

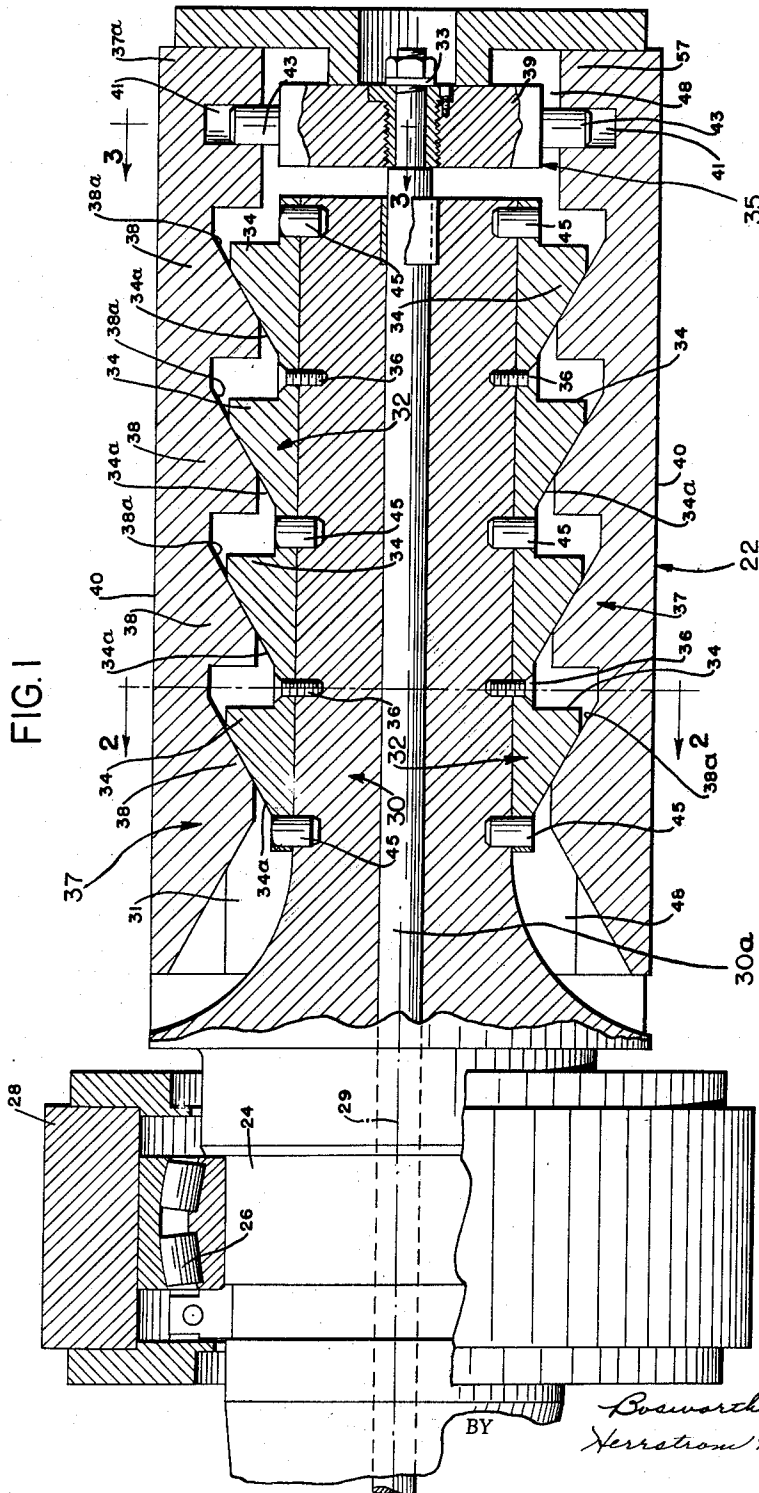
Jan. 12, 1960

J. K. WINGARD
TENSION REEL JAW

2,920,837

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4 Sheets-Sheet 1



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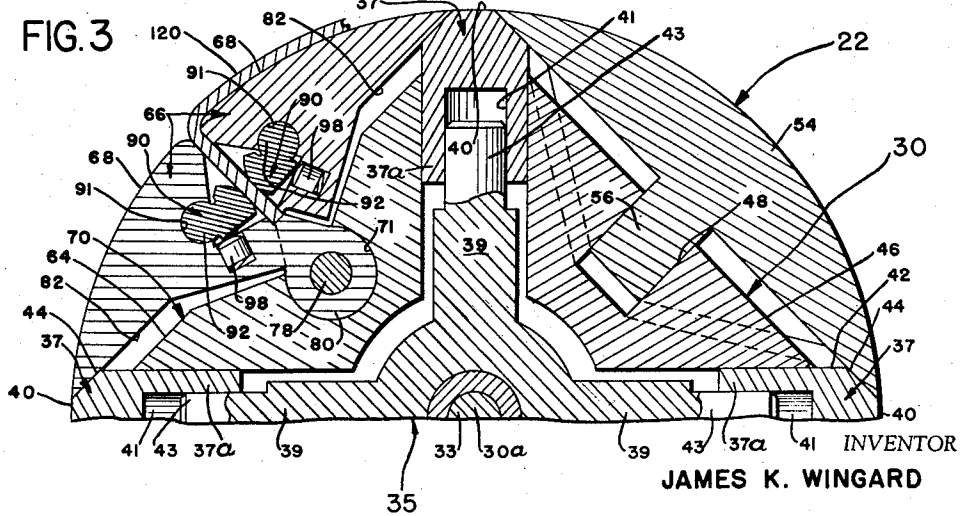
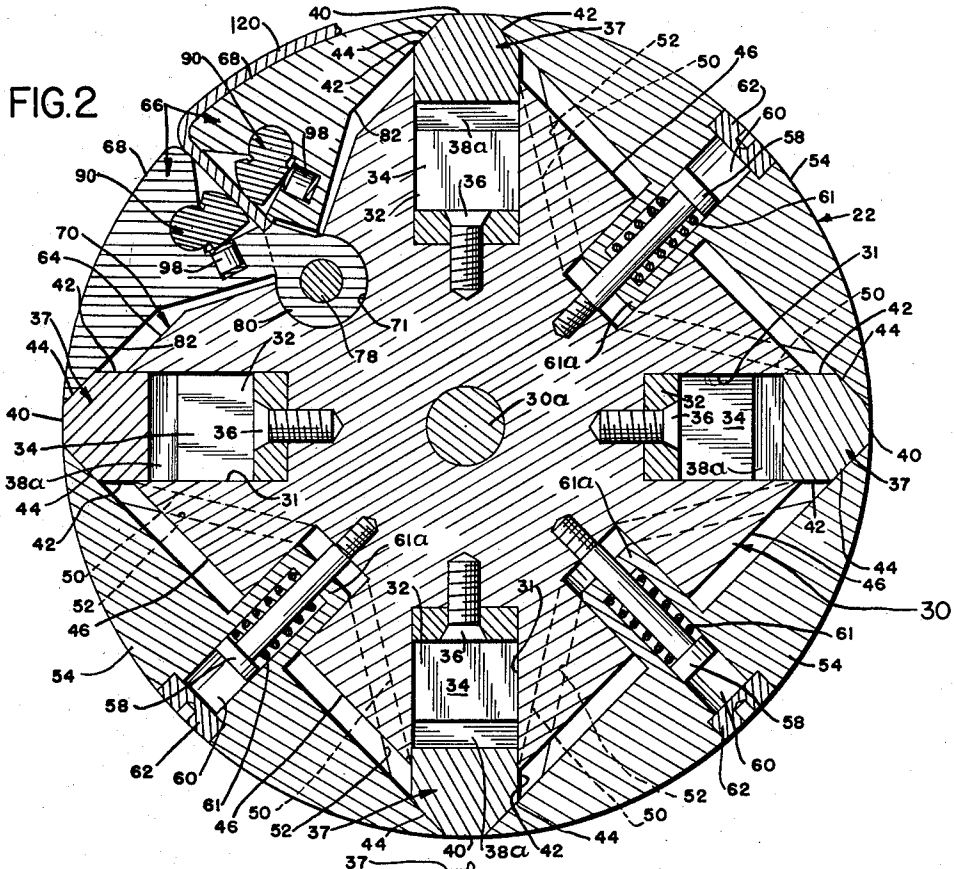
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4 Sheets-Sheet 3

FIG. 4

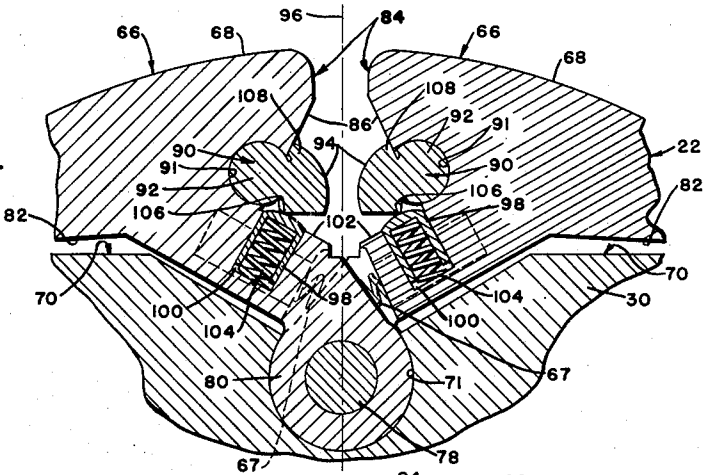


FIG. 5

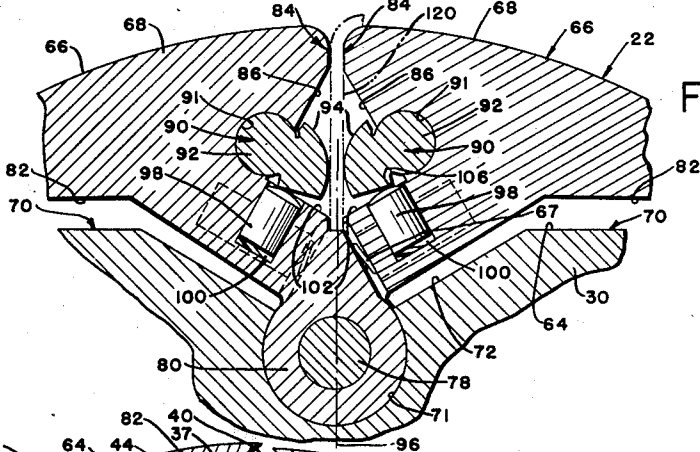
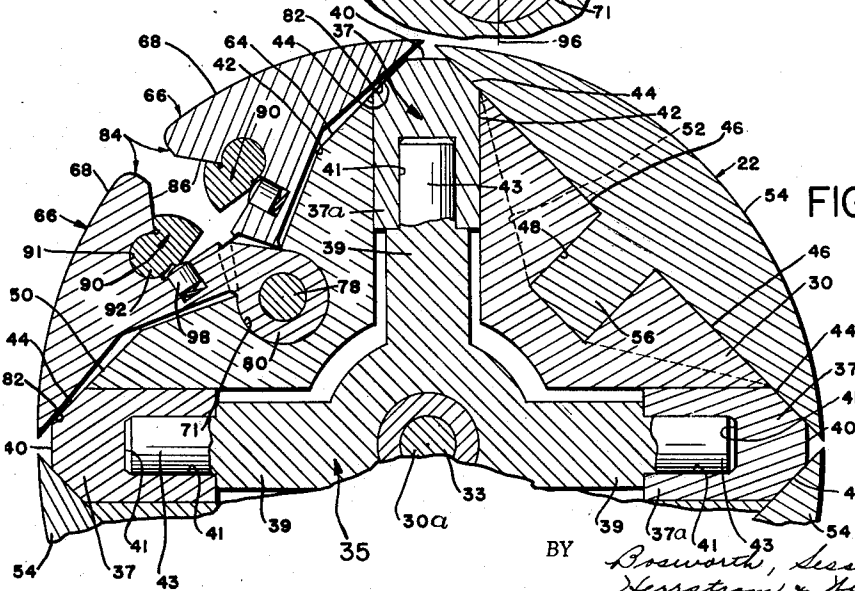


FIG. 6



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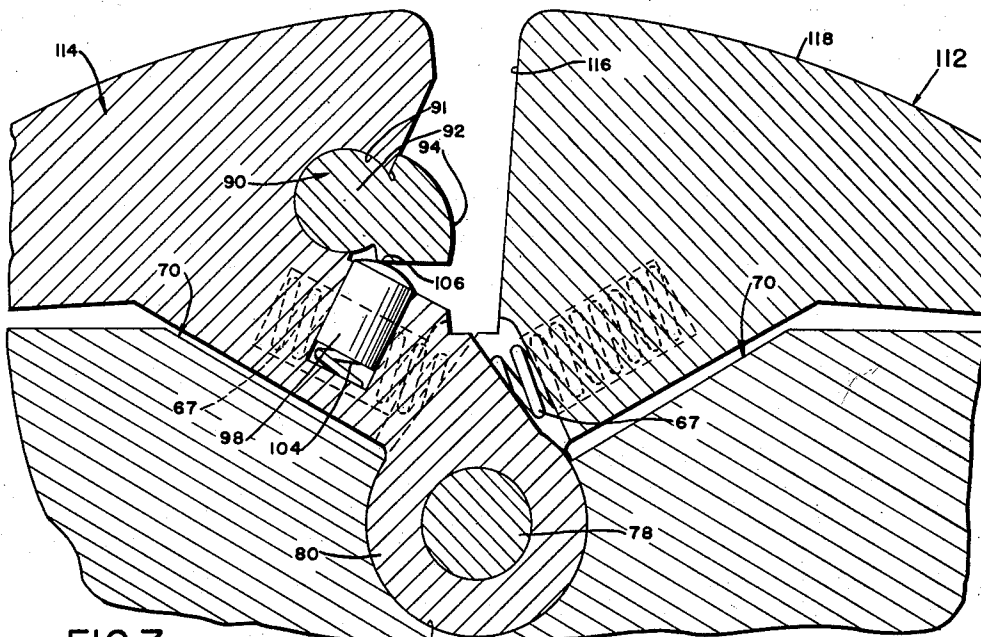


FIG. 7

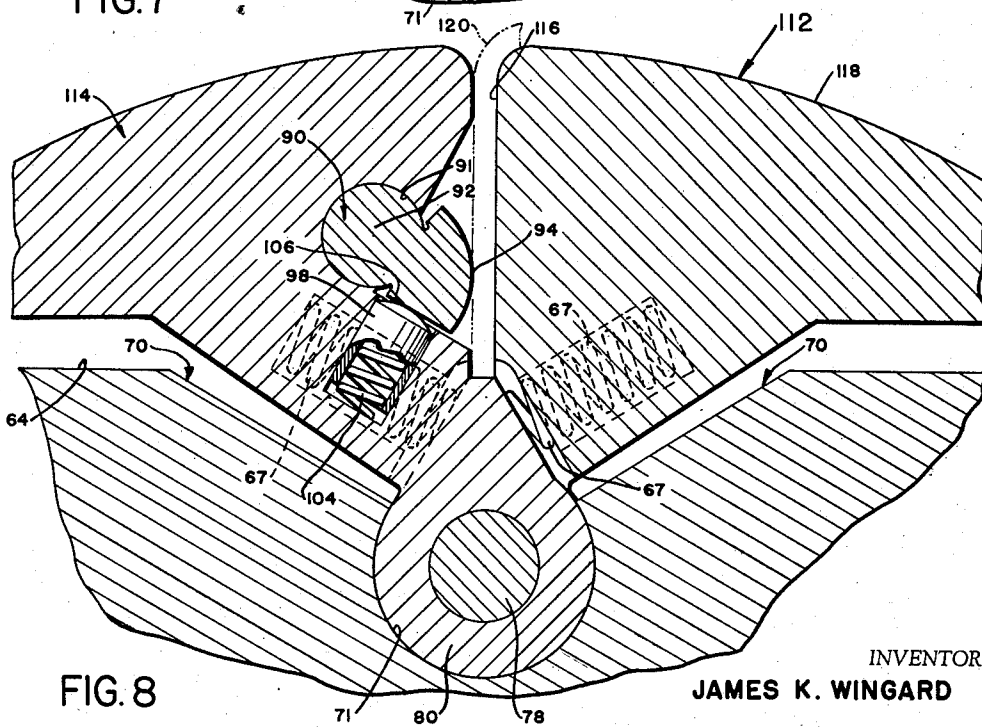


FIG. 8

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1

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TENSION REEL JAW

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Application August 4, 1954, Serial No. 447,855

11 Claims. (Cl. 242—72)

This invention relates in general to winding and reeling apparatus and more particularly to apparatus for winding and reeling continuous strip metal under conditions of high tension at one end of a rolling mill or the like.

It is well known that when winding strip metal under high tension, very severe forces build up on a coiling mandrel as the number of convolutions increase on the coil. It has been submitted that the total force on a mandrel approaches the summation of the individual forces caused by the contractive effort of each layer of strip metal and that the direction in which the force acts is radially towards the mandrel.

It is common practice, therefore, to employ a coil supporting mandrel, the circumference of which may be expanded prior to winding a coil and which may be collapsed when the coil is completed in order that the coil may be removed from the mandrel after a coiling operation. These collapsible mandrels usually comprise a mandrel shaft adapted to support a plurality of cylindrical segments aligned longitudinally and spaced circumferentially thereon to form a cylindrical surface thereabout. Means are also secured on said mandrel shaft, such as slidable wedge blocks, radially to expand and contract the cylindrical segments about the mandrel shaft.

In a common type of expanding mandrel having slidable wedge blocks to expand the cylindrical surface of the mandrel, any suitable device such as a spider may be employed to engage the wedge block ends so that axial movement of the spider provides a combination axial and radial movement of the wedge blocks. The spider is usually secured to an actuating rod extending through the center of the mandrel shaft and this rod is longitudinally reciprocable by fluid pressure means, mechanical means or the like. If, however, one of the wedge blocks should for any reason freeze or become stuck during the expansion of the mandrel, or the movement of any of the cylindrical segments should become restricted, the radially outward movement of the other wedge blocks will tend to tip the spider on the end of its actuating rod and tip the cylindrical segments adjacent the jammed wedge block, thereby bending, cracking or otherwise damaging these members.

For instance, in expanding mandrels which grip the metal strip on its end by crimping or bending the metal, a tooth is secured to one longitudinal edge of a pivotal cylindrical mandrel segment to force the metal into a recess or cavity formed opposite the tooth in an adjacent cylindrical segment. When the metal is the proper thickness and is forced well within the said recess, the tooth carrying cylindrical segment will be enabled to pivot into cylindrical alignment with the other segments to form a smooth cylindrical expanded mandrel surface. However, should the thickness of the metal exceed the permissible tolerance between the tooth and its mating recess, then the tooth carrying pivotal cylindrical segment will be prevented from pivoting into a fully expanded position thereby setting up the chain of events set forth hereinabove with resulting damage to the mandrel.

2

Heretofore it has been necessary to replace the tooth for one of different size each time a coil of different thickness was to be wound. Since this is time consuming, and if the operator has but a few coils to run of one metal thickness, rather than change the gripping tooth, he will usually prefer and may attempt to coil the strip with a partially expanded mandrel. Consequent damage to the mandrel thereafter oftentimes ensues.

Thus, inasmuch as most known collapsible mandrels are threaded in the collapsed state and then expanded to grip the end of the strip of metal, damage due to jamming, therefore, presents a serious problem in servicing and maintaining winding and reeling apparatus in operable condition.

Accordingly, it is a general object of the present invention to provide an improved coiling mandrel having a universal metal securing means which will grip metal sheet irrespective of thickness without jamming the mandrel parts. Other objects of the invention include the provision of an improved mandrel which will receive the end of a strip of metal therein whether said mandrel is expanded or collapsed; the provision of improved cylindrical segments secured to the mandrel to accommodate strip material therebetween; the provision of improved gripping means for securing the end of a strip of metal in the mandrel; the provision of improved gripping means which will permit strip metal to pass inwardly and outwardly therebetween when said mandrel is collapsed and which will allow said strip metal to pass inwardly therebetween and be securely gripped against outward movement when said mandrel is expanded; the provision of improved automatically operating gripping means which cooperate to secure and to release strip metal therebetween; and the provision of metal gripping mandrel jaws which are stronger, easier to use and require less maintenance than jaws heretofore in use.

To the attainment of these and other new and useful objects as will appear hereinafter, the invention consists in the features of novelty more fully described, claimed and shown in the accompanying drawings which illustrate preferred embodiment of the invention and in which:

Figure 1 is a sectional view of the mandrel showing in the mandrel expanded position the several elements of the mandrel including the sliding wedge blocks, the wedge block engaging spider and the spider actuating rod,

Figure 2 is a vertical section of the mandrel taken on line 2—2 of Figure 1, to show yet another view of the parts seen in Figure 1 and also to show in section a pair of pivotal cylindrical segments and a preferred form of a pair of pivotal gripping jaws carried by said pair of pivotal cylindrical segments,

Figure 3 is a vertical partial section taken on the line 3—3 of Figure 1 to show yet another view of the spider and associated members when the mandrel is expanded,

Figure 4 is an enlarged fragmentary sectional view of the mandrel showing the pivotal cylindrical segments and the gripping jaws in the collapsed position,

Figure 5 is an enlarged fragmentary sectional view similar to that of Figure 4 but showing the pivotal cylindrical segments and the gripping jaws in the expanded position,

Figure 6 is a fragmentary sectional view of the mandrel similar to that of Figure 3, but showing the cylindrical segments in the collapsed position,

Figure 7 is an enlarged fragmentary sectional view of a modified form of the gripping means in the collapsed position, and

Figure 8 is an enlarged fragmentary sectional view similar to that of Figure 7 and showing the position of the gripping means when the mandrel is expanded.

Referring now to the drawings, one embodiment of a

3

winding and reeling mechanism incorporating the invention is illustrated in Figure 1 and generally includes a radially expanding mandrel 22 having a journal portion 24 extending from one end thereof and rotatably mounted in roller bearings 26 which are carried in a housing 28. The housing 28 is integral with a mandrel supporting frame (not shown) and the journal portion 24 is coupled to a driveshaft and motor drive means (not shown).

More specifically, the mandrel 22 comprises a substantially rectangular mandrel shaft 30 (see Figure 2) which is provided with slots 31 extending longitudinally along each corner edge of the mandrel shaft to encase a set of wedge bars 32 (see also Figure 1). The upper surface of each bar 32 comprises an integral series of wedge blocks 34 which form a so-called "saw tooth" configuration. The bars 32 are secured to the mandrel shaft 30 with screws 36 and dowels 45 which pass through the bars into the said mandrel shaft 30. A second set of wedge bars 37 have a like series of wedge blocks 38 extending downwardly to match with wedge blocks 34 for sliding contact between adjacent inclined planes 34a and 38a. The upper surfaces 40 of bars 37 are slightly convex with radii substantially equal to the radius of the mandrel 22, and the sides 42 (see Figure 2) are beveled adjacent the curved surfaces 40 to provide bearing surfaces 44, the function of which will be set forth more fully hereinafter.

The mandrel shaft 30 is bored along its longitudinal axis 29 to house a mandrel expanding rod 30a (see Figure 1) which is secured near the journal end 24 of the mandrel 22 to reciprocating means (not shown), and carries on its outboard end 33 a spider 35. The spider 35 is provided with radially extending arms (see also Figures 3 and 6). The outboard ends 37a of wedge bars 37 have blind holes 41 formed therein to receive pins 43 which are rigidly secured to the end portions of the spider arms 39.

Movement of the actuating rod 30a outwardly, or to the right as seen in Figure 1, along the longitudinal axis 29 of the mandrel 22 carries the spider 35 and attached bars 37 with it in the same longitudinal direction. The opposed faces of the wedge blocks 34a and 38a are so inclined that the movement of the outer wedge bars 37 is radial as well as axial, thereby moving the cylindrical segments 54 outwardly to expand the mandrel 22. As the outer wedge bars 37 move radially outward, the outboard end portions 37a are engaged by the spider pins 43 in holes 41 and are drawn outwardly away from the pins so that the length of the pins and the depth of the holes in the end portions must be calibrated to prevent disengagement between the spider 35 and the wedge bars 37.

In order to collapse the mandrel, the actuating rod 30a is moved axially to the left, as seen in Figure 1, which causes the spider 35 to push the outer wedge bars 37 downwardly along the inclined surfaces 34a and 38a of wedge blocks 34 and 38. At the same time, the outboard end portions 37a move downwardly fully to encase the spider pins 43. When the mandrel 22 is in the full collapsed position, the wedge blocks 38 fit between the wedge blocks 34 of the wedge bar 32.

The faces 46 of the mandrel shaft 30 (see Figure 3) are provided with pairs of slots 48 at the opposite ends of the shaft and the opposite end portions 56 of the undersides of the cylindrical segments 54 are fitted to be received within these slots 48. The cylindrical segments 54 are secured to the mandrel shaft 30 by means of bolts 58 (see Figure 2) which are housed in counterbored holes 60 of end portions 56 and slidingly pass therethrough to engage threadedly the mandrel shaft 30. Springs 61 are placed in the counterbored holes 60 between the undersides of the bolt heads and the shoulders 61a of the said holes to urge the cylindrical segments 54 radially toward the center of the mandrel shaft 30. The bolt holes 60 are capped with plugs 62 which are made flush with the surface of the segments 54. The outer surfaces of the cylindrical segments 54 are cylindrically curved and have

4

radii substantially equal to the radius of the mandrel 22, each surface being substantially a quadrant of a circle. The under surfaces of the cylindrical segments 54 are provided with V-shaped reinforcing webs 52 (see Figures 2 and 6) which are received within V-shaped matching recesses 50 (Figure 2) provided in respective adjacent faces 46 of the mandrel shaft 30. Wedge bars 37 (see Figure 2) are positioned longitudinally beneath the under surfaces of adjacent pairs of cylindrical segments 54 and are provided with the said beveled surfaces 44 to make contact therewith. Thus it may be seen that as wedge bars 37 are moved radially outwardly from the center of the mandrel shaft 30, the cylindrical segments 54 will be likewise carried radially outwardly on beveled surfaces 44 of wedge bars 37. The discussion of the cylindrical segments set forth hereinabove pertains to three faces of the mandrel shaft only, the fourth face 64 being especially adapted to carry the sheet metal gripping means as will now be set forth more fully.

In lieu of a fourth cylindrical segment adjacent the fourth face 70 of the mandrel shaft to complete the encirclement of the mandrel shaft 30, a pair of cylindrical segments 66 are pivotally secured in a cylindrical slot or groove 71 machined in the aforesaid fourth face 70. The outer surface 68 of each cylindrical segment 66 is cylindrically curved to encompass substantially one-eighth of the circumference of the mandrel so that this pair of pivotal segments, taken in combination with the three radially adjustable cylindrical segments 54, provides a substantially cylindrical surface extending entirely about the mandrel shaft 30.

As shown in Figure 2, a hinge pin 78 extends longitudinally through the cylindrical slot 71 of the mandrel shaft 30 and the lower edges of the cylindrical segments 66 are fitted with gudgeons 80 to encircle alternately the hinge pin 78 in a hinge-like fashion. The use of a hinge pin is optional depending on the strength of the undercut portions of the mandrel shaft encasing the gudgeons 80 and may be omitted where expedient to do so. The edge undersurfaces 82 of the segments 66 are contacted by adjacent beveled surfaces 44 of the wedge bars 37 and whereas outward movement of these wedge bars cause cylindrical segments 54 to move radially outward therewith, the cylindrical segments 66 are caused to pivot in opposite directions outwardly about hinge pin 78. Conversely, as the wedge bars 37 recede inwardly into matching contact with wedge bars 32, cylindrical segments 66 pivot inwardly about hinge pin 78 toward the mandrel shaft 30. As wedge bars 37 are drawn inwardly toward the axis of the mandrel shaft, springs 67 (see Figure 4) bear against opposite segments 66 to force the segments pivotally downwardly in bearing contact with the said wedge bars 37 (see also Figures 7 and 8).

The adjacent longitudinal edges 84 of the cylindrical segments 66 (see Figures 4 and 5) are rounded near outer surfaces 68 and extend downwardly to meet inclined faces 86 which form a cavity therebetween. Gripping jaws 90 have cylindrical base portions 92 which are housed in and extend longitudinally through cylindrical grooves or slots 91 of segments 66 and are fitted to pivot therein. The jaws are comprised of series of short lengths to compensate for varying thicknesses of the metal from edge to edge across its width. Hinge pins (not shown) may optionally be used to secure the jaws in the segments 66 in the same manner as segments 66 may be hingedly pivoted in mandrel shaft 30 and as set forth hereinabove. Arcuately shaped gripping portions 94 are integrally secured to the base portions 92 and are adapted to approach a common center line 96 therebetween when rotated outwardly toward the peripheral surface of the mandrel 22. When the mandrel 22 is fully expanded and the gripping portions 94 are thus outwardly rotated, they will seize and hold any strip sheet material which is placed therebetween and will not release this grip until the mandrel has been collapsed. The surfaces of gripping por-

5

tions 94 may be serrated or otherwise prepared to assist in holding the interposed sheet material by means well known to those skilled in the art.

When the mandrel 22 is fully collapsed (see Figure 4) and the cylindrical segments 66 have been pivoted inwardly to rest on inclined or beveled surfaces 44 of wedge blocks 37, gripping jaws 90 are spaced sufficiently apart to permit the sheet material to pass freely therebetween without being gripped by the jaws. In the fully expanded position (see Figure 5) opposed edges 84 of the cylindrical segments 66 are sufficiently spaced apart to permit the insertion of the end of a strip of sheet material, and sufficient clearance is provided between the gripping jaws 90 and the inwardly inclined surfaces 86 to permit the gripping jaws to rotate away from the metal strip. However, when the direction of the metal strip is reversed, the gripping jaws 90 will seize the strip therebetween and hold it securely. If the mandrel is to wind and reel alternately first to the right and then to the left, the shoulders 84 may be relieved to reduce the bend of the metal leading into the jaws 90.

To assist in this gripping action of the jaws, a series of spring-loaded buttons 98 (see Figure 4) are contained in holes 100 below surfaces 102 of segments 66. The buttons 98 are forced outwardly against lower shoulders 106 of the gripping jaws 90 by springs 104. These buttons 98 tend to pivot the gripping jaws outwardly into contact with any strip material placed therebetween. The limit of the pivotal movement of the gripping jaws is defined by lower shoulders 106 which bear against the aforesaid spring-urged buttons 98 and upper shoulders 108 which make abutting contact with surfaces 86 when no metal strip is interposed therebetween. Thus, the gripping jaws 90 pivot downwardly until the lower shoulders 106 contact surfaces 102 and upwardly until contact is made as aforesaid between the upper shoulders 108 and the inwardly inclined surfaces 86.

In a modification of the apparatus (see Figures 7 and 8), only one gripping jaw 90 is employed in combination with a modified cylindrical segment 112 opposed to the cylindrical segment 114 which pivotally carries the gripping jaw. The single gripping jaw 90 is contained in its cylindrical segment 114 in the same manner as described hereinabove relative to the pair of gripping jaws, but the opposed cylindrical member 112 carries no gripping jaw counterpart and instead of having an inwardly inclined surface 86 such as shown in Figures 4 and 5, segment 112 is provided with a modified surface 116 which extends downwardly from outer cylindrical surface 118 approximately parallel to the adjacent surface of sheet material placed between the cylindrical segments 112 and 114.

When the mandrel 22 is in the collapsed position (see Figure 7), metal strip 120 may be threaded between the cylindrical segments 112 and 114 and the spacing between surface 116 and the gripping surface 94 of the jaw 90 is such that the strip metal will pass freely therebetween. However, when the mandrel is expanded (see Figure 8), the space between surface 116 and the gripping jaw surface 94 is so reduced that the end of a piece of metal strip 120 placed alongside of surface 116 of segment 112 will be engaged by spring-urged buttons 98. This embodiment of the invention may be employed where winding or reeling in one direction only is contemplated.

From the foregoing, it will be evident that the preferred embodiments of the invention as heretofore described provide universal tension reels which will not jam regardless of the thickness of the sheet metal received therebetween and, if necessary, may be fully expanded prior to threading the ends of strip metal therein. If all of the cylindrical segments are not fully expanded, an inspection will determine this fact and correcting adjustments may be made before damage is suffered by the reel.

It is to be understood that changes and modifications may be made in the preferred forms of the invention dis-

6

closed herein without departing from the spirit and scope of the invention.

I claim:

1. In an expanding mandrel for winding and reeling, the improvement in sheet material securing means comprising a mandrel shaft, a pair of cylindrical segments hingedly secured to said mandrel shaft for pivotal hinged movement relative thereto about a common hinge pin, said pair of cylindrical segments comprising a minor portion of the periphery of said mandrel, a pair of jaws pivotally secured to opposed faces of said hinged cylindrical segments, said jaws having opposed cam-shaped gripping surfaces adapted to approach a common center line when said jaws are pivoted outwardly.

2. In an expanding mandrel for winding and reeling, the improvement in sheet material securing means comprising a mandrel shaft, a pair of cylindrical segments hingedly secured to said mandrel shaft for pivotal hinged movement relative thereto, said cylindrical segments having opposed undercut faces, a pair of jaws pivotally secured to said faces, said jaws having opposed arcuately shaped gripping surfaces adapted to approach each other as said jaws are pivoted outwardly toward the periphery of said cylindrical segments, whereby sheet material may be inserted between said cylindrical segments and be securely gripped against removal by said pair of jaws.

3. The apparatus set forth in claim 2, wherein when said mandrel is collapsed, said jaws are spaced apart to permit sheet material to pass freely therebetween.

4. The apparatus set forth in claim 2, wherein the outer limit of pivotal movement of said jaws is defined by said undercut faces and upper shoulders on said jaws adapted to abut against said faces.

5. The apparatus set forth in claim 2, including upper and lower shoulders integrally formed on opposite sides of said jaws, said upper shoulders being adapted to bear against said faces to delimit upward pivotal movement of said jaws, and resilient means adapted to bear against said lower shoulders to delimit downward pivotal movement of said jaws and to urge said jaws upwardly.

6. In an expanding mandrel for winding and reeling having a mandrel shaft, a series of expanding wedge means circumferentially arranged on said mandrel shaft, and a series of cylindrical segments circumferentially arranged between said wedge means for overlapping contact therewith, the improvement comprising a pair of cylindrical segments hingedly secured to said mandrel shaft, said pair of cylindrical segments having opposed recessed faces, a pair of jaws pivotally secured in said recessed faces, said jaws having arcuately shaped gripping surfaces adapted to approach each other as said jaws are pivoted outwardly toward the periphery of said mandrel and to recede from each other when said jaws are counter-pivoted toward the center of said mandrel, and resilient means adapted to urge pivotally said jaws outwardly, whereby sheet material threaded inwardly between said jaws will be automatically gripped against removal therebetween.

7. An expanding mandrel for winding and reeling, including a mandrel shaft rotatably supported adjacent one end, said shaft having a series of longitudinal extending radially aligned slots, a series of cylindrical segments arranged circumferentially on said mandrel shaft between and partially overlapping adjacent slots, an expanding member mounted in each slot having a series of longitudinally arranged outwardly facing wedge-like portions, a second expanding member mounted in each slot having a series of longitudinally arranged inwardly facing wedge-like portions, the said second expanding members being retained in said slots by the undersurfaces of said overlapping cylindrical segments, an actuator shaft extending through said mandrel shaft, and a spider secured to one end of said actuator shaft adapted to engage said second expanding members, a pair of cylindrical segments hingedly secured to said mandrel shaft between a pair

of said series of slots, the outside longitudinal edges of said pair of cylindrical segments partially overlapping adjacent slots and the inside longitudinal edges being spaced apart to provide hinged movement therebetween, a pair of cam-shaped jaws pivotally secured to opposed inside faces of said segments, and means outwardly to pivot said jaws into gripping contact with each other, whereby sheet material threaded inwardly between said segments will pass between and spread apart said jaws and reverse movement of said sheet material will cause said means to counterpivot said jaws and to grip and lock said sheet material therebetween.

8. In an expanding mandrel for winding and reeling having a mandrel shaft, and a plurality of expanding wedge means circumferentially arranged on said mandrel shaft, the improvement comprising a cylindrical slot extending longitudinally along said mandrel shaft parallel to and midway between a pair of said wedge means, a pair of cylindrical segments lying on opposite sides of said cylindrical slot and hingedly secured therein, said cylindrical segments having opposed recessed faces, the edges of said cylindrical segments remote from said opposed recessed faces overlaying adjacent wedge means for equal and opposite pivotal movement about the axis of said cylindrical slot as said wedge means are expanded or contracted, a pair of jaws pivotally secured in said recessed faces, said jaws having arcuately shaped gripping surfaces adapted to approach each other as said jaws are pivoted outwardly toward the periphery of said mandrel and to recede from each other when said jaws are counter-pivoted toward the center of said mandrel, said jaws being adapted to grip material therebetween when

said cylindrical segments are pivoted toward each other by said expanding wedges.

9. The apparatus set forth in claim 8, wherein said jaws are spaced apart to permit material to pass freely therebetween when said cylindrical segments are pivoted fully away from each other.

10. The apparatus set forth in claim 8, including resilient means to urge said jaws pivotally outward toward the periphery of said mandrel, said jaws being adapted to resist additional pivotal movement when said gripping surfaces are closest together, the smallest space between said gripping surfaces being sufficient to permit the passage of material therebetween when said cylindrical elements have been pivoted fully away from each other.

11. The apparatus set forth in claim 8, including resilient means pivotally to urge said jaws outwardly toward the periphery of said mandrel until the arcuate gripping surfaces of said jaws are closest together, whereby when said mandrel is fully expanded, material may be inserted between said cylindrical segments to wedge said jaws apart sufficiently to be received and securely gripped therebetween.

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