May 27, 1969 W. G. SHERWOOD 3,446,450

TENSION REEL GRIPPER MECHANISM

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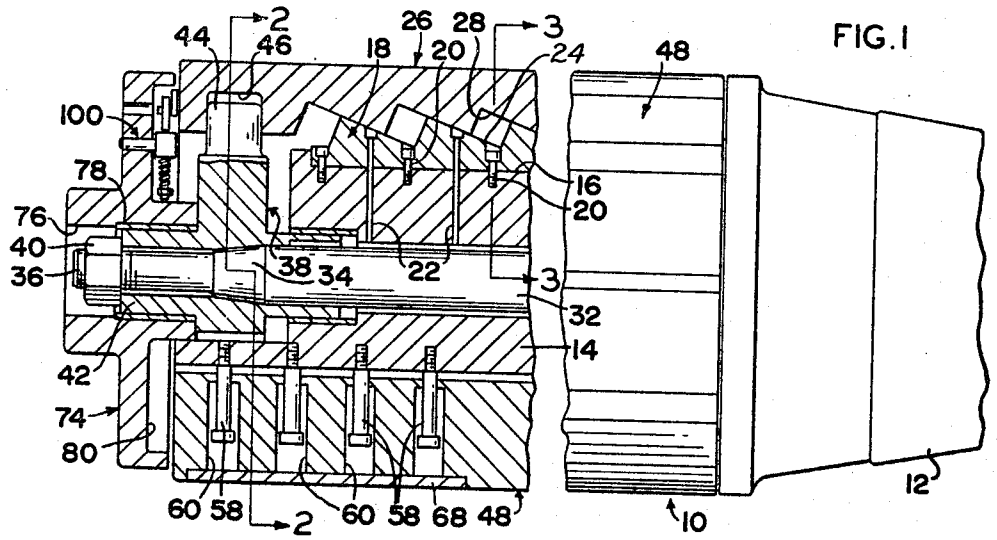
FIG. 1



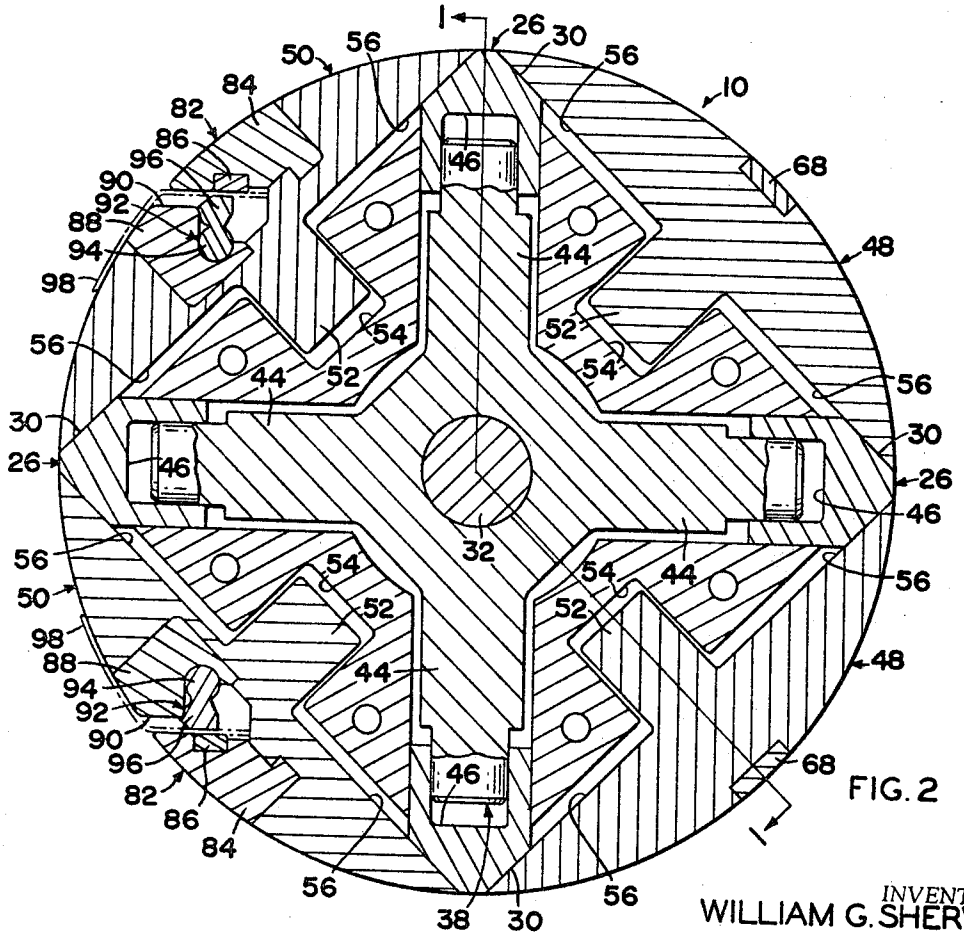


FIG. 2

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FIG. 3

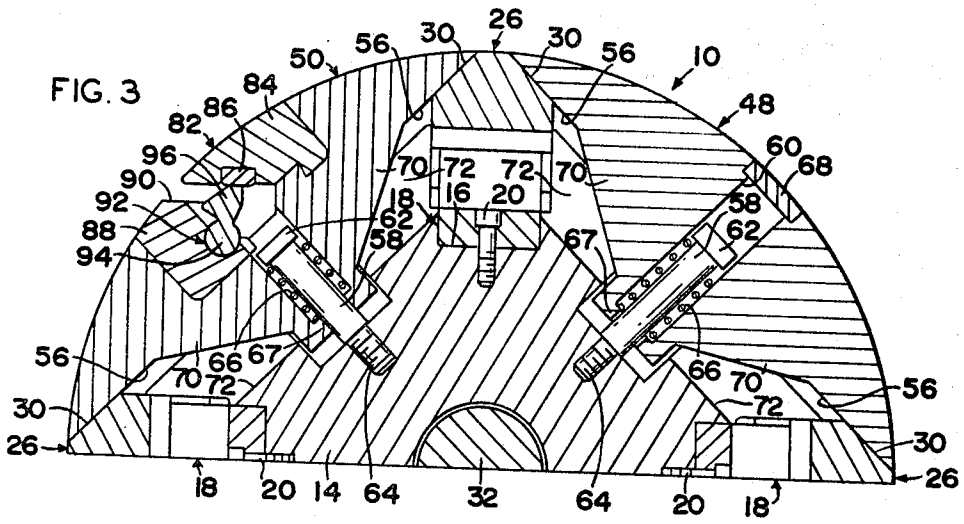
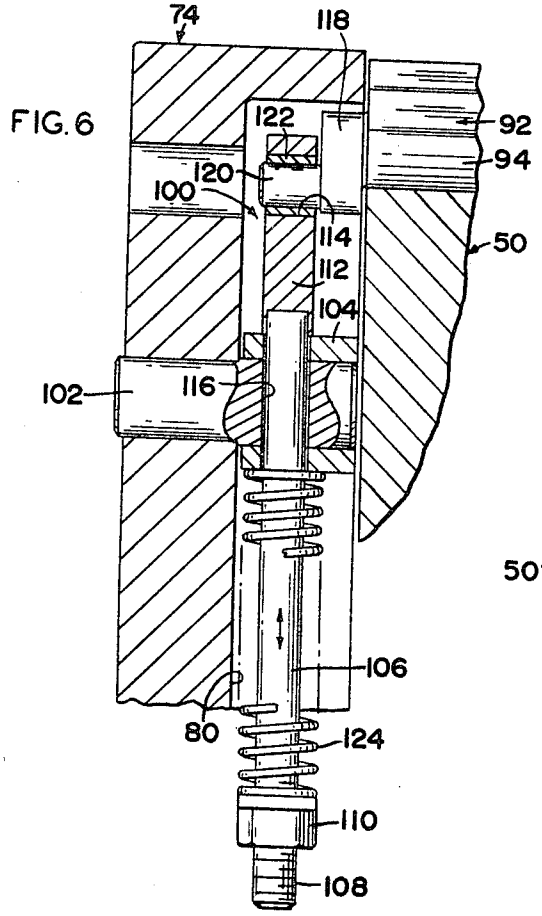


FIG. 6



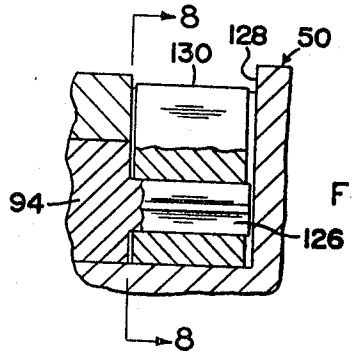


FIG. 7

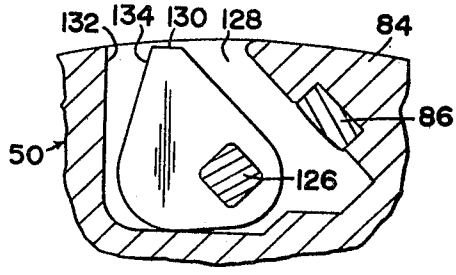


FIG. 8

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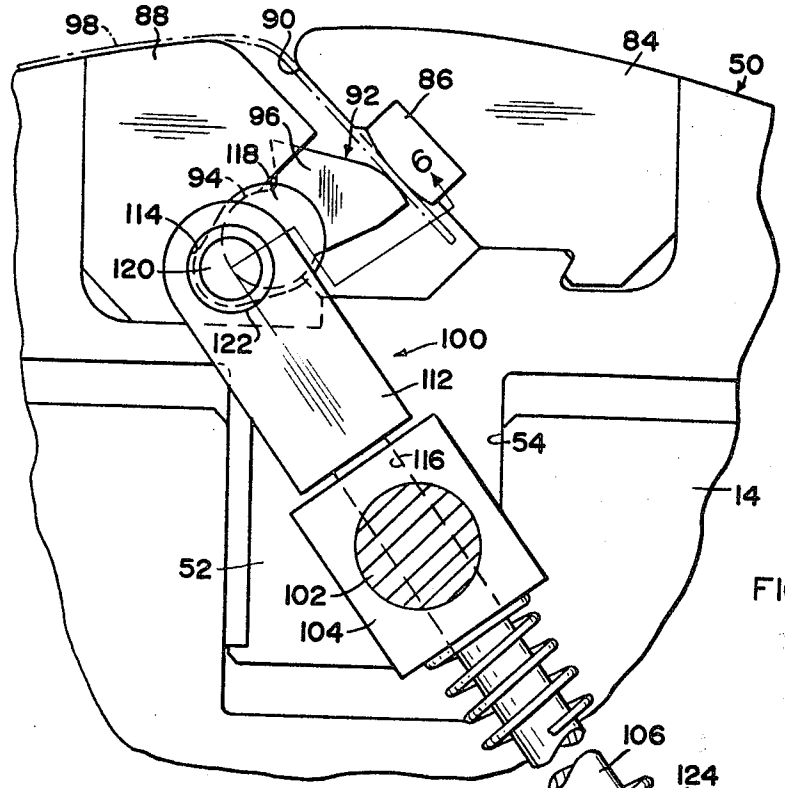

FIG. 4

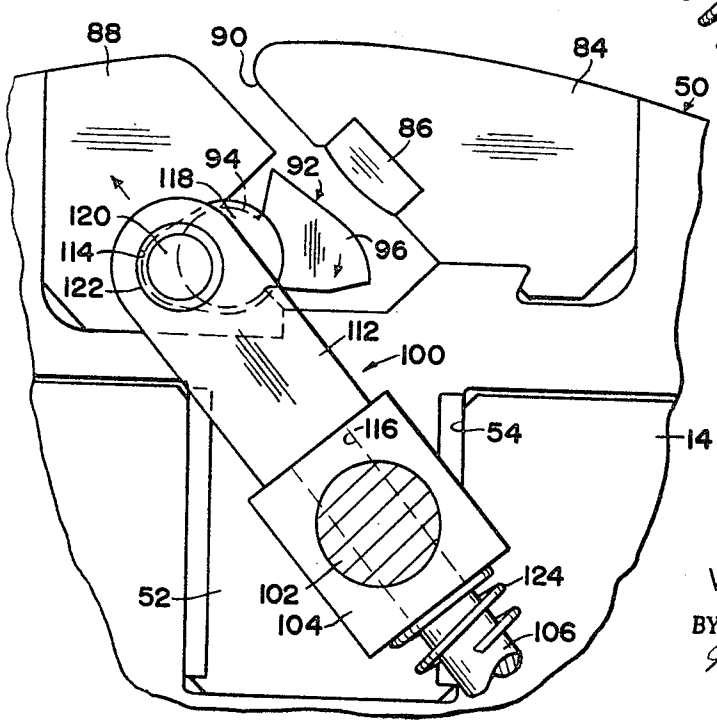

FIG. 5

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United States Patent Office 3,446,450 Patented May 27, 1969

3,446,450

TENSION REEL GRIPPER MECHANISM

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Int. Cl. B65h 75/18
U.S. Cl. 242—72.1 12 Claims

ABSTRACT OF THE DISCLOSURE

A mandrel including a stationary gripper jaw and a rotating gripper member mounted in an outwardly expanding and inwardly retracting mandrel segment, the rotating gripper member being operated by an assembly attached to a non-moveable portion of the mandrel and connected to a crank on the end of the rotating gripper member. Movement of the segment with expansion of the mandrel causes rotation of the moveable gripper jaw in a clamping direction. A spring in the operating mechanism permits automatic adaptation of the gripper mechanism for sheet material of various thicknesses.

This invention relates to the art of winding and reeling mandrels and more particularly to gripper mechanism for securing the end of sheet material in such mandrels.

The present invention is particularly applicable to expanding mandrels of the type used to wind and reel continuous strip metal to produce a coil of same, and it will be discussed with particular reference thereto; however, it is to be appreciated that the invention has much broader applications and may be used in various similar apparatus for winding and reeling sheet material.

Expanding mandrels have been used for many years in the business of winding and reeling sheet metal, and it is common practice for such mandrels to include a plurality of cylindrical segments that expand radially outwardly during the winding process, so that upon completing the winding and reeling, the segments may be retracted to permit removal of the coil from the mandrel. In such expanding mandrels, it is the usual practice to provide some sort of gripping mechanism to lock the leading end of the sheet metal in the mandrel such that rotation of the mandrel will cause the winding and reeling to occur. While there are many types and forms of gripping mechanisms known in the industry, these are normally complicated and cumbersome devices, containing a great number of moving parts that are expensive to manufacture and assemble and which require complicated operating means to produce the gripping action. Furthermore, such devices seldom are adaptable for sheet material of various thicknesses without considerable adjustment of the parts. The well known devices become easily fouled by the sheet metal, and are often difficult to disengage upon removal of the coil from the mandrel. Such mechanisms require considerable adjustment, depending on whether the sheet metal is being wound over or under the mandrel, necessitating reversal of parts or less than positive clamping pressure in order to accomplish this function. Accordingly, there has been an ever-present demand for a gripping mechanism that is positive in its clamping engagement, has relatively few parts, is inexpensive to manufacture and assemble and which will accomplish the intended functions in an economical and efficient manner.

The present invention is directed toward a tension reel gripper mechanism for an expandable winding and reeling mandrel that is substantially less expensive than known mechanisms, and the invention is further directed toward an apparatus that is positive in its operation, adapts the mandrel to sheet material of various thicknesses, and

which is readily accessible, automatically operated and simple in its manufacture and assembly.

In accordance with the present invention, there is provided a mechanism comprising a stationary gripper jaw mounted in one of the expandable segments of the mandrel, a moveable jaw mounted adjacent the stationary jaw and moveable into clamping engagement with sheet metal disposed therebetween, and having operating mechanism that automatically moves the moveable jaw into such clamping engagement.

In accordance with another aspect of the present invention, there is provided a mechanism including a stationary jaw and a moveable jaw mounted for movement into clamping engagement, and wherein the operating mechanism includes a biasing spring which may be overcome by sheet material of greater thickness.

In accordance with still a further aspect of the present invention, there is provided a mechanism comprising stationary and moveable jaws for clamping the leading edge of sheet material, such jaws being moveable outwardly with expanding portions of the mandrel, and an operating mechanism which automatically moves the moveable jaw into clamping engagement with such outward expansion of the mandrel portion.

In accordance with yet another aspect of the present invention, there is provided a mechanism comprising stationary and moveable jaw members, the moveable member being operated by an assembly attached to a non-moveable portion of the mandrel to automatically move the jaws into clamping engagement upon expansion of the mandrel and disengage the clamping jaws upon retraction of the mandrel, and further including secondary means for disengaging the clamping jaws in the event of jamming of the jaws.

The primary object of the present invention is the provision of tension reel gripper jaw mechanism in an expanding mandrel comprising gripper jaw actuating means to automatically move the jaws into sheet material clamping engagement upon expansion of the mandrel, and which is inexpensive to manufacture and use, is positive in its operation and contains a relatively few number of parts.

Another object of the present invention is the provision of tension reel gripper mechanism having operating means secured to a non-moveable portion of an expanding mandrel, and operable upon expansion of the mandrel to move the clamping jaws into positive sheet material clamping engagement regardless of the thickness of the sheet material disposed therebetween.

Still another object of the present invention is the provision of tension reel gripper jaw mechanism for an expandable mandrel which may be easily adapted to various thicknesses of sheet material.

These and other objects and advantages will become apparent from the following description used to illustrate the preferred embodiment of the present invention as read in connection with the accompanying drawings in which:

FIGURE 1 is a side elevational view, with parts broken away and in section, illustrating an expanding mandrel constructed in accordance with the present invention;

FIGURE 2 is an enlarged cross-sectional view of the expanding mandrel illustrated in FIGURE 1, taken substantially along the line 2—2 of FIGURE 1 and looking in the direction of the arrows;

FIGURE 3 is an enlarged cross-sectional view of the expanding mandrel illustrated in FIGURE 1, taken substantially along the line 3—3 of FIGURE 1 and looking in the direction of the arrows;

FIGURE 4 is an enlarged end view of a portion of the mandrel illustrated in FIGURES 1–3, showing the operating mechanism in one position of operation;

FIGURE 5 is an enlarged end view of a portion of the mandrel illustrated in FIGURES 1–3, illustrating the operating mechanism in another position of operation;

FIGURE 6 is a cross-sectional view of the operating mechanism illustrated in FIGURES 4 and 5, taken substantially along the line 6—6 of FIGURE 4 and looking in the direction of the arrows;

FIGURE 7 is an enlarged cross-sectional view of another portion of the mandrel illustrated in FIGURES 1–3, showing the jaw release mechanism; and

FIGURE 8 is a partial cross-sectional view of the structure illustrated in FIGURE 7, taken substantially along the line 8—8 of FIGURE 7 and looking in the direction of the arrows.

Referring now to the drawings, wherein the showings are for the purpose of illustrating a preferred embodiment of the invention only and not for the purpose of limiting same, FIGURES 1–3 best show the overall structure of an expanding mandrel of the type used to wind and reel sheet material, and particularly sheet steel. The expanding mandrel, indicated generally by the numeral **10**, includes a journal portion **12** extending from one end thereof and being suitably in roller bearings or the like, not shown, which are mounted in a frame or housing containing the driving mechanism for the mandrel **10**.

The mandrel **10** includes a generally rectangular mandrel shaft **14** provided with slots **16** at the corners thereof, such slots **16** extending longitudinally along the shaft **14** to receive inner wedge bars, indicated generally by the numeral **18**. Wedge bars **18** are secured in the mandrel shaft **14** by suitable screws **20** and dowel pins **22**, and include a plurality of inclined surfaces **24** forming a saw-tooth configuration, as illustrated in FIGURE 1.

Engaging the inclined surfaces of the wedge bars **18** are outer wedge bars, indicated generally by the numerals **26**, also extending longitudinally of the mandrel **10**. Outer wedge bars **26** include a series of inclined surfaces or ramps **28**, which engage the ramp surfaces **24** of the inner wedge bars **18**. It will be apparent that by movement of the outer wedge bars **26** in an axial direction relative to the inner wedge bars **18**, the outer wedge bars **26** will be moved radially outwardly of the mandrel shaft **14**. Outer wedge bars **26** are provided with arcuate outer surfaces formed on the same radius as the remainder of the mandrel **10**, and the wedge bars **26** also include angular bearing surfaces **30**, the purpose for which will be hereinafter more particularly described.

Axially disposed within the mandrel shaft **14** is a mandrel operating rod **32** which is attached at the right hand end thereof, as viewed in FIGURE 1 of the drawings, to suitable reciprocating mechanism, not shown, located in the drive housing in which the mandrel **10** is journalled. Expanding rod **32** includes a conical portion **34** and a threaded end portion **36** to receive and retain a spider member, indicated generally by the numeral **38**. Spider **38** is mounted on rod **32** and is held in place by a nut **40** received on the threaded portion **36** of the rod **32**. Spider **38** includes a hub portion **42** and four outwardly extending arms **44**, the arms being received in suitable blind bores **46** formed adjacent the ends of the outer wedge bars **26**. It will be apparent that upon reciprocation of the expanding rod **32**, the spider **38** being carried along with the rod **32**, the outer wedge bars will be moved axially relative to the inner wedge bars **18** to cause radial outward expansion of the outer wedge bars **26** by the ramps **24** and **28**.

Disposed between the outer wedge bars **26** are four generally cylindrical segments, indicated generally by the numerals **48** and **50**, the two right hand segments, as viewed in FIGURE 2, being identical and the two left hand segments being substantially the same, but with certain mirror-image differences to be hereinafter more particularly described. Segments **48** and **50** include longitudinal lands **52**, common to all four of the segments, and which are slidably received in slots **54** formed in the mandrel shaft **14**. Segments **48** and **50** include inner surfaces **56** which engage the inclined surfaces **30** on the outer wedge bars **26**, such that upon movement of the outer wedge bars **26** in a radial direction the beveled or inclined surfaces **30** and **56** will cause the cylindrical segments **48** and **50** to also expand outwardly in a radial direction.

Cylindrical segments **48** and **50** are secured in the mandrel shaft **14** by means of a plurality of bolts **58**, received in suitable bores **60** in the segments **48** and **50**, the bolts having enlarged heads **62** and threaded ends **64**. Springs **66** are disposed between the enlarged heads **62** and annular lands **67** at the lower ends of the bores **60**, to provide retraction force for the segments **48** and **50** relative to the mandrel shaft **14**. A suitable plug, or strip, **68** is received in the segments **48** to cover the bores **60**, the plugs **68** having arcuate outer surfaces to blend with the cylindrical outer surfaces of the segments **48**. Segments **48** and **50** further include generally triangular reinforcing webs **70** received in suitable slots or grooves **72** formed in the mandrel shaft **14**.

Secured in any suitable manner to the end of the mandrel shaft **14** is an end plate, indicated generally by the numeral **74**, having a central bore **76** receiving the spider hub **42** and with suitable bearing means **78** disposed therebetween. End plate **74** is provided with an inner annular chamber **80**, the purpose for which will be hereinafter more particularly described.

Thus, it will be apparent that upon reciprocation of the mandrel expanding rod **32** in the leftward direction, as viewed in FIGURE 1, the spider **38** will cause the outer wedge bars **26** to move axially toward the left, and thus radially outwardly through the inter-action of the inclined surfaces **24** and **28**. At the same time, the cylindrical segments **48** and **50** will move radially outwardly, due to the inter-action of the surfaces **56** on the segments and inclined surfaces **30** on the outer wedge bars **26**. This causes the mandrel to expand to permit a strip of sheet metal to be coiled therearound. Thereafter, the expanding rod **32** may be moved toward the right, as viewed in FIGURE 1, causing the spider **38** and outer wedge bars **26** to move longitudinally toward the right and radially inwardly along the ramps **24–28**. As a result, the springs **66** bias the cylindrical segments **48** and **50** radially inwardly to retract, or collapse, the mandrel **10** and allow removal of the sheet metal coiled therearound.

From the foregoing operation it will be apparent that some means must be provided to clamp or retain the leading end of the sheet material that is to be coiled around the mandrel **10**. For this purpose, the gripper mechanism, indicated generally by the numeral **82**, is provided in the cylindrical segments **50**. It is to be understood that gripper means **82** are provided in each of the segments **50** and that the mechanisms are reversed, as between the upper and lower segments of FIGURE 2, each being the mirror-image of the other. Since they are alike, only one such mechanism will be described and reference numerals common to both mechanisms are provided on the drawings.

Mounted in the cylindrical segment **50**, and extending longitudinally therealong, is an insert **84** which is secured in the segment **50** in any suitable manner. A stationary gripper jaw **86** is secured in the insert **84**, and may be of a hardened material so that wear will not present a major problem. Also disposed in the cylindrical segment **50** and extending longitudinally therealong is a second insert **88** which is spaced from the insert **84** to provide a slot **90** for receiving the end of the sheet metal that is to be coiled around the mandrel **10**. Disposed in insert **88** is a moveable gripper member, indicated generally by the numeral **92**, which includes a shaft portion **94** and a jaw portion **96**. Gripper member **92** is rotatable around the axis of the shaft portion **94**, as will become hereinafter more apparent, so that the jaw portion **96** may be moved into

clamping engagement with the sheet metal disposed in the slot **90**. As illustrated in FIGURE 2, the sheet material, indicated by dashed and dotted lines **98**, is received between the two jaw members **86** and **96**, and clamped therebetween, whereupon rotation of the mandrel **10** will cause the sheet material **98** to coil about the mandrel.

Located at the outward end of the cylindrical segment **50**, and within the chamber **80** formed in the end plate **74**, is the operating mechanism, indicated generally by the numeral **100**, for rotating the gripper member **92** into such clamping engagement. With reference now to FIGURES 4–6, the operating mechanism **100** will be more particularly described. FIGURE 4 illustrates the operating mechanism and the movable gripper member **92** in the gripping position, securing the sheet material **98** between the jaw portion **96** and the stationary jaw **86** of the assembly. Mounted in end plate **74** is a pin **102** extending into the annular chamber **80** in the end plate **74**, and mounted on the pin **102** is a block **104**. Extending through the pin **102** and the block **104** is a shaft **106**, having a threaded lower end **108** to receive a nut **110**. The opposite end of the shaft **106** is suitably secured in an operating member **112** having an aperture **114** in the end thereof. Operator **112** and shaft **106** are slidable relative to the pin **102** in the bore **116** formed therein.

At the outward end of the shaft portion **94** of the movable gripper member **92** is a crank **118**, having a crank pin **120** extending outwardly therefrom and along an axis parallel to the axis of the shaft portion **94**. Crank **118** and crank pin **120** are disposed within the chamber **80** formed in the end plate **74**. Crank pin **120** is received in a suitable bearing **122** mounted in the aperture **114** in the operating member **112**. A mechanical biasing means, such as for example, a spring **124** disposed between the nut **110** and the block **104**, serves to bias the shaft **106** in a direction away from the crank pin **120**.

When the mandrel **10** is in the retracted position the parts of the operating mechanism **100** will be in the positions shown in FIGURE 5. As shown, the movable gripper member **92** is spaced from the stationary jaw **86** and the crank pin **120** is in the position shown relative to pin **102**. At such time as the mandrel is expanded, the leading end of the sheet material is disposed in the slot **90** and between the gripper jaws **86** and **96**. Upon movement of the mandrel expanding rod **32** in a leftward direction, as viewed in FIGURE 1, and the consequent radial outward movement of the segments **50** as hereinbefore described, the moveable gripper member **92** will move radially outwardly with the segment **50**. Upon such movement, the spring **124** in the operating mechanism will cause the crank pin **120** to rotate about the axis of the shaft portion **94**, thus rotating the gripper member **92** into clamping engagement with the sheet metal **98**. The operating mechanism parts will, upon full expansion, assume the positions illustrated in FIGURE 4, wherein the operating member **112** has separated slightly from the block **104** against the urging of spring **124**. It will be apparent that the thicker the sheet material disposed between the jaw portions **96** and **86**, the more will be the separation between the block **104** and the operating member **112** against the spring **124**. Thus, the thickness of the sheet material is automatically compensated for by the operating mechanism **100**.

Upon retraction of the cylindrical segments **50**, when the mandrel **10** is collapsed for removal of the coil, the operating member **112** will cause rotation of the shaft portion **94** in a clockwise direction, as viewed in FIGURE 4, to thus rotate the jaw portion **96** away from the stationary jaw **86** and out of clamping engagement. Since the pin **102** is mounted in a non-movable portion of the mandrel **10**, being the end plate **74**, the disengagement of the moveable gripper member **92** is automatic with the retraction or collapse of the mandrel **10**. Thus, upon collapse of the mandrel, the sheet material is freed from the gripper members and may be easily removed from the mandrel.

Should for any reason the sheet material become jammed between the gripper jaws **96** and **86**, a cam release assembly is provided in the cylindrical segment **50** and is best illustrated in FIGURES 7 and 8. The right hand end of the shaft portion **94** of the moveable gripper member **92**, as viewed in FIGURE 1, is provided with a square, or other suitable shape, shank **126** extending into a groove **128** formed in the cylindrical segment **50**. Mounted on the shank **126** is a cam **130**, rotatable with the moveable member **92**. It will be apparent from viewing FIGURE 8, along with FIGURES 4 and 5, that upon movement of the gripper member **92** in a clamping direction, that is, counter-clockwise, the release cam **130** will move in the same direction. If the moveable gripper member becomes jammed it is only necessary to insert a suitable tool between the side wall **132** of the slot **128** and the side wall **134** of the cam **130**, and pry the cam **130** in a clockwise direction, thus releasing the moveable gripper member **92** from engagement with the sheet material.

Thus, a tension reel gripper jaw mechanism is provided in an expanding mandrel of the type utilized to wind and reel sheet material, such mechanism being automatic in its operation to clamp or disengage from the sheet material, and is also positive in its clamping movement. The number of parts involved in the clamping mechanism are relatively few and are easily accessible for repair, replacement or other adjustment, should such become necessary during the life of the mandrel. By providing mirror-image mechanisms in adjacent segments, the mandrel is readily adaptable for winding the sheet material in either direction without requiring considerable adjustment in the gripping device to compensate for the direction of rotation. At the same time, the gripping mechanism is readily adapted to sheet material of various thicknesses, automatically adjusting therefor by means of the biasing spring disposed in the operating mechanism.

The present invention has been described in connection with certain structural embodiments; however, it is to be appreciated that various changes may be made in the structural embodiments without departing from the intended spirit and scope of the present invention as defined by the appended claims.

Having thus described my invention, I claim:

1. In an expanding mandrel for winding and reeling and having a non-moveable portion and a plurality of segments expandable outwardly relative to said non-moveable portion, means for securing sheet material in said mandrel and comprising a stationary gripper jaw mounted in one of said segments, a rotatable gripper jaw mounted in said one of said segments and rotatable into engagement with said stationary gripper jaw, and means mounted on said non-moveable portion of said mandrel and operatively connected to said rotatable gripper jaw for rotating said gripper jaw in a clamping direction when said one segment is expanded outwardly, said means being operable for rotating said rotating gripper jaw in a non-clamping direction when said one segment is retracted.

2. The means for securing sheet material set forth in claim **1** wherein said means for rotating said rotating gripper jaw include spring means for biasing said gripper jaw in a clamping direction to permit said jaw to rotate away from said stationary jaw when clamping sheet material of greater thickness.

3. The means for securing sheet material set forth in claim **1** wherein said means for rotating said rotating gripper jaw include a crank member mounted on one end of said rotating gripper jaw, and an operating member engaging said crank member, said operating member being substantially non-moveable in an outward direction when said one segment is expanded outwardly.

4. The means for securing sheet material set forth in claim **1** and further including a cam member mounted on said rotating gripper jaw and adjacent one end thereof, said cam member being rotatable to rotate said gripper

jaw in an unclamping direction when said one segment is retracted.

5. Means for securing sheet material in an expanding mandrel for winding and reeling and having a non-moveable portion and a plurality of segments expandable outwardly relative to said non-moveable portion, said means comprising a stationary gripper jaw mounted in one of said segments and extending therealong, a rotatable gripper member mounted in said one of said segments and extending therealong in spaced ralation to said stationary gripper jaw, said member having a shaft portion and a jaw portion rotatable in a clamping direction toward said stationary gripper jaw to clamp sheet material therebetween, a crank on one end of said shaft portion, a crank pin extending from said crank in axially spaced relation to the axis of said shaft portion, and crank operating means secured in said non-moveable portion and connected to said crank pin for rotating said gripper member when said one segment is expanded in said mandrel and move said jaw portion in a clamping direction toward said stationary jaw.

6. The means for securing sheet material set forth in claim 5 wherein said crank operating means includes a spring biasing said jaw portion toward said stationary jaw, said spring adapting said mandrel to sheet material of different thicknesses.

7. The means for securing sheet material set forth in claim 5 and further including a cam member mounted on said gripper member and at the other end thereof, said cam member being rotatable to rotate said gripper member in an unclamping direction when said one segment is retracted.

8. Means for securing sheet material in an expanding mandrel for winding and reeling and having a non-moveable portion and a plurality of segments expandable outwardly relative to said non-moveable portion, said means comprising a stationary gripper jaw mounted in one of said segments and moveable therewith, a rotatable gripper member mounted in said one of said segments and moveable therewith, said gripper member having a shaft portion and a jaw portion rotatable toward said stationary gripper jaw and into clamping engagement with sheet material disposed therebetween, a crank member mounted on the end of said shaft portion and having a crank pin axially displaced from the axis of said shaft portion, a pin mounted in said non-moveable portion of said mandrel, and an operating member mounted on said pin and engaging said crank pin, said shaft portion moving outwardly with said one segment and said operating member causing rotation of said crank pin about the axis of said shaft portion to rotate said gripper member in a direction of clamping engagement.

9. The means for securing sheet material set forth in claim 8 and further including a spring engaging said operating member and biasing said operating member in a gripper member rotating direction, said spring being adjustable to maintain said gripper member in clamping engagement.

10. The means for securing sheet material set forth in claim 8 and further including a cam member mounted on said shaft portion of said gripper member and at the opposite end thereof, said cam member being rotatable to rotate said gripper member in an unclamping direction.

11. Means for securing sheet material in an expanding mandrel for winding and reeling and having a non-moveable portion and a plurality of segments expandable in an outward direction relative to said non-moveable portion, said means comprising a stationary gripper jaw mounted in one of said segments and extending therealong, a rotatable gripper member mounted in said one of said segments and extending therealong in spaced relation to said stationary gripper jaw, said gripper member having a shaft portion and a jaw portion rotatable toward said stationary gripper jaw and into clamping engagement with sheet material disposed therebetween, a crank member on one end of said shaft portion, a crank pin extending outwardly from said crank member and having an axis in parallel spaced relation to the axis of said shaft portion, a pin mounted in said non-moveable portion of said mandrel, a block mounted on said pin, a shaft extending through said block and said pin, an operating member on one end of said shaft and rotatably connected to said crank pin, a nut on the other end of said shaft, and a spring around said shaft and engaging said nut and said block and biasing said nut and said block in opposite directions, said operating member and said shaft and said block and said pin tending to retain said crank pin in position when said segment is moved outwardly to cause said gripper member to rotate about the axis of said shaft portion into clamping engagement against the force of said spring.

12. The means for securing sheet material set forth in claim 11 and further including a cam mounted on the other end of said shaft portion of said gripper member and in said one of said segments, said cam being operable to rotate said gripper member in an unclamping direction.

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