March 6, 1962 E. M. WALLACE 3,023,651

TONGS

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Fig. 1

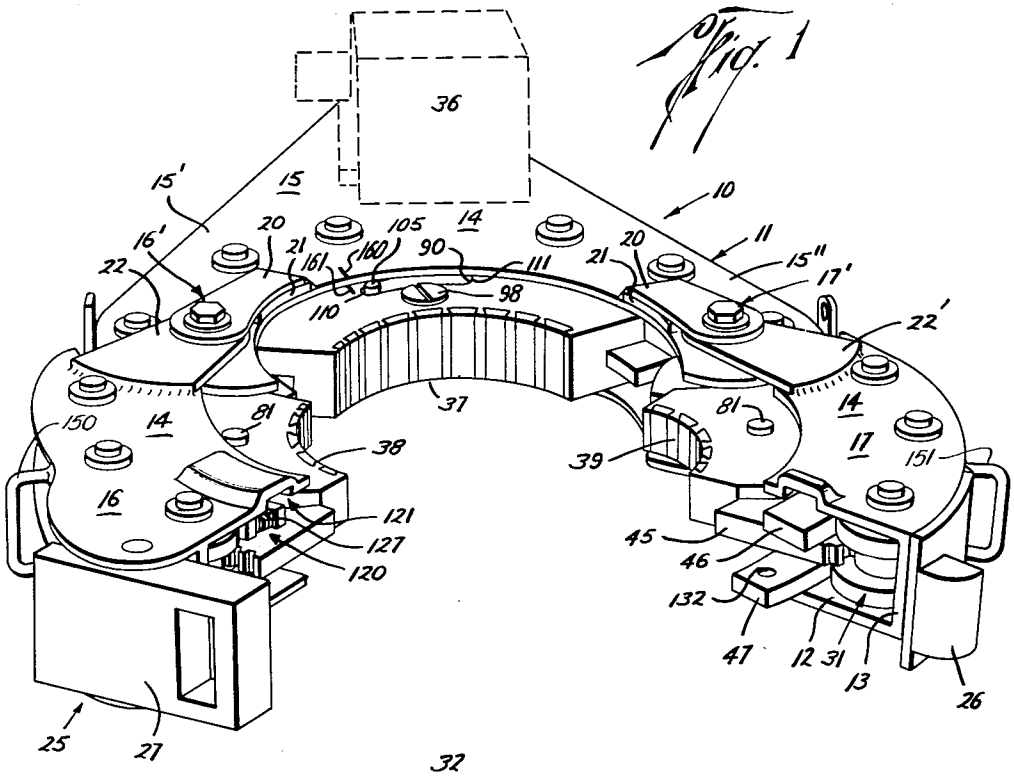
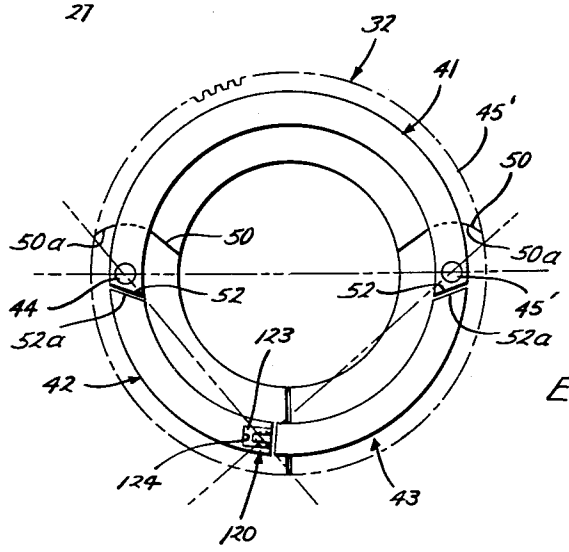


Fig. 2



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BY Hayden & Prasel

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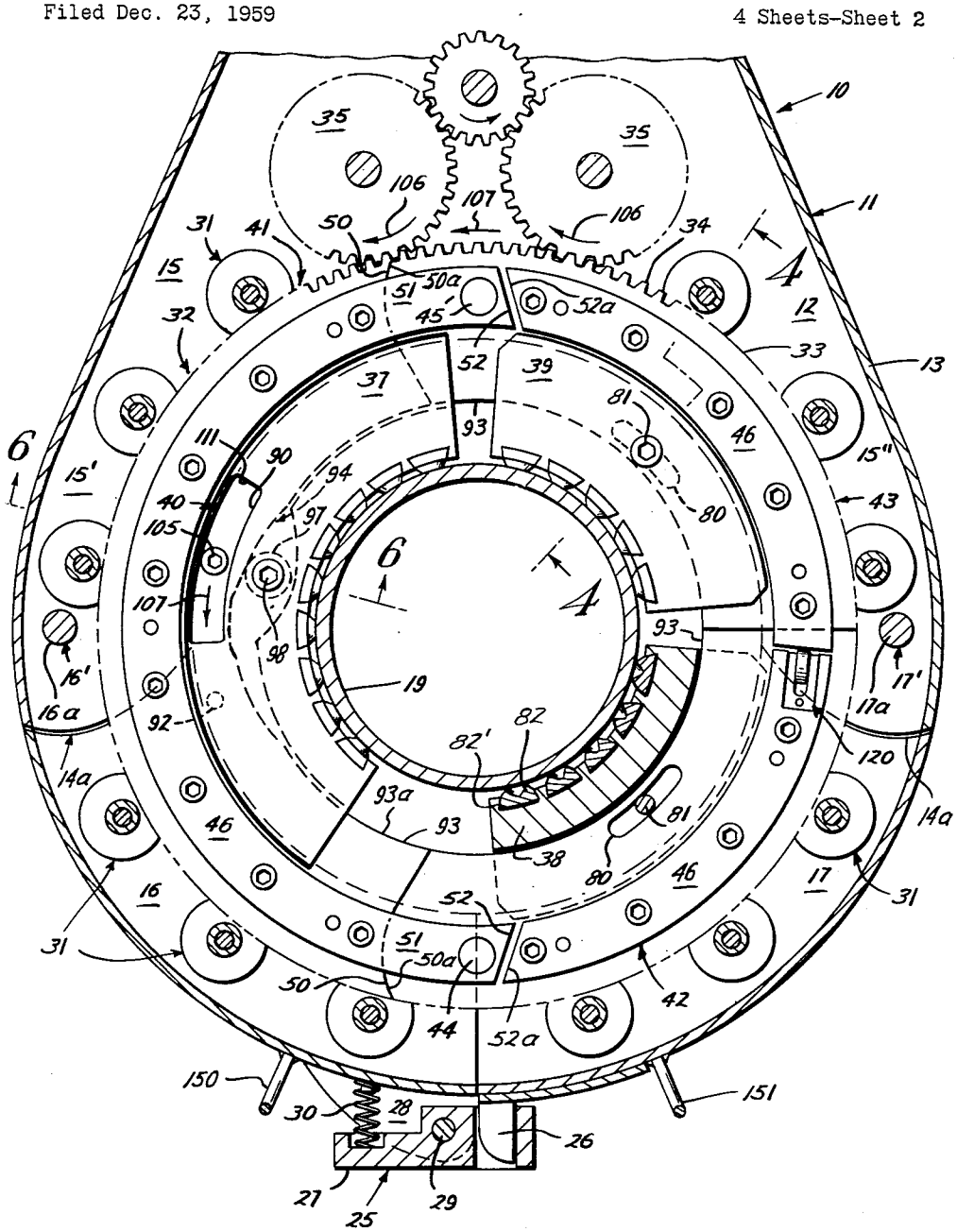

Fig. 3

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Fig. 4

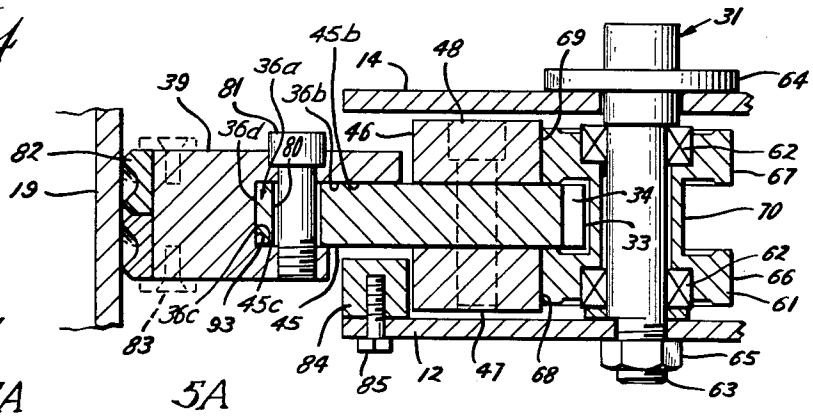


Fig. 5

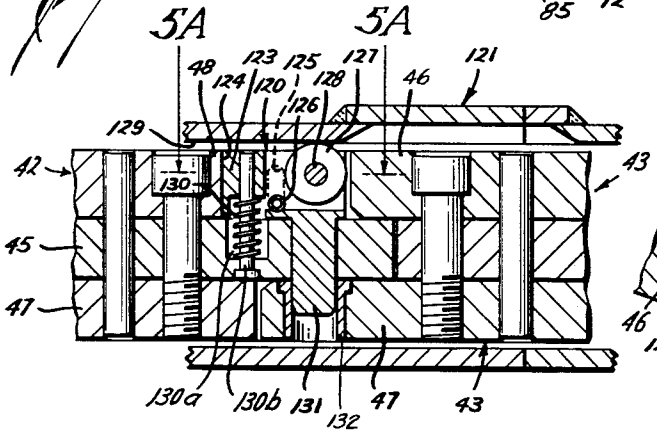


Fig. 5A

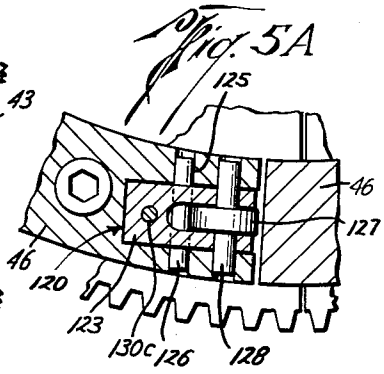


Fig. 6

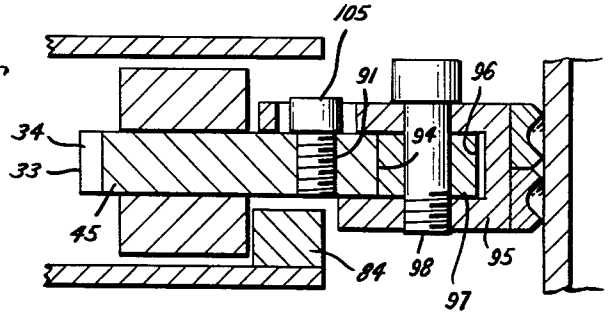
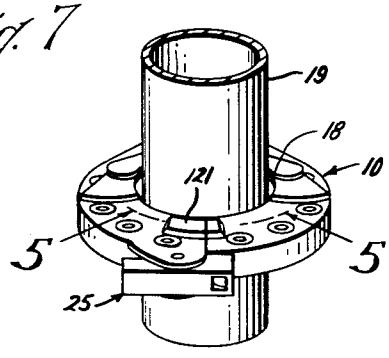


Fig. 7



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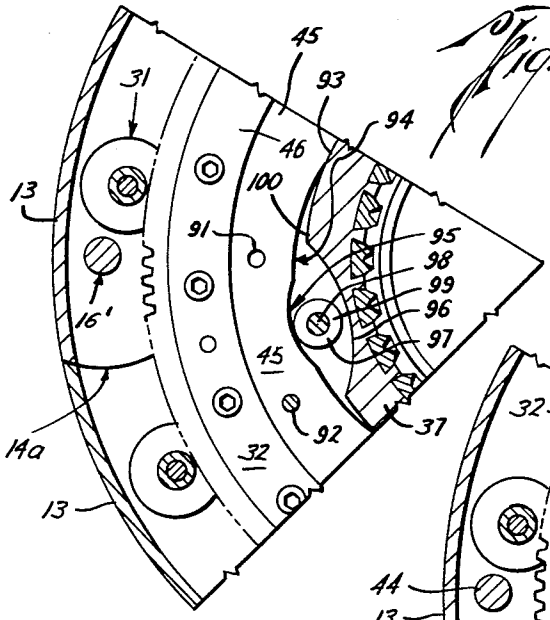

Fig. 8

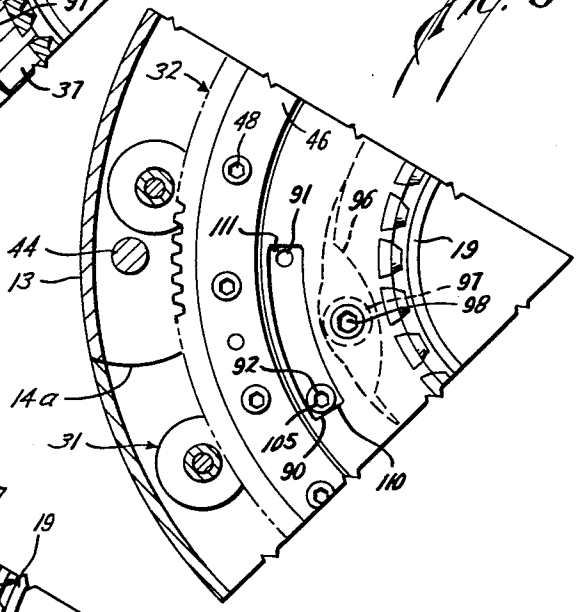

Fig. 9

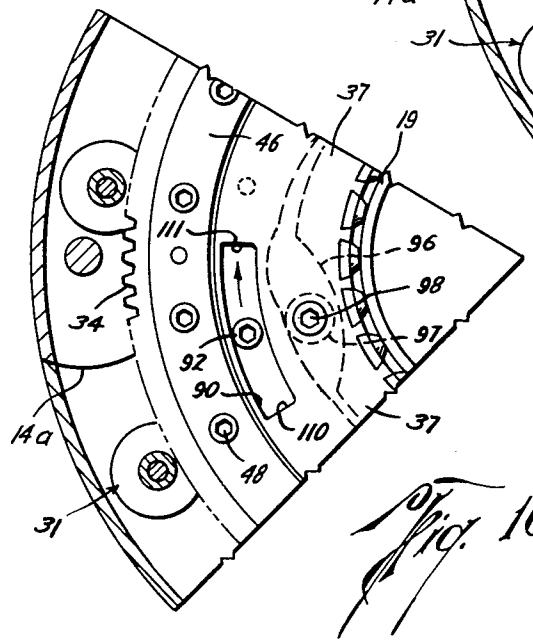

Fig. 10

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United States Patent Office 3,023,651 Patented Mar. 6, 1962

3,023,651

TONGS

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Filed Dec. 23, 1959, Ser. No. 861,620
10 Claims. (Cl. 81—57)

The present invention relates to a tong for gripping tubular members and imparting rotary motion thereto, and more particularly to improvements in power operated tongs for use with tubular members.

At the present time, various types of power operated tongs are provided whereby a rotary motion or torque may be imparted to a tubular member so as to threadedly connect the tubular member to another member or to disconnect tubular members. More particularly, in the drilling and completion of well bores, it is necessary to lower a long string of pipe into a well bore in the earth's surface, or to remove the pipe string from the well bore. This string of pipe is composed of a plurality of joints or sections of pipe of predetermined length, such as 20, 30 or 40 feet, and threads are provided on each of the joints of pipe whereby they may be threadedly connected together as the pipe is lowered into the well bore, and threadedly disconnected as they are removed from the well bore.

The tongs presently employed for rotating the pipe sections to connect or disconnect them relative to each other are disadvantageous for many reasons. For example, in order to most efficiently use a tong, it is desirable to supply power thereto so that the mechanism of the tong can be rotated by power, rather than manually, which rotation is in turn imparted to the tubular member or pipe section on which the tong is positioned. The tongs are generally provided with jaw segments, which segments are moved into engagement with the tubular member so that rotation may be transmitted from the tongs to the tubular member. In certain tongs, presently employed, the construction of the jaw segments is such that the area of contact of the jaw segments with the tubular member is restricted to a relatively small area on the circumferential periphery of the tubular member, so that when the jaw segments engage the pipe the rotating effort or force is applied over a relatively small circumferential area of the tubular member. Even under normal use of the tong, the pressure exerted may be sufficient to cause the tubular member to become damaged at the point of contact with the jaws.

Also, some power tongs mount the jaw segments in a manner so that the rotating effort, or load applied through the jaw segments of the tongs is concentrated over a relatively limited area of the pipe or tubular member, which further increases and enhances the possibility of damage to the tubular member not only by scarring, but by applying a load at a given point or on a circumferential area or portion of the tubular member which may cause the tubular member to become permanently deformed.

Not only is the construction of the jaw segments and the manner of moving the jaw segments into engagement with the tubular member objectionable, but also the manner of initiating the gripping action of the jaws with the tubular member, or the manner of starting the jaw segments to move into engagement with the tubular member creates additional problems in power tongs presently employed.

Additionally, power tongs presently employed are extremely difficult to engage about the tubular member. Some tongs are constructed so that they must be positioned about the tubular member by slipping the tong downwardly and longitudinally about the tubular member. It can be appreciated that this is extremely disadvantageous since it may be desirable to immediately unthread a pipe section after it has been threaded with another pipe section, such as for example where the pipe sections have threaded incorrectly and it is desirable to reverse the rotation of the tubular member in order to rethread it. Where the tongs are constructed so that they must be engaged with the tubular member by placing them over the tubular member from one end, the tong must thereupon under the above described circumstances be partially disassembled and the jaw segments then removed from the tong and reversed as to their position in the tong and the tong thereafter reassembled, whereupon the reversing operation may be performed. Thereafter the tong is again partially disassembled, the jaw segments returned to their normal position, and the tongs then reassembled for engagement with the pipe. It can be appreciated that this operation is extremely time consuming, and furthermore the raising and lowering of the tongs to position them on the pipe requires additional equipment which in turn creates problems in the installation and servicing thereof, as well as manipulation or operation of the equipment.

Other tong constructions presently employed provide a radial slot or opening in the tong so that the tong may be slipped laterally about the pipe, whereupon the radial opening is closed and rotation imparted to the tubular member engaged in the tong. It can be appreciated that this type of construction is also objectionable in that the size pipe which can be handled by the device is limited by the size of radial opening, so that it is necessary to employ several different tongs with various size radial openings where the handling of different diameter of pipe is necessary. When it is desirable to reverse the direction of rotation with this type construction, it is necessary to remove the tongs from about the tubular member, turn them over and then reposition them on the tubular member or take the jaw segments out of the tong and reverse their respective positions in the tong. This also is extremely disadvantageous.

Also, most tongs employ a cage mechanism which supports the jaw segments in the tong. This cage mechanism further reduces the range of pipe size which may be handled by any particular tong because the cage mechanism reduces the opening size in the tongs and the jaw segments mounted thereon reduce it even further. This reduction in the opening in the tong substantially decreases the range of pipe which can be handled by any particular size tong.

The present invention relates to a power tong which overcomes all of the above and other problems presently encountered with power tongs.

A primary object of the present invention is to provide a power tong for imparting rotation to tubular members which tong is formed of a segmented construction so that the tong can be opened up and easily positioned about a pipe, and which tong eliminates the use of a cage mechanism to thereby permit the tong to be used on a wider range of pipe sizes.

Also, the tong provides a jaw segment construction which engages the rotary member substantially over its entire circumferential periphery thereby more evenly distributing the torque applied to the tubular member to inhibit damage thereto, and which jaw segments are mounted in the tong so that they can be reversed without removing the tong from engagement about the tubular member. The present invention also employs an arrangement of jaw segments which eliminates special actuating mechanism to initially move the jaws into engagement with the pipe or tubular member.

Another object of the present invention is to provide a tong wherein the jaw segments for engaging a tubular

member are mounted in the tong so that they engage the tubular member substantially over its entire circumferential peripheral extent.

Yet a further object of the present invention is to provide a power tong wherein the direction of rotation of the tong may be reversed without removing the tong from a tubular member about which it is positioned.

Yet a further object of the present invention is to provide a power tong which is of segmented construction so that it can be easily opened up to be positioned about a pipe, the segmented tong including segmented jaws which engage the tubular member over substantially its entire circumferential peripheral extent.

Yet a further object of the present invention is to provide a power tong of relatively simple construction which can be disassembled, if desired, with a minimum of effort.

Still a further object of the present invention is to provide a segmented tong construction which can be readily positioned about a tubular member, which segmented construction automatically locks when positioned about a tubular member to inhibit relative movement of the segmented portions while the tong is in use.

Yet a further object of the present invention is to provide a power tong which is formed of segmented construction wherein the segments are constructed and arranged, and are provided with means, whereby they are locked against undesired relative movement when the tong is positioned about a tubular member, and which construction and arrangement enables the power tong to be quickly and easily disengaged from the tubular member when desired.

Still a further object of the present invention is to provide in a power tong a construction for imparting rotation to a tubular member wherein jaw segments are mounted on a segmented ring adapted to be positioned about the tubular member, a support means for supporting the segmented ring in the tong to accommodate rotation of the ring.

Another object of the present invention is to provide a tong which does not interfere with the operation and manipulation of other equipment at a wellhead.

Yet a further object of the present invention is to provide a power tong wherein the jaw segments may be substantially instantaneously changed for gripping pipe of various diameter in the tong.

Other objects and advantages of the invention will become more readily apparent from a consideration of the following description and drawings wherein:

FIG. 1 is a perspective view illustrating the tong of the present invention opened and ready to be positioned about a tubular member;

FIG. 2 is a top plan view of the segmented ring and illustrates the rigid relationship of the ring segments when the tong is closed about a tubular member and imparting rotation thereto;

FIG. 3 is a sectional view partly in elevation and illustrating the tong of the present invention engaged about a tubular member and showing the relationship of the components of the device during operation thereof;

FIG. 4 is a sectional view on the line 4—4 of FIG. 3 to illustrate additional structural details of the segmented rotary ring, as well as illustrating the roller means for supporting the rotary ring in the housing, and the manner of supporting certain of jaw segments on the segmented ring;

FIG. 5 is a sectional view on the line 5—5 of FIG. 7 and illustrates the locking means for holding the segments of the rotary ring in rigid relationship when the tong is actuated;

FIG. 5A is a sectional view on the line 5A—5A of FIG. 5 showing further structural details of the segmented ring locking means;

FIG. 6 is a sectional view on the line 6—6 of FIG. 3 and shows in greater detail the cam surface means and arrangement on one of the rotary ring segments and one of the jaw segments for actuating the jaw segments and moving them into engagement with the tubular member;

FIG. 7 is a perspective view of the tong of the present invention showing it in position on a pipe;

FIG. 8 is a fragmentary view, partly in section, of one of the segments of the rotary ring and the jaw segment thereon, showing in greater detail the cam surface arrangement for actuating the jaw segments. FIG. 8 shows the relative position of the jaw segment on the ring segment when the cam surface means is in inoperative position;

FIG. 9 is a view somewhat similar to FIG. 8 but showing the jaw segment in elevation in order to illustrate the window therein forming part of the cam surface arrangement; and

FIG. 10 is a view similar to FIG. 9 and illustrating the relative position of the jaw segment to the ring segment and the relative position of the components of the cam surface arrangement for engaging the segmented jaws with the tubular member.

Attention is first directed to FIG. 1 of the drawing wherein the invention is illustrated generally by the numeral **10** and is shown as being opened for receiving a tubular member therein whereby the tong may thereafter be closed about the tubular member and rotation imparted to the tong and the tubular member.

In FIG. 3 the tong **10** is illustrated in closed position about the tubular member and the components thereof in position for imparting rotation to the tubular member in a desired direction. The tong **10** includes the housing designated generally at **11** which housing is illustrated as being hollow and including the bottom wall **12**, side wall or peripheral end wall **13** and top wall **14**. The housing **11** walls **12**, **13** and **14** are cut as illustrated at **14***a* to form the housing in segments **15**, **16** and **17**, with the segment **15** being designated the main housing segment and the segments **16** and **17** being connected to the main segment portion **15** at the pivot points **16'** and **17'**, respectively.

The main segment portion **15** of the housing **11** is of a general Y configuration as better illustrated in FIG. 7 with the segments **16** and **17** mounted on the legs **15'** and **15''**, respectively of the housing segment **15** as illustrated in FIGS. 3 and 7. The lower wall **12** and top wall **14** extend laterally from end wall **13** a suitable distance so that the segments **15**, **16** and **17** when closed as illustrated in FIGS. 3 and 7 define a substantially circular opening **18** in which the tubular member **19** is received. The lower wall **12**, top wall **14** and end wall **13** are also constructed so that each segment **15**, **16** and **17** is circular, and define a housing portion for receiving segmented rotary ring **32** and jaw segments **37**, **38** and **39**.

The pivot points **16'** and **17'** for the segments **16** and **17** respectively may assume any suitable construction and as illustrated in the drawings pivot pins **16***a* and **17***a* of suitable size are provided and extend through the top wall **14** and the bottom wall **12** of the main segment **15** and also extend through reinforcing brackets **20**. There are four reinforcing brackets which are secured on the top and bottom of legs **15'** and **15''** by any suitable means such as support blocks **21** which are welded to the top **14** and bottom **12** and to the reinforcing brackets **20**.

Brackets **22** and **22'** secured to the top and bottom of each of the segments **16** and **17** respectively, extend from each of the segments to overlap the legs **15'** and **15''** respectively, and fit beneath the reinforcing bracket **20** on each of the legs **15'** and **15''** as illustrated in FIG. 1 of the drawings. The pivot pins **16***a* and **17***a* extend through the upper and lower walls **12** and **14** of the main segment **15** as well as the reinforcing brackets **20** and the rearwardly extending brackets **22**, **22'** mounted on each of the segments **16** and **17**. The pins **16***a*, and **17***a* may be provided with an enlarged end and a threaded end

whereby a nut may be engaged thereon to hold them each in place.

This construction permits the housing **11** to be opened up easily and quickly as shown in FIG. 1 for receiving pipe therein and thereafter the segments **16** and **17** can be pivoted to a closed position as illustrated in FIGS. 3 and 7 whereupon the latch **25** locks the segments **16** and **17** relative to the main segment **15** to prevent relative movement of the segments, or opening of the segments as the tong is in operation. The latch or lock means **25** includes the projection or lug **26** mounted on one of the segments such as the segment **17** illustrated in FIGS. 1 and 7 and the latch member **27** which is mounted on the bracket **28** by means of the pivot pin **29** on the other of the segments. A spring **30** is arranged so as to urge the latch member **27** into engagement with the lug **26** when the segmented housing is closed about a tubular member **19**. In order to open the housing, the latch member **27** must be depressed towards the tong and against the action of the coil spring **30** so that the member **27** may disengage from the lug **26**, whereupon the housing may be open.

A plurality of roller means as illustrated generally at **31** are mounted at spaced intervals in each of the housing segments **15**, **16** and **17** and provide a means for supporting the rotary ring designated generally at **32**. The outer periphery **33** of the rotary ring is provided with gear teeth **34** so that the rotary ring **32** may be rotated through the gear train **35** which is actuated by a suitable power source (illustrated in dotted line at **36** in FIG. 1). The rotary ring **32** in turn supports the jaw segments **37**, **38**, and **39** thereon whereby the segments may engage the tubular member **19** and impart rotation thereto. A cam surface arrangement illustrated generally by the numeral **40** is provided on the ring **32** and one of the jaw segments whereby all of the jaw segments may be moved into operative engagement with the tubular member when rotation is imparted to the rotary ring **32**.

The rotary ring **32** is also segmented so that it can be opened or spread apart simultaneously when the housing **11** is spread apart and thereafter closed about the tubular member **19** as the housing **11** is closed about the tubular member.

The rotary ring **32** includes the main segment **41** with the segments **42** and **43** being pivotally connected to the main segment **41** by any suitable means such as the pivot pins **44** and **45'**. Each of the rotary ring segments **41**, **42** and **43** includes a central plate **45** with an upper plate **46** and a lower plate **47** secured thereto by any suitable means such as bolts or the like, as illustrated at **48** as best seen in FIG. 4 of the drawings. It will be noted that the central plate **45** is substantially wider than the upper and lower plates **46** and **47** and that the upper and lower plates **46** and **47** are positioned adjacent, but spaced from, the outer periphery or edge **33** of the central plate **45**.

The upper plate **46** on the main segment **41** and the lower plate **47** on the main segment **41** extend beyond the ends of the central plate **45** so as to overlap the central plate **45** of each of the segments **42** and **43**. As can be seen in FIG. 3 of the drawing, the central plate **45** of the segment **41** is illustrated as terminating at **50** in the arcuate recess as shown and the central plates **45** of each of the segments terminate in the arcuate projection **50***a* which interfits the recess **50**. The upper and lower plates **46** and **47** of the main ring segment **41** have portions **51** which extend beyond the end of **50** of the central plate **45** of the segment **41**. The central plate **45** of each of the segments **42** and **43** fits between the extended portions **51** of the upper and lower plates **46** and **47** on the main rotary ring segment **41**, and the overlapping portions **51** of the upper and lower plates **46** and **47** on the ring segment **41** terminate as illustrated at **52**. The upper and lower plates **46** and **47** of each of the ring segments terminate as shown at **52***a*, and each extends arcuately about its respective segment as shown in the drawing. The upper and lower plates **46** and **47** of each of the ring segments **42** and **43** are constructed in a manner, and are provided with means to lock them in engagement as will be described in greater detail hereinafter.

The pivot pins **44** and **45'** extend through the upper and lower plates **46** and **47** which are mounted on the main segment **41** of the rotary ring **32**, and extend through the central plate **45** of each of the segments **42** and **43** whereby the segments **42** and **43** are pivotally mounted on the main rotary ring segment **41**.

The interfitting ends **50**, **50***a* of the central plates **45** on the main ring segment **41** and each ring segment **42**, **43** respectively, and the manner of fitting the central plate **45** of each ring segment **42**, **43** between the extended portion **50** of each upper and lower plate **46**, **47** along with the arrangement of the pivot pins **44**, **45'** enable the rotary ring **32** to be opened easily when the housing **11** is opened and thereafter closed about a tubular member.

Of course, the ring segment **41**, as well as the segments **42**, **43** must be in a predetermined position in the housing **11** to enable the tong to be opened, and if desired a suitable marking on the housing **11** and ring **32** may be utilized to visually indicate when the ring **32** is aligned in the housing **11** so that the tong can be opened.

In FIG. 3 the segments **41**, **42** and **43** of the rotary ring **32** are illustrated in a position when the jaw segments **37**, **38** and **39** are moved into engagement with the tubular member **19**. When the rotary ring **32** is in this position the housing **11** and the rotary ring **32** are locked in position about the tubular member **19**, and the segments of the housing **11** as well as the segments of the rotary ring **32** are locked against relative movement. In order to open the housing **11** and the rotary ring **32** to either engage or disengage the tubular member **19**, the rotary ring **32** must be aligned with the housing as noted above and as will be described in greater detail hereinafter.

The roller means **31** for supporting the rotary ring **32** is best illustrated in FIG. 4 of the drawing and is shown as including the roller member **61** which is rotatably mounted by any suitable means such as the bearings **62** upon the eccentric shaft **63**. The shaft **63** extends through the upper and lower surfaces **14** and **12** of the housing and is retained in position by means of the enlarged annular collar **64** at the upper end and the nut **65** which is threadedly connected to the lower end. The roller member **61** provides the roller surfaces **66** and **67** which are adapted to abut the edges **68** and **69** of the lower and upper plates **47** and **46**, respectively.

As can be viewed in FIG. 3 the rollers are circumferentially spaced about the rotary ring **32** so that when the rotary ring **32** is rotated, the surfaces **66** and **67** roll around and engage the outer peripheral edges **68** and **69** of the lower and upper plates **47** and **46**, respectively. The central plate **45** extends into the recess **70** on member **61** formed between the roller surfaces **66** and **67**.

The eccentric shaft **63** enables the roller member **61** to be adjusted relative to the outer peripheral edges **68** and **69** to compensate for wear of the roller surfaces **66** and **67** and wear of the edges **68** and **69**.

The termination of upper and lower plates **14** and **12** of the housing **11** defines an opening **18** in the housing as shown in FIGS. 3 and 7. The central plate **45** of the rotary ring **32** extends inwardly relative to the opening **18** in the housing and the edge **93** of each central plate **45** of each ring segment **41**, **42** and **43** defines a circular opening **93***a*. The plate **45** also supports the jaw segments **37**, **38** and **39** on the rotary ring **32**.

The jaw segments **37**, **38** and **39** are generally arcuate in configuration, and each is provided with an arcuate slot **36***a* in its rear edge between the upper and lower surfaces

of the jaw segment, in which slot the plate **45** of each ring segment is received, as best seen in FIG. 4. The slot *36a* includes the side walls *36b* and *36c* spaced to slide on the surfaces *45b* and *45c* of each central plate respectively. The edge **93** of each of the plates **45** abuts the end *36d* of the slot in the jaw segment mounted thereon.

The above enables the jaws to slide circumferentially, but inhibits the jaws from becoming skewed in relation to each other or in relation to the plate **45** on which they are carried so that they are always in position to properly engage the pipe **19** when contacted therewith.

The jaw segments **38** and **39** are retained on the plate **45** of each of the rotary ring segments **42** and **43** by suitable means such as the arcuate window **80** which is provided in each of the central plates **45** of each of the ring segments **42** and **43**. A pin **81** extends through the slot *36a* in each of the jaw segments **38** and **39** and through each of the windows **80** to position the jaw segments on the central plate **45**. The window **80** is slightly larger in width than the diameter of the pin **81**, to enable the transmission of the load from the jaw segment to the ring segment as noted before.

The pin **81** may be threaded into the lower portion of the jaw segment as illustrated in FIG. 4 of the drawing if desired. This arrangement accommodates circumferential sliding of each of the jaw segments **38** and **39** on each of the rotary ring segments **42** and **43** to enable the jaw segments **37, 38** and **39** to engage the pipe **19** properly and to enable the jaw segments to disengage from the tubular member **19** when desired. Any suitable configuration or means may be provided on the face of jaw segments as illustrated at **82** for aiding in gripping the surface of the tubular member **19**, as shown in FIG. 3, the means **82** may be fitted in dovetail grooves **82'** on the jaw segments, and if necessary the means **82** may be held in position on the jaw segments by any suitable means such as the brackets illustrated in dotted line at **83** of FIG. 4.

A retaining block **84** may be provided on the inside surface of the bottom wall **12** of each of the housing segments **15, 16** and **17** for retaining the rotary segments **41, 42** and **43** in position therein. The block **84** may be retained in position in each of the housing segments by any suitable means such as the screw **85** secured through the lower plate **12** of the housing **11** and into the block **84** as shown in FIG. 4 of the drawing.

A cam arrangement **40** is provided for moving the jaw segments **37, 38** and **39** into engagement with tubular member **19**. The cam arrangement includes the arcuate window **90** in the jaw segment **37**, holes **91** and **92** positioned adjacent each end of the window and in the central plate **45** of the ring segment **41**, a pin **105** for fitting in either hole, and a recess, or cam surface designated generally by the numeral **94** on the edge **93** of the plate **45** of ring segment **41**. The jaw segment **37** is illustrated as being cut away as shown at **96** in the slot *36a* for receiving the roller **97** therein which roller is mounted on the pin **98** that extends through the jaw segment **37**. The roller **97** is positioned in the jaw segment **37** so that the outer peripheral edge **99** of the roller extends beyond the normal peripheral edge *36d* of the jaw segment **37** as illustrated at **100** in FIG. 8.

When the jaw segment **37** is in the position on the rotary ring segment **41** as represented in FIG. 8 of the drawings, the cam surface or cam arrangement **40** is inoperative to move the jaw segment **37** inwardly relative to the ring segment **41** to engage the tubular member **19**. It will be noted that when the jaw segment **37** is in the position as illustrated in FIG. 8, the roller **97** is adjacent, but spaced from the central recessed portion **95** in the recessed portion **94** on the edge **93** of the central plate **45**.

The edge **93** of the plate **45** on the segment **41** along with the edges **93** of each of the central plate **45** of each of the segments **42** and **43** define the circular opening *93a*, as noted previously, and as also previously noted with regard to FIG. 4, the jaw segments in their normal position are adapted to abut the edge **93** of the central plate **45** and slide therealong. In order to engage the tubular member **19**, at least one of the jaw segments must be moved inwardly toward the tubular member **19** to engage it whereupon the diameter of the opening *93a* existing in the tong **10** between the jaw segments will be reduced sufficiently to thereby effect gripping of the tubular member **19** by the jaw segments **37, 38** and **39**. A pin **105** is adapted to be positioned in either of the openings **91** or **92** depending upon the direction of rotation of the rotary ring **32** and the direction of rotation in which it is desired to engage the tubular member **19** with the jaw segments **37, 38** and **39**.

For example, if the pin **105** is positioned as shown in FIG. 3, it is in the opening **91** and if the gear train **35** is rotated in the direction as illustrated by the arrow **106**, then rotation is imparted to the rotary ring **32** in a counterclockwise direction as represented by the arrow **107**. When this occurs the segments **41, 42** and **43** will rotate together and upon initial rotation of the rotary ring **32** each of the jaw segments **37, 38** and **39** will tend to remain stationary relative to the plate **45** upon which it is supported until the pin **81** in each of the jaw segments **38** and **39** engage the end of the groove **80** whereupon they will then rotate in unison with the rotary ring **32**.

However, since the peripheral edge **99** of the roller **97** projects outwardly beyond the edge *36d* of the slot in jaw segment **37**, rotation of the segment **41** relative to jaw segment **37** will cause the roller **97** to ride upon the cam surface **94** as shown in dotted line in FIG. 3, thereby forcing the jaw segment **37** inwardly against the tubular member **19**. When this occurs, the opening between the jaw segments **37, 38** and **39** is decreased so that the jaw segments **38** and **39** also then engage with the tubular member **19**. As a practical matter, the engagement of the jaw segment **37** and the engagement of the jaw segments **38** and **39** with the tubular member **19** is substantially simultaneous.

As long as the rotary ring **32** is rotated in the direction of the arrow **107** when the pin **105** is in the hole **91**, the jaw segments will be retained in engagement with the tubular member **19**. If the direction of rotation of the rotary ring **32** is reversed with the pin **105** in hole **91**, then the jaw segment **37** will tend to remain stationary so that the ring segment **41** moves relative thereto to disengage the peripheral edge of the roller **97** from the surface **94** to reposition the roller as illustrated in FIG. 8. Since jaw segment **37** is thereby released from tubular member **19**, the opening size between the jaw segments is increased, and the jaws **38** and **39** also disengage from the member **19**.

An advantage of the present invention is that the cam arrangement **40** enables the jaw segments **37, 38** and **39** to grip the tubular member **19** in either direction of rotation of the rotary ring **32** with a minimum of adjustment. For example, if the pin **105** is moved to the hole **92** as illustrated in FIG. 9 of the drawing and if the gear train **35** is again rotated in the direction of the arrow **106**, the rotary ring **32** will again rotate in the direction of the arrow **107**; however, the pin **105** will abut the edge **110** of the window **90** when the segment **41** moves relative to the jaw segment **37** and thereby prevent the roller **98** from engaging the cam surface **94** on the edge **93** of the plate **45** of the segment **41**. In this manner, the rotary ring **32** may be turned relative to the pipe **19** and not engage the jaws therewith.

If the direction of rotation of the gear train **35** is reversed so that the direction of rotation of the rotary ring **32** is in a clockwise direction, that is in a direction opposite to the arrow **107** of FIG. 3, then the pin **105** when in hole **92** must travel the length of the window **90** before it engages the edge **111** of the window. The relationship of the roller **97** and the arrangement of the cam surface **94** is such that prior to the time that the pin **105** has traversed the length of the window **90**, the peripheral edge **99** of

the roller will have engaged the cam surface **94** as illustrated in dotted line in FIG. 10 of the drawing. This causes the jaw segment **37** to move radially inwardly to decrease the opening between the jaw segments **37, 38** and **39** whereupon the jaw segments **37, 38** and **39** grip the tubular member **19**.

It should be noted that when the pin **105** is positioned in the hole **91** as previously described with regard to the FIG. 3 illustration, the rotary ring **32** can be moved in a clockwise direction, that is in a direction opposite to the direction of arrow **107** in FIG. 3, and the pin **105** in such event will contact the edge **111** of the window **90** and thereby lock the jaw segment **37** and the rotary segment **41** together so that the jaw segment **37** will not move inwardly.

From the above description, it can be seen that when the pin **105** is in the hole **91** the rotary ring **32** when moved in a counterclockwise direction as represented by the arrow **107** will cause the jaw segments **37, 38** and **39** to grip the tubular member **19**, whereas clockwise direction of rotation of the rotary ring **32** will release the jaw segments **37, 38** and **39** from engaging with the tubular member **19** and maintain them in non-engaged position. When the pin **105** is in the hole **92**, then the jaw segments **37, 38** and **39** will engage the tubular member **19** when the rotary ring **32** is rotated in a clockwise direction and will release from the tubular member when the rotary ring is rotated in a counterclockwise direction as represented by the arrow **107** in FIG. 3.

This construction is particularly advantageous in that it enables the operator to reverse the direction of actuation of the tongs without breaking the tong apart and disengaging it from the tubular member, and without removing the jaw segments from the tong.

It is necessary to retain the segmented rotary ring **32** in locked position when the segments are closed about the tubular member **19** to prevent relative movement of the ring segments **41, 42** and **43** during actuation of the tongs, and to prevent the rotary ring **32** from becoming disconnected during use. FIG. 5 illustrates a form of lock means used in connection with the present invention to accomplish this purpose.

In FIG. 5 the lock means is illustrated generally by the numeral **120**. In describing the lock or latch means **120**, it should be noted in connection with FIGS. 1 and 2 of the drawing that the ring segment **41** of the rotary ring **32** is received within the housing segment **15** when the tong is opened to receive the tubular member, or immediately after the tong has been closed about a tubular member as illustrated in FIG. 7. Also, the segment ring **42** of the rotary ring **32** is received within the housing segment **16**, and the ring segment **43** of the rotary ring **32** is received within the housing segment **17**. FIG. 2 represents schematically the relationship of the segments **41, 42** and **43** of the rotary ring **32** immediately after the housing **11** and rotary ring **32** have been closed about the tubular member and the lock means **120** is shown in position ready to lock the ring segments **42, 43** relative to each other and relative to the segment **41**.

It will be noted that the housing segments **16** and **17** are each provided with an upstanding portion defining a recess as illustrated generally at **121** in FIGS. 1 and 5. This recess is formed in the upper surface **14** of the housing **11** and when the housing **11** and rotary ring **32** are closed about the tubular member **19** the housing segments assume the locked relationship shown in FIG. 3, and the rotary ring **32** assumes the position shown in FIG. 2 of the drawing relative to the tubular member and relative to the housing **11**. At this time the lock means **120** is positioned immediately below the recess **121** so that the lock means is as yet unactuated, but ready to actuate to connect the segments **42** and **43** together, while FIG. 3 represents the lock means **120** actuated and connecting the segments **41, 42** and **43** together in rigid relationship.

The lock means **120** includes the block **123** which is adapted to fit in the recess **124** formed in the upper plate **46** at the end of the ring segment **42**, as best seen in FIG. 5A. It will be noted that the upper plate **46** of the ring segment **43** overlaps the center plate **45** of the segment **42**, as best illustrated in FIG. 5 of the drawings. Also, the lower plate **47** of ring segment **43** underlaps the central plate **45** of the segment **42** so that when the segments **16** and **17** are abutted together, the central plate **45** of the ring segment **42** extends between the upper and lower plates **46** and **47** of the ring segment **43**. This is the relative position of the adjacent ends of the ring segments **42** and **43** when the housing **11** and the segments **16** and **17** thereof are closed about a tubular member. In order to hold the block **123** in position in the recess **124**, while accommodating up and down movement thereof, a groove or slot **125** may be provided on each side of the slot in plate **46** so as to receive the pin **126** therethrough, as shown in FIGS. 5 and 5A. This holds the block **123** in position in plate **46** of ring segment **42**, and prevents it from falling out when the ring segments **42** and **43** are not engaged. A roller **127** is mounted on the shaft **128** in block **123** and is adapted to abut the inner surface **129** of the upper plate **14** of the housing **11** as rotation is imparted to the rotary ring **32**.

A spring **130** tends to urge the block **123** and roller **127** outwardly relative to the upper plate **46** so as to abut the inner surface **129** of the plate **14** of the housing. The spring **130** is mounted in the recess **130*a*** of the central plate **45** and surrounds the spindle **130*b***. The spindle **130*b*** extends upwardly into the opening **130*c*** and guides the block **123** as it moves up and down in the slot **124**.

When the roller **127** is adjacent the raised portion **121** of the upper housing surface or plate **14**, the block **123** by reason of the spring **130** acting thereon, will urge it outwardly into the recess **121**. The block **123** has the projection **131** depending therefrom which extends through plate **45** of ring segment **42**, and when the rotary ring **32** is rotated so that the block **123** is moved out of the recess **121** and reseated in **124**, then the block **123** will be depressed so that the projection **131** engages in the opening **132** in the lower plate **47** of the ring segment **43**. This locks the segments **42** and **43** together and prevents relative movement thereof. When the roller **127** is urged upwardly into the recess **121**, projection **131** is disengaged from opening **132**.

The pivot pins **44, 45'** and the lock or latch **120** form a rigid construction which prevents the ring segments **41, 42** and **43** of the rotary ring **32** from moving relative to each other. This is diagrammatically represented in FIG. 2 wherein it can be seen that the rotary ring **32** forms a rigid construction by reason of the triangular relationship of the pivot pins **44, 45'** and the lock means **120** which hold the segments in rigid relationship when closed about and rotating about a tubular member. Additionally, it will be noted that the central plate **45** is segmented in an arcuate manner as indicated at **50** and **50*a*** so that when the ring segments are closed about a tubular member and the ends thereof are positioned together, they will interlock with each other along the line of segmentation. The end **50** provides a recess in the ring segment **41** and the end **50*a*** of each ring segment **42, 43** in effect provides a projection to aid in interlocking the ends of the ring segments together.

While it is believed that the operation of the invention is apparent by reason of the foregoing description, to further amplify and illustrate, it will be assumed that the device is to be engaged on a tubular member such as a casing or the like for rotating the casing to threadedly engage it with a casing section immediately therebeneath. The tong **10** will be moved toward the tubular member while in open position as illustrated in FIG. 1 of the drawing, and after the tong is positioned about the tubular member the housing **11** will be closed man-

ually by grasping the handles **150, 151,** whereupon the latch **25** locks the housing **11** segments **15, 16** and **17** together about the tubular member **19,** and simultaneously ring segments **41, 42** and **43** of the rotary ring **32** are closed about the tubular member **19.**

When rotation is imparted to the rotary ring **32,** the segments of the rotary ring **32** are locked together by reason of the latch **120,** to prevent relative movement of the ring segments during operation of the tong. The pin **105** is then positioned either in the hole **91** or **92,** depending upon which direction it is desired to rotate the tubular member **19.** If it is desired to impart rotation to the tubular member **19** in a counterclockwise direction as viewed in FIG. 3, then the pin **105** will be placed in the hole **91;** however, if it is desired to rotate the tubular member **19** in a clockwise direction then the pin **105** will be placed in the hole **92.**

Thereupon rotation may be imparted to the rotary ring **32** in the desired direction to cause the actuation of the cam arrangement **40** to engage the tubular member **19** and obtain the desired direction of rotation of the tubular member **19.** It will be noted that the jaw segments **37, 38** and **39** extend substantially around the entire circumferential periphery of the tubular member **19** thereby distributing the torque applied to the tubular member **19** by the tongs **10** over a greater area so as to inhibit scarring or damage to the pipe, and to inhibit the application of an excessive pressure to a localized area of the tubular member.

Additionally, it is to be noted that the jaw segments move into engagement with the tubular member **19** without any actuating mechanism other than the difference in momentum between the rotary ring **32** and the jaw segment **37,** at the beginning of rotation of the rotary ring **32.** Similarly, the jaw segments **37, 38** and **39** move out of engagement with the tubular member **19** merely by reversing the direction of rotation of the rotary ring **32** from the direction required to engage the jaw segments with the tubular member.

The construction of the present invention is such that the rotary ring **32** transmits the reaction of the torque applied to the tubular member **19** to the rollers **31** and then to the tong housing **11** thereby distributing the load over a plurality of members, and over the substantial circumferential extent of the tong. This prevents the application of any undue reaction forces in the tong mechanism and tends to retain the reaction forces balanced in the tong.

When it is desired to open the tong **10** to disengage it from the tubular member **19** or to engage it with a tubular member, the ring **32** may be visually aligned, with housing **11,** by aligning marks **160, 161** which indicates that each ring segment **41, 42** and **43** is positioned respectively in hollow housing segments **15, 16** and **17** whereupon the tong may be opened as shown in FIG. 1.

It will be further noted that the rotary ring **32** is supported in the housing solely on the roller means **31** and retained in position only by means of the blocks **84** thereby enabling the ring to be removed from the housing for repair or replacement with a minimum of effort. Similarly, the jaw segments **37, 38** and **39** are mounted on the ring segments **41, 42** and **43** in a manner so that the jaw segments can be removed if desired and jaw segments of different sizes placed in the tong in order to engage tubular members of larger or smaller diameter as desired. To remove jaw segments **38** and **39** the pin **80** in each jaw segment is unthreaded and the jaw removed. To remove jaw segment **37,** pin **105** is removed, whereupon jaw **37** may be removed.

No cage mechanism is provided for supporting the jaw segments, rather the jaw segments are mounted directly on the rotary ring which enables the tong of the present invention to function on various size diameter pipes.

The segmented construction of the housing and the segmented construction of the rotary ring enable the device to be quickly and easily positioned about a tubular member, while the lock means associated with the housing and the lock or latch means associated with the rotary ring positively engage the housing and the ring segments in rigid relation to each other to prevent relative movement thereof during rotation of the rotary ring.

The cam surface or cam arrangement designated generally at **40** provides the surface **94** upon which the roller edge **99** is adapted to engage, and additionally provides the deeper cam surface **95** so that the roller **99** will engage with the surface **94** quickly as it moves towards the surface, and on the other hand will disengage from the cam surface **94** rapidly as it moves away from engagement therewith.

Broadly the invention relates to a power tong which overcomes many of the problems encountered at the present time.

What is claimed is:

1. A power tong for rotating tubular members including a rotary ring having gear teeth on its outer periphery whereby it may be rotated to transmit rotation to a tubular member about which said rotary ring is positioned, said rotary ring being formed of segments with two segments being pivotally mounted on a third segment whereby said rotary ring may be opened to receive a tubular member therein and thereafter closed about the tubular member, jaw segments slidably mounted on each of said rotary ring segments and extending substantially circumferentially about the tubular member to grip it, a plurality of roller means circumferentially spaced to support said rotary ring, a housing to support said roller means, said housing being formed in segments which are pivotally connected together whereby it may be opened simultaneously when said rotary ring is opened to receive the tubular member therein, lock means on said two rotary ring segments cooperating when said rotary and housing are closed to lock said rotary segments together against relative movement when rotation is imparted to said rotary ring, and cooperating cam surface means on one of said rotary ring segments and one of said jaw segments whereby rotation of said rotary ring feeds said jaw segments inwardly to grip the tubular member and rotate it.

2. The combination recited in claim 1 wherein said cooperating cam surface means includes a roller mounted on said jaw segment, and a recessed portion on said rotary segment adjacent said roller whereby rotation of said rotary segment engages said roller and recessed portion and forces said jaw segment inwardly to grip the pipe, and means to actuate said cam surface means in either direction of rotation of said rotary ring and to release said jaws from the tubular member in either direction of rotation.

3. The combination recited in claim 2 wherein said last named means includes a window in said jaw segment, openings at each end of said window in said rotary ring, and pin means for fitting in either of said openings whereby said pin locks said jaw segment and ring segment for rotation together in one direction to prevent engagement of said jaws with the tubular member, but accommodating a relative movement between said jaw and segment in the other direction to force said jaw segment into engagement with the tubular member.

4. The combination recited in claim 1 wherein said lock means on said rotary ring segments includes roller means adapted to abut said housing as said rotary ring rotates, a carrier supporting said roller in one of said segments, a plunger mounted on said carrier and extending through said segment in which said carrier is mounted, spring means abutting said carrier and normally urging said carrier and plunger away from the adjacent rotary ring segment, an opening in the adjacent rotary

ring segment, said plunger moving into said opening when said rotary ring rotates in said housing to lock said rotary ring segments against relative movement, and latch means for holding said housing closed when said ring segments are locked together.

5. A power tong for rotating tubular members including a rotary ring having gear teeth on its outer periphery whereby it may be rotated to transmit rotation to a tubular member about which said rotary ring is positioned, said rotary ring being formed of segments with two segments being pivotally mounted on a third segment whereby said rotary ring may be opened to receive a tubular member therein and thereafter closed about the tubular member, jaw segments slidably mounted on each of said rotary ring segments and extending substantially circumferentially about the tubular member to grip it, a plurality of roller means circumferentially spaced to support said rotary ring, a housing to support said roller means, said housing being formed in segments which are pivotally connected together whereby it may be opened simultaneously when said rotary ring is opened to receive the tubular member therein, lock means on said two rotary ring segments cooperating when said rotary and housing are closed to lock said rotary segments together against relative movement when rotation is imparted to said rotary ring, cooperating cam surface means on one of said rotary ring segments and one of said jaw segments whereby rotation of said rotary ring feeds said jaw segments inwardly to grip the tubular member and rotate it, and wherein said rotary segments each include a central plate having said gear teeth on its outer periphery, upper and lower plates mounted thereon, said central plate being wider than said upper and lower plates and said upper and lower plates being adjacent, but spaced from the outer periphery of said central plate, said roller means comprising spaced upper and lower rollers on a shaft for receiving said central plate therebetween, said rollers abutting the edge of each said upper and lower plates respectively to support said rotary, and means mounted on said housing to retain said rotary ring therein.

6. The combination recited in claim 5 wherein said slidable mounting for said jaw segments on said pivotally mounted ring segments includes a window in said central plates of each of said pivotally mounted ring segments, and a pin fixed in each jaw segment and extending through said window to slidably support said jaws on said central plate.

7. A power tong for fitting about a tubular member to transmit torque thereto comprising a hollow housing, including a main segment portion, and segments pivotally mounted on said main portion to define an opening in said housing when said pivoted segments are engaged, a plurality of circumferentially spaced roller means mounted in said housing, a rotary ring formed of segments supported by said roller means, a jaw segment mounted on each of said rotary ring segments for engaging a tubular member extending through said housing opening, gear means mounted in said housing and gear teeth on said segmented ring whereby rotation may be imparted to said segmented ring and jaws supported thereon, said jaw segments being slidably mounted on said rotary segments, cooperating cam surface means on at least one of said rotary ring segments and at least one of said jaw segments whereby rotation of said rotary ring feeds said jaw segments inwardly to grip the tubular member and rotate it, said cooperating cam surface means including a roller means mounted on said jaw segment, and a recessed portion on said rotary segment adjacent said roller whereby rotation of said rotary segment engages said roller and recessed portion and forces said jaw segment inwardly to grip the pipe, and means to actuate said cam surface means in either direction of rotation of said rotary ring and to release said jaws from the tubular member in either direction of rotation.

8. The combination recited in claim 7 wherein said roller means are mounted in said housing to abut said segmented ring for support thereof, and means associated with said roller means for adjusting them to position said roller means closer to said ring as wear occurs between said roller means and ring.

9. The combination recited in claim 7 wherein said last named means includes a window in said jaw segment, openings at each end of said window in said rotary ring, and pin means for fitting in either of said openings whereby said pin locks said jaw segment and ring segment for rotation together in one direction to prevent engagement of said jaws with the tubular member, but accommodating a relative movement between said jaw and segment in the other direction to force said jaw segment into engagement with the tubular member.

10. A power tong for fitting about a tubular member to transmit torque thereto comprising a hollow housing, including a main segment portion, and segments pivotally mounted on said main portion to define an opening in said housing when said pivoted segments are engaged, a plurality of circumferentially spaced roller means mounted in said housing, a rotary ring formed of segments supported by said roller means, a jaw segment mounted on each of said rotary ring segments for engaging a tubular member extending through said housing opening, gear means mounted in said housing and gear teeth on said segmented ring whereby rotation may be imparted to said segmented ring and jaws supported thereon, said jaw segments being slidably mounted on said rotary segments, cooperating cam surface means on at least one of said rotary ring segments and at least one of said jaw segments whereby rotation of said rotary ring feeds said jaw segments inwardly to grip the tubular member and rotate it, said cooperating cam surface means including a roller means mounted on said jaw segment, and adjacent cam surface portions on said rotary segment one of which is a deeper cam surface than the cam surface adjacent thereto whereby engagement of said roller means and said deeper cam surface portion affects rapid radial movement of said jaw segments to grip the tubular member.

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