

[54] TORQUE LIMIT MEANS FOR POWERED PIPE WRENCH MEANS

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[58] Field of Search. 81/57.18, 57.35, 58.2

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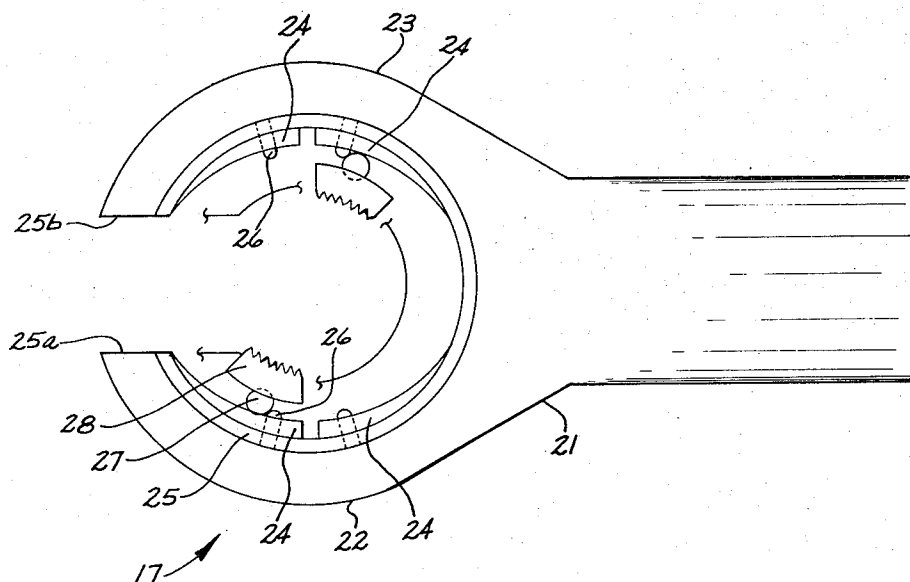
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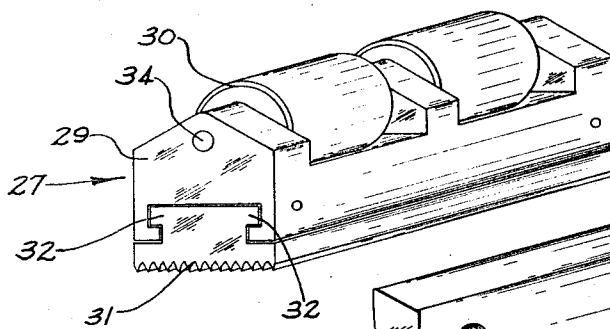
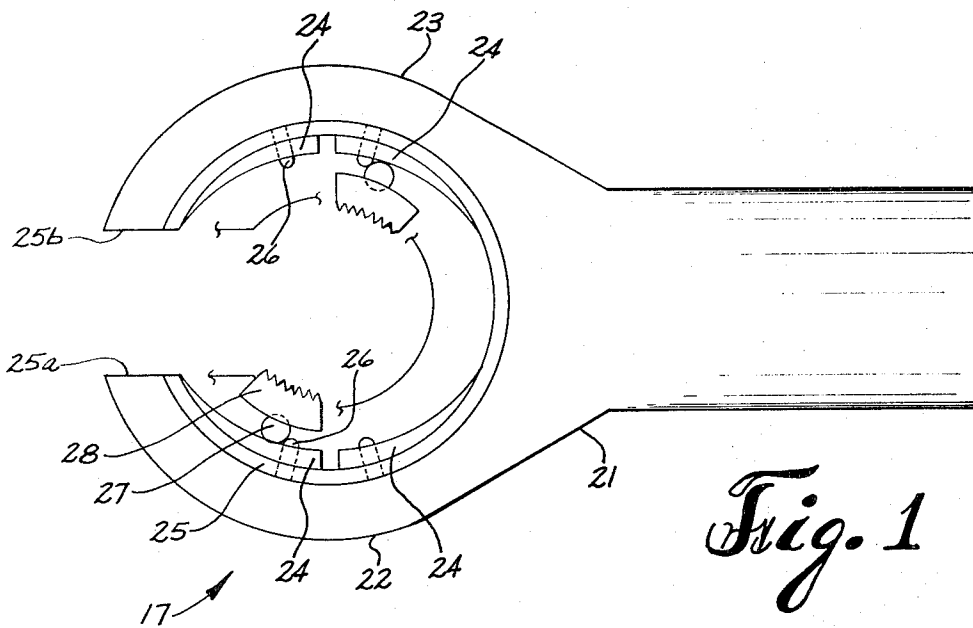
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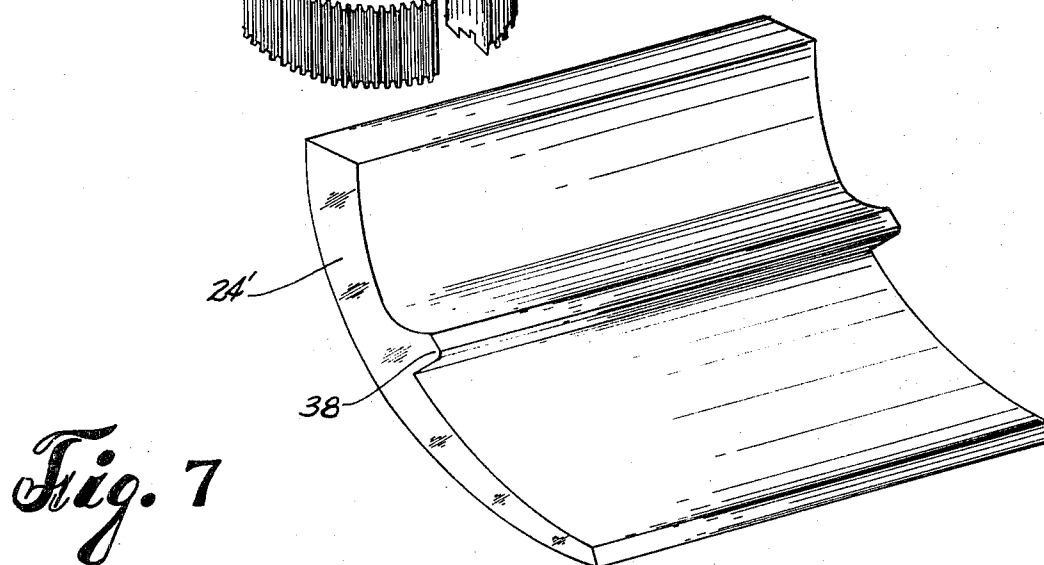
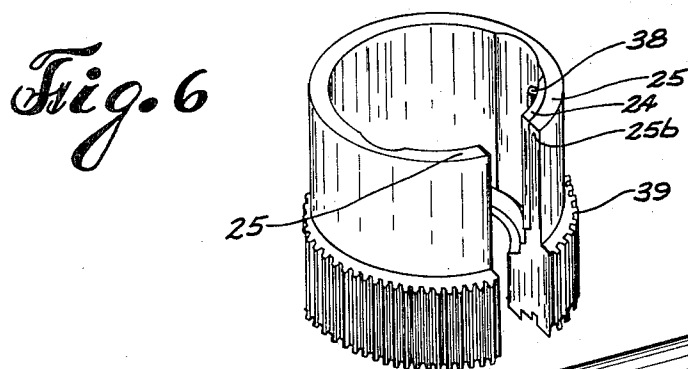
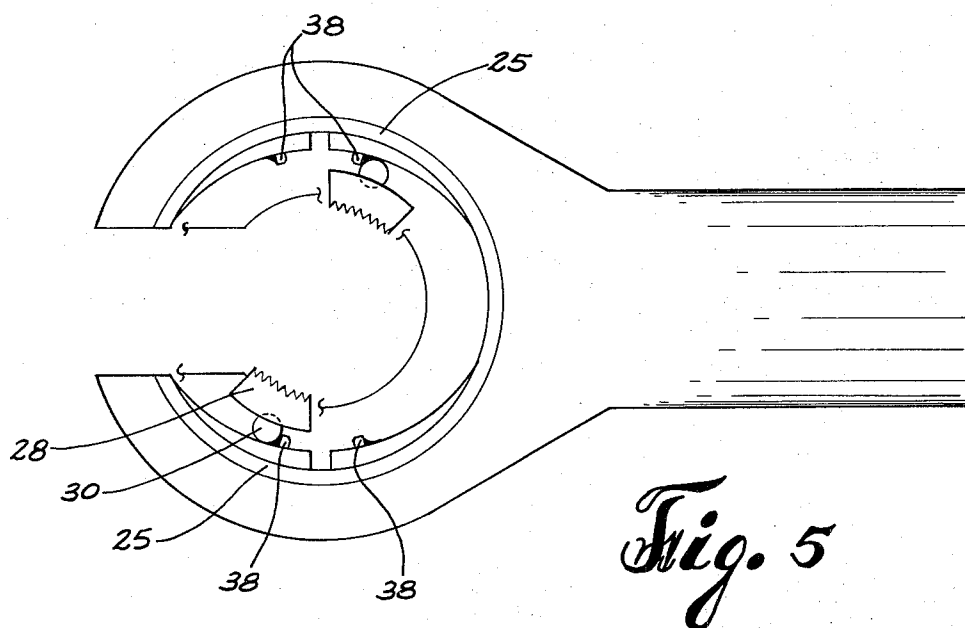
[57] ABSTRACT

Disclosed is a powered wrench means or "tong" for making or breaking threaded pipe joints. A torque limit device is provided in the tong to prevent pipe damage. The tong includes a housing, a collar rotatably mounted within the housing, power drive means, internal cam surfaces provided in the rotary collar, cam followers adapted to be driven radially by relative rotational movement between the cam surfaces and the followers, pipe gripping means carried by the followers and, stop means to limit the relative rotational movement between the cam surface and the cam followers to thereby limit the radial movement of the pipe gripping means. One embodiment of the invention discloses adjustable stop means for selecting different limits of radially inwardly directed movement of the pipe gripping means. A second embodiment employs fixed stop means for limiting the radial movement of the pipe gripping means to a single position.

8 Claims, 8 Drawing Figures







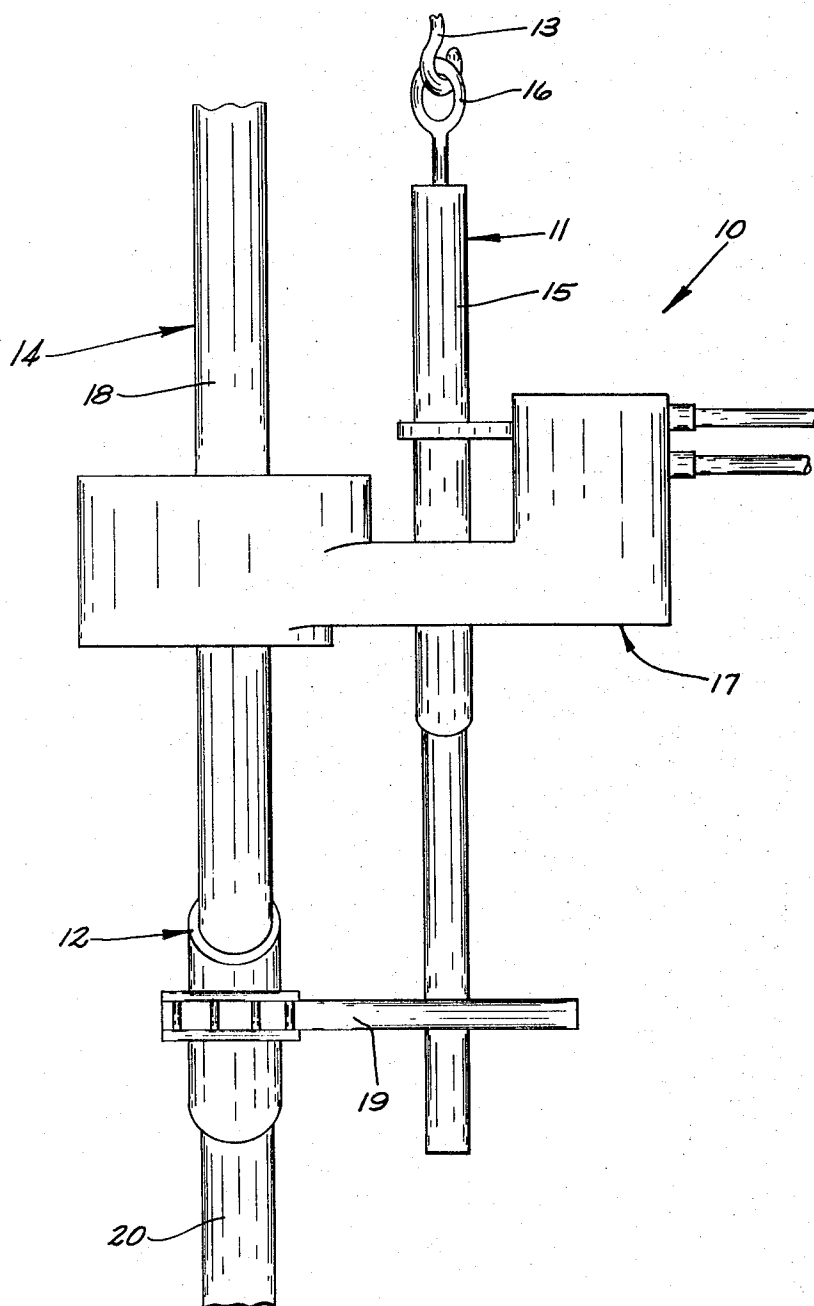


Fig. 8

TORQUE LIMIT MEANS FOR POWERED PIPE WRENCH MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to devices employed for powered rotation of tubular members. In the particular application of the invention to be described herein, the invention relates to powered tongs employed to make and break threaded connections in pipe strings used in the drilling and completion of wells.

2. Description of the Prior Art

Powered tongs have long been employed to make and break threaded connections in conventional well drilling and completion procedures. These devices, which are normally hydraulically or electrically driven, are capable of producing extremely large radial and circumferential forces during the pipe gripping and rotating portions of their operation.

In many conventional powered tong designs, no limiting means are provided to prevent the radially directed gripping force from exceeding a selected upper limit. In such devices, the sole limit to the radial gripping force is the gripped element itself. As a result, where excessive gripping forces are exerted, structural damage is produced in the gripped pipe. The implications of damaged pipe are serious in that such pipe is customarily employed to confine high pressure oil and gas. The untimely failure of the drill string or tubing used in a petroleum well can be disastrous to life and property.

In recognition of the problem, various prior art tong designs have attempted to deal with the problem of over torquing. One of the basic approaches suggested is that of operator controlled limits to the gripping force exerted by the powered tong. This approach is unsatisfactory, however, to the extent that operator judgment and alert reflexive action are required to prevent pipe damage. These characteristics are variable depending on operator experience and ability.

A simple method employed to prevent pipe damage is to use a specific tong size for handling pipe of a corresponding size. If different size pipe is to be handled, different tong fittings are conventionally employed. This common technique affords certain safety features in that the tong design can be such as to inherently prevent damage when handling pipe of the appropriate size. The requirement of changing tong accessories with each change in pipe size and the inflexibility associated with the use of a different tong assembly for each different size of pipe, coupled with the time loss associated with the changeover in equipment, renders the described conventional procedure undesirable.

In an attempt to overcome these undesirable features, the prior art had suggested the use of direct retainers to limit the radial movement of the pipe gripping means. With such retainers, the need for switching tongs or substituting large portions of the tong each time a different size pipe is to be handled can be eliminated. The problem continues to persist, however, in that such direct retainers are exposed to the full force of the radially movable pipe gripping means and therefore the retainers often fail. Failure of the direct retainer permits a sudden crushing force to be exerted on the pipe and can produce severe pipe damage.

SUMMARY OF THE INVENTION

In the preferred embodiment of the present invention, adjustable stop means are provided along the internal cam surface of a conventional power tong to limit the relative rotation between the cam surface and the cam follower. Tongs having this design arrest the radial movement of the pipe gripping means which is driven by the cam follower at the position where the follower engages the cam stop. The forces tending to rotate the cam surface relative to the follower are insufficient to damage the cam stop. By contrast, the direct retainers employed in the prior art are exposed to the radial forces exerted by the pipe gripping means which forces are many times larger than those tending to rotate the cam follower relative to the cam surface.

In one specific embodiment of the invention, a plurality of circumferentially spaced, internally threaded bores are formed along the cam surface. Externally threaded nipples are then threadably engaged within the appropriate bore for limiting the cam follower movement at a desired position. By this means, when a given size of pipe is to be handled by the powered tong, the threaded nipple is inserted into the appropriate bore for that particular pipe size. Accommodation of the tong to the pipe is accomplished without the need for exchanging tongs and without the need for extensive dismantling of the tong assembly.

In a modified form of the invention, the cam surfaces are provided by removable cam plates. An inwardly projecting, axially extending, ridge is formed along the internal cam surface of the cam plate to arrest and thereby limit the cam follower motion during relative rotation between the cam surface and the cam follower. The tongs are quickly and easily modified to handle different size pipe by simply installing a cam surface plate having the arresting ridge provided at the appropriate location for limiting the radial movement of the pipe gripping means to correspond to the size of pipe to be handled. As with the adjustable cam stop assembly of the preferred embodiment, the tongs may be quickly and easily modified to accommodate the different size pipe without the need for exchanging tongs and without the need for extensive dismantling of the assembly.

From the foregoing it will be appreciated that it is a primary object of the present invention to provide a powered pipe tong which can be quickly and easily modified to provide an inner limit to the travel of the radially movable pipe gripping means whereby the pipe being handled by the tong is prevented from being damaged by excessive forces exerted by the pipe gripping means.

It is also an object of the present invention to provide means for modifying conventional tongs whereby the inwardly directed gripping force of the tongs may be quickly and easily regulated to conform to the different size pipe to be handled by the tong.

It is a further object of the present invention to provide means for automatically controlling the radial force exerted by a power tong whereby the need for operator judgement is eliminated.

One of the important objects of the present invention is to provide a powered tong having the described characteristics in which the means employed for limiting the radial gripping force is exposed to forces which are less than said radial gripping force. By thus isolating the

limit device from the large radial gripping forces, the safety and reliability of the limit means of the present invention is substantially improved over the direct retaining limit devices of the prior art.

The foregoing objects, advantages, features and results of the present invention, together with various other objects, advantages, features and results thereof which will be evident to those skilled in the powered tong art in light of this disclosure may be achieved with the exemplary embodiments of the invention described in detail hereinafter and illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 of the drawings is a plan view, partially in section, illustrating the preferred embodiment of the powered pipe tong of the present invention;

FIG. 2 is an enlarged scale perspective view illustrating a cam follower and pipe gripping means employed in the powered tong of the present invention;

FIG. 3 is an enlarged scale perspective view of an inclined cam plate employed in the tong of the present invention illustrating a plurality of stop receiving bores;

FIG. 4 is an enlarged scale elevation illustrating a threaded nipple adapted to be threadedly engaged in one of the bores illustrated in FIG. 3;

FIG. 5 is a plan view, partially in section, schematically illustrating a modified form of the powered tong of the present invention;

FIG. 6 is a perspective view of a rotary collar and cam plate employed in the powered tong of FIG. 5;

FIG. 7 is an enlarged scale perspective view of an inclined cam plate employed in the tong of FIG. 5; and

FIG. 8 is an elevation of the powered pipe tong of the present invention illustrating a pipe string which is to be made up or broken out by the tong.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

In FIG. 8 of the drawings, a powered tong apparatus 10 of the present invention is schematically illustrated in position for making or breaking threaded joints in a pipe string. The illustration of FIG. 8 depicts a threaded pipe joint 12 in a drill string 14 with the tong apparatus 10 being suspended from a support 11 by a hook 13. The hook in turn is supported from a conventional cable (not illustrated) so that the apparatus 10 may be moved vertically and horizontally about the drill string 14. The support 11 includes a vertical post 15 having at its upper end an eye 16 secured by the hook 13. A powered tong member 17 is carried by the post 15 and is illustrated in position about an upper pipe section 18 of the drill string 14. Also carried by the vertical post 15, in a conventional manner, is a backup wrench 19 of any standard type. The wrench 19 grips a lower section 20 of the drill string pipe to prevent the drill string from rotating when the power tong 17 applies torque to the upper pipe section 18. By this means, the threaded joint 12 may be made up or broken out depending upon the direction of torque applied by the power tong. The assembly of FIG. 1 is substantially conventional with the exception of the limit means of the present invention provided in the tong 17.

Referring to FIG. 1, the powered tong 17 of the present invention includes a housing 21 carried by the sup-

port 11 (not illustrated in FIG. 1). The housing is equipped with a pair of stationary support members 22 and 23 which are spaced apart at their ends. The members 22 and 23 rotatably carry a collar 25, more particularly shown in FIG. 6, which is equipped along its internal surfaces with camming surfaces provided by inclined cam plates 24. While the cam surfaces are illustrated as being formed on cam plates, it will be appreciated that in the present form of the invention, the cam surfaces may be formed as an integral part of the collar 25. The opening formed between faces 25a and 25b in the collar 25 is aligned with the opening in the supports 22 and 23 to receive the vertical pipe joint. Gear teeth 39 formed along the lower outer surface of the collar are employed to rotatably drive the collar in the supports 22 and 23. The arrangement of the housing, collar and drive are conventional.

Cam stops 26 project radially inwardly from the internal surfaces of the cam plates 24. As best illustrated in FIG. 1, the cam stops are adapted to engage and limit the rotary movement of the cam followers 27 relative to, and along, the cam plates. The mounting and operative connection between the cam followers and the internal camming surface of the cam plates, which are conventional, produce radial movement of the cam followers as the followers ride over the inclined cam surface of the cam plates during relative rotational movement between the two components. The cam followers 27 carry pipe gripping means 28 which are adapted to engage and firmly grip the pipe encircled by the tongs.

When the collar 25 is initially rotated, the cam followers tend to resist rotation causing the followers to advance along the internal cam surface. This movement drives the cam followers and attached gripping means radially inwardly until the gripping means engage the encircled pipe. Engagement of the pipe and gripping means causes the cam follower to further resist rotation with the collar which in turn forces the cam follower further along the internal cam surfaces. This relative movement between the cam follower and the cam surfaces continues until the cam followers engage the stops 26.

Cam follower 27 and pipe gripping means 28, both of which are conventional, are illustrated in FIG. 2. The follower includes a die holder 29 and roller bearings 30. The die holders 29 are provided with receptacles 32 which receive a replacable slip die 31.

FIGS. 3 and 4 illustrate a specific form of stop mechanism which may be employed in the present invention. In the illustrations, a stop pin 35, provided along its base portion with threads 37 is adapted to be threadedly engaged within an internally threaded bore 36 formed in the cam plate 24. As depicted in dotted line in FIG. 1, the pins 35 are designed to engage the bearings 30 to limit the relative rotational movement between the cam follower 27 and the cam plate 24. While cam plate 24 is illustrated as having four different circumferential positions for the stop pins 35, it will be appreciated that additional or fewer bores may be provided to give the desired degree of adjustability. Moreover, while the cam plate 24 illustrates the use of two pins for each stop position, only one pin or several pins may be employed if desired.

FIGS. 5-7 illustrate a modified tong 117 of the present invention. The tong 117 is similar to the tong 17 with the exception that the former is provided with a

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cam plate 24' having a permanent ridge 38 which functions as the limit means for the cam follower motion. The tong 117 is modified to accommodate different size pipe by replacing the cam plate 24' with a plate having the ridge 38 located at the desired position along the cam surface of the plate.

While two specific forms of the present invention have been illustrated in detail, it will be appreciated that other means may be provided for limiting the advancement of the cam follower along the cam surface employed to radially drive pipe gripping means in a powered tong. It will therefore be appreciated that the foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials as well as in the details of the illustrated construction may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A powered pipe tong for making up and breaking out threaded connections in a pipe string without damaging the pipe, comprising:
 - a. support means;
 - b. housing means connected to said support means and including a pair of stationary extending members spaced apart for receiving a pipe;
 - c. collar means rotatably mounted within said housing;
 - d. powering means operatively connected to said collar means for rotatably driving said collar means;
 - e. cam surface means carried by said rotary collar means;
 - f. cam follower means mounted adjacent said cam surface means for radial movement in response to relative rotational movement between said cam follower means and said rotary collar;

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g. stop means selectively positionable along said cam surface means for engaging said cam follower means and selectively limiting rotation of said cam surface means relative to said cam follower means; and

h. pipe gripping means driven by said cam follower means for gripping said pipe.

2. A powered pipe tong as defined in claim 1 wherein said cam surface means are provided at opposite sides of said rotary collar means.

3. A powered pipe tong as defined in claim 1 wherein said stop means are removably carried by said cam surface means for placement at a plurality of positions therealong to accommodate different size pipe strings.

4. A powered pipe tong as defined in claim 1 wherein said stop means include ridges on the surface of said cam surface means, said cam surface means being removable from said housing for replacement thereof.

5. A powered pipe tong as defined in claim 3 wherein said cam surface means include a plurality of receiving locations for receiving said removable stop means whereby the locations of said stop means may be varied.

6. A powered pipe tong as defined in claim 2 wherein said stop means are removably carried by said cam surface means for placement at a plurality of locations to accommodate different size pipe strings.

7. A powered pipe tong as defined in claim 2 wherein said stop means include ridges on the surface of said cam surface means, said cam surface means being removable from said housing for replacement thereof.

8. A powered pipe tong as defined in claim 5 wherein said cam surface means are provided at opposite sides of said rotary collar means.

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