DIFFERENTIAL FEED MECHANISM FOR A SEWING MACHINE

This invention relates to industrial sewing machines and particularly to an overedge sewing machine having an improved differential feed mechanism.

The differential feed mechanism of the present invention is particularly useful in connection with overedge sewing machines such as are disclosed in Wallenberg U.S. Pat. No. 2,704,042, issued Mar. 15, 1955. Reference is made to the Wallenberg patent for a description of the general construction of a sewing machine adaptable to the present invention.

A principal object of the invention is to provide a simple, compact and sturdy sewing machine capable of operation at high speeds, e.g., 5,000 to 6,000 or more stitches per minute without objectionable noise or vibration and in which the work feed mechanism is of the differential type having an improved means for imparting horizontal feed motion to feed dogs carried on feed bars.

Another object of the invention is to provide a differential feed mechanism for an overedge sewing machine having provision for adjusting the length of the feed stroke of each feed bar individually and in a precise and controllable manner.

Still another object of the invention is to provide a differential feed mechanism for a sewing machine in which the driving connections from a drive shaft to each feed bar are separate from the others.

A feature of the present invention is the provision of a new and improved differential feed mechanism having the two feed dogs carried on respective feed bars arranged in side by side relation. Common mechanism is provide for both feed bars to impart vertical movements to the feed dogs. Separate driving mechanism is provided for each of the two feed bars for effecting horizontal movement. Similarly, separate feed adjustment means for individually adjusting the feed stroke length of each feed bar, independently from the other, is provided.

Another feature of the invention is the provision of adjusting means and control means for quickly and intermittently varying the horizontal feed stroke of at least one of the two feed bars during operation of the sewing machine and providing a limit on the variation of the feed stroke to a preselected minimum and maximum which may be changed at the will of the operator at any time even during the operation of the sewing machine.

Still another feature of the invention is the provision of differential feed mechanism having a pair of feed bars, a feed dog carried on each of the feed bars and driving means for each of the feed bars which comprise separate connections, from the main drive shaft to each feed bar, in spaced relation to each other. In this way, the connections to one of the feed bars from the main drive is disposed within the enclosed housing of the sewing machine frame while the connections to the other of the feed bars is disposed in a feed mechanism compartment at the end of the sewing machine frame.

Another feature of the differential feed mechanism of the present invention is the space-saving characteristic. The mechanism for separately adjusting the horizontal stroke length of each of the feed bars comprises a pair of crank means operable concentrically with an actuating shaft on which one of the two crank means is rigidly fixed and the other loosely supported for carrying into effect the adjustment of each feed bar individually in response to a respective actuation of micrometer-type control means by the operator.

Finally, it is a feature of this invention to provide means for returning lubricants from the feed mechanism through the hollow main shaft to the enclosed housing of the machine frame. This means comprises a felt pad arranged in the bottom portion of the feed mechanism compartment, tubing means having one end communicating with the felt pad and the other end opening into a bearing bushing which, in conjunction with the main shaft, functions as a pump due to the provision of internal spiral grooves in the bushing.

Other objects, features and advantages of the invention will appear from the following detailed description of an illustrative machine embodying the invention. In the accompanying drawings:

FIG. 1 is a front elevational view, partly in section, of a machine incorporating the present invention;

FIG. 2 is a side elevational view, partly in section, taken along line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view of the differential feed mechanism shown in FIGS. 1 and 2 and taken substantially along the planes of line 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view of the differential feed mechanism and operating means therefor, taken along line 4—4 of FIG. 1;

FIG. 5 is a horizontal sectional view, taken along the broken line 5—5 of FIG. 2;

FIG. 6 is an exploded perspective view of the entire feed and feed adjusting mechanism;

FIG. 7 is a side elevational view of the operator actuated control means for adjusting the horizontal feed stroke of the auxiliary feed means. The mechanism shown in FIG. 7 appears at the left end of FIG. 1;

FIG. 8 is an enlarged fragmentary view of a portion of the feed control mechanism, taken along the transverse plane of line 8—8 of FIG. 7;

FIG. 9 is a view of the operator actuated control means shown in FIG. 7;

FIG. 10 is a vertical sectional view taken substantially along line 10—10 of FIG. 1 showing the driving connections for imparting horizontal movement to the auxiliary feed bar.

Referring now to FIGS. 1 and 2 of the drawings, a sewing machine 10 is provided with a main frame 11 having an enclosed housing 11*a* for the main operating portions of the machine. A top cover 13 of the frame 11 provides a closure for the top of the frame and also serves to support various devices, including thread-tensioning devices which, not being relevant to the present invention, are not shown in the drawings. A work-supporting frame portion 11*b* extends from the enclosed housing 11*a*. A bottom closure plate 16 extends beneath the enclosed housing 11*a* and the work-supporting frame portion 11*b* and provides a means for supporting the machine from a suitable table or stand. Adjacent to its left end, as viewed in FIG. 1, the bottom plate 16 contains an opening 17 which is closed by a plate 18. The plate 18 is provided with a downwardly bulging portion to accommodate parts of the feed mechanism to be described hereinafter. A cloth plate 20 is positioned on top of the supporting frame portion 11*b* and contains an imbedded throat plate 21. An arm 22 extends longitudinally from the top cover 13 at a suitable distance above the cloth plate 20. Arm 22 serves as a support for spring means acting upon a presser arm 25 which, in turn, carries a presser foot 26. The stitch forming parts of the machine, so far as shown, comprise a curved needle 27 which is clamped to the head of an arm 28 the other end of which is secured to rock shaft 29. As disclosed in the Wallenberg patent referred to above, the rock shaft 29 is arranged to be rocked upon each revolution of the main drive shaft 30 of the machine. The needle 27 cooperates with upper and lower looper means which are not shown in the present drawings, since such looper means are disclosed in the Wallenberg patent. Other details of the actual machine which are not shown, since they are disclosed in said patent, include a work-trimming means disposed in advance of the zone in which the stitch-forming devices serve to produce the overedge stitch.

Work is advanced to and through the region where the stitches are formed by means of a main feed dog 35 and an auxiliary or differential feed dog 36 (see FIGS. 2, 4 and 6). The main feed dog 35 is mounted on the forward end of a feed bar 37 while the differential feed dog 36 is mounted on a feed bar 38 which is adjacent and substantially parallel to the feed bar 37. Preferably, the two feed dogs 35 and 36 are mounted on their respective feed bars 37 and 38 in such manner as to permit a certain amount of vertical adjustment thereof in relation to the respective bars, as for example, by the elongated holes 35*a* and 36*a* provided in the feed dogs 35 and 36. Each

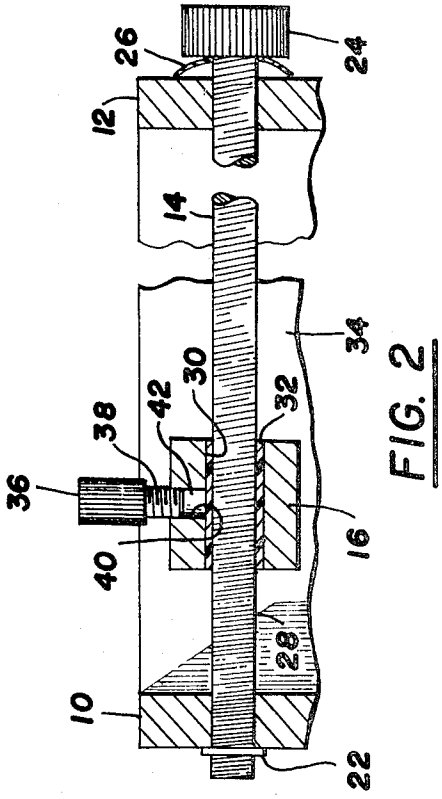


FIG. 2

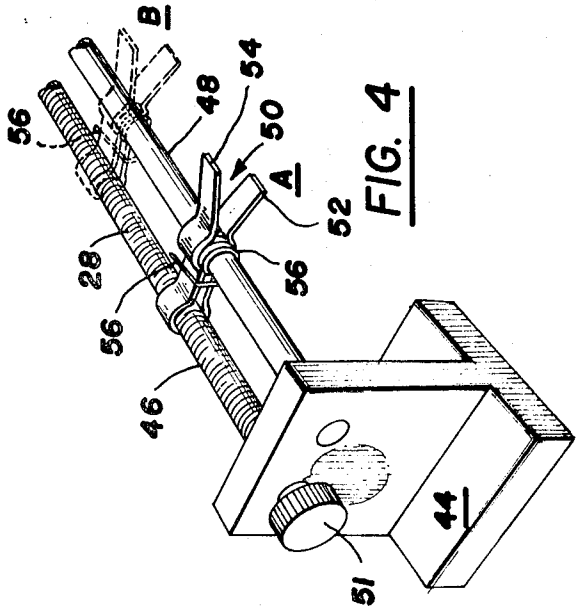


FIG. 4

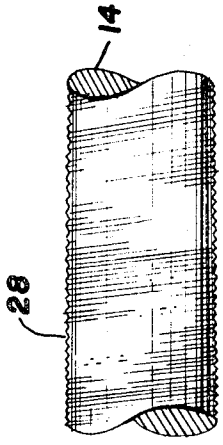


FIG. 3

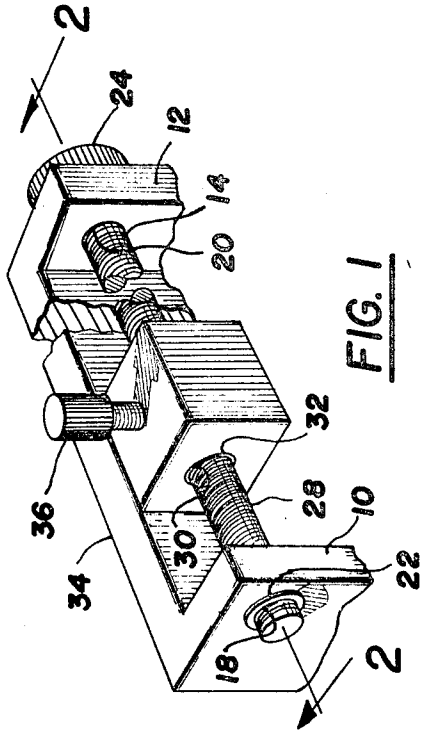


FIG. 1

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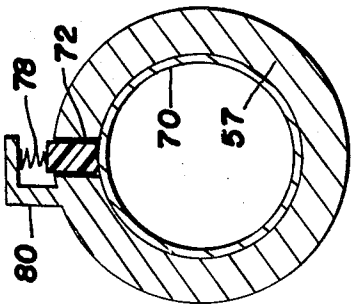


FIG. 8

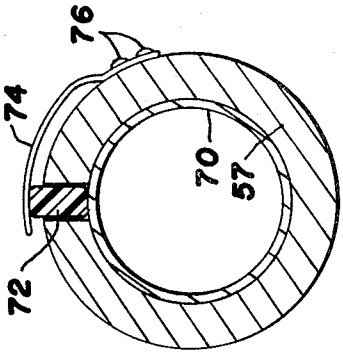


FIG. 7

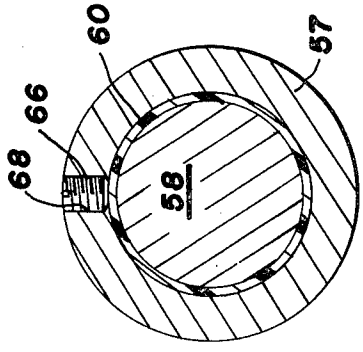


FIG. 6

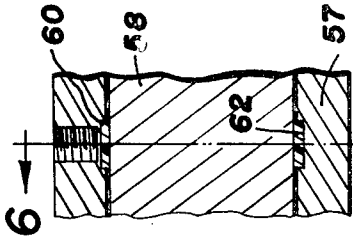


FIG. 5

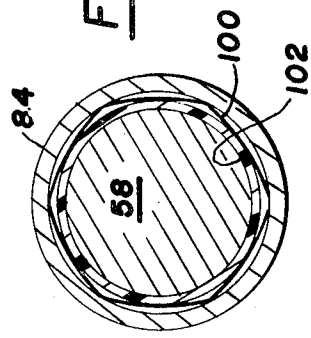


FIG. 11

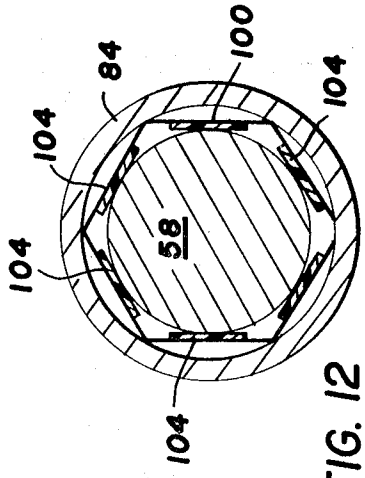


FIG. 12

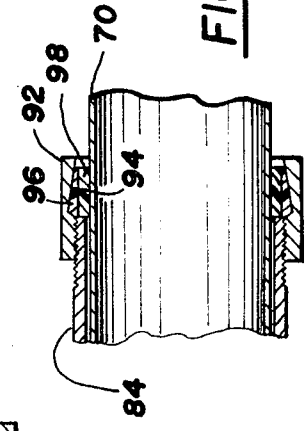


FIG. 10

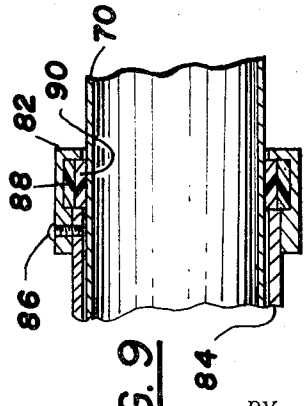


FIG. 9

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TRANSLATION CONTROL MECHANISM

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a motion-transmitting control and more particularly to a control for transmitting linear motion to a follower by a sliding movement of the follower or by a rotary movement of a control shaft.

2. Description of the Prior Art

In the past mechanical controls for accurately converting rotary motion into linear movement of a follower assembly have for the most part comprised threaded assemblies having finely machined parts for controlling thread backlash and for achieving smooth operation. Assemblies of this type are fairly complex in design and relatively expensive to machine or manufacture. In addition, a threaded assembly control providing for translational movement of a follower assembly is usually of a single type which rotates to cause the follower assembly to translate. Translation of the follower can only be accomplished by rotation. Single control assemblies of that type are unable to quickly step the follower an appreciable distance from its starting point, which is often desirable. With only a rotary control considerable time is wasted in turning the control through the requisite number of revolutions until the follower reaches the desired station. Clamps or the like which are provided for disengaging a follower from its gear train, in order to cause it to be moved a substantial linear distance, often are cumbersome to operate and frequently the gear teeth must be aligned before reengagement can occur after a sliding translatory step has been made.

SUMMARY OF THE INVENTION

This invention provides a control which is rotatably operated to cause a follower to move in variable diminutive lengths for very accurate positioning thereof and which is, additionally, slidably operated to provide for quick lateral stepping of the follower for movement of it to a location remotely spaced from its starting location. To this end a shaft having a surface finish with a predominantly helical lay, comprising, for example, continuous or noncontinuous spiralling grooves of diminutive depth and breadth, engages a follower having a substantially uniform contact surface formed of deformable material which causes the uniform follower contact surface to substantially mate with the grooved surface. When the shaft is rotated the follower translates along the shaft. For translating the mechanism from location to location in one single step without rotation, it is only necessary to laterally slide the mechanism to the desired location. Lateral displacement by sliding is accomplished without disengagement of the engaged surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view of a translation control mechanism according to the principles of the present invention;

FIG. 2 is a fragmentary sectional view of the translational control mechanism of FIG. 1 viewed along the plane of line 2—2 of FIG. 1;

FIG. 3 is a fragmentary enlarged view of rotary shaft according to the principles of the present invention;

FIG. 4 is a fragmentary perspective view of a translational control mechanism according to the principles of the present invention;

FIG. 5 is a fragmentary sectional view of a pressure control assembly according to the principles of the present invention;

FIG. 6 is a sectional view of the pressure control assembly of FIG. 5 viewed along the plane of line 6—6 in FIG. 5;

FIG. 7 is another embodiment of a pressure control assembly according to the principles of the present invention;

FIG. 8 is a sectional view of a still different embodiment of the pressure control assembly according to the principles of the present invention;

FIG. 9 is a fragmentary sectional view of still another embodiment of a pressure control assembly according to the principles of the present invention;

FIG. 10 is a fragmentary sectional view of yet another embodiment of a pressure control assembly according to the principles of the present invention;

FIG. 11 is a sectional view of another embodiment of a pressure control assembly according to the principles of the present invention;

FIG. 12 is still another embodiment of a pressure control assembly according to the principles of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIG. 1, there is provided a translational control mechanism which overcomes the hereinbefore-mentioned deficiencies of the prior art devices. Spaced-apart end supports 10 and 12 have extended therebetween a rotary control shaft 14 carrying a translating follower block 16. The rotary control shaft 14 journals within the end supports 10 and 12 at apertures 18 and 20, respectively. The left end of the rotary control shaft 14, as viewed in FIGS. 1 and 2, engages a retainer 22 and the right end, a control knob 24. A resilient spring 26 encircles the control shaft 14 and bears against the under side of the control knob 24 and one side of the end support 12 to maintain the retainer firmly against the left most surface of the support 10.

The rotary control shaft 14 is provided with helical or spirally extending groove or grooves 28. The pattern of the grooves 28 need not be regular, but it appears to the naked eye as one comprising regularly spaced spiralling scratches about the periphery of the control shaft 14. The grooves 28 are diminutive and varying in size, as best seen in the enlarged view of FIG. 3, and are, for example, less than 0.005 inch deep, 0.010 inch from crest to crest and are pitched to form 10 turns per inch. The rotary control shaft 14 is formed of a substantially rigid machinable material such as anodized aluminum or stainless steel. The spirally extending groove or grooves of the shaft 14 may be formed by abrading the surface with fine grit abrasive.

In FIGS. 1 and 2, there is disposed within an aperture 30 in the translating block 16, a bushing 32. The bushing 32 has a substantially uniform regular cylindrical inner surface for engaging the grooves 28 formed on the periphery of the rotary control shaft 14. The bushing 32 is formed of a suitable deformable material such as a thermoplastic, like nylon, Teflon or Delrin, and is, for example, extruded to form the uniform cylindrical inner surface. The bushing 32 is constructed to tightly engage the grooved surface of the rotary shaft 14.

In operation, it will be appreciated that when the control knob 24 is rotated the rotary shaft 14 is caused to rotate and the follower block 16 longitudinally moves along the rotary shaft 14, being limited in travel by the end supports 10 and 12. It will be further appreciated that any number of antirotational devices may be provided for precluding the follower block 16 from rotating when the control knob 24 and the control shaft 14 are rotated. One such antirotational device is a support wall 34 which extends between the end supports 10 and 12 and is integral therewith.

Separate devices for adjustably controlling or regulating the pressure exerted by the bushing 32 against the peripheral surface of the rotary shaft 14 are preferred. Such a device comprises a thumb knob 36 having a cylindrical knurled surface at one end for positive gripping for manual operation and a stud 38 extending therefrom threadably engaged in an aperture 40 provided in the block 16. Housed within the aperture 40 between the threaded end of the thumb knob 36 and the peripheral surface of the bushing 32 is a cylindrical plug 42. Rotational actuation of the thumb knob 36 causes the plug 42 either to be pressed against the peripheral surface of the bushing 32 to generally cause the bushing material to deform and

thereby be forced into tighter engagement with the rotary shaft 14 or if turned in the opposite direction to decrease the pressure exerted on the shaft 14. In this manner a uniform and consistent engagement can be maintained between the bushing 32 and the rotary shaft 14 throughout the life of the mechanism.

Regardless of whether a pressure control device is included, the follower block 16 can be translated along the length of the rotary shafts 14 merely by the application of the force applied to the side of the block 16 opposite the end support toward which travel is desired.

In FIG. 4, an embodiment according to the principles of the present invention, comprises an inverted T-shaped base 44 rotatably carrying a rod 46 and a support rod 48 for carrying a resiliently biased clip 50. The rotary rod 46 and its control knob 51 are similar in all respects to the hereinbefore-mentioned rotary control shaft 14 and control knob 24, respectively. The clip 50 is of two-part construction comprising sections 52 and 54 joined by a spirally formed spring 56 which encircles the support rod 48 to thereby provide for a sliding engagement between the sections 52 and 54 with the clip 50 and the support rod 48. One end of the each clip section 52 and 54 is C-shaped and the concave side of each section engages the rotary rod 46 to substantially totally encompass a portion of the periphery of the rotary rod 46. The opposite ends of the clip sections 52 and 54 together are shaped to form a V, the vertex of which is disposed at the support rod 48. The clip sections 52 and 54 are formed for example, of a thermosetting plastic material such as nylon or Delrin. The C-shaped ends of the clip sections 52 and 54 are resiliently biased, as provided for by the spring 56, to engage the grooves 28 on the rotary rod 46 similarly to the engagement of the bushing 32 with the rotary shaft 14, as hereinbefore described and as illustrated in FIGS. 1 and 2.

In operation, the clip 50 of FIG. 4 is caused to translate along the support rod 48 by either rotary actuation of the control knob 51 or by an operation involving a force exerted on the legs of the clip 50 at the V-shaped end, thereby squeezing them together against the resilient tendency of the spring 56 and lifting the C-shaped areas away from the rotary rod 46 to permit lateral sliding of the clip 50. The lateral sliding translation, for example, from a position A to a position B as illustrated in FIG. 4, can be easily and quickly accomplished. Thusly, there is provided, as shown in FIG. 4, a translational control mechanism of great accuracy controllable by the rotary knob 51. It is a practical mechanism which can be easily and quickly moved from a given location to a substantially distant location without the tiring and tedious time-consuming task involving rotation by the control knob 51.

In FIG. 6, there is illustrated another embodiment according to the principles of the present invention which comprises a cylindrical follower tube 57 housing a control shaft 58 having spiralling grooves formed as hereinbefore mentioned, for example, for the rotary control shaft 14, and a sleeve 60 which totally encircles, as best seen in FIG. 6, a portion of the peripheral surface of the control shaft 58. For retention of the sleeve 60 and for a close fit between 58 and the tube 57 a recess slot 62 is provided in the cylindrical follower tube 57 for positively seating the sleeve 60. The sleeve 60 is formed of a suitable material, such as those hereinbefore mentioned, for forming the bushing 32.

A pressure device 66 comprising, for example, a set screw is threadably engaged in a aperture 68 communicating with the inner space formed by the cylindrical tube 57. The pressure device 66 is rotatable and bears against the outer surface of the sleeve 60 to regulate the pressure exerted by the sleeve 60 on the control shaft 58.

In FIGS. 7 and 8, there is illustrated a tubular control shaft 70 having spiralling grooves 28 formed thereon, housed within the follower tube 57 supporting a plug 72 for engaging the grooves 28. In FIG. 7, the plug 72 is urged into engagement with the tubular control shaft 70 by a resilient leaf spring 74 affixed in any suitable manner, for example, by rivets 76 to the peripheral surface of the follower tube 57. In FIG. 8, the plug 72 is urged into engagement with the tubular control shaft 70 by a coil spring 78 disposed between one end of the plug 72 and a spring retainer arm 80 carried by the follower tube 57. The plug 72 is formed of a suitable material, such as, Delrin, Teflon or mylon. The pressure devices of FIGS. 7 and 8 provide a constant pressure.

The embodiment illustrated in FIG. 9, comprises a pressure control device which is also regulatory. A collar clamp 82 is affixed to a follower tube 84 by any suitable means, such as a machine screw 86. Captured between the inner surface of the collar 82 and the outer surface of a tubular control shaft 70 are two bands 88 and 90. The band 90 is formed of a suitable deformable material, such as those hereinbefore mentioned for the bushing 32. The band 88 is preferably formed of a resilient material which is compressed to tend to urge the band 90 into tight engagement with the control shaft 70.

In FIG. 10, a collar 92 is threadably engaged with an end of the follower tube 84. Housed between an undercut surface 94 of the collar 92 and the periphery of the grooved tubular control shaft 70 are bands 96 and 98 formed of a material not unlike the materials suggested for bands 88 and 90, respectively. In operation, the collar 92 is threaded to more fully engage the threaded follower tube 84 thereby forcing the bands 96 and 98 into tight engagement with the peripheral surface of the control shaft 70, the undercut surface 94 pressing downwardly upon the band 96.

In FIGS. 11 and 12, a resilient open-ended hexagonal spring 100, each side of which is formed of a substantially flat material, substantially totally encircles the control shaft 58. In FIG. 11 as in FIG. 12, the hexagonal spring 100 is fit within the inner space of the follower tube 84 and is positively affixed thereto. The spring 100 is caused to bear against a suitable deformable material 102 or 104, such as that suggested for bushing 32, thereby urging the material 102 and 104 into engagement with the peripheral grooved surface of the control shaft 58. The spring 100 is caused to bear against the selected material proximate the midpoint of each of the hexagonal sides of the spring 100. In FIG. 11 the deformable material 102 is not unlike the material of the band 90 in FIG. 9. In FIG. 12 deformable material 104 is in the form of pads which are affixed in any suitable manner to the inner surface of each hexagonal side proximately midway between two vertex points of the formed hexagon.

It will be appreciated that the sleeve 60, the bands 88, 90, 96 and 98 and the material 102 can satisfactorily function whether continuous or broken.

Having thusly described our invention, as illustrated in the hereinbefore-disclosed practiced embodiments we claim the following:

1. Apparatus for interchanging linear and rotary motions, comprising:
   a. a nondeformable member disposed about an axis and having a surface at least partially substantially cylindrical about said axis, said surface having diminutive grooves formed therein, said grooves varying in size but being uniformly aligned in a common spiral pitch, all of said grooves being less than 0.005 inch in depth; and
   b. deformable means defining a smooth surface having a shape deformably corresponding to said cylindrical surface of said nondeformable member, said surfaces being adapted to mutual contact and one of said surfaces being disposed for rotation while in contact with the other.

2. The apparatus of claim 1 further comprising means for urging said surface together.

3. The apparatus of claim 2 wherein said urging means comprises a spring-biased member for urging said surfaces together.

4. The apparatus of claim 3 wherein said deformable means comprises a plug of resilient material.

5. The apparatus of claim 3 wherein said deformable means comprises a cylinder of deformable material disposed as a sleeve about said nondeformable member and biased against

said nondeformable member by an open-ended, multisided spring.

6. The apparatus of claim 3 wherein said deformable means comprises a plurality of pads in biased contact with said nondeformable member.

7. Mechanism for conversion between linear and rotational motions, comprising:

a. a deformable member defining a smooth surface;

b. a nondeformable member having about an axis, a substantially cylindrical surface having a finish comprising diminutive helical abrasions varying in size but less than 0.005 inch in depth, said cylindrical surface being adapted for contact with said smooth surface of said deformable member; and

c. means for rotating one of said deformable and nondeformable members about said axis.

8. An assembly for translating rotary motion into linear motion, comprising:

a. a cylindrical shaft having grooves of varying size but less than 0.005 inch in depth formed in a surface of said shaft said grooves being aligned in a common spiral pitch; and

b. deformable means having substantially uniform surface rotatably engaging the grooved surface whereby when one of said shaft and said deformable means is rotated relative to the other, said one linearly traverse in an axial direction relative to the other.

9. The assembly of claim 8 wherein said uniform surface is biased against said grooved surface.

10. The assembly of claim 9 wherein said uniform surface comprises a plug and said bias is accomplished by a spring urging said plug against said cylindrical shaft.

11. The assembly of claim 8 wherein said uniform surface and said grooved cylindrical surface are urged together by spring means.

12. The assembly of claim 11 wherein said uniform surface is formed on a collar substantially encircling said cylindrical surface.

13. The assembly of claim 12 further comprising releasable clamping means for engaging and disengaging said grooved and uniform surfaces.