

Description

This invention relates to cold forging of tubular members.

The cold forging of a tubular member into an annular member such as a well hanger or a connector has been known in the past. The cold forging has also been used to form a tubular member into an annular connector in a remote location, such as in a subsea pipeline repair. This is shown in U. S. Patent Nos. 3,432,916 and 4,330,144. U. S. Patent No 4,662,663 discloses the use of pressure compensating material between the two members being cold formed and such material prevents the buildup of pressure which would prevent the proper completion of the cold forming.

A tool previously used in this type of cold forging process is shown in U. S. Patent No. 3,88,752. This tool includes an alloy shaft having a shoulder on one end and a ring surrounding the other end and a rubber tube expansion element surrounding the shaft with annular nylon rings engaging the ends of the rubber expansion element and alloy rings supporting the exterior of each of the nylon rings. The radial force is developed by the tool responsive to longitudinal force exerted on the expansion element. The nylon rings are provided to prevent extrusion of the rubber expansion element.

Other tools have been suggested which include a resilient tubular member which is exposed to hydraulic pressure internally and secured at its ends and is allowed to exert outward radial forces to cold forge a tubular member into the interior of an annular member.

EP-A-0177045, forming the base for the preambles of the claims describes a forging tool in which opposite ends of a resilient sleeve are formed with sealing beads which locate in grooves in a mandrel body.

An object of the present invention is to provide an improved tool for cold forging a tubular member within an annular member which reliably prevents extrusion of the resilient sleeve even when forging high strength tubular steel members surrounding said resilient sleeve.

According to the present invention there is provided a tool for forging tubular members comprising a cylindrical body, a resilient sleeve surrounding said body, means securing the ends of said sleeve to said body, means for delivering fluid under pressure to expand said sleeve outward with sufficient force within a first tubular member to cause it to be forged radially outwardly with respect to a second tubular member to cause the tubular members to be joined and characterised by a pair of coacting upper anti-extrusion rings mounted around the upper end of said resilient sleeve,

the upper of said pair of upper rings being expandable to a first outer support diameter, the lower of said pair of upper rings being expandable to a second outer support diameter larger than the first outer support diameter so that said upper of said pair of upper rings supports the lower of said pair of upper rings and the lower of said pair of upper rings supports said resilient sleeve completely around its outer diameter when fully expanded during forging responsive to pressure exerted within said resilient sleeve, and a pair of coacting lower anti-extrusion rings mounted around the lower end of said resilient sleeve, the lower of said pair of lower rings being expandable to said first outer support diameter, the upper of said pair of lower rings being expandable to said second outer support diameter so that said lower of said pair of lower rings supports the upper of said pair of lower rings and the upper of said pair of lower rings supports said resilient sleeve completely around its outer diameter when fully expanded during forging responsive to pressure exerted within said resilient sleeve so that said resilient sleeve is protected from extrusion during its exposure to forging pressures.

The invention will be described now by way of example only, with particular reference to the accompanying drawings. In the drawings:

FIGURE 1 is an elevation view partly in section of the tool of the present invention having a tubular member to be cold forged positioned in surrounding relationship thereto and with the annular member, into which the tubular member is to be forged, being connected to the tool and in surrounding relationship to the tubular member and the tool.

FIGURE 2 is a partial detail sectional view of the improved tool in its relaxed position with the tubular member and the annular member being shown.

FIGURE 3 is a partial detail sectional view of the improved tool in its forming position with the tubular member.

FIGURE 4 is a sectional view taken along line 4 - 4 in FIGURE 3.

FIGURE 5 is a sectional view taken along line 5 - 5 in FIGURE 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A cold forging tool 10, as best seen in FIGURE 1, included central body or mandrel 12 with packer assembly 14 being mounted thereon in surrounding relationship to the exterior of mandrel 12. Annular member 16 is suitably supported from tool 10 and has been lowered into a position so that the upper end of tubular member 18 which is to be forged

into the interior of annular member 16 is within the upper portion of the contoured recess 20 within annular member 16.

Body or mandrel 12 includes upper and lower annular recesses 22 and 24 into which the upper and lower ends of resilient sleeve 26 is molded to leave the central or expansion portion of sleeve 26 free to expand radially outward responsive to hydraulic fluid under pressure delivered to its interior surface by passage 28 which extends through body 12 and is connected by fitting (not shown) or other suitable means to a source of pressurized hydraulic fluid.

Body 12 immediately at the outer opening of its upper annular recess 22 extends radially outward to axial flange 30 which forms a stop shoulder 32 on its inner surface as hereinafter explained. The lower end of body immediately at the outer opening of its lower annular recess 24 extends radially outward to axial flange 34 which forms a stop shoulder 36 on its inner surface as hereinafter explained.

Dual expandable anti-extrusion means are provided to prevent extrusion of the upper and lower portions of sleeve 26 between gaps which might exist without such anti-extrusion means. Each of the anti-extrusion means is made of segments of a metal ring as hereinafter explained.

Upper outer support segments 38 are positioned in a ring around the upper portion of resilient sleeve 26 and include flange 40 extending upward so that their outer faces 42 will be engaged by stop shoulder 32 on flange 30 to provide a stop for the radial outward movement of segments 38. A suitable resilient biasing means 44, such as a garter spring or an O ring, is positioned in grooves 46 in the exterior surfaces of segments 38 to urge segments 38 inwardly. Segments 38 are positioned to have their upper surfaces in engagement with the lower surface of flange 40 at all times. Lower outer support segments 48 are positioned in a ring around the lower portion of resilient sleeve 26 and include flange 50 extending downward so that their outer faces 52 will be engaged by stop shoulder 36 on flange 34 to provide a stop for the radial outward movement of segments 48. A suitable resilient biasing means 54, such as a garter spring or an O ring, is positioned in grooves 56 in the exterior surfaces of segments 48 to urge segments 48 inwardly. Segments 48 are positioned to have their lower surfaces in engagement with the upper surface of flange 50 at all times.

Inner segments 58 and 60 are positioned around the upper and lower portions of resilient sleeve 26 in abutting relationship with the lower surfaces of upper segments 38 and with the upper surfaces of lower segments 48 as shown. Suitable biasing means 62 and 64 respectively, such as

garter springs or O rings, are positioned in grooves 66 and 68 in the outer surfaces of segments 58 and 60.

Member 70 connects into the upper end of body 12 and also connects to bracket 72 which is suitably connected to support annular member 16 as it is being lowered into position around tubular member 18. Member 70 may extend to the surface to provide the string by which tool 10 and member 16 are lowered into position or some other suitable connecting means is provided.

Annular member 16 includes outer flanges 74 and a tubular body 76 with the lower interior of body 76 having a contoured recess 20. It is preferred that recess 20 include upper and lower threaded sections 78 and 80 and intermediate section 82 which includes alternate lands and grooves as shown.

With tool 10 and annular member 16 positioned with respect to tubular member 18 shown in FIGURE 1, pressure is delivered through passage 28 into the interior of resilient sleeve 26 so that it expand radially outward into contact with the interior of tubular member 18. Continued application of hydraulic pressure causes tubular member 18 to be cold forged into engagement within recess 20 of annular member 16. As resilient sleeve 26 commences its movement radially outward, segments 38, 48, 58 and 60 move radially outward in supporting relationship to the exterior of sleeve 26 and with the end faces of segments 38 and 48 being maintained in contact with the ends of flanges 30 and 34. Further, the abutting faces of segments 38 and 58 and the abutting faces of segments 48 and 60 are maintained in engage as can be seen in FIGURE 3. When segments 38 and 48 have their flange surfaces 42 and 52 come into contact with stop shoulders 32 and 36, they are in their circular or outermost position as is shown in FIGURE 4. Segments 58 and 60 continue to move outward as sleeve 26 continues to move and the exterior surfaces of segments 58 and 60 are maintained in contact with the interior surface of tubular member 18 to provide continuous support for sleeve 26 so that it does not have spaces available through which it could extrude. In their outermost positions as shown in FIGURE 5, segments 58 and 60 form a substantially continuous ring as shown. When the segments are retracted they move inwardly responsive to the biasing means and assume a non-circular or irised position.

Segments 38, 48, 58 and 60 are preferably cut from a metal ring at angles to the radial direction or to explain in another manner they are cut along lines which are at an angle substantially less than ninety degrees to a tangent at the point of entry of the cut into the exterior surface of the metal ring as can be seen from FIGURE 5. The outer diameter of

the ring from which segments 58 and 60 are cut is preferred to be the maximum outer diameter to which they will be exposed in operations of tool 10. The outer diameter of the ring from which segments 38 and 48 are cut is preferred to be their outer diameter when they have engaged their respective stop shoulders.

The inclusion of the pair of support segment rings at each end of resilient sleeve 26 provides improved support to sleeve 26 over a much wider range of diameters than could be provided with the tools of the prior art. It is easily seen that the selection of the particular size of the rings from which the segments are cut should be done with care so that the best support can be provided at the smallest and the largest diameters of operations for which tool 10 is to be used.

Claims

1. A tool for forging tubular members comprising a cylindrical body (12), a resilient sleeve (26) surrounding said body, means (38, 48, 58, 60) securing the ends of said sleeve to said body, means (28) for delivering fluid under pressure to expand said sleeve outward with sufficient force within a first tubular member (18) to cause it to be forged radially outwardly with respect to a second tubular member (16) to cause the tubular members to be joined and characterised by a pair of coacting upper anti-extrusion rings (38, 58) mounted around the upper end of said resilient sleeve (26), the upper (38) of said pair of upper rings being expandable to a first outer support diameter, the lower (58) of said pair of upper rings being expandable to a second outer support diameter larger than the first outer support diameter so that said upper (38) of said pair of upper rings supports the lower (58) of said pair of upper rings and the lower of said pair of upper rings supports said resilient sleeve (26) completely around its outer diameter when fully expanded during forging responsive to pressure exerted within said resilient sleeve, and a pair of coacting lower anti-extrusion rings (48, 60) mounted around the lower end of said resilient sleeve (24), the lower (48) of said pair of lower ring being expandable to said first outer support diameter, the upper (60) of said pair of lower rings being expandable to said second outer support diameter so that said lower (48) of said pair of lower rings supports the upper of said pair of lower rings and the upper of said pair of lower rings supports said resilient sleeve (26) completely around its outer diameter when fully expanded during forging responsive to pressure exerted within said resilient

sleeve so that said resilient sleeve is protected from extrusion during its exposure to forging pressures.

2. A tool according to claim 1, wherein said anti-extrusion rings (38, 48, 58, 60) each include a plurality of ring segments and means (44, 54, 62, 64) biasing said segments inwardly.
3. A tool according to claim 2, wherein said segments are cut from a metal ring having the largest diameter which said segments are expected to assume when installed on said sleeve.
4. A tool according to claim 3, wherein said segments when cut from their ring are cut at angles to the radius of the ring to allow said rings (38, 48, 58, 60) to have an iris action when moved to a smaller diameter than their maximum desired diameter.
5. A tool according to claim 4, wherein said segments are cut from their ring along lines which are at an angle substantially less than ninety degrees to a tangent at the point of entry of the cut into the exterior surface of the metal ring.

Patentansprüche

1. Vorrichtung zum Schmieden von Rohrformteilen, die einen zylindrischen Körper (12), eine elastische Hülse (26), die den Körper umgibt, Einrichtungen (38, 48, 58, 60), mit denen die Enden der Hülse an dem Körper befestigt sind, umfaßt, sowie eine Einrichtung (28) zur Zuführung von Fluid unter Druck, wodurch die Hülse mit ausreichender Kraft in einem ersten Rohrteil (18) nach außen ausgedehnt wird, so daß sie in Bezug auf ein zweites Rohrteil (16) radial nach außen geschmiedet wird, wodurch die Rohrteile miteinander verbunden werden, und gekennzeichnet durch ein Paar von zusammenwirkenden, oberen Anti-Durchdrück-Ringen (38, 58), die um das obere Ende der elastischen Hülse (26) herum angebracht sind, wobei der obere (38) des Paares der oberen Ringe auf einen ersten äußeren Stützdurchmesser erweitert werden kann, und der untere (58) des Paares der oberen Ringe auf einen zweiten äußeren Stützdurchmesser erweitert werden kann, der größer ist als der erste äußere Stützdurchmesser, so daß der obere (38) des Paares der oberen Ringe den unteren (58) des Paares der oberen Ringe stützt, und der untere des Paares der oberen Ringe die elastische Hülse (26) bei Vollständiger Erweiterung



the ring from which segments 58 and 60 are cut is preferred to be the maximum outer diameter to which they will be exposed in operations of tool 10. The outer diameter of the ring from which segments 38 and 48 are cut is preferred to be their outer diameter when they have engaged their respective stop shoulders.

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während des Schmiedens aufgrund des in der elastischen Hülse wirkenden Drucks vollständig um ihren Außendurchmesser herum stützt, und durch eine Paar von zusammenwirkenden, unteren Anti-Durchdrückringen (48, 60), die um das untere Ende der elastischen Hülse (26) herum angebracht sind, wobei der untere (48) des Paares der unteren Ringe auf einen ersten äußeren Stützdurchmesser erweitert werden kann, und der obere (60) des Paares der unteren Ringe auf einen zweiten äußeren Stützdurchmesser erweitert werden kann, so daß der untere (48) des Paares der unteren Ringe den oberen (60) des Paares der unteren Ringe stützt, und der obere des Paares der unteren Ringe die elastische Hülse (26) bei vollständiger Erweiterung während des Schmiedens aufgrund des in der elastischen Hülse wirkenden Drucks vollständig um ihren Außendurchmesser herum stützt, so daß die elastische Hülse vor dem Durchdrücken geschützt ist, während sie den Schmiededrücken ausgesetzt ist.

2. Vorrichtung nach Anspruch 1, wobei die Anti-Durchdrück-Ringe (38, 48, 58, 60) jeweils eine Vielzahl von Ringsegmenten enthalten, sowie Einrichtungen (44, 54, 62, 64), die die Segmente nach innen drücken.

3. Vorrichtung nach Anspruch 2, wobei die Segmente aus einem Metallring geschnitten werden, der den größten Durchmesser hat, den die Segmente erwartungsgemäß annehmen, wenn sie auf der Hülse angebracht sind.

4. Vorrichtung nach Anspruch 3, wobei die Segmente, wenn sie von ihrem Ring geschnitten werden, in Winkeln zum Radius des Rings geschnitten werden, durch die Iris-Wirkung der Ringe (38, 48, 58, 60) ermöglicht wird, wenn sie auf einen kleineren Durchmesser als ihren erwünschten maximalen Durchmesser gebracht werden.

5. Vorrichtung nach Anspruch 4, wobei die Segmente an Linien von ihrem Ring geschnitten werden, die in einem Winkel zu einer Tangente am Eintrittspunkt des Schnitts in die Außenfläche des Metallrings liegen, der erheblich kleiner ist als 90°.

Revendications

1. Outil pour le forgeage de pièces tubulaires comprenant un corps cylindrique (12), un manchon élastique (26) entourant ledit corps, des moyens (38, 48, 58, 60) fixant les extrémités dudit manchon audit corps, un moyen (28)

pour distribuer un fluide sous pression pour dilater le manchon vers l'extérieur avec une force suffisante dans une première pièce tubulaire (18) pour provoquer le forgeage radialement vers l'extérieur en ce qui concerne une seconde pièce tubulaire (16) provoquant le raccordement des pièces tubulaires et caractérisé par une paire d'anneaux supérieure anti-extrusion en coaction (38, 58) montée autour du bord supérieur dudit manchon élastique (26), celui du dessus (38) de ladite paire d'anneaux supérieure étant extensible à un premier diamètre de support externe, celui du dessous (58) de ladite paire d'anneaux supérieure étant extensible à un second diamètre de support externe plus grand que le premier diamètre de support externe de sorte que ledit anneau du dessous (38) de ladite paire d'anneaux supérieure supporte celui du dessous (58) de ladite paire d'anneaux supérieure et celui du dessous de ladite paire d'anneaux supérieure supporte ledit manchon élastique (26) entourant complètement son diamètre externe lorsqu'il est complètement dilaté pendant le forgeage sous l'action de la pression exercée à l'intérieur dudit manchon élastique, et une paire d'anneaux anti-extrusion inférieure (48, 60) montée autour du bord inférieur dudit manchon élastique (26), celui du dessous (48) de ladite paire d'anneaux inférieure étant extensible à ce premier diamètre de support externe, celui du dessus (60) de ladite paire d'anneaux inférieure étant extensible à ce second diamètre de support externe de sorte que ledit anneau du dessous (48) de ladite paire d'anneaux inférieure supporte celui du dessus de ladite paire d'anneaux inférieure et celui du dessus de ladite paire d'anneaux inférieure supporte ledit manchon (26) entourant complètement son diamètre externe lorsqu'il est complètement dilaté pendant le forgeage sous l'action de la pression exercée à l'intérieur dudit manchon élastique de sorte que ledit manchon élastique est protégé de l'extrusion pendant son exposition aux pressions de forgeage.

2. Outil selon la revendication 1, dans lequel lesdits anneaux anti-extrusion (38, 48, 58, 60) comprennent chacun une pluralité de segments formant un anneau et un moyen de tension (44, 54, 62, 64) rétractant lesdits segments intérieurement.

3. Outil selon la revendication 2, dans lequel lesdits segments sont coupés dans un anneau métallique ayant le diamètre le plus large que lesdits segments sont supposés atteindre lorsqu'ils sont installés sur ledit manchon.



4. Outil selon la revendication 3, dans lequel lesdits segments lorsque, coupés dans leur anneau, ils sont coupés en formant des angles avec le rayon de l'anneau pour permettre auxdits anneaux (38, 48, 58, 60) d'avoir une action iridescente lorsqu'ils sont déplacés vers un diamètre plus petit que leur diamètre maximum désiré.

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5. Outil selon la revendication 4, dans lequel lesdits segments sont coupés dans leur anneau le long de lignes qui forment un angle sensiblement inférieur à quatre-vingt-dix degrés à une tangente au point d'entrée de la coupure dans la surface extérieure de l'anneau métallique.

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