

APPARATUS AND METHOD FOR GRIPPING A TUBULAR MEMBER

This invention concerns an apparatus for gripping a tubular member. More precisely, it concerns an apparatus for gripping a tubular member where the apparatus includes a die and a die holder, and where at least one of the die or the die holder, on its portion
5 facing the other, has at least two axially formed ridges that complementary fit in valleys in the other of the die or the die holder, the ridges having a larger bottom width than top width. Further, the invention includes a method for gripping a tubular member.

When gripping tubular members, as is well known from the petroleum drilling industry,
10 try, a number of spaced apart grippers are forced against the tubular member. The grippers, that have specially prepared contact surfaces towards the tubular member, are subjected to heavy wear.

It is well known to utilize a fairly hard material body, termed die, as a wear member. The die is fixed in a die holder, and designed to be easily exchangeable.

15 WO 9810899 discloses a die that has a specially prepared gripping surface towards the tubular member. The portion facing the die holder has a number of axially formed ridges and valleys that are spaced in a semi-circular manner. The ridges and valleys, of the die correspond to ridges and valleys in a die holder.

US 5845549 shows a number of dies placed in a ring of fixed diameter. The dies are
20 radially adjustable in the ring.

US 6070500 discloses a die that is fixed in a dove tail slot, and where the die is allowed to align itself against a pipe.

During operation of the gripper, the forces acting tend to deform the die. One result of such deformation is that the relatively narrow clearances that initially exist between
25 the die and the die holder are closed. Removing a deformed die from the die holder may be nearly impossible while the die holder is in its operational position.

The invention has for its object to remedy or to reduce at least one of the drawbacks of the prior art, or at least provide a useful alternative to prior art.

The object is achieved through features, which are specified in the description below and in the claims that follow.

- 5 According to the invention, a contact surface between the die and the die holder is designed to allow some deformation of the die without locking the die to the die holder, while at the same time keeping the die in its correct orientation relative a tubular member.

The die is, when unengaged, allowed to some radial movement relative the die holder.

- 10 By maintaining the looseness of the die in the die holder, the die may be removed from the die holder by the use of a relatively simple manual or mechanised tool.

The invention is defined by the independent patent claims. The dependent claims define advantageous embodiments of the invention.

- 15 In a first aspect the invention relates more particularly to an apparatus for gripping a tubular member where the apparatus includes a die and a die holder, and where at least one of the die or the die holder, on its portion facing the other, has at least two axially, in the direction of the tubular member when engaged by the die, formed ridges that complementary fit in valleys in the other of the die or the die holder, the ridges having a larger bottom width than top width in the radial direction from the die or die holder towards the other of the die or die holder, wherein radial centre lines of the die ridges are substantially parallel, and where the die, when unengaged, is radially movable between abutment of the die ridges to the die holder and abutment of the die to at least one stop member of the die holder.

- 25 Herein the terms "radial" and "axial" refer to the radial and axial directions, respectively, of a pipe when engaged by the die. Further, terms like "upper", "lower" and "vertical" refer to the items in their working positions.

- 30 When the die ridges are positioned in the holder valleys, the die is kept in alignment with the tubular member. As the die ridges are wider at their bottom than at their top, the die ridges has a tapered form in the radial direction that prevents the ridges from being fixed in the holder valleys even when some deformation of the die is experienced.

If the top of the die ridges are positioned along a curved plane, such as shown in WO 9810899, a slight deformation of the die will fix the die in the die holder even with tapered die ridges. According to the invention the radial centre lines of the die ridges are substantially parallel.

- 5 As there is some room for radial movement of the die in the die holder, the die may be lifted from the die holder without the use of heavy forces.

Typically the die ridges are spaced apart by a die valley and the holder valleys are spaced apart by a holder ridge.

- 10 The holder ridges may be plough-formed at their upper, axial portion in order to ease the entry of the die into the die holder.

A pair of stop members of the die holder may form a dove tail slot. Generally, the stop member is designed to prevent the die from moving out of the die holder in the radial direction.

- 15 A lock member, which is biased towards its locking position, may be present for preventing the die from unintentionally being lifted out of the die holder. Supports in the die holder below the die may prevent the die from falling out from the die holder.

- 20 A magnet may be fixed to the die holder close to the die ridges or in the die close to the holder ridges when the die is in its working position in the die holder. The magnet will bias the die towards the die holder, thus avoiding matter, such as drilling mud, from entering between the die and die holder. Such matter between the die and the die holder could enhance wear.

There is also described a tool for moving a die in to or out of a die holder, the tool having a handle or an adapter, wherein the tool has a pair of biased lower bodies that are releasably engageable in corresponding recesses in the die.

- 25 When the tool is engaged to the die, the die may be lifted in or out of the die holder by manually or remotely operating the tool. When in position in the die holder, the tool is released from the die.

The tool, when in its active position with the die in the die holder, may abut the lock member, thus keeping the lock member in its released position.

- 30 In an alternative embodiment, the die may be placed in to and removed from the die holder without the use of a tool.

In a second aspect the invention relates more particularly to a method for gripping a tubular member by use of an apparatus according to the first aspect of the invention wherein the method includes:

- 5 - releasably latching a tool to the die and sliding the die into the die holder, thereafter releasing the tool from the die;
- gripping and releasing a tubular item by means of the apparatus; and
- latching the tool to the die and retrieving the die from the die holder.

When a lock member is present, the method includes releasing the lock member prior
10 to retrieval of the die.

The apparatus, tool and method according to the invention substantially overcome the difficulties experienced when changing dies in a die holder. This is of particular importance when automating drill floors where no manual intervention is intended.

In the following is described an example of a preferred embodiment illustrated in the
15 accompanying drawings, wherein:

- Fig. 1 shows a perspective view of a die and a die holder according to the invention, and where the die is releasably fixed to a tool for inserting the die in the die holder;
- Fig. 2 shows a perspective view of the die in its working position in the die holder, and where the tool is released and removed from the die;
- Fig. 3 shows a plane view of the die and die holder;
- Fig. 4 shows to a larger scale a section from fig. 3;
- Fig. 5 shows the same as in fig. 4, but in an exploded view;
- Fig. 6 shows a section III-III in fig 3, a tubular member is not shown;
- 25 Fig. 7 shows to a larger scale a section I-I in fig. 1;
- Fig. 8 shows the same as in fig. 7, but at a preceding stage when a lower body of the tool is entering the die; and
- Fig. 9 shows to a larger scale the section III-III in fig. 3, but with the tool connected to the die.

On the drawings, the reference number 1 denotes an apparatus for gripping a tubular member 2. The apparatus 1 includes a die 4 and a die holder 6. In addition, a tool 8 for inserting or retrieving the die 4 to or from the die holder 6 may be included in the apparatus 1.

5 The apparatus 1 is part of a gripping device, not shown.

The die 4 has on its tubular member 2 facing side a surface 10 that is prepared to give a good grip on the tubular member 2 when forced against it. On its opposite side, facing the die holder 6, the die has a number of die ridges 12 spaced apart by die valleys 14. The die ridges 12 have a larger bottom width 16 than top width 18. Thus, the die
10 ridges 12 have a tapered form. See fig. 5 and also figs. 3-4.

The die 4 has two side portions 20 that are tapered in the direction from the die holder 6 towards the tubular member 2.

A pair of openings 22 extends into the die 4 from the top surface 24 of the die 4. Each of the openings 22 has a recess 26, see figs. 7, 8.

15 The die holder 6 is on its side facing the die 4 equipped with a number of holder ridges 28 that are spaced by holder valleys 30. The holder ridges 28 and holder valleys 30 are designed to interact with the die ridges 12 and die valleys 14. At least some of the holder ridges 28 are upwardly given a plough form 32.

The die holder 6 is equipped with brackets 34 for fixing the die holder 6 to the gripping
20 device not shown.

Stop members 36 are extending forward on each side of the die holder 6, forming a dove tail slot.

At its lower portion, the die holder 6 has a couple of supports 38. A lock member 40 is positioned at the upper portion of the die holder 6 and is movable between a protruding active position and a passive retracted position. The lock member 40 is biased to-
25 wards its active position. In alternative embodiments, the lock member 40 may be placed on one of the side portions or at the bottom of the die holder 6, instead of at the upper portion. Placement and retrieval of the die 4 to and from the die holder 6 may also be done by means of bare hands without the use of a specifically designed tool 8.

30 The shown tool 8, that has a handle or adapter 42, has a pair of lower bodies 44 with pointed ends 46. The bodies 44 are designed to be inserted in the openings 20 and releasably latch in the recesses 26.

When the tool 8 is in its latched position with the die 4, and the die 4 is in the die holder 6, a release member 48 abuts the lock member 40 in its released position, see fig. 9. The release member 48 is designed to move the lock member 40 from its active to its passive, released position when the tool 8 is inserted in the die 4 with the die 4 in the die holder 6.

When the die 4 is inserted in the die holder 6, the plough form 32 of the holder ridges 28 helps in entering the die 4 into the die holder 6. At the same time, the lock member 40 is moved to its passive position. The die 4 is moved downwardly between the holder ridges and valleys 28, 30 and the stop members 36 until the die 4 rests at the supports 38. The tool 8 is then released from the die 4 by moving the lower bodies 44 first out from the recesses 26, and then out of the openings 22. When the tool 8 is removed, the lock member 40 is free to move into its active, locked position.

As indicated on fig. 3 and 4, there is a substantial clearance 50 between the side portions 20 of the die 4 and the stop members 36 of the die holder 6 when the die 4 is engaged in the die holder 6. This clearance allows the die 4 some radial movement in the die holder 6 when the tubular member 2 is released. This feature, together with the tapered form of the die ridges 12 and the fact that the centre lines 52 of the die ridges 12 are substantially parallel with a distance 54, see fig. 5, render the die 4 unfixed to the die holder 6 even when some deformation of the die 4 is experienced.

The distance 54 may vary between pairs of die ridges 12.

In one embodiment, a magnet 56 is fixed at least at the die 4 or the die holder 6, here at the die holder 6. When unengaged in the die holder 6, the die 4 is biased towards the die holder 6 to avoid matter entering between the ridges 12, 28 and valleys 14, 30 of the die 4 and die holder 6. Such matter could enhance wear.

Removal of the die 4 from the die holder 6 may be undertaken in the reversed sequence from inserting the die 4 into the die holder 6.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

C l a i m s

1. Apparatus (1) for gripping a tubular member (2) where the apparatus (1) includes a die (4) and a die holder (6), and where at least one of the die (4) and the die holder (6), on its portion facing the other, has at least two axially, in the direction of the tubular member (2) when engaged by the die (4), formed ridges (12, 28) that complementary fit in valleys (14, 30) in the other of the die (4) and the die holder (6), the ridges (12, 28) having a larger bottom width (16) than top width (18) in the radial direction from the die (4) or die holder (6) towards the other of the die (4) or die holder (6), characterised in that centre lines (52) of the ridges (12, 28) in the radial direction from the die (4) or die holder (6) are parallel, and where the die (4), when unengaged, is radially movable between abutment of the die ridges (12) to the die holder (6) and abutment of the die (4) to at least one stop member (36) of the die holder (6).
2. The apparatus (1) according to claim 1, wherein holder ridges (28) are plough-formed (32) at their upper portion.
3. The apparatus (1) according to claim 1 or 2, wherein a pair of stop members (36) forms a dove tail slot.
4. The apparatus (1) according to any of the preceding claims, wherein a lock member (40) is fixed to the die holder (6), and the lock member (40) is biased towards its locking position.
5. The apparatus (1) according to any of the preceding claims, wherein a magnet (56) is fixed to the die holder (6) adjacent to the die ridges (12), or in the die (4) adjacent to the holder ridges (28) when the die (4) is in its working position in the die holder (6).
6. Method for gripping a tubular member (2) by use of an apparatus (1) according to claim 1, characterised in that the method includes:
 - releasably latching a tool (8) to the die (4) and sliding the die (4) into the die holder (6), thereafter releasing the tool (8) from the die (4);
 - gripping and releasing a tubular member (2); and
 - latching the tool (8) to the die (4) and retrieving the die (4) from the die holder (6).
7. The method according to claim 6, wherein the method includes releasing a lock member (40) prior to retrieval of the die (4).