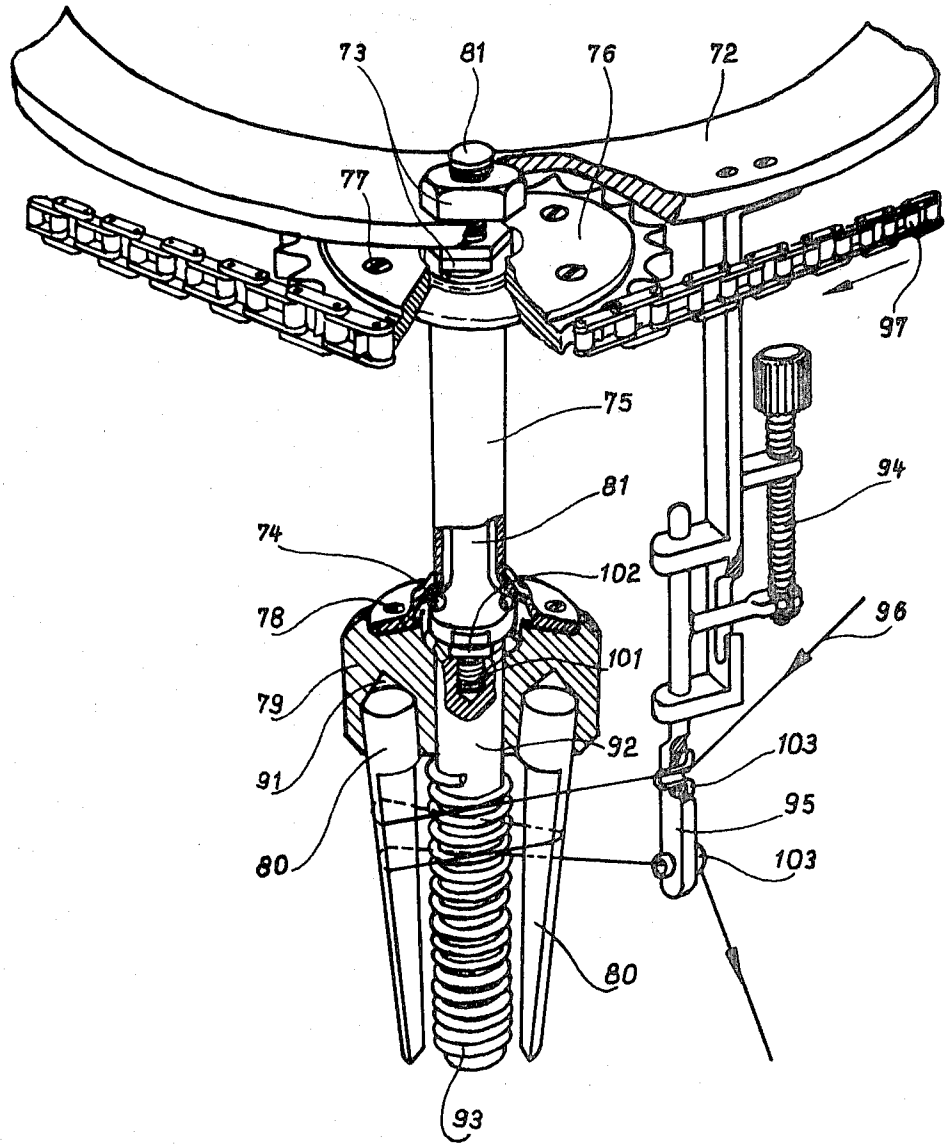
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Fig. 15

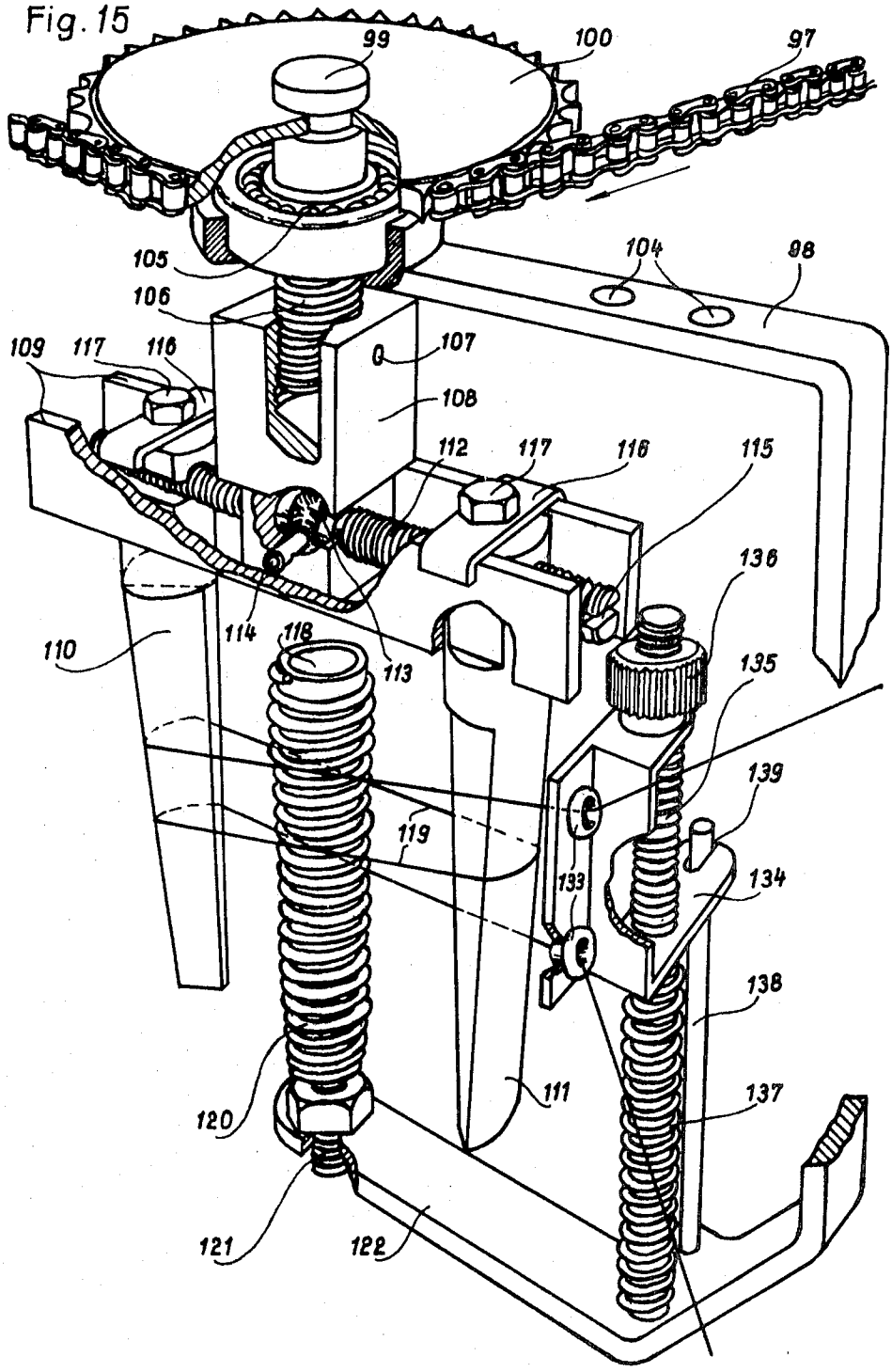
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Fig. 16

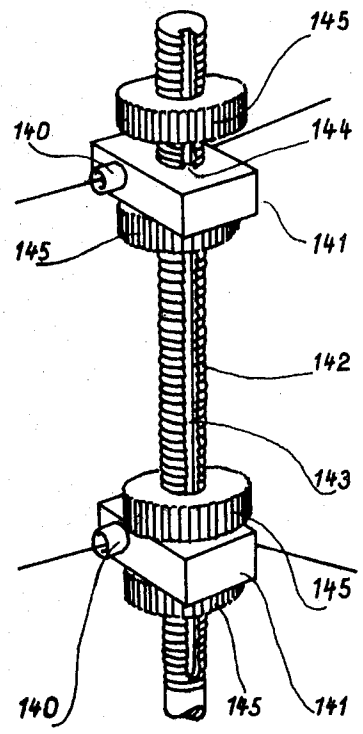
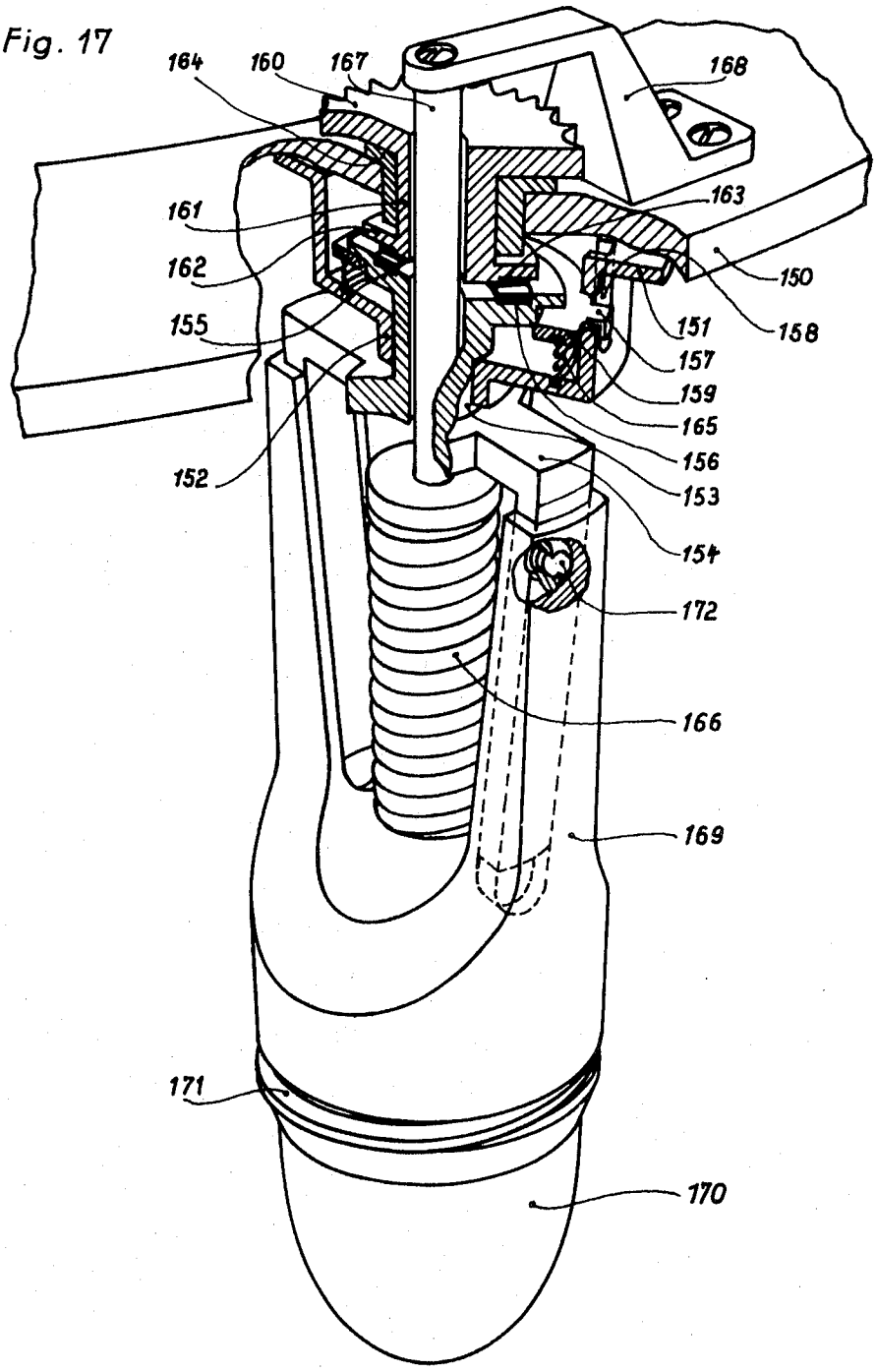


Fig. 17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THREAD SUPPLY APPARATUS FOR TEXTILE MACHINERY

The present invention relates to a thread supply apparatus for textile machinery, and particularly for multisystem circular knitting machines, in which thread is taken off a supply spool and delivered to a working position, such as a knitting position, by means of a rotating thread delivery element. The apparatus is useful in any kind of textile machinery, or equipment requiring the delivery of thread at a working position, and generally useful not only for multisystem circular knitting machines, but for any kind of textile machinery, such as various kinds of weaving looms, for example with weft inserting hooks, weft insertion by means of compressed air, flat bed knitting machines and, in general, any kind of machine in which a nonuniform thread delivery is desirable.

Thread supply systems in which thread is continuously taken off a supply reel and which has a single storage loop from which a weft thread is pulled off, in axial direction, has been disclosed in Swiss Pat. No. 374,345,particularly for weaving looms. Such a thread supply apparatus requires a drive gear which is continuously variable. Such drives are expensive and additionally are very difficult to keep operating at an even speed of revolution, thus variably affecting the thread supply. The drive to the thread supply element utilizes belting driven by worm gears which, however, due to the complex construction does not permit thread supply without slip of the thread on the supply apparatus.

It is an object of the present invention to provide a thread supply apparatus which is simple in construction, versatile in application and which can be used for any type of thread, including very fine thin-gauge threads.

SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, the actual thread supply element is a forked body having a pair of tines extending essentially parallel to the outer surface of a cylindrical body formed with a spirally extending track thereon, for example a spirally extending groove. The forked thread supply body is rotatable, and, additionally, axially movable. Upon axial movement, the thread supply body is engaged with, or disengaged from a constantly rotating drive, such as an electric motor, a clutch element, or the like. Axial movement of the thread supply body is obtained by the tension of the thread itself. Upon being looped several times about the tines extending parallel to the cylindrical body, thread will be spaced by the spiral track on the cylindrical body. If the thread taken off the thread supply reel is less than the thread being supplied thereto, adjacent loops of the thread will bunch up along the tines and the tension of the thread itself will exert an axial pull on the thread supply body, to disconnect it from the drive, thus stopping further thread supply thereto. When the thread on the tines has been used up to a predetermined amount, the axial pull will be insufficient to overcome a bias force, such as a spring, and the thread supply body will again engage with the rotating drive so that more thread will be wound over the tines of the forked body, until, again, axial pull on the bunched-up threads will disconnect the rotating drive.

Preferably, and in accordance with a feature of the invention, a thread guide element is located adjacent the thread supply body to guide thread thereon; a second removal thread guide element, preferably hinged, is provided so that thread can be pulled off the forked body either substantially concentric with its axis, or in a different direction, for example at right angles thereto. In a preferred form, the thread supply body has a bullet-shaped end, which may be formed with an oval cross section to provide for ready removal of thread therefrom.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic, partly perspective side view of one embodiment of the thread supply apparatus;

FIG. 2 is a cross-sectional view along lines I—I of FIG. 1;

FIGS. 3 to 5 are schematic perspective views illustrating progressive stages of the thread supply apparatus in operation;

FIGS. 6 and 7 are perspective views, partly cut open and partly in section of another embodiment of the thread supply apparatus;

FIGS. 8 through 10 are perspective views of the thread supply apparatus of FIGS. 6 and 7, illustrating different operating modes, and to a different scale;

FIG. 11 is a schematic perspective view of a further embodiment;

FIG. 12 is a schematic perspective view of an additional embodiment;

FIG. 13 is an electrical circuit diagram useful, for example, in the embodiment of FIG. 12;

FIG. 14 is a schematic perspective view, partly in section, of yet another embodiment;

FIG. 15 is a schematic perspective view of an embodiment having adjustable tines;

FIG. 16 is a schematic perspective view of an adjustable thread guide; and

FIG. 17 is an embodiment of the invention illustrating combination of the concept illustrated in FIG. 1 with that illustrated in FIG. 11.

Referring now to FIGS. 1 and 2: The machine, or a carrier or support 1 thereof to which the thread carrier is to be attached is shown schematically only, since the thread delivery apparatus may be applied anywhere where desired, and where drive power is available. A longitudinal, essentially cylindrical body 2 is secured to the machine, or support 1. Two bearings 3,4, are formed in the ends of body 2, in which a longitudinal shaft 5 is journaled. A forked body 6 is secured to shaft 5. Body 6 has a tip 61 which is essentially bullet shaped, and which is extended upwardly in a pair of tines 7, 8, extending essentially parallel to the cylindrical body 2, and to shaft 5. Shaft 5 is so journaled that, besides rotation, it can move axially counter to the bias force of a spring 9. Spring 9, on the one hand, bears against bearing 3, or against the cylindrical body 2, and on the other against a thrust bearing schematically shown at 10 and then against a coupling disk 11 forming portion of a clutch, in combination with a similar coupling disk 13. Shaft 12, connected to coupling disk 13 and driven for example in the direction of the arrow 57 drives the forked member when the spring moves disk 11 into engagement with disk 13.

The bullet-shaped tip of the forked member 6 is formed with a circumferential groove 14. A ring 15, with rounded edges and a polished surface is loosely set into the groove 14. The surfaces of the groove 14, as well as its edges are preferably also highly polished. Ring 15 which is preferably flat, is used to steady the thread when axially pulled off and to prevent lateral throw due to centrifugal force.

The cylindrical body 2 is formed with a spiral track, for example by a groove spiralling upwardly so that the sides of the cylindrical body will have an undulating appearance, as seen in FIG. 1.

A pair of thread guide eyes 17, 18 are provided to guide a thread 16. Eye 17 is held on an arm 55^1which is hinged at 56 and terminates in a second portion 55^2; the hinge 56 is so arranged that arm 55^2, with the terminal end eye 18 can be placed in either the full line position of FIG. 1 or in the dashed position, so that the arm 55^2 will be in the position 55^3 and terminal eye 18 will be at the position 18^1, the thread extending along the chain-dotted line. The operation is best understood in connection with FIGS. 3 to 5.

Thread 16 is supplied from a payout spool through the first thread guide eye 17, is then looped around the tines of the forked member 6, threaded between the ring 14 and the forked member, that is in the groove 14, and then passes over the tip of the bullet shaped end into the delivery eye 18. Upon threading, the forked member 6 is rotated a few times, for example by hand, about drive shaft 5, so that a number of windings 19 will be stored on the tines. If desired, coupling disk 11 can be brought into engagement with disk 13 to rotate the drive for shaft 12, a motor, or the like.

Upon start of the drive to shaft 12, new windings 19 will constantly be wound on the tines, held apart by the threaded undulating surface of the cylindrical body, and gradually delivering the windings 19 towards the bullet-shaped tip 61 of the forked body 6. It is assumed that the delivery thread guide 18 is in the full line position shown in FIG. 1, that is that the thread guide arm 52^2 extends downwardly.

FIG. 2 illustrates that the windings 19 of the thread, under tension, are sharply bent around the edges of the tines 7, 8. The sharp bend around the tines prevents slip of the thread with respect to the forked body and the thread is thus positively supplied. It is therefore preferred to have definitely formed corners, which may be sharpened, at the edges of the outer surfaces of the tines.

Upon rotation of the forked body 6 about the shaft 5, that is about the axis of the stationary cylindrical body with its spiral track 2, those windings 19 which extend into the spiral grooves 22 will be gradually supplied towards the tip of the forked body, as seen in FIG. 3. The spiral grooves form, what may be termed, a screw thread to move the windings 19 towards the tip of body 6. If the amount of thread removed from body 6 is less than the amount of thread wound up, then friction of the thread with respect to the tines will increase, so that the thread will bunch together, as illustrated in FIG. 4. Preferably, the tines 7,8 become wider and broader as they approach the tip of the forked body, as clearly seen in the figures. The portions of thread windings 19 engaged in the spiral grooves 22, will then advance with respect to the portion of the thread on tines 7, 8. Tension forces will result in those portions of the thread between the edges 21 of the tines (FIG. 2) and the contact points of the threads with the grooves 22, which will exert an axial force on the forked member 6. This axial force will break the clutched connection between disks 11, and 13, thus interrupting drive to the forked body 6, and causing forked body 6 to stop (see FIG. 4).

As thread is removed from the bullet-shaped tip, and below the flat ring 15 acting as a brake and through the supply or delivery eye 18, the initial condition will again obtain, that is, spring 9 will again be able to lift disks 11, 13, in engagement and storage of further portions of thread on the tines will begin anew (see FIG. 5).

FIGS. 3 to 5 also show a latch member 71 which, in the form of a ratchet, can engage disk 11, or a portion thereof, to prevent reverse running and possible stray looping of the thread.

Embodiment of FIGS. 6 and 7: Rather than having a drive from a machine element over shaft 12, the embodiment of FIGS. 6 and 7 illustrates individually driven thread supply units in accordance with the present invention. Motor 24 is secured within the cylindrical body 25, which forms a housing for the motor. A flange 26 is provided to secure the entire assembly to any convenient support member on the machine. Electrical connections 27 extend through flange 26. The outer surface of the cylindrical body 25 has the spiral track 22 formed thereon. A thread guide holder 28, having a supply eye 29 is likewise secured to the flange. A cylindrical holder 31 having an axially directed sleeve 32 is located at the shaft end of the motor 24 within cylindrical body 25. A slip coupling transfers rotational force at this end of the motor to the forked body 6. The operation of the embodiment of FIGS. 6, 7, is similar to that in FIG. 1. A clutch disk 34 is secured to motor shaft 30 to rotate therewith. A second clutching disk 33 can be placed in driving arrangement with the clutch disk 34 by means of a spring 35 and a ball bearing 36. When both disks 33, 34, are in coupled engagement, shaft 37 will be driven by friction. Shaft 37 is journaled in a bearing 44, and connected by means of an end or tip unit 38 and a screw 39 with forked body 6, so that forked body 6, with tines 7, 8, will rotate upon rotation of the motor and engagement of the clutch disks. The arrangement is particularly advantageous since it is easily serviced and can be mounted as an integral unit within cylindrical body 25, by setting in the cylindrical elements 31, 32, an additional sleeve 40 retaining the ball bearing 36 in position. Sleeve 40 is held in nonrotating position by any suitable means, for example by a pin, setscrew or the like, and not shown. The pin should engage in a longitudinal groove, or opening to permit small axial excursions to effect coupling and uncoupling of disks 33, 34. Preferably, a circular groove 42 is provided in the cylindrical element 31, engaged by a setscrew 41 and accessible through a tool opening 43 through the tip of the forked body 6. The arrangement, as illustrated in FIGS. 6 and 7, protects the motor, as well as the clutching elements from dust or other contamination, thus ensuring reliable operation over long periods of time. Groove 14, and flat ring 15, as explained in connection with FIGS. 1 and 2, are likewise provided in the bullet-shaped tip of body 6.

Thread wound around the tines of the forked body would be removed from beneath ring 15 in repetitive, jerky motion, since the thread is not wound about the tines, and the cylindrical body with a uniform diameter—see FIG. 2. To provide for continuous, even thread supply, the surface of the forked body 6, with which the thread actually comes in contact, is shaped to compensate for the nonuniformity, with respect to rotation of the distance of the thread at any point from shaft 5, for example by providing the body 6 with a flattened, or a relieved surface 23, or shaping the tip portion 61 to have a somewhat oval, elliptical cross section when looked at in a plane transverse to shaft 5 (or shaft 30, FIGS. 6, 7).

The operation of the thread supply under conditions where several windings of thread are to be stored on the tines has been explained in connection with FIGS. 1, and 3 to 5. In this form of operation, the thread guide arm 55^2, together with the thread delivery eye 18 is in the full line position of FIG. 1, the thread 16 being threaded through ring 15.

The thread supply in accordance with the present invention can be so arranged that thread will be supplied positively thereby without, however, any storage action. If this type of delivery is desired, then arm 55^2 (FIG. 1) is turned sideways in its joint 56, that is into the chain-dotted position 55^3, so that the thread delivery eye 18 will be in the position of 18^1, Ring 15 and groove 14 are then not used. Thread 16 is threaded through the inlet eye 17, then several times around forked member 6, as previously explained, so that a series of adjacent windings 19 will be formed; thereafter, the thread is threaded in the chain-dotted direction through eye 18^1 for delivery to a work position. The number of the windings 19 in this mode of operation is usually less than in the mode illustrated in connection with FIGS. 3–5. If the thread supply is to be interrupted, in the mode of the chain-dotted position of FIG. 1, then known brakes are used to stop the forked body 6 from rotation. Any excess thread delivered while body 6 is decelerating and stopping can be taken up in known compensating guides, such as spring-loaded arms, pulleys, or the like.

FIGS. 8 to 10 illustrate an embodiment of the present invention in which the thread supply assembly formed of the forked body and the spiral cylindrical element, in combination with a thread guide, can readily be used for positive thread supply with storage capability, as well as without, and which, additionally, is capable of sensing and controlling the speed of the rotating body. The cylindrical element, and the forked body 6 are similar to the embodiments of FIG. 6, in that they include a drive motor 24 located therein; the assembly is secured to a machine element 45. The arm 28 of the thread guide has a joint 52 which permits placing the lower portion 49 of the arm in the position shown in FIGS. 8 and 9 or, selectively, in the position shown in FIG. 10. The lower portion of arm 49 carries a thread-guiding eye 48. Arm 49 has a potentiometer 58 located therein, the resistance of which can be changed upon motion of the sensing lever 54, movable between a pair of end stops 59, 60. Potentiometer 58, shown schematically only, is connected into the circuit of the drive motor of the forked body 6 in such a manner that the speed of the motor is changed upon change of the resistance of the potentiometer 58. Alternatively, the speed of the motor could be changed by interrupting, and energizing the motor circuit, at time-varying cyclical rates, depending upon swinging motion of arm 54 between a pair of contacts which open and close. Such con-

tacts can be located in the housing shown in FIG. 8 for potentiometer 58. Regardless of the type of control, the speed of the motor will then depend on the position of the arm 54. Thread 16 passes through the supply thread eye 29, is wound in the same manner as previously described about the two tines 7, 8, the windings of the thread engaging into the spiral grooves 22 of the cylindrical body 46. The thread being removed is then guided through the eye 48, over the terminal hook of arm 54 and then to the working point in the machine. The position of lever 54 is changed in dependence on the tension of the thread. The sensitivity to tension changes can be regulated either by the potentiometer, or by some damping arrangement, such as a spring, controlled for example by an adjustment screw 51. FIG. 9 illustrates the position of the thread at low tension, FIG. 8 the position of the thread at normal tension, that is between the stops.

If the thread supply apparatus is to have, additionally, storage functions, then arm 49 is slipped downwardly as seen in FIG. 10. Joint 52 is preferably provided with a spring-loaded ball and detent arrangement to hold the arm in either selected position. If the arm is placed as shown in FIG. 10, then the thread is previously described in connection with FIGS. 1–5. Potentiometer 58 will not be used in the position of the arm shown in FIG. 10.

FIG. 11 illustrates an embodiment of the present invention similar to FIG. 10 but in which the drive of the forked body is by means of a toothed drive belt 53 which is common to several similar thread supply assemblies, all located on the machine. Each one of the thread supply assemblies is secured to a projection 64 of the machine itself. The construction of the thread supply assembly can be similar to that shown in FIG. 6 with the exception that instead of the drive motor 24, clutch disk 34 is directly connected by means of a longitudinally extending shaft 62 to gear 63, meshing with drive belt 53.

It is preferred to utilize a tooth, or chain belt for the drive 53 to provide for synchronous drive of all thread supply assemblies. As a modification similar to that of FIG. 11, two thread supply assemblies can be driven by a single motor by providing a gear drive, such as a gear wheel between adjacent thread supply units. Such an arrangement is particularly useful when two threads are to be supplied to knitting machines, at a matching, and constant rate. Two such units, one having a motor as described in detail in connection with FIG. 6, and the other being driven from the motor of the first similar to the drive in FIG. 11, or by means of a single transfer gear, can thus form a twin unit for multiple thread supply to a single-knitting position.

The thread supply apparatus of the present invention supplies thread to the working positions without slip. It is thus possible to relate the number of revolutions of the forked body 6 to the length of the thread being supplied. FIG. 12 illustrates one arrangement which can be used to measure the length of thread. The general construction of the unit is similar to that discussed in connection with FIG. 6. The lower end of the cylindrical body 25 has a pair of contact elements 65, 65', preferably mounted flush with the circumference of the carrier 25, and connected to a pair of contact wires 66, extending through the interior of the hollow body 25 through suitable holes in flange 26. A contact spring 67 is mounted on the inside of the bullet-shaped tip of body 6, preferably by means of a small mounting block 68 providing a bending space for increased resiliency. At each revolution of body 6, contact spring 67 bridges the insulating gap 69 between the contacts 65, 65' so that the two contacts 65, 65' will be briefly interconnected, generating a pulse which can be applied to a counter 70 to step the counter by one count. The circuit diagram is illustrated in FIG. 13. Other systems can be used to generate pulses, for example scanning of a gap, or a light source by means of photocells, magnetic scanning or other noncontacting pulse generating systems as known in the art.

The count pulses delivered by the several thread supply assemblies can be counted separately, at counters located at a common console, so that the thread consumption at the various working positions, for example of the various knitting systems of a knitting machine, can readily be checked and controlled and to effect adjustment if the thread consumption at any one working position deviates from the average, or from a predetermined value. Automatic regulation of thread, at working positions, for example at knitting positions can be effected by automatic control of the knitting machines themselves, as known in the art. The control parameters are derived from the counts of the counter. To prevent reverse running of the forked body, a reverse rotation lock 71 in form of a ratchet, may be used as previously discussed in connection with FIGS. 3–5. The ratchet may be no more than a leaf spring having a sharp edge which can bind against the lateral edge of the coupling or clutch disk 11 upon reverse rotation thereof.

FIG. 14 illustrates a different form of the invention, in which all thread supply assemblies are secured to a common carrier ring 72, by means of nuts 73 threaded on a bolt 81. A hub 75, journaled in bearings 74 is rotatable about shaft 81. A gear 76, secured by means of screws 77 is attached to the upper end of hub 75. The lower end of hub 75 is connected by means of screws 78 to forked body 79 which has a pair of diametrically located tines 80 which are secured into bores 91, for example by a press fit, or other suitable means. Thread 101 forms an extension of shaft 81, and carries a stub 92, bearing against an adjustment screw 102. A wire 93 is spirally wrapped around stub 92, and secured thereto for example by soldering, brazing, or the like. The thread guide 95 is longitudinally adjustable by means of a screw 94, and located at the side of the thread supply assembly including the rotating tines 80. By adjustment of screw 94, thread eyes 103 may shift up and down along the tines 80 to adjust the position of the thread on the thread supply body.

Tines 80 are inclined downwardly with respect to the stub 92 which forms the cylindrical body. Thus, the position of the thread 96 can be adjusted with respect to the width of the tines 80 by changing position of screw 94. The pitch of the spiral track formed by the wire 93 is selected in dependence on the distance of the two thread eyes 103. Thread 96 can be looped around the tines of the fork once, twice, or several times, in dependence on the distance of the tines with relation to the pitch of the spiral track. A common drive chain 97 synchronously drives all thread supply assemblies of the machine; the drive chain can be replaced by belts, a common central gear, or the like.

Since the tines 80 are inclined towards each other so that, upon rotation, they will describe a cone, the amount of thread can be changed by changing the position of adjustment screw 94, to increase or decrease the length of the thread windings looped around the tines; the amount of thread looped around the tines will, of course, decrease as the screw 94 moves the eyes 103 towards the bottom (as seen in FIG. 14) of the spiral track formed by wire 93. FIG. 15 illustrates another embodiment in which the position of the thread-guiding eyes can be accurately determined.

The entire unit is secured to a common support 98. To secure support 98 to the machine, attachment holes 104 are provided, the attachment being effected, for example, similarly to that disclosed in connection with FIG. 14 on a holding ring on the machine. Shaft 99 is rotatably journaled and connected to the forked body. Gear 100 is attached to shaft 99, guided in a bearing 105, the outer race of which is secured in support 98. A block 108 is secured to shaft 99 by means of a thread 106 and pin 107. Block 108 carries a pair of guide tracks 109, secured thereto, to provide an adjustable guide for adjustably mounted tines 110, 111. A spindle 112, rotatable for example by means of a screwdriver slot 115 and carrying a right-hand thread on one side, and a left-hand thread on the other, engages the end portions of the tines 110, 111. Spindle 112 is held in position by means of a pin 114 extending into a central groove 113. Upon rotation of the spindle by means of the screwdriver slot 15, the tines 110, 111 will

be moved towards or away from the center, depending upon the sense of rotation of spindle **112**. To secure the tines in position, wedge blocks **116** and holding screws **117** lock the tines in place.

A tube **118** is provided in the longitudinal axis of the forked body, and has, similar to the arrangement of FIG. **14**, a spiral track formed of a spirally extending wire **120**, soldered on the tube. Tube **118** is secured to an extension **122** of the support **98** by means of a screw thread **121**.

The thread-guiding eyes **133** are placed in a common holder, secured likewise to the arm **122** of support **98**. Holder **134** is vertically adjustable about a spindle **135**, by turning knurled screw **136**, the thread-guiding eyes **133** being moved downwardly against compression of a spring **137**. A vertical pin **134**, engaged in a notch **139** of the thread guide holder prevents rotation thereof.

FIG. **16** illustrates a thread-guiding arrangement which can be substituted for that of FIG. **15**, and located likewise on the lower portion **122** of support **98**. The thread-guiding eyes **140**, **140'**, each are secured in a respective guide block **141**, **141'** and independently adjustable along the length of a threaded bolt **142**. Bolt **142** has a longitudinal notch **143** engaged by projections **144** formed in the blocks **141**, **141'**, as seen at the upper block **141**, to prevent rotation of blocks **141**, **141'**. The blocks themselves are located in position by set nuts **145**.

FIG. **17** illustrates an embodiment of the present invention which has been found to be particularly useful in application. A thread supply apparatus similar to that disclosed in connection with FIG. **11** is combined with an apparatus similar to that disclosed in connection with FIG. **14**, with minor modifications. Thus, the thread supply apparatus in accordance with FIG. **14** which positively supplies predetermined amounts of thread, without storage function, that is the same amount of thread all the time can be also utilized to supply thread variable amount, and constant tension, that is can be used to have storage functions. A bullet-shaped forked end piece is assembled to the tines, as desired, which permits a construction which is simple and thus inexpensive to manufacture.

Carrier **150**, secured to the machine, has a bearing housing **151** terminating in a flange **152**. A rotating sleeve **153** secured to the forked body **154** has a flange, or disklike extension **155**, the upper side of which has a clutch face **156**. A ring **159** is held in a notch **158** of housing **151**, and secured against the rotation therein by means of a projection **157**. A central gear in the machine, not shown, and conventional, engages all thread supply units of the machine by means of gears **160**. Each one of the gears **160** is formed with a bearing sleeve **161**, the lower end of which terminates in a clutch disk **162**, provided with clutch facing **163**. Gear **160** itself is journaled in a bushing **164**. A spring **165** tends to connect the clutch faces together.

The cylindrical body **166** with the spiral track is secured by means of a pin **167**, extending through gear **160**, sleeve **161** and sleeve **153** without contact, and secured to an arm **168**. A forked extension **169**, having a bullet-shaped tip **170** and a braking ring **171** (similar to ring **15**) is secured to the forked body **154** by means of a spring-loaded ball and detent arrangement, as well known in the art, for ready removal from the depending tines of the forked body.

In operation, the assembly in accordance with FIG. **17** operates similarly to the previously described embodiments, for example similarly to that of FIG. **1**. IF the extension unit **169** is removed, then the operation will be similar to that described in connection with FIGS. **14** and **15**. A thread guide assembly similar to that, for example, described in connection with FIG. **1**, or FIGS. **8–10**, and omitted from the drawing of FIG. **17** for clarity, may be used.

The present invention has been illustrated particularly in connection with a multisystem knitting machine, but can be applied to any type of textile, or other machinery, in which thread is to be supplied either at a constant rate, or under substantially constant tension, and as demanded at various work stations. Various changes and modifications may be made within the inventive concept, as determined by requirements of use, application, or design of the machine with which the apparatus is to be used.

I claim:

1. Thread supply apparatus, particularly for textile machinery, comprising

a substantially cylindrical element (**2**) having a spirally progressing track (**22**) along the circumference thereof;

a forked member (**6**) having a pair of tines (**7**, **8**) which have a width less than the diameter of the cylindrical element and extending along at least a portion of the length thereof, the forked member being mounted and rotatably driven with respect to the cylindrical element;

and thread guide means guiding thread to the cylindrical element, then around the tines, and over circumference portions of the cylindrical element, whereby the thread will engage into the spiral track, and guiding the thread away from the tines to a utilization point and including means for guiding said thread, selectively, over the head end of the cylindrical element, or laterally away from said cylindrical element.

2. Apparatus according to claim **1**, wherein the forked member (**6**) is mounted additionally for axial movement;

and a driven clutch element, providing a driving force for rotatably driving said forked member, said clutch element being engageable upon axial movement of the forked member, to permit engagement and disengagement of said forked member with said driving force provided by said driven clutch element.

3. Apparatus according to claim **2**, in combination with a thread (**16**) looped about the tines and passing along portions of the spiral track on the cylindrical element;

said thread being guided to frictionally engage the tines and, in combination with the spiral guiding of the thread about the spiral track, exerting axial forces on the tines and thus on the forked member to control engagement and disengagement of said clutch element.

4. Apparatus according to claim **3**, including spring bias means (**9**) engaging the forked member (**6**) and biassing said forked member for engagement with the clutch element.

5. Apparatus according to claim **1**, wherein said forked member has a bullet-shaped closed end (**61**) coaxial with the cylindrical member;

said thread guide means including means for selectively guiding the thread over the bullet-shaped end of the forked member, or laterally of the tines of the forked member.

6. Apparatus according to claim **5**, wherein the cross section of the bullet-shaped end, in the region of the root of the tines, is elliptical.

7. Apparatus according to claim **3**, wherein the tines (**7**, **8**) have defined corners at the termination of the outside surfaces, to provide for a sharp bend of the thread looped thereover and frictional engagement of the thread with the tines.

8. Apparatus according to claim **3**, wherein the cross section of the tines is increasing in the direction of the roots thereof.

9. Apparatus according to claim **3**, wherein the forked member has a bullet-shaped closed end (**61**), coaxial with the cylindrical member;

said bullet-shaped end (**61**) being formed with a circumferential groove (**14**);

and a ring of slightly larger diameter than the groove floatingly located therein, the thread (**16**) being threaded between the groove and the ring, the ring being held by centrifugal force upon rotation of the forked member.

10. Apparatus according to claim **1**, wherein the thread guide means comprises an arm extending substantially parallel to the tines of the forked member, said arm having a joint intermediate its length and providing a terminal portion (55^2) swingable between a position adjacent an axial extension of said cylindrical element and a position intermediate its length and laterally thereof.

11. Apparatus according to claim 10, wherein a thread-guiding eye (17) is secured to the fixed portion (55[1]) of said thread guide arm.

12. Apparatus according to claim 10, including a thread tension sensing means (54, 58) located adjacent the terminal portion of said arm.

13. Apparatus according to claim 2, including a shaft (5, 37) rotatably journaled within said cylindrical element and connected to said forked member (6);

and clutch means (12, 24) engageable with said driven clutch element secured to said shaft.

14. Apparatus according to claim 13, wherein said clutch means includes a pair of opposed clutch disks (11, 13) to form a friction clutch;

and a spring (9, 35) is provided biassing said clutch disks into engagement.

15. Apparatus according to claim 13, for use in a machine having at least a pair of similar thread supply apparatus assemblies, a gear (63) coupled to the shaft (5) of each said apparatus, said gears being engaged with said machine drive for synchronous drive of each said apparatus.

16. Apparatus according to claim 1, wherein said cylindrical element (2) is hollow;

and an electric motor (24) is provided for driving said rotatable forked member.

17. Apparatus according to claim 14, including a housing element (31) retaining said clutch disks (11, 13) and said spring means (9) as a clutch unit, said clutch unit being removable as assembly and located within said cylindrical element (24).

18. Apparatus according to claim 1, including rotation counter means (65, 67) and located on said forked member and said cylindrical element, respectively, said rotation counting means counting rotation of the forked element with respect to said cylindrical member;

and an electrical counter (70) controlled by said rotation counting means.

19. Apparatus according to claim 1, including a one-way direction of rotation latch (71) fixedly located with respect to said rotatable forked member (6) and preventing rotation thereof in a direction reversely to that of a predetermined direction.

20. Apparatus according to claim 1, wherein said tines (80, 110, 111) are conically inclined towards each other over at least a portion of their longitudinal extent;

and said thread guide means guiding the thread are located to be adjustable with respect to the length of the conically inclined tines in the direction axially of the axis of rotation of said tines.

21. Apparatus according to claim 1, including a fixed shaft (81); said forked member (79) being journaled on said fixed shaft; and a drive wheel (76) in driving connection with said forked member and journaled on said fixed shaft.

22. Apparatus according to claim 1, wherein said forked member comprises a rotatable body having guide means extending in a plane transverse to the axis of rotation of said rotatable body;

said tines being secured to said rotatable body and movable in said plane towards and away from the axis of rotation of said body.

23. Apparatus according to claim 22, including a spindle (112) extending through said body and having a right-hand thread, and a left-hand thread, respectively, at either side of said body, said tines having matching threads and being engaged by said spindle, said spindle being adjustable to adjust the position of said tines with respect to said body and hence with respect to the axis of rotation of said rotatable forked member.

24. Apparatus according to claim 1, wherein said thread guide means includes a thread-supply-guiding eye and a thread removal guiding eye, said eyes being independently adjustable with respect to the length of the tines of said forked member.

25. Apparatus according to claim 1, in combination with a textile machine having a drive belt; and drive means are provided, for driving connection with said rotatable forked member, said drive means being in driving engagement with the drive means on said machine.

26. Apparatus according to claim 1, including a bullet-shaped end member (169 FIG. 17);

and means securing said bullet-shaped end member to said tines to provide a bullet-shaped end for axial removal of thread looped over said tines upon association of said bullet-shaped end member to said tines.

27. Apparatus according to claim 26, wherein said bullet-shaped end member (169) has a pair of projecting tines matching the tines (7, 8) of said forked member;

and means securing the tines of said end member and said forked member together.

28. Apparatus according to claim 1, including thread tension sensing means located on said thread guide means and having said thread guided therethrough;

electrical drive means driving said forked member;

and means controlling the drive speed of said electric drive means in dependence on sensed thread tension.

29. Apparatus according to claim 28, wherein said means controlling the speed of said electric drive means includes a potentiometer having its setting controlled by said thread tension.

30. Apparatus according to claim 28, wherein said means controlling the drive means includes a thread tension sensing arm and a pair of on-off contacts positioned to connect, or disconnect electrical power to said electric drive means in dependence on sensed thread tension.

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