United States Patent [19]

Glaser

[11] **3,823,892**

[45] **July 16, 1974**

[54] **EXPANDABLE ROLL CORE SHAFT UNIT**

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[22] Filed: **Sept. 5, 1972**

[21] Appl. No.: **286,216**

[52] **U.S. Cl.** **242/72**

[51] **Int. Cl.** **B65h 75/24**

[58] **Field of Search** 242/72, 72.1

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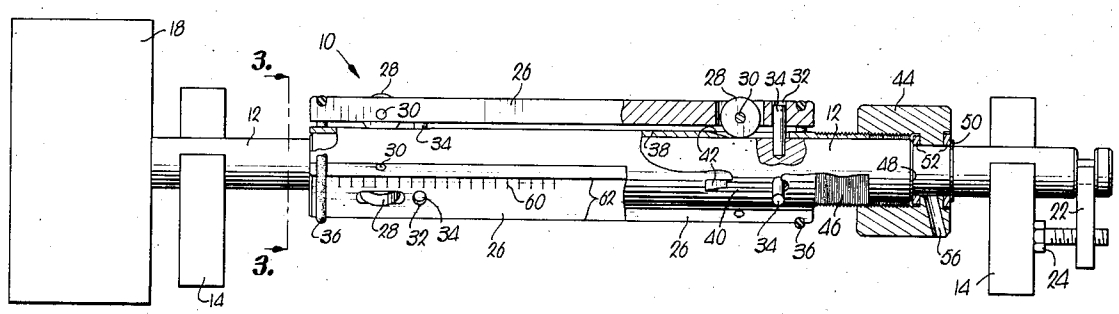
[57] **ABSTRACT**

A mechanically operated, expandable spool useful as a roll core shaft unit and having a plurality of longitudinally extending segments symmetrically located about a central shaft. A longitudinally movable, tubular member is located intermediate the shaft and segments with cam surfaces disposed to engage follower wheels carried by each of the segments. A drive collar carried by the shaft is threaded to the tubular member to drive the latter longitudinally relative to the segments causing the cam and follower to shift the segments radially and concentrically relative to the shaft to engage and disengage a roll of material. In one form the segments are rectangular bars having sharp corners for positively gripping a roll core carrying the material, and in another form the segments have circular outer surfaces allowing wind-up of the material directly therein.

19 Claims, 9 Drawing Figures



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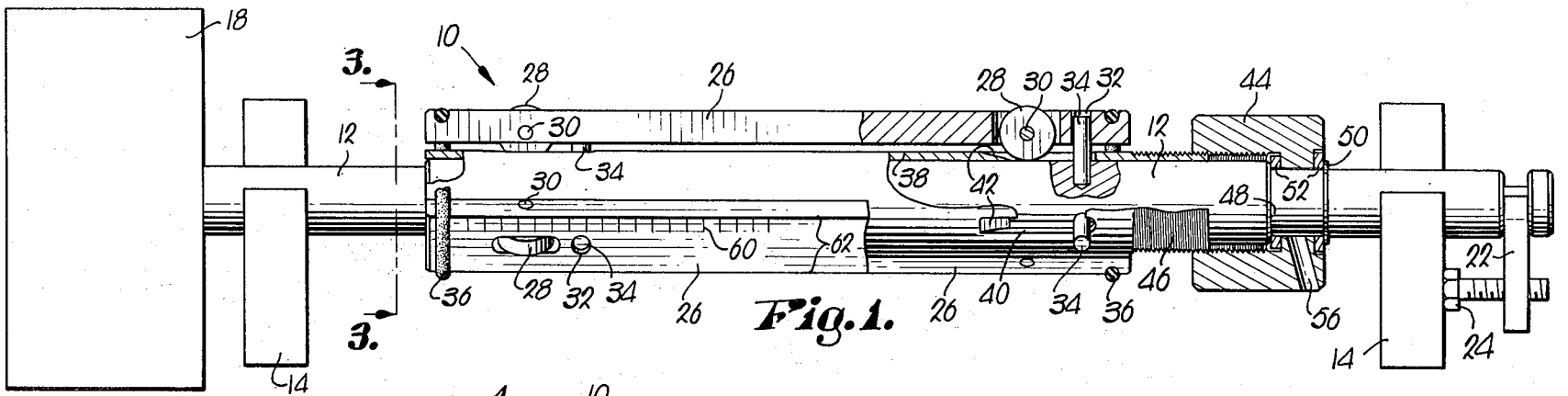

Fig.1.

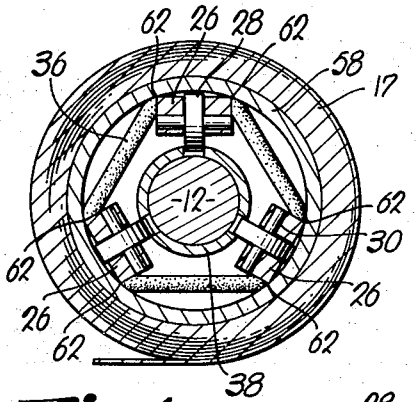

Fig.4.

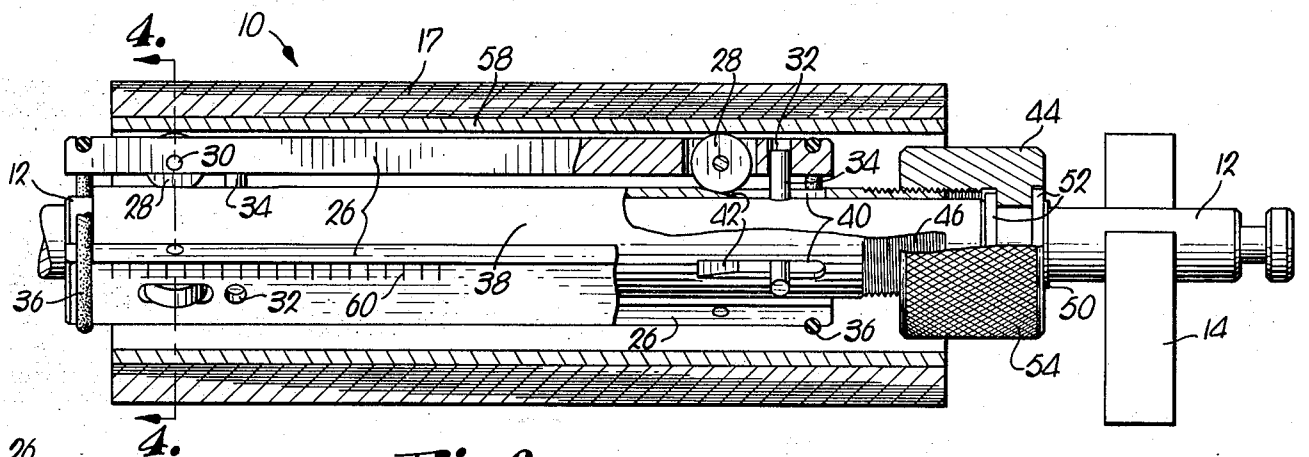

Fig.2.

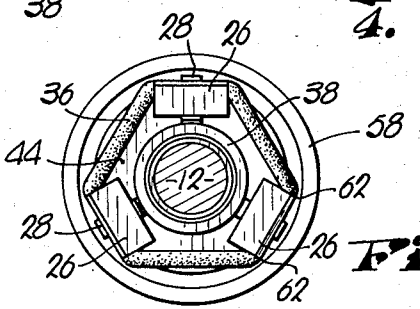

Fig.3.

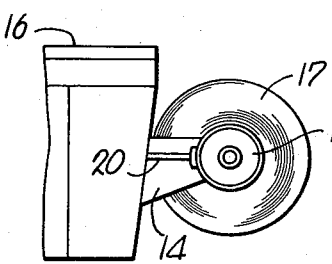

Fig.5.

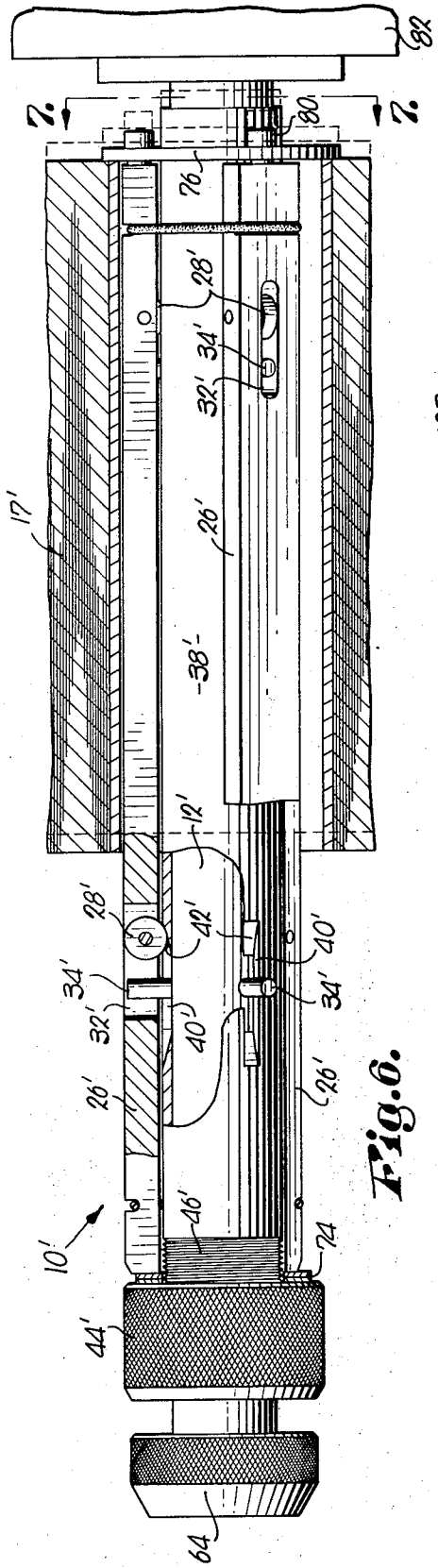

Fig.6.

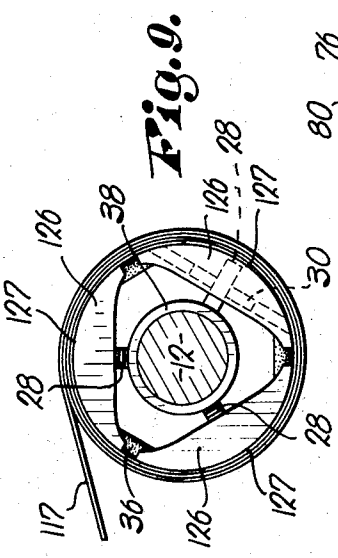

Fig.9.

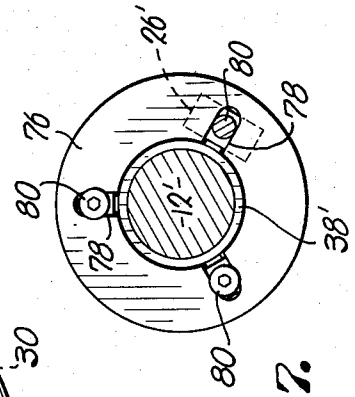

Fig.7.

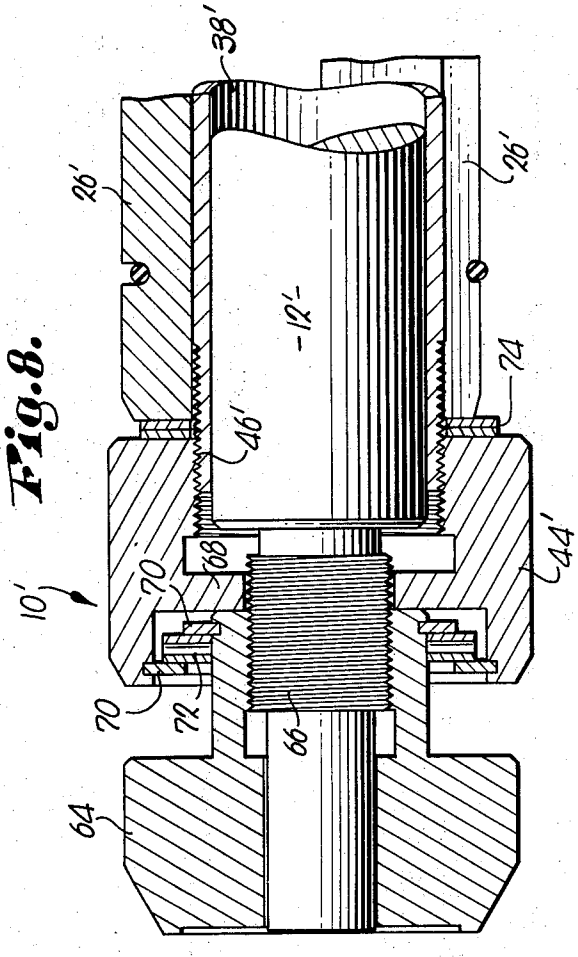

Fig.8.

EXPANDABLE ROLL CORE SHAFT UNIT

This invention relates to shaft spools for carrying rolls of material and relates more particularly to spools which are radially expandable to selectively lock and be released from engagement with the roll of material.

Expandable type spools are particularly useful as a roll core shaft unit carrying rolls of materials that are relatively large and heavy, or which are rotated at relatively high speed and thereby must be firmly held in concentric relationship to the central support shaft. Radial adjustment of the spool permits firm lockup thereof with a roll core carrying the material while permitting selective release of the spool from the roll core to facilitate easy assembly and disassembly. Accordingly, such expandable spools are also particularly useful in winding up discardable material into a compact roll due to the ease in which the spool may be released from the roll by radial contraction of the spool.

The only expanding type spools now available that function adequately are very expensive, normally being pneumatically or otherwise power-operated to create concentric expansion and proper lockup with the roll core. Inexpensive, mechanically expandable spools now available are subject to a variety of problems. Primarily, it is difficult to lock the roll core in proper concentric relationship to the central shaft. The expandable spool tends to mount the roll core eccentrically relative to the shaft and/or cant the roll lengthwise relative thereto, since the spool does not positively locate the roll of material concentric to the shaft. This results in wobbling of the roll of material and makes it difficult to maintain proper material tension because of the eccentricity. Further, these prior art arrangements will not work properly with oversized, deformed or out-of-round cores. Certain arrangements will operate in only one direction of rotation of the roll core with the roll coming loose from the shaft if it is rotated in reverse. Other types, in addition to requiring the use of special tools, are extremely difficult to adjust manually because of small mechanical advantage.

Accordingly, it is a broad object of the present invention to provide a mechanically operated, expandable spool for use as a roll core shaft unit of inexpensive and simple structure which locks a roll core carrying a roll of material in concentric, non-canted relationship to the central support shaft.

It is an important object of this invention to provide a spool which has radially expandable segments symmetrically disposed about a central shaft, and a longitudinally movable member located intermediate the shaft and the segments which is engageable with the segments to simultaneously shift the latter radially and concentrically relative to the shaft and thereby carry the roll of the material in proper concentric relationship to the shaft, while presenting a simple, inexpensive, and compact arrangement facilitating easy insertion and removal of the roll of material therein.

A more particular object of the invention is to provide cam surfaces on the member, and follower wheels on the segments in contact with the corresponding cam surfaces to effect concentric radial shifting of the segments with minimal frictional resistance in response to longitudinal movement of the member, there being a threaded collar carried by the shaft and in engagement with the tubular member to provide high mechanical advantage in manually shifting the member longitudinally.

Another object of the invention is to provide means engaging the shaft, the member, and the segments to locate the segments and the tubular member in symmetric relationship to the shaft to thereby assure aconcentric shifting of the segments.

Another important object of the invention is to provide segments in the form of a plurality of separate polygonal, preferably rectangular, bars each of which presents a pair of locking edges extending longitudinally of the roll core to positively grip the latter in nonslipping relationship, even if the roll core is irregular or out-of-round, and thereby positively lock the roll of material onto the central shaft.

Yet another important object is to provide an expandable spool having expandable segments which are configured to allow wind-up of material directly thereon into a compact roll so that upon subsequent radial contraction of the segments the spool may be quickly and easily removed from the roll.

Yet another object of the invention is to provide a spool of the type described wherein is included biasing means engaging the several segments to urge the latter radially inwardly so that the spool assembly has no loose parts.

Another object of this invention is to provide a spool of the class described wherein the segments are selectively longitudinally adjustable in unison relative to the shaft to facilitate positioning of the roll of material on the shaft.

These and other more particular objects and advantages of the present invention are specifically set forth in or will become apparent from the following detailed description of a preferred form of the invention when read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a side elevational view, with portions broken away and shown in cross-section to reveal details of construction, of one form of the invention as mounted upon supporting machinery;

FIG. 2 is an enlarged, longitudinal, partial central cross-sectional view of the unit shown in FIG. 1 with a roll of material mounted thereon and the unit in radially expanded condition;

FIG. 3 is a transverse cross-sectional view taken along line 3—3 of FIG. 1, a roll core being shown mounted thereon;

FIG. 4 is a transverse cross-sectional view taken along line 4—4 of FIG. 2;

FIG. 5 is an end elevational view of the supporting machinery and shaft unit with a roll of material mounted thereon;

FIG. 6 is a side elevational view, with portions broken away to reveal details of construction, of another form of the invention;

FIG. 7 is a transverse cross-sectional view taken along line 7—7 of FIG. 6;

FIG. 8 is an enlarged, longitudinal, cross-sectional view of the outer end of the shaft unit shown in FIG. 6; and

FIG. 9 is a transverse cross-sectional view similar to FIG. 4 but showing a modified form of radially expandable segments.

Referring now more particularly to FIGS. 1–5, an improved spool in the form of a roll core shaft unit, generally designated by the numeral 10, includes a central

shaft 12 which is cradled within a pair of support brackets 14 of press machinery 16 or the like. A brake drum 18 at one end of shaft 12 is engageable by a brake shoe 20 on the machinery, while at the other end of the shaft a plate 22 fits within a corresponding groove in the shaft. An adjusting nut 24 extends between plate 22 and one of the support brackets 14 and is adjustable to shift the entire unit 10 longitudinally relative to support brackets 14 and machinery 16. A roll of material 17 is mountable about unit 10 as shown in FIGS. 2, 4 and 5.

Unit 10 includes segment means in the form of three rectangularly-shaped segment or locking bars 26 which are symmetrically disposed about shaft 12 and extend longitudinally therealong. Each bar 26 has a pair of radially arranged follower wheels 28 rotatably mounted thereon by small transverse spindles 30. As shown in FIG. 1, these wheels 28 depend radially inwardly to engage the outer surface of shaft 12. Each locking bar 26 also has a pair of apertures 32 which receive alignment roll pins 34 which are press-fit into shaft 12. Pins 34 locate the bars symmetrically about the shaft in approximately 120° spacing, align the bars in longitudinally parallel relationship to the shaft 12, and act as mechanism interconnecting shaft 12 and bars 26 to prevent relative longitudinal movement between the shaft 12 and the bars. Elastomeric O-rings 36 are carried in grooves at each end of the bars 26 and extend around all of the bars to bias the bars 26 radially inwardly toward the shaft.

Located intermediate bars 26 and shaft 12 is a longitudinally movable tubular member in the form of a tube 38 surrounding the shaft. Tube 38 has a plurality of longitudinally elongated slots 40 located in corresponding alignment with pins 34 and wheels 28. The pins 34 are loosely received in slots 40 to locate and align tube 38 relative to bars 26 and to hold the tube against rotation relative to shaft 12 and the bars 26. One end of each slot 40 is inclined to define a cam surface 42 for engagement with the corresponding follower wheel 28. Tube 38 is of a size snugly fitting over shaft 12 but permitting free longitudinal sliding movement of tube 38 along the shaft, with the elongated configuration of slots 40 facilitating longitudinal movement of the tube.

Drive means in the form of an internally threaded collar 44 mounts upon a threaded end 46 of tube 38. Shaft shoulder 48 and snap ring 50 define securing means operably engaging collar 44 through bearing washers 52 to hold collar 44 against longitudinal movement relative to shaft 12 while permitting free rotation of collar 44.

A knurled outer surface 54 on collar 44 permits easy manual rotation of the collar to cause longitudinal shifting of tube 38 relative to shaft 12 and the bars 26. The screw engagement of collar 44 with tube 38, along with leverage created by the engagement of the sloped cam surfaces 42 with wheels 28, provides high mechanical advantage facilitating easy, powerful radial shifting of bars 26. Collar 44 also has a bore 56 for receiving a screwdriver or other tool to yet further increase the mechanical advantage in shifting bars 26.

In operation, bars 26 are placed in a radially retracted condition as shown in FIG. 1 to facilitate easy mounting of a roll of material 17 about unit 10 as illustrated in FIG. 3. Scale graduations 60 on the outer surfaces of bars 26 facilitate quick longitudinal centering of the roll core upon the shaft unit. Upon rotation of collar 44 to advance upon the threaded end 46, tube 38 moves longitudinally rightwardly along the shaft, causing follower wheels 28 to roll upwardly upon cam surfaces 42. As a result, the three locking bars 26 shift radially outwardly until their corners 62 firmly, positively grip the inside surface of roll core 58.

The matching inclines of the several cam surfaces 42 and matching positioning of the several follower wheels 28 assure that the three bars 26 shift simultaneously. Accordingly, the six core-engaging corners 62 shift concentrically and radially relative to the shaft to grip and lock the roll core 58 in concentric relationship to shaft 12 as shown in FIGS. 2 and 4. While the follower wheels are shown extending slightly above the radially outermost surface of the corresponding bar 26, it will be appreciated that only the corners of bars 62 engage roll core 58, with wheels 28 remaining free to rotate upon their spindles 30. The concentric radial shifting of the bar segments also assures that the roll core will not be canted lengthwise when locked to unit 10.

The six, concentrically spaced, longitudinally extending corners 62 present contact areas at a sufficient variety of points on the inner surface of core 58 to assure firm grippage of roll core 58 regardless of any deformation or irregularity therein. Further, to this end, the diameters of pins 34 and apertures 32 permit a limited amount of play therebetween so that each bar 26 may rotate slightly about its longitudinal axis and more readily assure firm lockup of both edges 62 of each bar with core 58. The unit will accommodate large variation in core diameter as well as fit out-of-round cores such as those which are deformed by handling, etc. Shaft 12 is rotatable in either direction without affecting the tight interengagement of the locking bars and roll core.

The compact configuration of unit 10 presents no element which extends radially outwardly to interfere with insertion and removal of roll 17, and yet presents an arrangement having minimal frictional resistance to radial shifting of the bars and having extremely high mechanical advantage to effect such radial shifting. The unit is comprised of few and inexpensive parts requiring no special tools to operate, and has no parts which are loose from the shaft. The arrangement facilitates fast lockup and quick removal of an old core and replacement with a new roll. Insertion of an elongated tool within bore 56 of collar 44 permits easy access to collar 44 even if the roll core extends partially thereover.

Disengagement of the bars 26 from roll core 58 to facilitate removal thereof is accomplished simply by rotating collar 44 in the opposite direction to retreat upon threaded end 46 to drive tube 38 back leftwardly and permit the follower wheels 28 to roll back down on cam surface 42 under the urging of O-rings 36.

The form of the invention illustrated in FIGS. 6–8 is quite similar to that above described, but as modified to be supported from one end only and to permit longitudinal adjustment of the core-engaging segments relative to the central supporting shaft. An expandable spool or roll core shaft unit 10′ illustrated in FIGS. 6–8 has a central shaft 12′, a longitudinally movable tube 38′, and three rectangular locking bars or segments 26′, all of which operate in a manner similar to the corresponding elements in the FIG. 1 arrangement. Radially extending alignment pins 34′ pass through corre-

sponding elongated slots 40' in the tube and into longitudinally elongated apertures 32' in the locking bars. Each locking bar carries cam follower wheels 28' which roll up and down upon corresponding cam surfaces 42' in the tube 38'. A drive collar 44' is in engagement with a threaded end 46' of tube 38'.

Unit 10' additionally includes a threaded stop nut 64 which is mounted upon a threaded section 66 of shaft 12'. One end of stop nut 64 abuts a shoulder 68 on collar 44' and engages collar 44' in the opposite direction through snap rings 70 and thrust bearing 72 to act as means normally securing the drive collar 44' against longitudinal movement relative to the shaft. Also, the drive collar 44' is rotatably carried by shaft 12' through stop nut 64. The inner end of collar 44' abuts the several locking bars 26' through a thrust bearing 74 so that stop nut 64 also acts as mechanism operably engaging locking bars 26' through collar 44' to interconnect the bars 26' with the shaft in a manner normally preventing leftward longitudinal movement of bars 26' relative to shaft 12'. The engagement of all of follower wheels 28' with the cam surfaces of tube 38' which, in turn, is threaded to collar 44', normally prevents rightward longitudinal movement of the bars 26' relative to shaft 12'.

At the right-hand end of bars 26' there is an annular stop plate 76 located radially outwardly of tube 38' and extending outwardly to contact the end of a material roll 17'. Stop plate 76 has three radial grooves 78 that receive shoulder bolts 80 which are screwed into the ends of the three locking bars 26'. The elongated configuration of grooves 78 prevents interference with radial shifting of the locking bars by shoulder bolts 80.

The concentric, radial shifting of locking bars 26' is accomplished in precisely the same manner as above described with respect to FIGS. 1–5 by advancing collar 44' on threaded end 46' of tube 38'. In addition to this, unit 10' permits selective adjustment of the longitudinal position of bars 26' relative to shaft 12' in order to adjustably position roll 17' relative to a fixed support 82. To this end, advancement of stop nut 64 upon threaded section 66 pushes collar 44', tube 38', and bars 26' in unison rightwardly toward support 82 to the phantom position shown in FIG. 6. Movement of these three elements in unison maintains the same positional relationship of follower wheels 28' to the cam surfaces 42'. The elongated apertures 32' permit such longitudinal shifting of bars 26'. Stop plate 76, the left-hand face of which defines a reference plane for locating roll 17' relative to support 82, moves with bars 26' to permit adjustable positioning of roll 17' relative to the support.

Bars 26' may be moved away from support 82 by rotating collar 64 in the opposite direction to pull collar 44' and tube 38' leftwardly. Engagement of wheels 28' with the corresponding cam surfaces in the tube causes the bars 26' to also move leftwardly in unison with the tube.

The unit 10' maintains all of the advantageous operating and structural characteristics described with respect to unit 10 of FIG. 1. Both collars 44' and 64 are located for each access and are of less diameter than the core of roll 17' to facilitate easy insertion and removal thereof upon unit 10'.

FIG. 9 illustrates a modified spool having radially shiftable segments in the form of elongated, curved elements 126 having circular outer surfaces 127 that lie in a common circle concentric to central support shaft 12. The same arrangement of follower wheels 28 contacting cam surfaces on tube 38 effects simultaneous radial shifting of elements 126 as effects shifting of bars 26 in FIG. 1. The outer surfaces 127 are of sufficient circumferential width, together forming almost an entire circle, to allow winding and unwinding of material 117 directly on surfaces 127. At the same time however, the elements 126 and outer surfaces 127 are spaced from each other to allow radial shifting of the elements.

The FIG. 9 arrangement is particularly useful for coreless winding and unwinding of material as well as in winding up discardable material 117 without the use of a central roll core. After winding material 117 on elements 126 into a compact roll, the elements can be radially contracted under the urgings of elastomer O-rings 36 in the manner described with respect to FIG. 1 to allow removal of the entire spool from the roll so the latter may be discarded. It is also useful for providing uniform support for relatively weak roll cores which would otherwise be unable to properly support the material carried thereon. This modified form retains all the advantages and operational features as the previously described forms, except for the use of circular elements 126 instead of the locking bars 26. The circular elements 126 may be utilized equally well in conjunction with either the FIG. 1 arrangement or the FIG. 6 construction.

Having thus described the invention, what is claimed as new and desired to be secured by letters Patent is:

1. An expandable spool comprising:
an elongated shaft;
a plurality of elongated, rigid, apertured rods positioned in circumferentially spaced relationship about said shaft;
a plurality of pins extending outwardly from said shaft and received in the apertures of respective rods;
an axially shiftable sleeve positioned between said shaft and rods, said sleeve being operable upon axial shifting thereof to engage said rods to effect simultaneous radial movement of the latter with respect to said shaft; and
means for axially shifting said sleeve to thereby radially move said rods.

2. A spool as set forth in claim 1, wherein said rods are of substantially identical configuration and are symmentrically arranged about said shaft.

3. A spool as set forth in claim 2, wherein each of said rods has a cylindrical outer surface remote from said shaft.

4. A spool as set forth in claim 2, wherein each of said rods is of polygonal cross-section.

5. A spool as set forth in claim 4, wherein said rods is of rectangular cross-section.

6. A spool as set forth in claim 1, wherein said sleeve has slots therein through which said pins extend to be received in the apertures of respective rods, said slots being elongated and axially aligned with said shaft to permit axially shifting of the sleeve.

7. A spool as set forth in claim 6, wherein said sleeve includes cam surfaces disposed in corresponding relationship to each of said rods, there being a follower carried by each of said rods operable to engage the corresponding cam surface to effect said simultaneous radial

movement of the rod in response to axially shifting of the sleeve.

8. A spool as set forth in claim **7,** wherein each of said followers comprises a follower wheel rotatably mounted on the corresponding rod.

9. A spool as set forth in claim **2,** wherein is provided means circumscribing said rods and biasing the same radially inwardly with respect to said shaft.

10. A spool as set forth in claim **1,** wherein is provided mechanism interconnecting said shaft and said respective rods to prevent relative axial movement therebeween.

11. A spool as set forth in claim **10,** wherein said mechanism is axially adjustable to selectively move said rods axially of the shaft.

12. A spool as set forth in claim **11,** wherein said shaft has a threaded section, said mechanism including an adjustable, threaded stop nut carried on said threaded section and operably engaging said rods to normally prevent axial movement thereof, said stop nut being advanceable on said threaded section to move said rods axially relative to the shaft.

13. A spool as set forth in claim **12,** wherein said stop nut also operably engages said sleeve to axially move the same in unison with said rods upon advancement of the stop nut on said threaded section.

14. A spool as set forth in claim **1,** wherein said means for axially shifting said sleeve includes drive means carried by said shaft.

15. A spool as set forth in claim **14,** wherein said drive means is in threaded engagement with said sleeve and rotatably carried by said shaft, there being means for securing said drive means to said shaft to prevent axial movement thereof while allowing rotation of the same relative to the shaft, and means for preventing rotation of said sleeve relative to the shaft.

16. A spool as set forth in claim **15,** wherein said drive means includes a rotatable collar surrounding said shaft and in threaded engagement with said sleeve.

17. A spool as set forth in claim **16,** wherein said shaft has a threaded section thereon, said means for securing said drive means to the shaft including a threaded stop nut abutting said collar and carried on said threaded section, said collar abutting said rods whereby advancement of said stop nut on said threaded section moves said sleeve and said rods in unison axially relative to the shaft.

18. A spool as set forth in claim **16,** wherein said means for securing said drive means to the shaft comprises stationary, spaced shoulders on said shaft located to contact said collar and permit rotation thereof relative to the shaft.

19. An expandable spool comprising:

an elongated shaft;

a plurality of elongated rods positioned in circumferentially spaced relationship about said shaft;

an axially shiftable sleeve positioned between said shaft and rods, said sleeve being operable upon axial shifting thereof to engage said rods to effect simultaneous radial movement of the latter with respect to said shaft;

mechanism interconnecting said shaft and rods permitting selective axial movement of the latter with respect to said shaft; and

means for axially shifting said sleeve to thereby radially move said rods.

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