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[54] **EXPANSIBLE WINDING DRUM ASSEMBLY**

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[52] **U.S. Cl.** **242/72**, 242/78.3

[51] **Int. Cl.** **B65h 75/24**, B65h 75/28

[58] **Field of Search** 242/72, 72.1, 78.3

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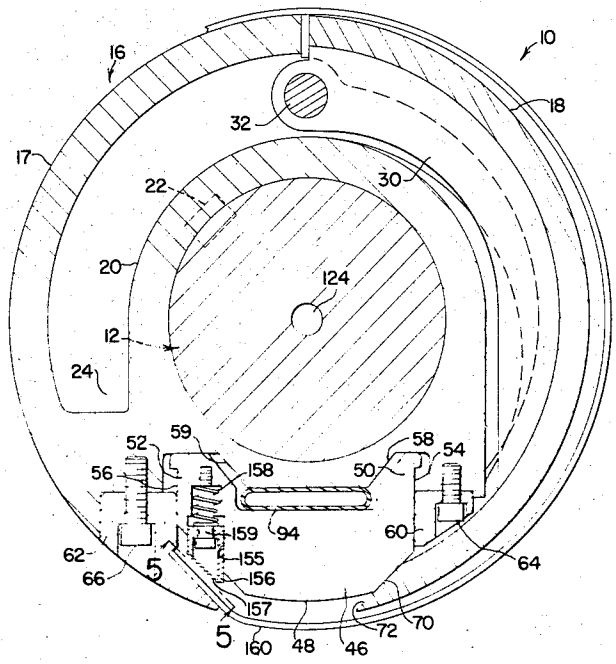
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[57] **ABSTRACT**

The specification and drawings disclose an expansible drum assembly particularly suited for use in rewinding metal strip. The disclosed device comprises a rotatably mounted center shaft having arcuate outer shells or segments carried thereon. The segments define the drum assembly's winding surface and each has a circumferential extent of less than 180°. One of the shells is pivotally connected to the shaft for arcuate movement in a generally radial direction. An actuating member extends longitudinally of the shaft between the shells. The actuating member has a surface which defines a continuation of the winding surface between the shells. Also, one surface on the actuating member is arranged to cam the pivotally mounted shell. Power means are provided for reciprocating the actuating member and radially. In the preferred embodiment, the power means comprise an expansible drum positioned between the actuating member and the shaft. Also disclosed is a strip clamp arrangement wherein the strip is clamped during outward movement of the actuating member.

11 Claims, 7 Drawing Figures



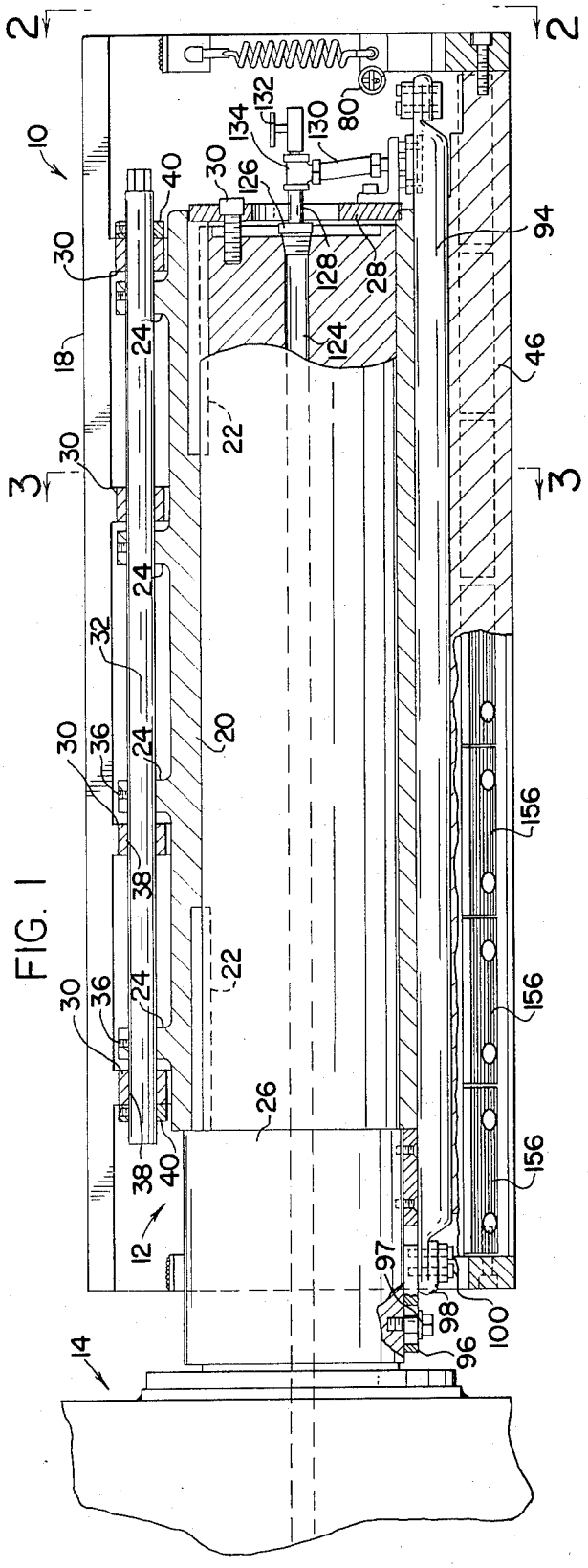


FIG. 1

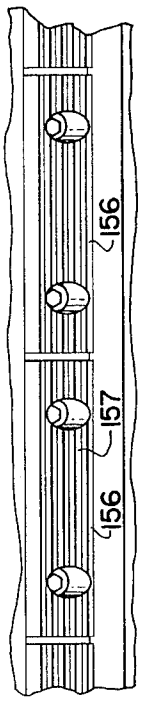


FIG. 5

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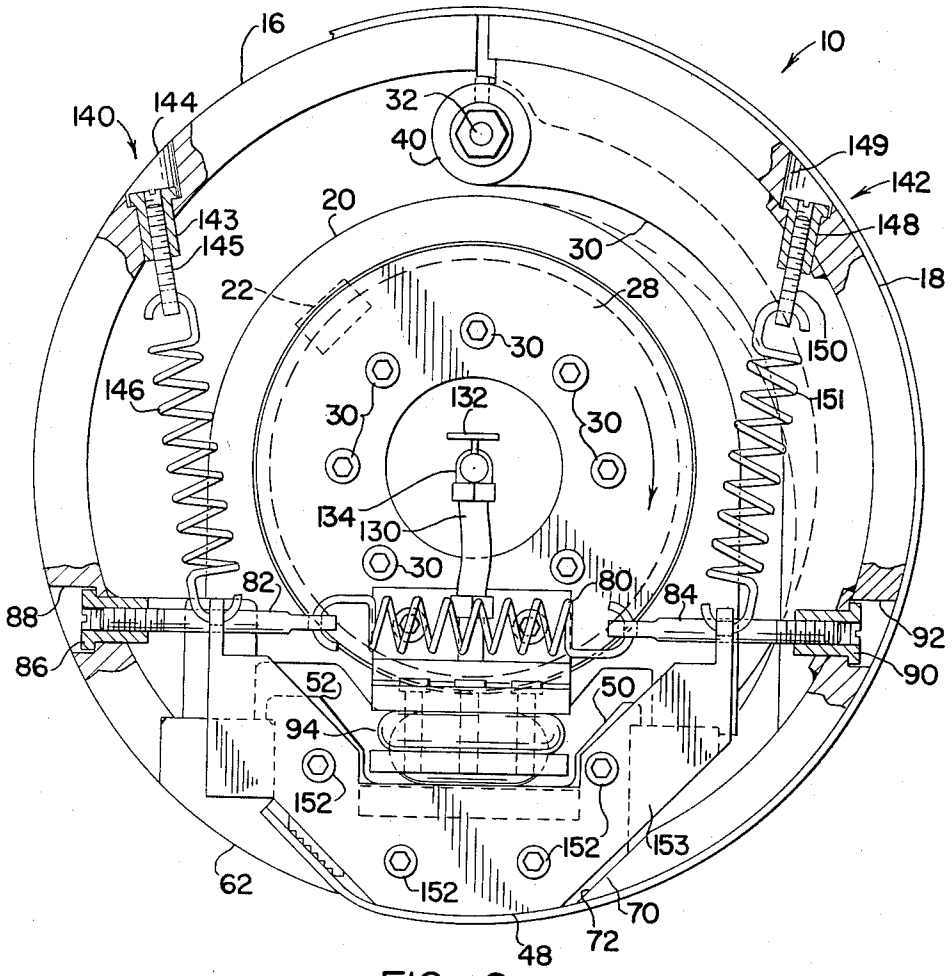


FIG. 2

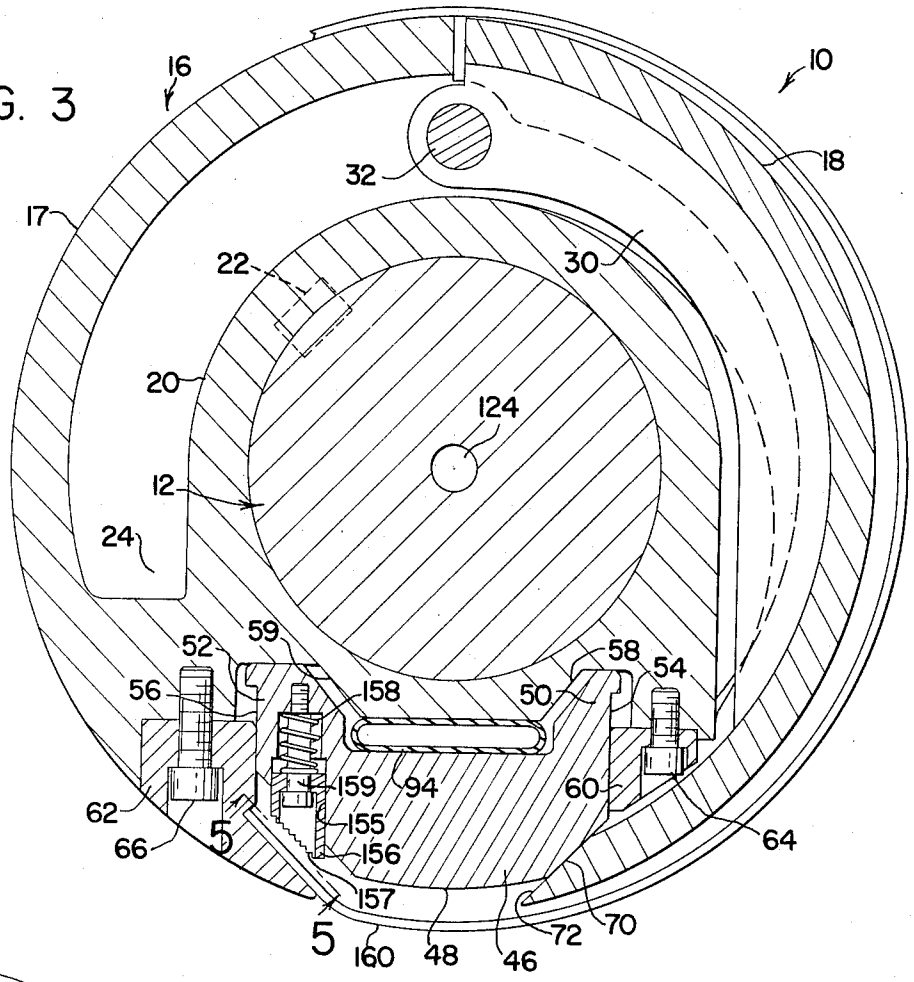
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FIG. 3



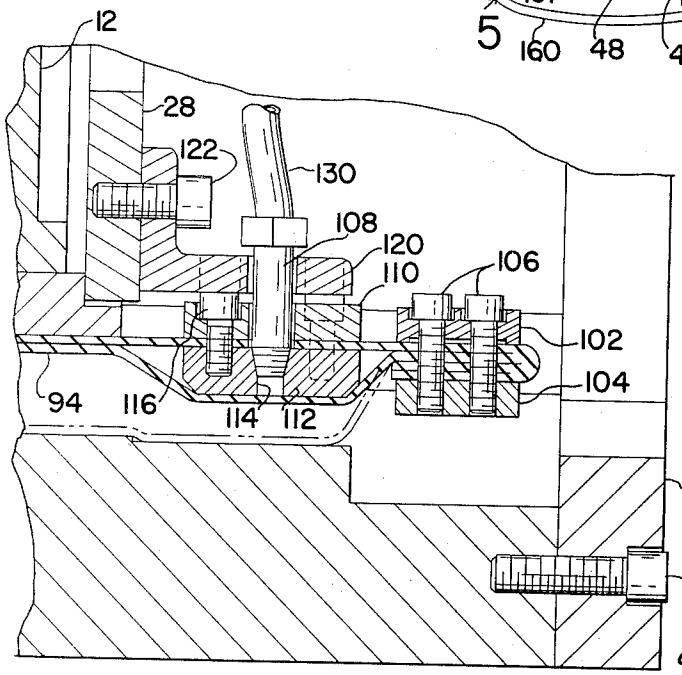


FIG. 4

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FIG. 6

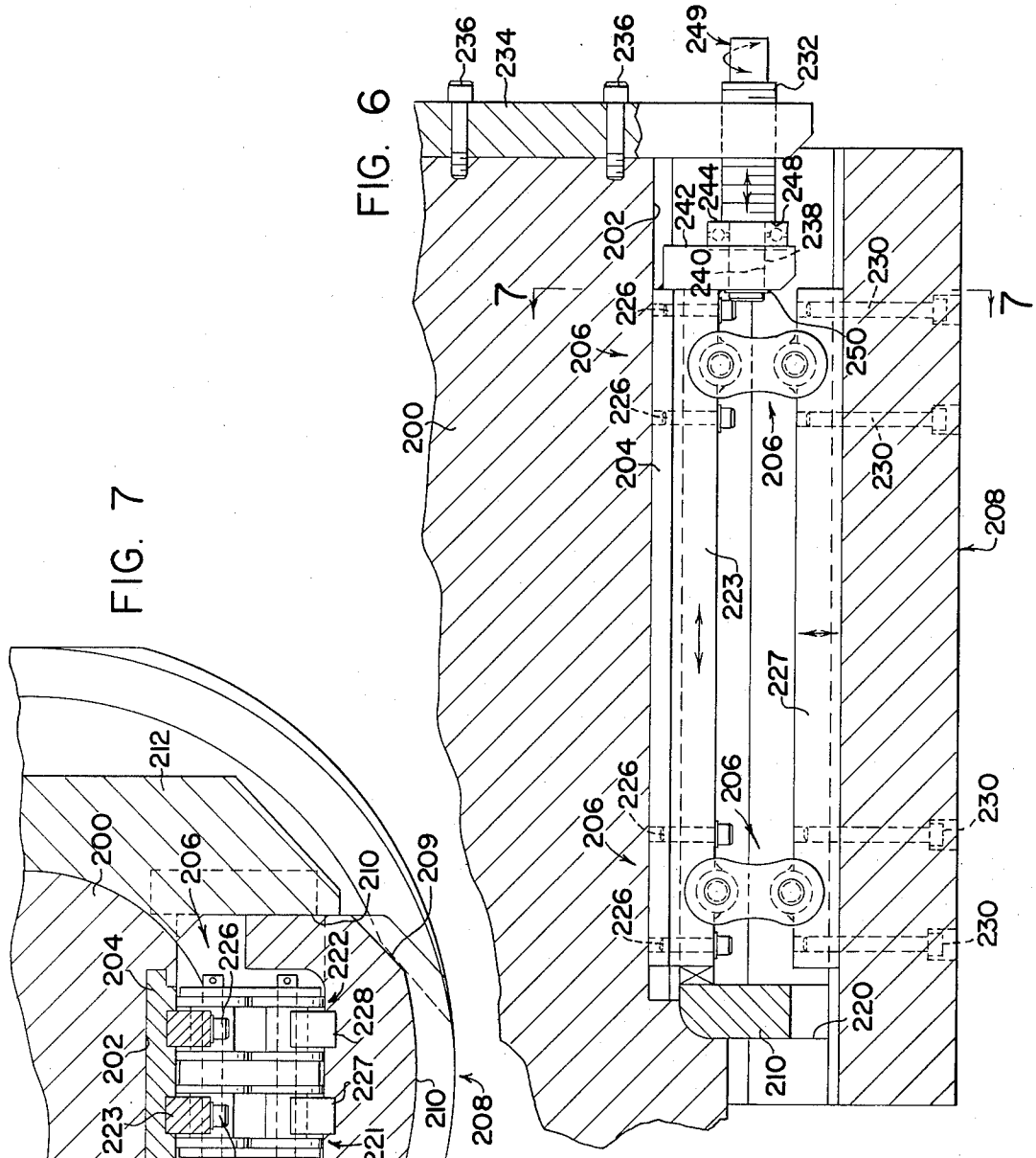


FIG. 7

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EXPANSIBLE WINDING DRUM ASSEMBLY

The subject invention is directed toward the winding and reeling art and, more particularly, to an improved expansible winding mandrel or drum.

The invention is especially suited for use as a rewind drum for metal strip and will be described with particular reference thereto; however, as will be apparent, the invention is capable of broader application and could be used in many different winding, reeling and pay-out operations.

During the manufacture of metal strip, the strip must be wound into coils. Typically, an expansible and contractable drum having gripping jaws is used for the winding operation. With the drum in the expanded condition, the lead end of the strip is gripped in the jaws. As the drum is rotated, the strip is tightly wound into a coil on the outer surface of the drum. Thereafter, the drum is contracted and the end of the strip released from the jaws. The coil is then removed by sliding it outwardly off the drum.

Many different types of expansible drums have been used in the past. Generally, th drums have included multiple exterior segments carried on a rotatable center shaft. Cams or wedges were mounted between the shaft and the segments so that when relative longitudinal movement was produced between the shaft and the segments, the segments moved radially. Many different types of actuators were used internally of the drums for producing the required movements. Additionally, separate actuators were generally provided for moving the gripping jaws.

The most common feature of the prior drums was their large number of parts and general complexity which resulted from their design. Additionally, the sliding surfaces on the cams required much relatively precision machining. These factors combined to make the drums relatively expensive.

The subject invention provides an expansible drum assembly which is extremely simple in construction and reliable in operation. Drums formed in accordance with the invention basically require only two moving parts, thus greatly reducing manufacturing and maintenance costs. Further, no relative axial movement is required between the center shaft and the winding surface. In general, the invention contemplates a center shaft adapted to be cantileverly supported and having first and second arcuate outer shells or segments which define the winding surface and extend throughout a substantial portion of the length of the shaft. Each of the shells have a circumferential extent of less than 180° and, preferably, the first shell is formed integrally with or affixed to the shaft. The second shell is connected to the shaft along one of its longitudinal edges so that it can pivot radially. Means are provided to maintain the second shell continually biased in an inward direction. Also carried by the shaft and extending axially thereof is an elongated actuating member. The member is mounted for radial movement and has a first surface which forms a continuation of the winding surface and a second surface which engages the free end portion of the second shell. Power means are provided for selectively moving the member radially outward to cause the second shell to move outwardly against the biasing means to expand the shell.

Preferably, and in accordance with another aspect of the invention, one longitudinal edge of the actuating member forms half a gripping jaw. The other half of the gripping jaw is carried by the first segment and located so that during outward movement of the actuating member, the jaws engage. Thus, the gripping operation is produced simultaneously with the expansion and by the same power means.

The power means can be of many types; however, it preferably comprises a length of expansible hose positioned between the shaft and the actuating member. This provides an extremely simple and reliable power means. Merely by regulating the supply of pressure fluid to the hose, the expanding and gripping operations are controlled. Other types of power means can be used. The specification discloses a second power means embodiment which uses a manually driven screw member which acts against a slide bar pivotally connected to the actuating member to produce radial movement of the actuating member.

A more limited aspect of the invention contemplates that at least one-half the gripping jaws will comprise a series of separate sections. Each of the sections is preferably biased toward the other jaw half. This allows the jaws to compensate for strip having varying thickness across its width.

As can be appreciated from the above, a primary object of the invention is the provision of an expansible drum of extremely simple design.

A further object of the invention is the provision of a drum of the general type described wherein only two moving parts are required to produce expansion and contraction.

Yet another object is the provision of an expansible winding drum in which expansion takes place without any longitudinal relative movement.

Yet another object is the provision of a drum of the type described wherein a flexible hose serves as the power means.

The above and other objects and advantages will become apparent from the following description when read in conjunction with the accompanying drawings wherein:

FIG. **1** is a longitudinal sectional view through a winding drum formed in accordance with a preferred embodiment of the invention;

FIG. **2** is an end view of the FIG. **1** embodiment taken on line **2—2** of FIG. **1**;

FIG. **3** is a cross-sectional view taken on line **3—3** of FIG. **1**;

FIG. **4** is an enlarged view of the lower right-hand corner of FIG. **1**;

FIG. **5** is an enlarged view taken on line **5—5** of FIG. **3**;

FIG. **6** is a longitudinal cross-sectional view similar to FIG. **1** but showing a modified form of actuating and power means; and,

FIG. **7** is a view taken on line **7—7** of FIG. **6.**

Referring more particularly to FIGS. **1** and **2**, the overall arrangement of the preferred embodiment of the expansible drum assembly **10** is shown as including a main, generally cylindrical, center shaft **12** which is cantileverly mounted in or from a main support **14.** The center shaft **12** is carried in suitable bearings (not shown) for driven rotation about its longitudinal center axis. The particular mechanisms provided for mounting and driving the mandrel assembly form no part of the present invention and any of the conventional arrangements could be used.

Carried on the shaft **12** for rotation therewith are a pair of first and second elongated shell or segment members **16** and **18** which cooperate to define the outer winding surface of the mandrel throughout a major portion of its total circumference. In the embodiment under consideration, each of the shells **16** and **18** extend substantially the length of the free end portion of the shaft **12** and have a circumferential extent of slightly less than 180°.

Shell section **16** could be formed integrally with the center shaft **12** if desired; however, as best shown in FIGS. **2** and **3**, it is preferably a separate element and includes a center sleeve or hub portion **20** which is positioned about shaft **12** and non-rotatably connected thereto in any convenient manner such as through the use of keys **22**. The winding surface defining portion **17** is connected to hub **20** at its lower end and by spaced webs **24** which connect between the outer surface of hub **20** and the inner surface of portion **17** (see FIG. **1**). As best shown in FIG. **1**, the center hub **20** extends substantially the length of the shaft and is received against an enlarged diameter shoulder portion **26** formed at the inner end of the shaft. At the outer end, a circular retainer plate **28** engages a recess or shoulder formed in the free end of the hub. The retainer plate **28** is connected to the center shaft by a plurality of socket screws or the like **30** (see FIG. **2**). This arrangement allows the entire outer portion of the drum to be readily removed from the center shaft **12**, if desired.

As previously mentioned, winding drum assembly **10** is arranged so that its outer circumference can be selectively collapsed or contracted to permit ready withdrawal of a wound coil from the drum. For this reason, the shell **18** is mounted so that it can be moved in a generally radial direction relative to the center axis of the shaft. For this reason, the shell section **18** is pivotally connected along its upper edge by a shaft **32** which extends longitudinally of the drum. As seen in FIGS. **1** and **3**, a plurality of spaced, radially inwardly extending reinforcing ribs **30** having a tapered shape as best shown in FIG. **3**, connect to the back of the shell. As best shown in FIG. **1**, shaft **32** passes through aligned openings formed in each of the ribs **30** and the web sections **24**. Set screws **36** pass through web sections **24** to engage the shaft and prevent its rotation. Openings **38**, however, are sized so as to closely receive the shaft **32** while permitting free rotation so that oscillation of the shell section **18** is possible. Suitable collars **40** are connected at each end of the shaft to hold the shell section **18** properly located. As can be appreciated, the mounting arrangement for shell section **18** allows it to oscillate about the shaft **32** so that it can be moved from the expanding position shown in FIG. **2** to a collapsed or contracted position as shown in FIG. **3**. It is important to note that each of the sections **16** and **18** have a circumferential extent of less than 180°. This allows the effective winding diameter of the shell to be reduced for ready removal of a wound coil.

As is apparent, means must be provided for selectively actuating the shell section **18**. Additionally, means are generally required for gripping the lead end of a metal strip and holding it, particularly during the start of a winding operation. In the subject invention, the means for controlling drum expansion and gripping the lead end are combined into a single unit in a manner which greatly reduces the overall complexity of the device and allows a single power actuator to perform both functions.

Referring in particular to FIGS. **1** and **3**, it will be seen that an elongated actuating member **46** is carried in the lower portion of the drum (as viewed in FIGS. **1** and **3**) and extends the length of the drum. Member **46** comprises a relatively rigid metal bar which is mounted for radial reciprocation relative to the drum axis. The cross-sectional configuration of the actuator bar is best shown in FIG. **3**. Note that it has a first outer surface **48** that is contoured to form a continuation of the winding surface defined by shell members **16** and **18**. A pair of leg portions **50**, **52** extend upward from the main body of member **46** and define slide surfaces **54**, **56**, respectively. A suitable shaped opening **58** receives leg portion **50** and a similar opening **59** formed in the hub section **20** receives leg portion **56**. Guide blocks **60**, **62** are connected adjacent the recesses **58**, **59** and form a guideway for the member **46**. The guide blocks can be connected to the hub in any convenient manner but are shown as releasably connected by socket screws **64**, **66**, respectively. Note that each of the guide blocks closely and slidably engages respective ones of the slide surfaces **54**, **56**.

Referring in particular to FIGS. **2** and **3**, it will be noted that the member **46** has a second outer surface **70** which is inclined and arranged to engage a correspondingly inclined surface **72** formed on the lower free end of shell **18**. When member **46** is moved outwardly, surface **70** acts to wedge or cam the segment radially outward about the shaft **32** (i.e., counterclockwise as viewed in FIG. **2**). When the member **46** is moved radially inward to the position shown in FIG. **3**, the segment **18** can move inwardly to the solid line position causing an effective contraction of the outer circumference of the winding drum.

As can be appreciated, positive movement of the segment **18** in a radial outward direction is assured by the movement of the member **46**; however, to assure contractive movement, biasing means are provided to maintain the segment **18** under a continual bias in the radially inward direction. Means for accomplishing this could take many forms but, as best shown in FIGS. **1** and **2**, the means utilized in the subject embodiment comprise a tension spring member **80** connected between segments **16** and **18**. As shown in FIG. **2**, spring **80** is connected by studs **82** and **84**, respectively. The outer end of stud **82** is threaded and received in a flanged collar **86**. Collar **86** is positioned in a counterbroed opening **88** formed in segment **16**. The end of stud **84** is similarly threaded and received in a flanged collar **90** received in the counter-bored opening **92** formed in segment **18**. Collars **86** and **90** are preferably provided with transverse slots so that a screwdriver or the like can be used for rotating the sleeves to vary the tension on spring **80**. This arrangement assures that during inward retraction of the member **46**, the drum segment **18** will be moved radially inward to produce the required drum collapse or contraction.

Many different types of power arrangements could be used for moving the member **48** radially outward at the desired times. According to the preferred embodiment, the subject device utilizes a highly simple and easily constructed hydraulic actuator arrangement which can best be seen in FIGS. **1** and **4**. As shown, an elongated expansible hose member **94** extends substantially the length of the drum between the hub **20** and

the member **46.** At one end, the hose member **94** is folded over and connected to a plate **96** adjustably carried on the enlarged diameter portion **26** of center shaft **12** by a shoulder bolt **97** which passes through a slot in the plate and into the shaft. As best shown in FIG. **1,** the end of the hose is folded over at **98** and a short metal plate positioned thereover and connected by machine screws **100** which pass through the hose into plate **96.** The other end of the hose is arranged as shown in FIG. **4** and is folded over and closed by a pair of plates **102** and **104** interconnected by socket screws **106** which pass through the hose and plate **102** into threaded engagement with plate **104.**

FIG. **3** shows the hose **94** in its collapsed condition. To expand the hose, means are provided for supplying hydraulic fluid to its interior. As shown in FIG. **4,** the means comprise a threaded section of tubing **108** which is in fluid communication with the interior of the tube through a pair of plates **110** and **112.** Plate **112** is positioned inside the hose and has a threaded bore **114** which receives the end of tube **108.** The plate **110** is positioned exteriorly of the hose and several machine screws **116** pass through the plate **110** and hose **94** into tapped openings in plate **112.** An angle plate or bracket **120** is connected to the end plate **28** by a socket screw **122.** Plate **120** acts as a guide and inner stop for the outer end of the hose.

Hydraulic fluid is supplied to the tube **108** through a center bore **124** formed longitudinally of the center shaft assembly **12.** A suitable rotary fitting (not shown) connects the left-hand end of the bore **124** with a source of hydraulic fluid. The right-hand end of bore **124** is provided with an adaptor **126** which is connected through tubing **128, 130** and T-fitting **134** with the tube **108.** A bleed or drain valve **132** is connected to the T-fitting **134.**

As can be appreciated, expansion of the hose drives the member **48** outwardly causing the drum leaf or segment **18** to be expanded radially. Upon release of the hydraulic pressure within hose **94,** the member **48** can move radially inward. To assure the required radial inward movement upon release of the pressure, biasing means are provided which maintain the member **46** under a continual inward bias.

Referring to FIGS. **1** and **2,** the biasing means are shown as including a pair of tension springs positioned at the outer or right-hand end of the drum assembly and adjustably connected to the shells by assemblies **140** and **142.** Assembly **140** comprises a flanged sleeve **143** which is received in the counterbored opening **144** formed in sector **16.** A threaded stud **145** extends outwardly of sleeve **143** and receives the upper end of a tension spring **146.** The assembly **142** is identical in arrangement and comprises a flanged sleeve **148** received in a counter-bored opening **149** formed in the shell **18.** The threaded stud **150** receives the end of tension spring **151.** The lower ends of springs **146** and **151** are connected to a generally U-shaped plate **153** attached to the outer end of member **46** by a plurality of socket head machine screws **152.** Accordingly, the member **146** is continually maintained under an upward bias and moves radially inward under the influence of the springs whenever the hydraulic pressure is relieved from within the hose **94.**

The simplicity of the expansible drum thus far described is apparent. Note that only two moving machine parts are required to perform the expansion and contraction functions. Additionally, no special machining or complex hydraulic or mechanical actuators are required to produce the necessary movement. Further, all parts are arranged for ready disassembly for maintenance or repair.

As previously mentioned, when the drum is used as a rewind drum, means must be provided for gripping the lead end of the strip at the start of a winding operation. In the subject device, the gripping mechanism is interrelated with the expanding and contracting mechanism so as to produce further simplification in the overall drum structure. Referring in particular to Figures **1, 2** and **5,** it will be seen that the left-hand portion of member **46** (as viewed in FIG. **3**) has an elongated slot **155** formed the length thereof. Slot **155** receives gripper jaw segments **156** which are spaced uniformly along the length of the drum. Each of the gripper jaw segments are mounted for independent relative movement so that the assembly can grip strip which is of nonuniform thickness across its width. The segments **156** are preferably provided with a serrated inclined edge **157** adapted to cooperate with a correspondingly inclined surface formed on member **62.** As mentioned, each of the gripper bars **156** are mounted for independent relative movement. As shown in FIG. **3,** bars **156** are slidably received within the elongated groove **155.** They are maintained therein by shoulder screws **157** which engage in suitable tapped openings formed in the bottom of the groove **155.** Compression springs **158** are positioned about each of the screws **157** and maintain the jaws continually biased outwardly in the groove **155.**

FIG. **3** shows the position of the jaws when the member **46** is in the radially contracted position. Note that a substantial space is present between the serrated edge **157** and the cooperating surface on member **62.** This allows the lead end of a metal strip, for example, strip **160,** to be inserted between the gripper jaw segments and members **62.** Thereafter, expansion of the drum and the outward movement of member **46** causes the serrated edge to engage the strip and clamp it firmly against members **62.** The springs allow individual variations in the position of the segments to compensate for differences in thickness of the strip across its width.

Referring now to FIGS. **6** and **7,** a modified form of actuating member and power arrangement is shown. The FIGS. **6** and **7** embodiment is substantially the same in all details as the FIGS. **1** through **5** embodiment. The primary differences reside in the mounting and actuating of the segment drive members. Accordingly, only this portion is shown in detail.

In particular, in this embodiment, the center shaft **200** is provided with a generally T-shaped groove **202** which extends along its lower surface. Positioned within the groove or T-slot **202** and arranged for reciprocation therein is a slide member **204.** Member **204** is preferably made from a material such as brass or the like so as to have a good sliding coefficient of friction with the steel center shaft **200.** Carried from the slide member **204** by a pair of pivot link assemblies **206** is the actuating member **208.**

Broadly, actuating member **208** is of the same general construction as the actuating member **46** of the FIGS. **1** through **5** embodiment. As shown, it has a lower surface **210** which defines a continuation of the winding surface formed by the two outer shells. Also, it has an inclined cam surface **209** which serves to actu-

ate the pivotal shell member. The actuating member **208** is slidably mounted for radial reciprocation in a groove or slot **210** formed in the sleeve or hub portion **212.** As shown in FIG. **7,** the actuating member **208** has a generally U-shaped cross-section and the two legs of the member extend upwardly and engage the side walls of the groove **210.** In the left-hand leg (as viewed in FIG. 7), a strip clamp assembly **216** is arranged to cooperate with the left-hand shell for clamping the lead end of a strip. The clamp assembly **216** is identical in construction to the clamp assembly described in detail with reference to the embodiment of FIGS. **1** through **5.** Accordingly, further description is not required.

Of importance to the subject embodiment is the arrangement used for causing selective radial reciprocation of the actuating member **208.** As best shown in FIG. **6,** the actuating member **208** is supported from the slide member **204** by the previously mentioned link assemblies **206.** Member **208** is mounted so that it can have radial movement but is prevented from moving longitudinally of the shaft. This is accomplished by a transversely positioned slide or guide member **210** which extends downwardly from the center shaft **200.** The guide member **210** extends into slots **220** formed in the left-hand ends of the leg portions of member **208** (as viewed in FIG. **6**). As can be appreciated, member **210** allows the actuating member to move radially but prevents longitudinal movement.

The link assemblies **206** comprise links **221** and **222** of standard, commercially available roller chain. The links are connected at their opposite ends to the slide member **204** and the actuating member **208.** As best shown in FIG. **7,** the upper ends of links **221** and **222** are respectively connected to elongated bars **223** and **224.** The bars are welded to the rollers and releasably connected to the slide member **204** by socket head machine screws **226** (see FIG. **6**). The lower ends of the links are similarly joined to elongated bars **227** and **228,** respectively. Bars **227** and **228** are connected to the actuating member **208** by screws **230** which extend through counterbored openings formed through actuating member **208** into threaded openings in the bar members.

As can be appreciated, by reciprocating slide member **204** to the right, the actuating member is caused to move radially inward from the position shown in FIG. **6.** Conversely, movement to the left causes the actuating member to be moved radially outward. The extent of outward movement can be varied by stop blocks or the like positioned in the T-groove **202.** During movement of the actuating member, the pivotal shell is caused to move radially in the manner described with reference to the FIGS. **1** through **5** embodiment.

Many different types of power means could be used for moving slide member **204;** however, in the subject embodiment, the preferred means comprise a threaded shaft **232** carried in a support plate **234** which is connected to the outer end of center shaft **200** by screws **236.** The inner end of shaft **232** has a reduced diameter portion **238** which is rotatably received within opening **240** of a push block **242.** Block **242** is joined to the right-hand end of slide member **204** in any convenient manner, such as by welding. It will be noted that a thrust bearing **244** is positioned between block **242** and shoulder **248** on shaft **232.** The inner end of shaft **232** is provided with a snap ring **250** which maintains it releasably connected to block **242** while permitting it to rotate relative thereto. As can be appreciated, rotation of shaft **232** causes it to impart movement to slide member **204.** The outer end of shaft **232** is preferably provided with crank or tool receiving flats **249** so that it can be manually rotated.

The invention has been described in great detail sufficient to enable one of ordinary skill in the winding art to make and use the same. Obviously, modifications and alterations of the preferred embodiment will occur to others upon a reading and understanding of the specification and it is our intention to include all such modifications and alterations as part of our invention insofar as they come within the scope of the appended claims.

What is claimed is:

1. An expansible drum assembly for winding or unwinding strip material comprising:

a center shaft adapted to be cantileverly supported and carrying first and second arcuate outer shells which define all but a portion of the winding surface and extend throughout a substantial portion of the length of the shaft;

each of the shells having a circumferential extent of less than 180°;

said first shell being rigidly affixed to said shaft and second shell being pivotally connected to the structure defined by the first shell and the shaft about an axis adjacent to one of the longitudinal edges of the second shell;

biasing means for maintaining the second shell continuously biased in an inward direction;

actuating means comprising an elongated actuating member between said shells and mounted for radial sliding movement, said actuating member having a first surface which forms said portion of the winding surface and a second surface which engages the free end portion of the second shell; and,

drive means for selectively moving the member radially outward to cause the second shell to move outwardly against the biasing means to expand the shell.

2. The assembly as defined in claim **1** wherein said actuating member is carried by pivot link assemblies.

3. The assembly as defined in claim **1** wherein said drive means includes an expansible hose member positioned between said actuating member and said shaft.

4. The assembly as defined in claim **1** including strip gripping means, said gripping means including a first gripping jaw carried on said actuating member and a second gripping jaw carried by the first shell and located so that during outward movement of the actuating member, the jaws engage.

5. The assembly as defined in claim **4** wherein at least one of the gripping jaws comprises a series of separate sections, each of said sections being independently biased toward the other gripping jaw.

6. The assembly as defined in claim **1** wherein said second shell has a cam surface formed along its free edge and wherein said actuating member is positioned to engage said cam surface upon outward radial movement.

7. The assembly as defined in claim **1** wherein said drive means comprise a member adapted to be moved longitudinally to impart radial movement to said actuating member.

8. The assembly as defined in claim 1 wherein said actuating member is carried from said shaft by a slide member mounted for longitudinal movement.

9. The assembly as defined in claim 8 wherein pivot links connect said actuating member to said slide member.

10. The assembly as defined in claim 1 wherein said drive means comprise an expansible member positioned between said shaft and said actuating member.

11. The assembly as defined in claim 10 wherein said expansible member comprises a hose extending longitudinally of said shaft.

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