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PIPE TONG

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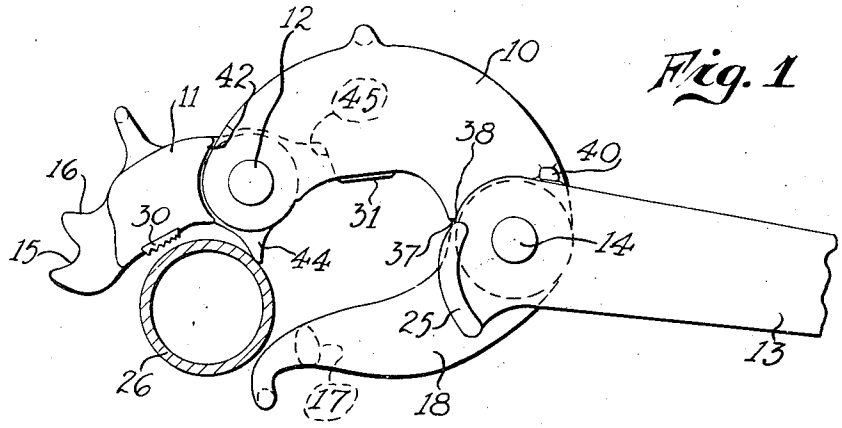


Fig. 1

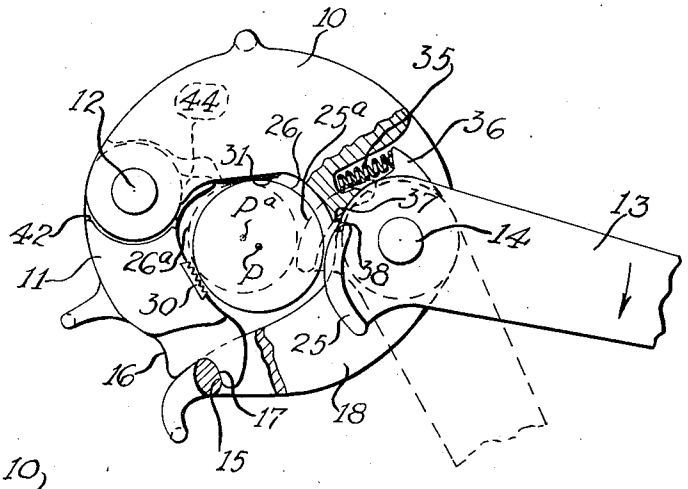


Fig. 2

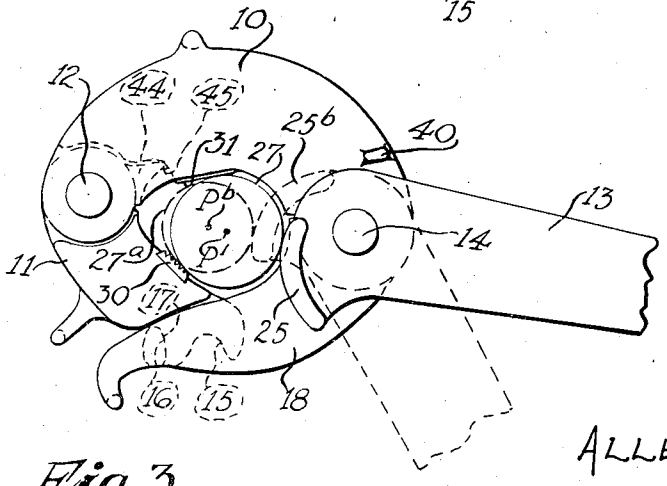


Fig. 3

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PIPE TONG

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5 Claims. (Cl. 81—66)

This invention relates generally to pipe tongs, and particularly to tongs such as are used in making up or breaking out joints in drill pipe, well casing, or well tubing.

Pipe tongs of the aforementioned type are usually suspended in the well derrick in position to be swung laterally onto the pipe and latched about the pipe joint. In order to possess the necessary strength, such tongs are unusually heavy and their repeated manipulation while making up or breaking out the joints in a string of pipe involves considerable manual effort. In addition to the manual effort involved, the time consumed in applying the tong to the pipe is also an important factor, inasmuch as it is multiplied by the number of joints to be made up or broken out. For the above reasons, the ease with which the tong may be applied to and removed from the pipe is as important a factor in the success of the tong as is its ability to properly grip the pipe.

Closely associated with the ease of manipulation of the tong is the problem of balance. In order to maintain the tong is properly balanced condition while suspended at a single point from a wire line, as is customary, it is essential that the center of gravity of the suspended mass be, as nearly as possible, directly below the point of suspension. It is impossible to maintain the center of gravity directly below the suspension point at all times because of the relative movement between the tong jaws when opening and closing them about the pipe. It is possible, however, to maintain an approximately balanced condition by so constructing the tong that the shifting of the center of gravity resulting from opening and closing movements of the jaws is reduced to a practical minimum.

In addition to the foregoing features essential to the success of a well pipe tong, it is also desirable that the tong be capable of accommodating several different sizes of pipe, and that it properly grip all sizes of pipe or pipe joints within its range of adjustment.

A general object of this invention is to provide a pipe tong which is capable of being applied to a wide variety of sizes of pipe, and which is easily applied to and removed from the pipe.

A further object is to provide a pipe tong of the type adapted to be suspended from a single point, and in which the shifting of the center of gravity of the suspended mass during opening and closing movements of the jaws is minimized.

A still further object of the invention is to provide a tong embodying the foregoing advantageous features and involving a minimum number of parts, thereby simplifying the construction and reducing the manufacturing cost.

Other objects and advantages will be apparent from the following detailed description of one embodiment of the invention, reference being had to the accompanying drawing wherein:

Fig. 1 is a plan view of a tong embodying the invention, showing the jaws in open position to receive a pipe;

Fig. 2 is a plan view showing the tong latched in one position to grip any one of several different sizes of pipe; and

Fig. 3 is a view similar to Fig. 2 but showing the tong latched in another position to grip a series of smaller pipe sizes than that accommodated by the tong in the latched position shown in Fig. 2.

For purpose of illustration, I have shown in the accompanying drawing a tong which is particularly adapted to use as a rotary tong for making up and breaking out the tool joints in a string of drill pipe. It will become apparent as the description proceeds, however, that the essential features are equally well adapted to being embodied in a casing tong or a tubing tong.

Referring to the drawing, the tong comprises generally a pair of pipe-gripping jaws 10 and 11 pivotally interconnected at one end by a pivot pin 12, the opposite end of the jaw 10 being pivotally connected to a lever 13 as by a pivot pin 14. Formed on the free outer end of the jaw 11 are a plurality of stepped latching surfaces 15 and 16 which are adapted to be selectively engaged by an oppositely directed latching surface 17 formed on a latch 18 pivotally connected to the jaw 10. As shown herein, the latch 18 is connected to the jaw 10 by the pivot pin 14 which also connects the jaw to the lever 13, but this is solely for the purpose of reducing the number of parts and the number of machining operations. From a functional standpoint, the latch could as well be connected to the jaw 10 on a separated pivot. For reasons set forth below, the essential feature of this connection is that the latch be pivotally connected to the jaw 10 for pivotal movement relative thereto independently of pivotal movement of the level 13 relative to the jaw. Thus, when the latch engages one of the latching surfaces 15 or 16 a closed pipe recess is defined by the two jaws 10 and 11 and the latch 18, the size of the recess being determined by which latching surface 15 or 16 is engaged by the latch 18.

It will be observed from a comparison of Figs. 2 and 3 that the relative disposition of the latching surfaces 15 and 16 on the jaw 11 is such that in order to shift the latch surface 17 on the latch 18 from engagement with the first latching surface 15 into engagement with the second latching surface 16, the jaw 11 must be swung inwardly about its pivot pin 12 to substantially reduce the size of the pipe opening between the jaws. Inasmuch as the reduction in the size of the pipe opening takes the form of a pivotal closing movement between the jaws about the pivot pin 12, unaccompanied by a corresponding pivotal closing movement between the jaw 10 and the latch 18, it follows that the center P' of the maximum size pipe which can be accommodated in the smaller pipe opening, as indicated in Fig. 3, is located at a greater distance from the pivot pin 12 than is the center P of the largest size pipe receivable in the larger pipe opening shown in Fig. 2. The construction is such that the centers P and P' are as close to a line extending between the pivot pins 12 and 14 as it is practical to dispose them, thereby locating the center P' of Fig. 3 closer to the pivot pin 14 than is the center P of Fig. 2. This is an important consideration, for reasons which will become apparent as the description proceeds.

In order to enable the tong to grip a wide range of sizes of pipe in each of the two latched positions, an adjustable pipe-engaging means is provided for gripping the pipe on the side thereof opposite the pivot pin 12, and at varying distances from the pivot pin 14. In the present instance this means comprises a cam member 25 formed integral with the lever 13 and provided with a spiral cam surface so as to present a wedging surface to the pipe at progressively increasing distances from the pivot 14 as the lever is swung in the direction of the arrow in Fig. 2. By forming the cam surface as a spiral, the wedge angle between the cam and the surface of the pipe is constant, irrespective of the location of the line of contact between the cam and the pipe.

Referring to Fig. 2, the lever and the cam are shown in full lines in a position to engage a large diameter pipe indicated by the full line circle 26, and it will be observed that the point of tangency between the pipe and the cam is adjacent the inner, small radius end of the cam. When the lever is swung to the dotted line position, the larger radius end of the cam projects a substantial distance into the pipe opening to engage a relatively small diameter pipe indicated by the dotted circle 26^a, having its center at P^a. It will be understood, of course, that any intermediate size of pipe between the two extreme sizes 26 and 26^a will be gripped at an intermediate point on the cam. In a similar manner, when the tong is latched on the second latching step as shown in Fig. 3, the lever may be moved into either extreme position to cause the cam 25 to engage either a relatively large pipe 27 or a small pipe 27^a, or any intermediate size. The tong is preferably designed so that the range of sizes of pipe accommodated in the two latching positions overlap each other—or in other words, so that the largest size pipe 27 that can be accommodated in the latching position shown in Fig. 3 is equal to or slightly larger than the smallest size 26^a capable of being gripped by the tong in the latching position shown in Fig. 2. In this manner, the tong is capable of gripping any size of pipe between the minimum size 27^a and the maximum size 26.

It will be understood that the range of take-up of the cam 25 is not limited to that shown in the drawing, but, on the contrary, the cam may be as long as desired. However, the practical limiting factor governing the length of the cam and the consequent range of take-up is the extent of angular movement of the lever about the pivot pin 14. It is not desirable to swing the lever through too great an angle, and that shown in the drawing is considered to be a practical maximum. In this connection, it should be noted that by the provision of a two-step latch and the resulting angular adjustment of the jaws 10 and 11, the range of adjustment of the tong is twice that obtainable by swinging the lever through a given angle.

If desired, the frictional engagement of the pipe by the jaws 10 and 11 and the cam 25 may be relied on to prevent slipping of the tong around the pipe when a pull is exerted on the lever. However, I prefer to provide positive gripping engagement of the pipe by at least one of the pipe-engaging surfaces, and thereby preclude the possibility of the tong slipping around the pipe. In the illustrative embodiment I have shown a die 30 mounted in the jaw 11. Inasmuch as the different sizes of pipe engage the jaws at different spaced points along their inner surfaces, the die 30 is elongated and is provided with a series of gripping teeth. The corresponding pipe-contacting surface of the jaw 10 is indicated at 31, and is shown as a plane surface. It will be understood, however, that the surface 31 and the points of the teeth of the die 30 may, if desired, lie in either convex or concave surfaces. It will also be understood that the die 30 or other toothed gripping surface may be provided either on the jaw 10 or on the cam 25, or on any two or all three surfaces. I prefer to mount it on the jaw 11, however, because in that case it is located in a protected position when the tong is open and hence is not subject to being struck and possibly damaged by forcible contact with the pipe when applying the tong to the pipe.

It will be observed that the two jaws and the cam 25 engage the pipe at three substantially equidistantly spaced points, in order to evenly distribute the pressure on the pipe and thus avoid the possibility of crushing it. It is not possible to contact all sizes of pipe at three exactly equidistantly spaced points, for two reasons. First, as the cam 25 is rotated to contact progressively smaller sizes of pipe, the point of tangency shifts with respect to a line through the center of the pipe and the axis of the pivot pin 12; and secondly, as the jaws 10 and 11 are adjusted angularly with respect to each other to shift the latch from one of the steps 15 or 16 to the other, the angular relation between the pipe-contacting surfaces on the jaws changes. It is considered desirable that this angle be as nearly 60° as possible, in order to cause the jaws to engage the pipe at points which are spaced apart approximately 120° on the circumference of the pipe. In the illustrated embodiment the angle between the pipe-contacting surfaces in the latching position shown in Fig. 2 is slightly greater than 60°, and in the latching position shown in Fig. 3 it is slightly less than 60°.

As stated in the introductory remarks, it is of paramount importance that a drill pipe tong be capable of being applied to and removed from the pipe with a minimum of manipulation, and

that its balance be maintained both when the jaws are opened and when closed about a pipe. To this end, suitable means are provided in the instant case to limit the relative angular movement between the pivotally connected elements of the tong, and to cause the jaws to automatically close about the pipe when the latter is inserted in the pipe opening between the jaws.

As shown in Fig. 2, a coil compression spring 35 is interposed between an abutment on the jaw 10 and a projection 36 formed on the hub portion of the latch 18, and thus yieldably urges the latch about the pivot pin 14 in a clockwise direction. The inward movement of the latch is limited by a pair of opposed shoulders 37 and 38 on the jaw 10 and the latch 18, respectively, and, as shown most clearly in Fig. 3, these shoulders permit the latch to swing inwardly slightly beyond the position it assumes when engaging the second latching surface 16 on the jaw 11.

A stop 40 is provided on the jaw 10 and engages the lever 13 to limit the counterclockwise pivotal movement of the lever relative to the jaw. As shown by a comparison of Figs. 1 and 3, a slight amount of free movement of the lever is permissible between its fully retracted position and that in which it engages the maximum size of pipe which the tong is intended to grip in each latching position. It will be understood that the lever is freely swingable relative to the tong head as a unit.

The jaw 11 is also freely swingable about the pivot pin 12, but its outward movement is limited by engagement of a stop shoulder 42 with the outer surface of the jaw 10, as shown most clearly in Fig. 1. It will be observed that when the jaw 11 is moved to its extreme open position it provides, in conjunction with the free outer end of the latch 18, a flared channel for guiding the pipe into the pipe opening.

When the pipe has been inserted in the opening between the jaws, the jaw 11 may be swung to closed position manually, if desired. However, I prefer to provide means for causing the jaw to be closed automatically by the movement of the pipe into the opening. For this purpose, a closing finger 44 is formed on the jaw in a position to extend partially across the opening in the path of the inwardly moving pipe. Thus, as the pipe moves into the opening it engages the finger and swings the jaw closed behind it. The finger moves into a recess 45 formed in the jaw 10. As shown in Figs. 2 and 3, the clearance between the finger and the pipe when the jaw is closed varies with different sizes of pipe, and hence the finger will not in all instances positively close the jaw into latching position. However, the momentum of the jaw will be such as to cause it to cam the latch 18 in a counterclockwise direction against the action of the spring, and the latch will then snap into latching position.

It will be observed that in opening and closing the jaws the relatively large and heavy jaw 10 does not move relative to the lever 13, and the only appreciable shifting of mass is that involved in the pivotal movement of the relatively small jaw 11. Inasmuch as the latter jaw is short, its center of gravity moves through an arc of short radius, and, since the weight of the jaw constitutes only a small proportion of the total suspended weight, this movement has no appreciable effect on the balance of the tong as a whole.

From the foregoing detailed description, it will be apparent that I have provided a tong of simple construction consisting of relatively few parts. In spite of its simplicity it is adaptable to a wide range of pipe sizes, and may be quickly and easily applied to and removed from the pipe.

It will be understood that the invention is not limited to the details of the embodiment disclosed herein, but may be modified in various respects without departing from the spirit of the invention. For example, while I have shown two latching steps, it is within the scope of the invention to provide a different number as, for instance, three steps arranged to dispose the pipe-contacting surfaces of the jaws at angles of 50°, 60°, and 70°, respectively, with respect to each other. Such an arrangement would have the advantage of reducing the extent of angular movement of the lever since a narrower range of pipe sizes would be accommodated by each latching position. Other modifications within the scope of the invention will occur to those skilled in this art.

I claim:

1. In a pipe tong adapted to grip pipe of different diameters, the combination of: an operating handle; a first jaw member pivotally connected to the handle adjacent one end thereof; a latch member, and means pivotally connecting the same to the pivotally connected end of the first jaw member, the first jaw member and latch member defining a pipe-receiving recess having a pipe passageway at one side thereof; a second jaw member pivotally connected to the free end of the first jaw member and being of a length to bridge said pipe passageway and being swingable about its pivotal axis into engagement with the free end of the latch member to close said passageway; the latch member and the second jaw member having cooperating latching surfaces thereon selectively engageable to releasably secure said jaw members in any one of a plurality of angularly related positions to selectively define different sized pipe-receiving recesses; and cam means on said handle projecting into said pipe-receiving recess and movable into gripping engagement with a pipe disposed in said recess.

2. In a pipe tong adapted to grip pipe of different diameters, the combination of: an operating handle; a first jaw pivotally connected to the handle adjacent one end thereof; a latch member pivotally connected at one end to said first jaw on an axis coinciding with the axis of pivotal connection of said handle and first jaw; spring means yieldably maintaining said first jaw and said latch member in fixed relative positions defining a pipe-receiving recess having a pipe passageway at one side thereof; a second jaw pivotally connected to the other end of said first jaw and being of a length to bridge said passageway and being swingable about its pivotal axis into engagement with the free end of said latch member to close said passageway; cooperating latching surfaces on said latch member and said second jaw for releasably securing said jaws in any one of a plurality of angularly related positions; and cam means on said handle movable, upon pivotal movement of said handle in one direction, into gripping engagement with any one of a plurality of pipes of different diameters received in said recess in any one of said angularly related positions of said jaws.

3. A pipe tong as set forth in claim 2, in which said second jaw includes closing means projecting into said pipe passageway when said jaw is in open position, said closing means being engageable by a pipe entering said passageway to

automatically move said jaw to closed position.

4. A multiple-size pipe tong comprising an operating lever, a first jaw member pivotally connected at one end to said lever; a latch member pivotally connected to said pivotally connected end of said jaw member, spring means acting between said members and resiliently urging the free ends thereof toward each other; stop means on said members inter-engageable to limit the pivotal movement of said members toward each other under the influence of said spring means; said jaw and latch members defining a pipe-receiving recess therebetween and the free ends thereof being spaced apart, when said last-named stop means are in engagement, to provide a pipe passageway leading to said recess; a second jaw member, of a length to bridge said passageway, pivotally connected at one end to the free end of said first jaw member and swingable about its pivotal connection into engagement with said latch member; said second jaw member and latch member having one of a plurality of stepped latching surfaces and the other a latching surface adapted to selectively engage any one of said stepped latching surfaces to secure said jaw members in any one of a plurality of angularly related positions; and cam means on said operating lever movable into said recess, on swinging movement of said lever, to engage pipe of different diameters selectively disposed in said pipe recess.

5. A pipe tong as set forth in claim 4, and including stop means on said first jaw member engaging said lever to limit the relative pivotal movement therebetween in one direction, said pipe passageway being disposed on the opposite side of said pipe-receiving recess and substantially in alignment with the longitudinal axis of said lever when said last-named stop means are in engagement, whereby said tong may be applied to a pipe by bodily movement thereof in a direction substantially parallel to the longitudinal axis of said lever.

ALLEN E. HAMBLY.

CERTIFICATE OF CORRECTION.

Patent No. 2,329,196. September 14, 1943.

ALLEN E. HAMBLY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, first column, line 22, claim 4, strike out the word "of" after "one"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of November, A. D. 1943.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.