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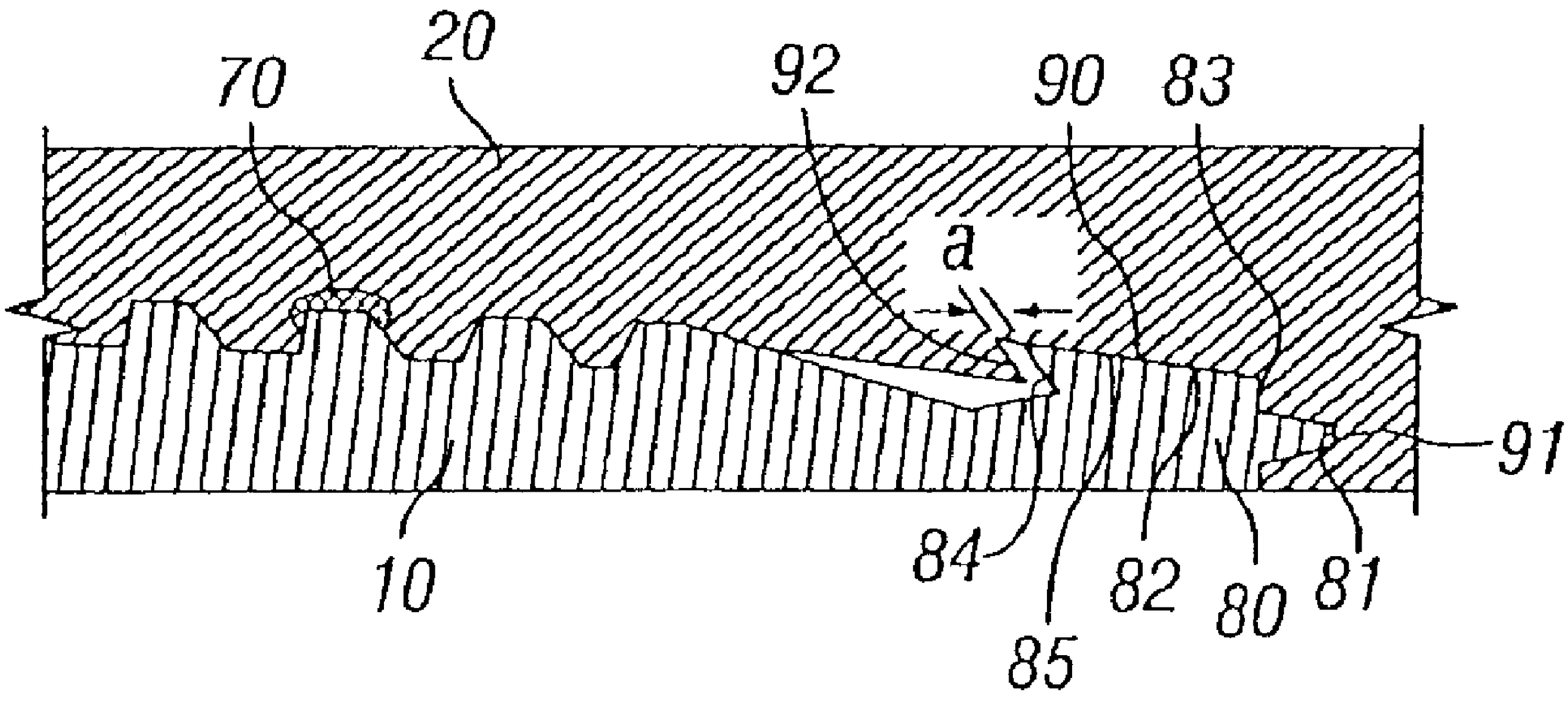
(54) **Titre : JOINT COULISSANT INVERSE POUR RACCORDS TUBULAIRES EXPANSIBLES**
(54) **Title: AN EXPANDABLE THREADED TUBULAR CONNECTION**



(57) **Abrégé/Abstract:**
An expandable threaded connection between segments of expandable tubulars that provides a high bearing pressure seal at a specific area along the pin and box members is disclosed. The invention utilizes first and second "grooves" in a surface of the box member and corresponding first and second "ribs" on the pin nose. The radial expansion of the tubulars causes the pin to become shorter in length, thereby causing the pin nose to retract from the back of the box member. As the pin nose retracts, a high bearing pressure, metal- to-metal seal, is formed between elements of the mating tubulars.

ABSTRACT

An expandable threaded connection between segments of expandable tubulars that provides a high bearing pressure seal at a specific area along the pin and box members is disclosed. The invention utilizes first and second "grooves" in a surface of the box member and corresponding first and second "ribs" on the pin nose. The radial expansion of the tubulars causes the pin to become shorter in length, thereby causing the pin nose to retract from the back of the box member. As the pin nose retracts, a high bearing pressure, metal-to-metal seal, is formed between elements of the mating tubulars.

AN EXPANDABLE THREADED TUBULAR CONNECTION

This is a divisional application of Canadian Patent Application Serial No. 2,865,078 which is a divisional application of Canadian Patent Application Serial No. 2,757,151 which is a divisional application of Canadian Patent Application Serial No. 2,555,709 filed on August 9, 2006 (now Canadian Patent No. 2,555,709).

The present invention relates to threaded tubular connections particularly useful in the oil and gas industry. In particular, the invention relates to an expandable tubular threaded connection having a high bearing pressure metal-to-metal seal formed as a result of the tubular expansion process that allows the threaded connection to withstand high pressure after expansion.

It should be understood that the expression "the invention" and the like encompasses the subject-matter of both the parent and the divisional applications.

In the conventional drilling of an oil and gas well, a series of tubulars, typically strings of casing, liner, and/or screen segments connected together, are sequentially installed in the well bore until the depth of the producing zone of the formation is reached. Standard practice requires that each succeeding string of tubulars placed in the well bore has an outside diameter smaller than the preceding string of tubulars and/or bore hole such that the tubular segments can be passed through the preceding string of tubulars and/or bore hole to their downhole location. The reduction in the diameter of each successive string of tubular segments placed in the well bore results in a significant reduction in the diameter of the tubular through which hydrocarbons can be carried to the surface. More importantly, to achieve the desired tubular diameter in the producing zone, the initial bore hole size at the surface must be sufficiently large to allow for a large diameter casing. The large initial bore hole size requires increased drilling time and increased material costs, including increased use of materials such as drilling mud and casing cement.

The technology of expandable tubulars addresses these shortcomings in the conventional casing/liner/screen hanging operations. Through radial expansion of successive strings of tubular segments until the outer wall of those segments contacts the inner wall of the host pipe, it is possible to create a tight fit between the expandable tubulars and the host pipe that holds the tubular segments in place and creates an annular seal. Further, it is possible to achieve a well bore of virtually uniform diameter (i.e., a monobore well). The expandable tubulars are radially expanded by various means known in the art, including, but not limited to, pulling or pushing fixed diameter

expansion cones through the tubular, extruding the tubular off of a hydraulically-actuated expansion tool, or rotating an expansion tool while pulling or pushing it through the tubular.

The tubular segments to be expanded are typically coupled together using threaded connections in which the male end, or pin member, of one tubular is threadably connected to the female end, or box member, of an adjacent tubular. Alternatively, the ends of the adjacent tubulars may have a pin member at each end, with the box member being formed by a short coupling threaded onto one of the pin members. When a conventional threaded connection is made up, the nose of the pin member is in contact with the back of the box member. This threaded engagement between properly secured pin and box members creates a conventional tubular joint that effectively maintains a secure mechanical connection that holds the tubular segments together and that effectively seals the internal tubular area from the formation and vice versa. Often, the sealing ability of the threaded engagement is augmented through the use of Teflon® rings or other deformable seal rings entrapped in the thread area.

Problems have arisen, however, at the threaded connection point between tubular segments during and after expansion when using conventional threaded tubular connections and seals currently available in the industry. When the tubular string is radially expanded, a conventional threaded connection changes dimensionally in a way that can prevent the pin and box members from maintaining proper engagement and sealing. The radial expansion of a conventional threaded connection can cause the pin and box members to radially separate, thereby causing the seal of the threaded engagement to fail. In effect, the radial expansion disables the seal that is created by the metal-to-metal engagement of the sealing surfaces of the pin and box members, and degrades or lowers the pressure holding integrity of the connections. The threaded connection point thus becomes a source of potential leaks during and after expansion of the tubular string.

Conventional threaded connections that use an elastomeric seal ring between the engaged surfaces of the pin and box members may also leak when the threaded connection is radially expanded. Typically, the elastomeric seal ring of a conventional threaded connection is carried in an annular groove formed in either the pin or box member, or both. The elastomeric seal ring creates a seal when it is "energized" by being radially compressed between the engaged pin and box members during make up of the connection. Radial expansion of the threaded connection, however, changes the radial compression of the elastomeric seal ring, thereby potentially allowing leakage through the threaded connection.

Additionally, the radial expansion of the tubular string causes the pin and box members to undergo axial movement. The amount of axial movement experienced by the pin and box members is dependent on numerous factors, including, but not limited to, the amount of radial expansion of the tubular string, the geometry of the threaded connection (the pin is thinner towards the pin end and the box is thinner towards the face of the box), and the type of expansion tool utilized to expand the connection (i.e., use of a rotary expansion tool versus pulling or pushing an expansion tool through the expandable tubulars). For example, in the case of moving or displacing an expansion "cone" through the expandable tubulars, the pin nose tends to pull away and separate from the back of the box. The resulting gap formed between the pin nose and the back of the box as a result of the axial movement of the pin nose creates a potential source of leakage through the threaded connection during and after the expansion process.

As deeper wells and more difficult completions are attempted using expandable tubulars, the threaded connections that hold the expandable tubulars together must address these known problems and must be able to accommodate the higher pressures faced in such applications. What is needed is a threaded connection for expandable tubulars that enhances the pressure integrity of the connections so that they will withstand high pressure after expansion, while not weakening the coupling strength of the connections. It is an object of the present invention to provide an apparatus and method for creating a threaded connection between segments of expandable tubulars

that enhances the pressure integrity of the expanded connection while not weakening the coupling strength of the connection. Those and other objectives will become apparent to those of skill in the art from a review of the specification below.

In accordance with one aspect of the present invention there is disclosed an expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means, a pin nose and a rib on the pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member and a groove for receiving the rib;

wherein the groove in the box member is sized to allow the rib to move within the groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

Thus an expandable threaded connection between segments of expandable tubulars that provides a high bearing pressure seal between the pin and box members is disclosed. The present invention, at least in preferred embodiments, provides a unique expandable threaded connection in which expansion of the tubulars creates a high pressure seal between the pin and box members. The connection utilizes a "groove" in a surface of the box member and a corresponding "rib" on the pin nose. The radial expansion of the tubulars via an expansion cone or via hydraulic pressure causes the pin to become shorter in length, thereby causing the pin nose to retract from the back of the box member. As the pin nose retracts, the rib on the pin nose moves backward until a portion of the rib contacts a portion of the groove in the box member. The point of contact between the rib and the groove creates a metal-to-metal seal between the pin and box members. Because the point of contact between the rib and the groove is a relatively small area, the force acting on the point of contact generates a high bearing pressure that is equal to or greater than the internal pressure within the expandable tubulars and, thus, generates a high pressure seal. Additionally, the contact between the

rib and the groove may help to prevent further retracting of the pin nose from the back of the box.

In the case of expansion of tubulars via a rotary expansion method (such as is disclosed in US 2003-0234538), the pin tends to increase in length, thereby causing the pin nose to move into engagement with (or toward) the back of the box member. In such a situation, the rib on the pin nose moves forward until a portion of the rib contacts a portion of the groove in the box member. Again, the point of contact between the rib and the groove creates a metal-to-metal seal between the pin and box members.

In an alternative embodiment, the portion of the rib and the portion of the groove that contact when the pin nose retracts can be designed with a reverse trapping angle that forces the nose of the pin member radially outwardly (i.e., toward the outer diameter of the expandable tubular string) as it retracts away from the back of the box member during the expansion process. The reverse trapping angle between the rib and groove forces the pin to remain engaged with the box.

In an alternative embodiment of the invention, an expandable elastomeric sealing ring can be inserted in a groove in the back of the box member such that when certain fluids contact the sealing ring as the pin nose retracts from the back of the box member, the sealing ring expands to fill the gap formed by the pin retracting from the box member thereby forming a secondary resilient seal that aids in containing the internal pressure until the primary metal-to-metal seal is completely formed.

In one aspect, the invention provides an expandable threaded tubular connection, comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means and a pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member;

a rib on one of the pin member and box member;

a groove on the other of the pin member and box member for receiving the rib, the groove being sized to allow the rib to move within the groove as a result of axial

movement of the pin nose during radial expansion of the threaded tubular connection; and

a resilient sealing element located on one of the pin member and box member for forming a seal between the pin member and box member.

In one aspect, the invention provides an expandable threaded tubular connection, comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means and a pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member;

a radially extending circumferential rib on one of the pin member and box member; and

a radially extending circumferential groove on the other of the pin member and box member for receiving the rib, the groove being sized to allow the rib to move within the groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection;

wherein the rib includes a reverse trapping angled wall forming an end of the rib and the groove includes an angled wall designed to mate with the reverse trapping angled wall of the rib in such a way that, upon the axial movement of the pin nose, the reverse trapping angled wall of the rib and the angled wall of the groove are in contact with each other so as to prevent the pin nose from being forced inwardly.

In one aspect, the invention provides an expandable threaded tubular connection, comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means and a pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member;

a first rib on one of the pin member and box member;

a first groove on the other of the pin member and box member for receiving the first rib, the first groove being sized to allow the first rib to move within the first groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection;

a second rib on one of the pin member and box member; and

a second groove on the other of the pin member and box member for receiving the second rib, the second groove being sized to allow the second rib to move within the second groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

In one aspect, the invention provides a method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection, the method comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means and a pin nose;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member;

providing a rib on one of the pin member and the box member, and a groove for receiving the rib on the other of the pin member and box member;

providing a resilient sealing element on one of the pin member and box member for forming a seal between the pin member and box member;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadably connecting the first tubular and the second tubular together;

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member; and

causing the rib to move within the groove until a portion of the rib contacts a portion of the groove to form a seal between the pin member and the box member.

In one aspect, the invention provides a method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means and a pin nose;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member;

providing a radially extending circumferential rib on one of the pin member and the box member, the rib having a reverse trapping angled wall at one end;

providing a radially extending circumferential groove for receiving the rib on the other of the pin member and box member, the groove having an angled wall for mating with the reverse trapping angled wall of the rib;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadably connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, causing the rib to move within the groove until the reverse trapping angled wall of the rib contacts the angled wall of the groove to form a seal between the pin member and prevent the pin nose from being forced inwardly.

According to an aspect of the present invention there is provided a method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a plurality of ribs;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a plurality of grooves for receiving each of the plurality of ribs on the pin member;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadedly connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, so that each rib moves within its corresponding groove to form a seal between the pin member and the box member.

According to another aspect of the present invention there is provided a method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a plurality of grooves;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a plurality of ribs for receipt into each of the plurality of grooves on the pin member;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadedly connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, so that each rib moves within its corresponding groove to form a seal between the pin member and the box member.

According to a further aspect of the present invention there is provided a method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a plurality of ribs and grooves;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a plurality of grooves and ribs for receiving each of the plurality of ribs and grooves on the pin member.

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadedly connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, so that each rib moves within its corresponding groove to form a seal between the pin member and the box member.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means, a pin nose and a rib on the pin nose, the pin nose having a pin nose end, the rib being preformed on the pin nose such that the rib is not deformed during radial expansion of the threaded tubular connection;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member and a groove for receiving the rib, the box member further including a shoulder engaging the pin nose end prior to radial expansion of the threaded tubular connection; and

a gap formed between the pin nose end and the shoulder during radial expansion of the threaded tubular connection,

wherein the groove in the box member is sized to allow the rib to move within the groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

According to a further aspect of the present invention there is provided a method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a rib on the pin nose, the pin nose having a pin nose end, the rib being preformed on the pin nose such that the rib is not deformed during the radial expansion;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a groove for receiving the rib, the box member further including a shoulder which engages the pin nose end prior to the radial expansion;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadably connecting the first tubular and the second tubular together;

radially expanding the threaded connection between the first tubular and the second tubular, whereby the pin nose moves axially away from the back of the box member during the radial expansion of the threaded connection, thereby creating a gap between the pin nose end and the shoulder; and

causing the rib to move within the groove of the box member until a portion of the rib contacts a portion of the groove to form a seal between the pin member and the box member.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular having a rib formed on its exterior surface such that the rib is not deformed during expansion of the tubular connection, the first tubular further having an end surface;

a second tubular having a shoulder and groove formed in its internal surface, the shoulder engaging the end surface prior to expansion of the tubular connection; and

a gap formed between the end surface and the shoulder during expansion,

wherein a portion of the second tubular is placed around a portion of the first tubular such that the rib moves within the groove as a result of the axial movement of the first tubular relative to the second tubular during expansion of the tubular connection.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular having a shoulder and groove formed in its exterior surface;

a second tubular having a rib and an end formed on its internal surface such that the rib is not deformed during expansion of the tubular connection, the shoulder and end engaging one another prior to expansion; and

a gap formed between the shoulder and end during expansion,

wherein a portion of the second tubular is placed around a portion of the first tubular such that the rib moves within the groove as a result of the axial movement of the first tubular relative to the second tubular during expansion of the tubular connection.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular having a rib formed on its exterior surface prior to make-up of the tubular connection;

a second tubular having a groove formed in its internal surface,

wherein a portion of the second tubular is placed around a portion of the first tubular such that the rib moves within the groove as a result of the axial movement of the first tubular relative to the second tubular during radial expansion of the tubular connection, and

wherein the rib is triangle shaped with a vertical or substantially vertical wall at an edge of the rib furthest from a leading edge of the first tubular, the groove being shaped to mate with the rib such that the wall of the rib and a wall of the groove come into contact with each other upon expansion of the tubular connection, thereby forming a seal.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular having a groove formed in its exterior surface; and

a second tubular having a rib formed on its internal surface prior to make-up of the tubular connection,

wherein a portion of the second tubular is placed around a portion of the first tubular such that the rib moves within the groove as a result of the axial movement of the first tubular relative to the second tubular during radial expansion of the tubular connection, and

wherein the groove is triangle shaped with a vertical or substantially vertical wall at an edge of the groove furthest from a leading edge of the first tubular, the rib being shaped to mate with the groove such that the wall of the groove and a wall of the rib come into contact with each other upon expansion of the tubular connection, thereby forming a seal.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular having a rib formed on its exterior surface, wherein the rib comprises:

a slanted top wall;

a vertical or substantially vertical front wall; and

an angled rear wall, and

a second tubular having a groove formed in its internal surface, the groove being shaped to mate with the rib such that the angled rear wall of the rib and an angled wall of the groove come into contact with each other upon expansion of the tubular connection, thereby forming a seal,

wherein the angled rear wall of the rib and the angled wall of the groove are both angled at 15-25 degrees.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular having a groove formed in its exterior surface; and

a second tubular having a rib formed on its internal surface, wherein the rib comprises:

a slanted top wall;

a vertical or substantially vertical front wall; and

an angled rear wall, the groove being shaped to mate with the rib such that the angled rear wall of the rib and an angled wall of the groove come into contact with each other upon expansion of the tubular connection, thereby forming a seal, wherein the angled rear wall of the rib and the angled wall of the groove are both angled at 15-25 degrees.

According to a further aspect of the present invention there is provided a method of sealing a threaded connection upon expansion of the connection comprising:

providing a pin member, the pin member including threads and a pin nose having a pin nose end, and a rib on the pin nose;

providing a box member, the box member including threads and a groove for receiving the rib, the box member further including a shoulder;

inserting the pin member into the box member;

engaging the pin nose end and shoulder prior to expansion of the connection;

radially expanding the connection;

creating a gap between the pin nose end and the shoulder during the expansion;

preventing the rib from deforming during the expansion; and

forming a seal between the rib and groove.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including threads, a pin nose and a groove formed in the pin nose;

a second tubular segment with a box member, the box member including threads for threadedly engaging the pin member and a rib designed to rest within and contact a

portion of the groove in the pin nose when the threaded tubular connection is made up prior to expansion;

wherein the groove in the pin member is sized to allow the rib to move within the groove from a contact point at a first end of the groove to a second contact point at a second end of the groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

According to a further aspect of the present invention there is provided an expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means and a pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member;

a plurality of ribs on one of the pin member and box member;

a plurality of grooves on the other of the pin member and box member for receiving the ribs, the grooves being sized to allow the ribs to move within them as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

Aspects of the present invention are provided by the following clauses.

Clauses

1. An expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means, a pin nose and a rib on the pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member and a groove for receiving the rib;

wherein the groove in the box member is sized to allow the rib to move within the groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

2. The expandable threaded tubular connection of clause 1 wherein the pin nose moves axially away from the back of the box member during radial expansion of the threaded tubular connection.

3. The expandable threaded tubular connection of clause 2 wherein the axial movement of the pin nose causes the rib to move within the groove in the box member until a portion of the rib contacts a portion of the groove.

4. The expandable threaded tubular connection of clause 3 wherein the contact between the rib and the groove creates a seal between the pin member and the box member.

5. The expandable threaded tubular connection of any one of clauses 1 to 4 wherein the rib includes an angled wall forming an end of the rib.

6. The expandable threaded tubular connection of clause 5 wherein the groove in the box member includes an angled wall designed to mate with the angled wall of the rib.

7. The expandable threaded tubular connection of clause 6 wherein the angled wall of the rib and the angled wall of the groove are in contact with each other upon the axial movement of the pin nose.

8. The expandable threaded tubular connection of clause 7 wherein the pin nose is forced outwardly when the angled wall of the rib and the angled wall of the groove are in contact with each other upon the axial movement of the pin nose.

9. The expandable threaded tubular connection of clause 7 or 8 wherein the contact between the angled wall of the rib and the angled wall of the groove creates a seal between the pin member and the box member.

10. The expandable threaded tubular connection of any one of clauses 1 to 9 further comprising a sealing element located at the back of the box member.

11. The expandable threaded tubular connection of clause 10 wherein the sealing element is made from an elastomeric material.

12. The expandable threaded tubular connection of clause 10 wherein the sealing element expands when contacted by a fluid.

13. The expandable threaded tubular connection of any one of clauses 1 to 12 further comprising a sealing element housed within a groove formed in the box member between two individual threads of the interengageable thread means of the box member.

14. The expandable threaded tubular connection of any one of clauses 1 to 13 further comprising a sealing element housed within a groove formed in the pin member between two individual threads of the interengageable thread means of the pin member.

15. The expandable threaded tubular connection of any one of clauses 1 to 14 wherein a leading edge of the rib on the pin nose is in contact with a back edge of the groove of the box member upon makeup of the threaded tubular connection such that the contact creates a metal-to-metal seal when the threaded tubular connection is made up.

16. An expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means, a pin nose and a groove formed in the pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member and a rib designed to rest within the groove in the pin nose when the threaded tubular connection is made up;

wherein the groove in the pin member is sized to allow the rib to move within the groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

17. The expandable threaded tubular connection of clause 16 wherein the pin nose moves axially away from the back of the box member during radial expansion of the threaded tubular connection.

18. The expandable threaded tubular connection of clause 17 wherein the axial movement of the pin nose causes the rib to move within the groove in the pin member until a portion of the rib contacts a portion of the groove.

19. The expandable threaded tubular connection of clause 18 wherein the contact between the rib and the groove creates a seal between the pin member and the box member.

20. The expandable threaded tubular connection of any one of clauses 16 to 19 wherein the rib includes an angled wall forming an end of the rib.

21. The expandable threaded tubular connection of clause 20 wherein the groove in the pin member includes an angled wall designed to mate with the angled wall of the rib.

22. The expandable threaded tubular connection of clause 21 wherein the angled wall of the rib and the angled wall of the groove are in contact with each other upon the axial movement of the pin nose.

23. The expandable threaded tubular connection of clause 22 wherein the pin nose is forced outwardly when the angled wall of the rib and the angled wall of the groove are in contact with each other upon the axial movement of the pin nose.

24. The expandable threaded tubular connection of clause 22 or 23 wherein the contact between the angled wall of the rib and the angled wall of the groove creates a seal between the pin member and the box member.

25. The expandable threaded tubular connection of any one of clauses 16 to 24 further comprising a sealing element located at the back of the box member.

26. The expandable threaded tubular connection of clause 25 wherein the sealing element is made from an elastomeric material.

27. The expandable threaded tubular connection of clause 25 wherein the sealing element expands when contacted by a fluid.

28. The expandable threaded tubular connection of any one of clauses 16 to 27 further comprising a sealing element housed within a groove formed in the box member between individual threads of the interengageable thread means of the box member.

29. The expandable threaded tubular connection of any one of clauses 16 to 28 further comprising a sealing element housed within a groove formed in the pin member between individual threads of the interengageable thread means of the pin member.

30. The expandable threaded tubular connection of any one of clauses 16 to 29 wherein a leading edge of the groove in the pin nose is in contact with a back edge of the rib of the box member upon makeup of the threaded tubular connection such that the contact creates a metal-to-metal seal when the threaded tubular connection is madeup.

31. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a rib on the pin nose;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a groove for receiving the rib;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadably connecting the first tubular and the second tubular together;

radially expanding the threaded connection between the first tubular and the second tubular, whereby the pin nose moves axially away from the back of the box member during the radial expansion of the threaded connection;

causing the rib to move within the groove of the box member until a portion of the rib contacts a portion of the groove to form a seal between the pin member and the box member.

32. The method of clause 31 further comprising providing the rib with an angled wall at an end of the rib.

33. The method of clause 32 further comprising providing the groove in the box member with an angled wall for mating with the angled wall of the rib.

34. The method of clause 33 further comprising causing the angled wall of the rib and the angled wall of the groove to contact each other upon the axial movement of the pin nose.

35. The method of clause 34 whereby the contact between the angled wall of the rib and the angled wall of the groove creates a seal between the pin member and the box member.

36. The method of any one of clauses 31 to 35 further comprising providing a sealing element located at the back of the box member.

37. The method of clause 36 further comprising contacting the sealing element with a fluid, whereby the sealing element expands in response to contact with the fluid.

38. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a groove in the pin nose;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a rib designed to rest within the groove in the pin nose when the threaded tubular connection is made up;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadably connecting the first tubular and the second tubular together;

radially expanding the threaded connection between the first tubular and the second tubular, whereby the pin nose moves axially away from the back of the box member during the radial expansion of the threaded connection;

causing the rib to move within the groove until a portion of the rib contacts a portion of the groove to form a seal between the pin member and the box member.

39. The method of clause 38 further comprising providing the rib with an angled wall at an end of the rib.

40. The method of clause 39 further comprising providing the groove with an angled wall for mating with the angled wall of the rib.

41. The method of clause 40 further comprising causing the angled wall of the rib and the angled wall of the groove to contact each other upon the axial movement of the pin nose.

42. The method of clause 41 whereby the contact between the angled wall of the rib and the angled wall of the groove creates a seal between the pin member and the box member.

43. The method of any one of clauses 38 to 42 further comprising providing a sealing element located at the back of the box member.

44. The method of clause 43 further comprising contacting the sealing element with a fluid, whereby the sealing element expands in response to contact with the fluid.

45. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, a rib on the pin nose, and a groove in the pin nose;

providing a pin member on a second tubular segment, the pin member including interengageable thread means, a pin nose, a rib on the pin nose, and a groove in the pin nose;

providing a coupling member, the coupling member including interengageable thread means suitable for threadedly engaging the pin member of the first tubular segment and the pin member of the second tubular segment, a groove for receiving the rib of the pin nose of the first tubular segment, a groove for receiving the rib of the pin nose of the second tubular segment, a rib for engaging the groove in the pin nose of the first tubular segment, and a rib for engaging the groove in the pin nose of the second tubular segment;

inserting the pin members of the first tubular segment and the second tubular segment into the coupling member and threadably connecting the first tubular and the second tubular together;

radially expanding the threaded connection between the first tubular and the second tubular, whereby the pin nose of the first tubular segment and the second tubular segment move axially during the radial expansion of the threaded connection;

causing the rib of the pin nose of the first tubular segment to move within one of the grooves of the coupling member until a portion of the rib contacts a portion of the groove to form a seal between the pin member of the first tubular segment and the coupling member;

causing the rib of the pin nose of the second tubular segment to move within one of the grooves of the coupling member until a portion of the rib contacts a portion of the groove to form a seal between the pin member of the second tubular segment and the coupling member;

causing one of the ribs of the coupling member to move within the groove in the pin member of the first tubular segment until a portion of the rib contacts a portion of the groove to form a seal between the pin member of the first tubular segment and the coupling member;

causing one of the ribs of the coupling member to move within the groove in the pin member of the second tubular segment until a portion of the rib contacts a portion of the groove to form a seal between the pin member of the second tubular segment and the coupling member.

46. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a box member on a first tubular segment, the box member including interengageable thread means, a rib on the box member, and a groove in the box member;

providing a box member on a second tubular segment, the box member including interengageable thread means, a rib on the box member, and a groove in the box member;

providing a coupling member with a pin member on each end of the coupling member, each pin member including interengageable thread means suitable for threadedly engaging the box member of the first tubular segment and the box member of the second tubular segment, a rib designed to rest within the groove in the box member of the first tubular segment, a rib designed to rest within the groove in the box member of the second tubular segment, a groove for receiving the rib of the box member of the first tubular segment, and a groove for receiving the rib of the box member of the second tubular segment;

inserting one of the pin members of the coupling member into the box member of the first tubular segment;

inserting one of the pin members of the coupling member into the box member of the second tubular segment;

threadably connecting the first tubular and the second tubular together;

radially expanding the threaded connection between the first tubular and the second tubular, whereby the pin members of the coupling move axially during the radial expansion of the threaded connection;

causing one of the ribs of the coupling member to move within the groove in the box member of the first tubular segment until a portion of the rib contacts a portion of the groove to form a seal between the coupling member and the box member of the first tubular segment;

causing one of the ribs of the coupling member to move within the groove in the box member of the second tubular segment until a portion of the rib contacts a portion of the groove to form a seal between the coupling member and the box member of the second tubular segment;

causing one of the grooves of the coupling member to move over one of the ribs of the box member of the first tubular segment until a portion of the rib contacts a portion of the groove to form a seal between the coupling member and the box member of the first tubular segment;

causing one of the grooves of the coupling member to move over one of the ribs of the box member of the second tubular segment until a portion of the rib contacts a portion of the groove to form a seal between the coupling member and the box member of the second tubular segment.

47. A seal for an expandable tubular connection comprising:

a first tubular having a rib formed on its exterior surface;

a second tubular having a groove formed in its internal surface,

wherein a portion of the second tubular is placed around a portion of the first tubular such that the rib moves within the groove as a result of the axial movement of the first tubular relative to the second tubular during radial expansion of the threaded tubular connection.

48. The seal of clause 47 wherein the axial movement of the first tubular relative to the second tubular causes the rib to move within the groove until a portion of the rib contacts a portion of the groove.

49. The seal of clause 48 wherein the contact between the rib and the groove creates a seal between the first tubular and the second tubular.

50. A seal for an expandable tubular connection comprising:

a first tubular having a groove formed in its exterior surface;

a second tubular having a rib formed on its internal surface,

wherein a portion of the second tubular is placed around a portion of the first tubular such that the rib moves within the groove as a result of the axial movement of the first tubular relative to the second tubular during radial expansion of the threaded tubular connection.

51. The seal of clause 50 wherein the axial movement of the first tubular relative to the second tubular causes the rib to move within the groove until a portion of the rib contacts a portion of the groove.

52. The seal of clause 51 wherein the contact between the rib and the groove creates a seal between the first tubular and the second tubular.

The following figures form part of the present specification and are included to further demonstrate certain aspects of the present invention. The invention may be better understood by reference to one or more of these figures in combination with the detailed description of specific embodiments presented herein.

Figure 1 is a side view of an expandable threaded connection for expandable tubulars prior to expansion of the tubulars.

Figure 2 is an enlarged view of the pin nose and back of the box member of Figure 1 showing the raised rib on the pin nose and the corresponding groove in the box member prior to expansion of the tubulars.

Figure 3 is an enlarged view of the pin nose and back of the box member of Figure 1 showing the raised rib on the pin nose and the corresponding groove in the box member after expansion of the tubulars.

Figure 4 is a side view of an expandable threaded connection for expandable tubulars in which an expandable elastomeric sealing ring is placed in a groove in the back of the box member of the threaded connection.

Figure 5 is a side view of the pin nose and back of the box member of an alternative expandable tubular connection. Figure 5 shows the raised rib on the pin nose and the corresponding groove in the box member prior to expansion of the tubulars.

Figure 6 is a side view of the expandable threaded connection of Figure 5 showing the raised rib on the pin nose and the corresponding groove in the box member after expansion of the tubulars.

Figure 7 is a side view of the pin nose and back of the box member of an alternative expandable tubular connection. Figure 7 shows the raised rib on the pin nose and the corresponding groove in the box member prior to expansion of the tubulars.

Figure 8 is a side view of the expandable threaded connection of Figure 7 showing the raised rib on the pin nose and the corresponding groove in the box member after expansion of the tubulars.

The following examples are included to demonstrate preferred embodiments of the invention. It should be appreciated by those of skill in the art that the techniques disclosed in the examples which follow represent techniques discovered by the inventors to function well in the practice of the invention, and thus can be considered to constitute preferred modes for its practice. However, those of skill in the art should, in light of the present disclosure, appreciate that many changes can be made in the specific embodiments which are disclosed and still obtain a like or similar result without departing from the scope of the invention.

Referring to Figure 1, an expandable threaded connection according to the present invention is shown fully made up. The expandable threaded connection of Figure 1 includes pin member 10 and box member 20 on adjacent segments of expandable tubulars. Pin member 10 includes helical threads 12 extending along its length. Box member 20 includes helical mating threads 24 that are shaped and sized to mate with helical threads 12 respectively on pin member 10 during make-up of a threaded connection between separate tubular joints or segments. The interengaged threads of pin member 10 with the corresponding threads of box member 20 on an adjacent joint provide a threaded connection upon final make-up. In this way, multiple segments of expandable tubulars can be threadably connected.

The helical threads can be machined on plain end tubulars, tubulars with both ends upset, tubulars with one plain end and one upset end, or other connection types as typically used in the oil and gas industry. Additionally, the threads can be selected from a broad range of thread types used in the industry. One of skill in the art can appreciate that the present invention is not limited in application to only certain kinds of tubular ends or thread types. In the preferred embodiment, the thread type is a generally reverse angle hooked type thread, or a modified profile thread as is disclosed and claimed in United States Patent No. 6,767,035 dated July 27, 2004. These threads are preferred for their ability to keep the pin and box members from separating during the expansion process.

The expandable threaded connection of Figure 1 is shown prior to radial expansion of the expandable tubulars. When the expandable threaded connection is made up, pin nose end 31 (comprising the end of the pin nose 30 of pin member 10) and box surface 32 (located at the back of the box member 20) are in contact, or very nearly in contact, when the expandable threaded connection is made up.

Figure 1 shows a preformed rib 14 on pin nose 30 residing in groove 28 formed in box member 20. Rib 14 is described as preformed in that it is preformed on pin nose 30 prior to make-up of the threaded connection and, thus, is not created during the expansion process. As shown in Figure 1, the leading "edge" of rib 14 (i.e., the edge nearest pin nose end 31) is in contact with the back "edge" of groove 28 (i.e., the edge closest to box surface 32) when the connection is made up. The point of contact between the leading edge of rib 14 and the back edge of groove 28 can form a metal-to-metal seal when the connection is made up.

Figure 2 shows an enlarged view of pin member 10 and box member 20 of Figure 1 in the area of rib 14 and groove 28 prior to expansion of the tubulars. As can be seen in Figure 2, the leading edge of rib 14 is in contact with the back edge of groove 28 when the connection is made up. As can also be seen in Figure 2, groove 28 in box member 20 is slightly larger than rib 14.

Figure 3 shows an enlarged view of pin member 10 and box member 20 of Figure 1 in the area of rib 14 and groove 28 after expansion of the tubulars. In the preferred embodiment, the expansion of the tubulars is accomplished by moving or displacing an expansion cone or other expansion tool through the tubulars. As the expansion cone is moved through the tubulars, the radial expansion of the tubulars causes pin nose 30 to shorten, thereby causing pin nose end 31 to "retract" away from the box surface 32. As a result of pin nose 30 retracting, an axial gap (a) is formed between pin nose end 31 and box surface 32.

As the pin nose 30 retracts, rib 14 moves backward (i.e., toward the left in Figure 3) until the trailing edge of rib 14 (i.e., the edge of rib 14 furthest from pin nose end 31) contacts the front edge of the groove 28 (i.e., the edge of groove 28 furthest from box surface 32). The point of contact between the trailing edge of rib 14 and the front edge of groove 28 creates a metal-to-metal seal between pin member 10 and box member 20.

Because this point of contact between rib 14 and groove 28 is a relatively small area, the axial force acting on the point of contact generates a high bearing pressure that is equal to or greater than the internal pressure within the expandable tubulars. The bearing pressure of the metal-to-metal seal formed by the contact of rib 14 with groove 28 prevents well fluids from migrating past this point of contact. As such, the expansion process creates a high-pressure seal. Additionally, the contact between rib 14 and groove 28 resists or impedes further retracting of the pin nose 30 from the box surface 32, thereby limiting the size of axial gap (a) created during the expansion process.

To augment the sealing capability of the threaded connection, a resilient seal 40 can be placed in the back of the box member 20 near box surface 32, as shown in Figure 4. Seal 40 helps seal the threaded connection when the connection is fully made up as well as after expansion of the threaded connection. When the connection is fully made up, pin nose end 31 will engage seal 40 to help seal against well fluids migrating into the threads of the threaded connection. When the pin nose end 31 retracts during the expansion operation, seal 40 helps block any fluid paths through the threaded connection created by the resulting axial gap (a) (shown in Figure 3) that is formed between the pin nose end 31 and the box surface 32.

While seal 40 can generally be made of any suitable resilient sealing material known in the art, in the preferred embodiment, seal 40 can be made of an "expanding" or "swelling" material that expands or swells when it is contacted by certain fluids. Such a material is disclosed in published United States Patent Application 2004/0017081 A1. More specifically, as fluids enter the axial gap (a) created during the expansion operation, they will contact seal 40. Such contact

causes seal 40 to expand or swell, thereby substantially filling the axial gap (a) and preventing the fluids from migrating past seal 40. Seal 40 is a secondary resilient seal that contains the pressure while the metal-to-metal primary seal is being formed.

Figure 5 shows an alternative design for pin nose 50. As shown in Figure 5, pin nose 50 is configured with a triangle shaped preformed rib 52 that has a vertical, or substantially vertical, wall 54 at the trailing edge of rib 52 (i.e., the edge furthest from pin nose end 51). Groove 60 is similarly shaped to mate with rib 52 when the threaded connection is made up. Groove 60 in box member 20 has a vertical, or substantially vertical, wall 62 at the leading edge of groove 60 (i.e., the edge furthest from box surface 61).

As shown in Figure 5, when the threaded connection is fully made up, pin nose end 51 is in contact with, or very nearly in contact with, box surface 61 at the back of the box member 20 prior to expansion of the threaded connection. In this position, the slanted wall of rib 52 is in contact with the slanted wall of groove 60, and a small axial gap (a) exists between wall 54 of rib 52 and wall 62 of groove 60.

When an expansion cone is moved through the tubulars, the radial expansion of the tubulars causes pin nose 50 to shorten, thereby causing pin nose end 51 to "retract" away from box surface 61. As a result of pin nose end 51 retracting, an axial gap (a) is formed between pin nose end 51 and box surface 61 (as shown in Figure 6).

As the pin nose 50 retracts, rib 52 moves backward (i.e., toward the left in Figure 6) until the wall 54 of rib 52 contacts wall 62 of groove 60. The contact between wall 54 of rib 52 and wall 62 of groove 60 creates a metal-to-metal seal between pin member 10 and box member 20. The axial force acting on the point of contact between walls 54 and 62 generates a high bearing pressure that is equal to or greater than the internal pressure within the expandable tubulars. The bearing pressure of the metal-to-metal seal so formed prevents well fluids from migrating past the point of contact between walls 54 and 62. As such, the expansion process creates a high-pressure seal. Additionally, the contact between walls 54 and 62 resists or impedes further retracting

of the pin nose end 51 from the box surface 61, thereby limiting the size of axial gap (a) created during the expansion process.

To augment the sealing capability of the threaded connection, a resilient seal 70 can be placed in a groove in the threaded portion of box member 20 between the metal-to-metal seal formed by the contact of walls 54 and 62 and the interengaged threads of the pin member 10 and box member 20 (as shown in Figures 5 and 6). Alternatively, the resilient seal 70 can be placed in a groove in the threaded portion of pin member 10.

Figure 7 shows an alternative design for pin nose 80. As shown in Figure 7, pin nose 80 is configured with a rib 82 that is designed with a slanted top wall 85, a vertical (or substantially vertical) front wall 83, and an angled rear wall 84. Groove 90 in box member 20 is similarly shaped to mate with rib 82 when the threaded connection is made up. Groove 90 has an angled rear wall 92 at the leading edge of groove 90 (the wall furthest from box surface 91).

As shown in Figure 7, when the threaded connection is fully made up, pin nose end 81 is in contact with, or very nearly in contact with, box surface 91 at the back of the box member 20 prior to expansion of the threaded connection. In this position, the slanted top wall 85 of rib 82 is in contact with the slanted wall of groove 90, and a small axial gap (a) exists between angled rear wall 84 of rib 82 and angled rear wall 92 of groove 90.

When an expansion cone is moved through the tubulars, the radial expansion of the tubulars causes pin nose 80 to shorten, thereby causing pin nose end 81 to "retract" away from box surface 91. As a result of pin nose end 81 retracting, an axial gap (a) is formed between pin nose end 81 and box surface 91 (as shown in Figure 8).

As the pin nose 80 retracts, rib 82 moves backward (i.e., toward the left in Figure 8) until the angled rear wall 84 of rib 82 contacts angled rear wall 92 of groove 90. The contact between angled rear wall 84 of rib 82 and angled rear wall 92 of groove 90

creates a metal-to-metal seal between pin member 10 and box member 20. The axial force acting on the point of contact between angled rear wall 84 and angled rear wall 92 generates a high bearing pressure that is equal to or greater than the internal pressure within the expandable tubulars.

The sealing ability of the expandable connection is enhanced by the "slanting" of angled rear walls 84 and 92. Specifically, by slanting the angled rear wall 84 and angled rear wall 92 as shown in Figures 7 and 8, a reverse trapping angle is incorporated into the sliding seal of the present invention. As shown, angled rear wall 84 and angled rear wall 92 have been machined with substantially equal trapping angles. The trapping angle is preferably in the range of 15-25 degrees. The above range of degrees for the reverse trapping angle of angled rear wall 84 and angled rear wall 92 is given by way of example only. One of skill in the art will recognize that the actual measurement of reverse trapping angle can vary greatly depending on numerous characteristics, including, but not limited to, the material of the expandable tubulars, the wall thickness of the pin and box members of the threaded connection, and the amount of radial expansion of the expandable tubulars.

The reverse trapping angle incorporated into the sliding seal of the present invention is designed to force pin nose 80 outwardly as angled rear wall 84 is forced into contact with angled rear wall 92. As pin nose 80 is forced in an outwardly direction, the bearing pressure between slanted top wall 85 of rib 82 and the corresponding slanted wall of groove 90 is increased. A larger trapping angle will cause higher bearing pressure between those surfaces. Both the increased bearing pressure between those surfaces and the increased bearing pressure caused by the forces acting on the surfaces at the trapping angles will produce a high strength metal-to-metal seal between pin member 10 and box member 20. The bearing pressure of the metal-to-metal seal so formed prevents fluids from migrating past the point of contact between angled rear wall 84 and angled rear wall 92. As such, the expansion process creates a high-pressure seal.

Additionally, the contact between angled rear wall 84 and angled rear wall 92 resists or impedes further retracting of the pin nose end 81 from the box surface 91, thereby limiting the size of axial gap (a) created during the expansion process. Further, such contact helps keep the threads of the pin member 10 engaged with the threads of the box member 20.

To augment the sealing capability of the threaded connection, a resilient seal 70 can be placed in a groove in the box member 20 between the metal-to-metal seal formed by the contact of angled rear wall 84 and angled rear wall 92 and the interengaged threads of the pin member 10 and box member 20 (as shown in Figures 7 and 8).

One of skill in the art will recognize that alternative embodiments of the present invention may utilize a pin nose and a box member of various shapes. Further, one of skill in the art will recognize that the dimensions of the expandable threaded connection and the geometry and size of the axial gap (a) can vary for given applications. Advanced finite element analysis can be used to aid in determining the optimal dimensions of the expandable threaded connection and the geometry and size of the axial gap that is necessary to be shaped before the expansion process.

One of skill in the art will also recognize that additional alternative embodiments exist in which the locations of the rib and the groove that form the sliding seal of the present invention can be reversed, i.e., the rib can be located on the box member and the groove can be located in the pin member. Additionally, one of skill in the art will appreciate that alternative embodiments exist in which the rib and groove can be placed on both the pin and box members, thereby allowing a coupling member to be used to connect two adjacent tubulars while still allowing for a sliding seal of the present invention to be formed upon expansion of the tubulars.

Further, one of skill in the art will appreciate that the sliding seal of the present invention can be formed when the tubulars are expanded by any known tubular expansion method, including rotary expansion techniques. For example, if the tubulars

are expanded by moving an expansion cone through the tubulars, the sliding seal will be created as discussed above. If the tubulars are expanded by a rotary expansion tool, the pin tends to increase in length, thereby causing the pin nose to move into engagement with (or toward) the back of the box member during the expansion process. In such a situation, the pin and box members prior to expansion would look similar to Figure 3. As the connection is expanded, the rib on the pin nose will move forward until a portion of the rib contacts a portion of the groove in the box member (similar to what is shown in Figure 2).

Moreover, one of skill in the art will appreciate that the sliding seal of the present invention can be utilized on tubulars that are not connected by traditional threaded means. For example, the sliding seal of the present invention can be utilized on tubulars to be expanded that are made-up through other connection means such as the method of joining expandable tubulars disclosed in United States Published Patent Application 2004/0069498 A1 published on April 15, 2004. When used on such tubulars, the rib and groove (or multiple rib and groove combinations) will be located on concentric sections of the tubulars such that the expansion process creates the seal as explained above.

While the apparatus, compositions and methods of this invention have been described in terms of preferred or illustrative embodiments, it will be apparent to those of skill in the art that variations may be applied to the process described herein without departing from the concept and scope of the invention. All such similar substitutes and modifications apparent to those skilled in the art are deemed to be within the scope and concept of the invention as it is set out in the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means and a pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member;

a first rib on one of the pin member and box member;

a first groove on the other side of the pin member and box member for receiving the first rib, the first groove being sized to allow the first rib to move within the first groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection;

a second rib on one of the pin member and box member; and

a second groove on the other of the pin member and box member for receiving the second rib, the second groove being sized to allow the second rib to move within the second groove as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

2. An expandable threaded tubular connection as claimed in claim 1, wherein the first rib is provided on the pin member and the first groove is provided on the box member.

3. An expandable threaded tubular connection as claimed in claim 1 or 2, wherein the second rib is provided on the box member and the second groove is provided on the pin member.

4. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a plurality of ribs;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a plurality of grooves for receiving each of the plurality of ribs on the pin member;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadedly connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, so that each rib moves within its corresponding groove to form a seal between the pin member and the box member.

5. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a plurality of grooves;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a plurality of ribs for receipt into each of the plurality of grooves on the pin member.

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadedly connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, so that each rib moves within its corresponding groove to form a seal between the pin member and the box member.

6. A method of sealing a threaded connection for expandable tubulars upon radial expansion of the threaded connection comprising:

providing a pin member on a first tubular segment, the pin member including interengageable thread means, a pin nose, and a plurality of ribs and grooves;

providing a box member in a second tubular segment, the box member including interengageable thread means suitable for threadedly engaging the pin member and a

plurality of grooves and ribs for receiving each of the plurality of ribs and grooves on the pin member;

inserting the pin member of the first tubular segment into the box member of the second tubular segment and threadedly connecting the first tubular and the second tubular together; and

radially expanding the threaded connection between the first tubular and the second tubular whereby, during the radial expansion of the threaded connection, the pin nose moves axially away from the back of the box member, so that each rib moves within its corresponding groove to form a seal between the pin member and the box member.

7. An expandable threaded tubular connection comprising:

a first tubular segment with a pin member, the pin member including interengageable thread means and a pin nose;

a second tubular segment with a box member, the box member including interengageable thread means suitable for threadedly engaging the pin member;

a plurality of ribs on one of the pin member and box member;

a plurality of grooves on the other of the pin member and box member for receiving the ribs, the grooves being sized to allow the ribs to move within them as a result of axial movement of the pin nose during radial expansion of the threaded tubular connection.

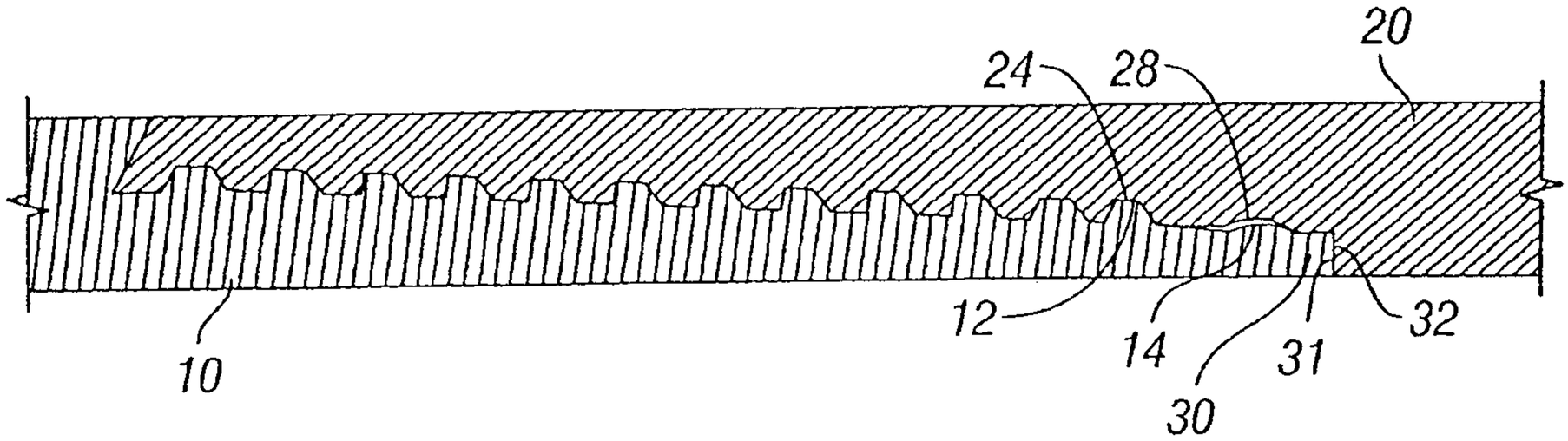


FIG. 1

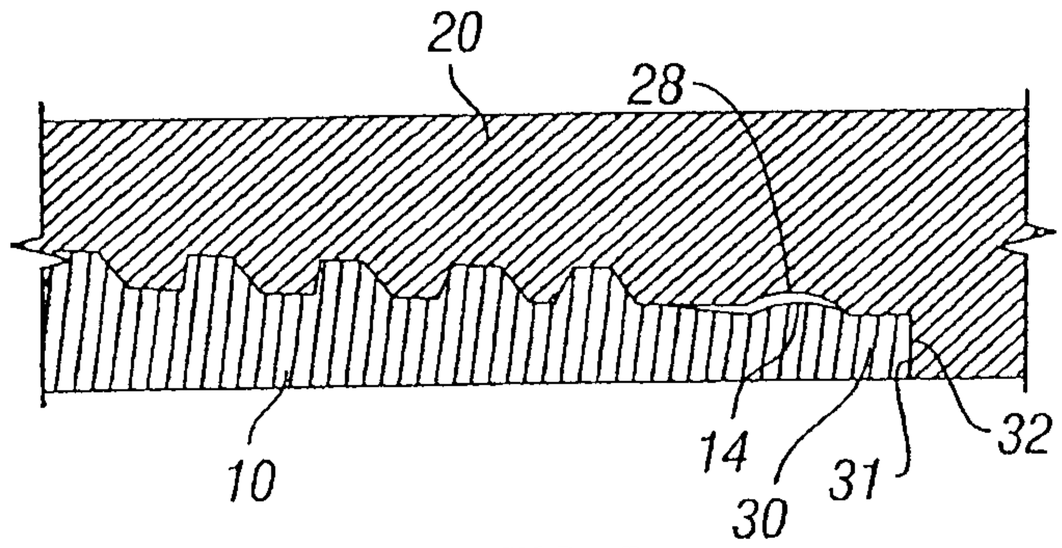


FIG. 2

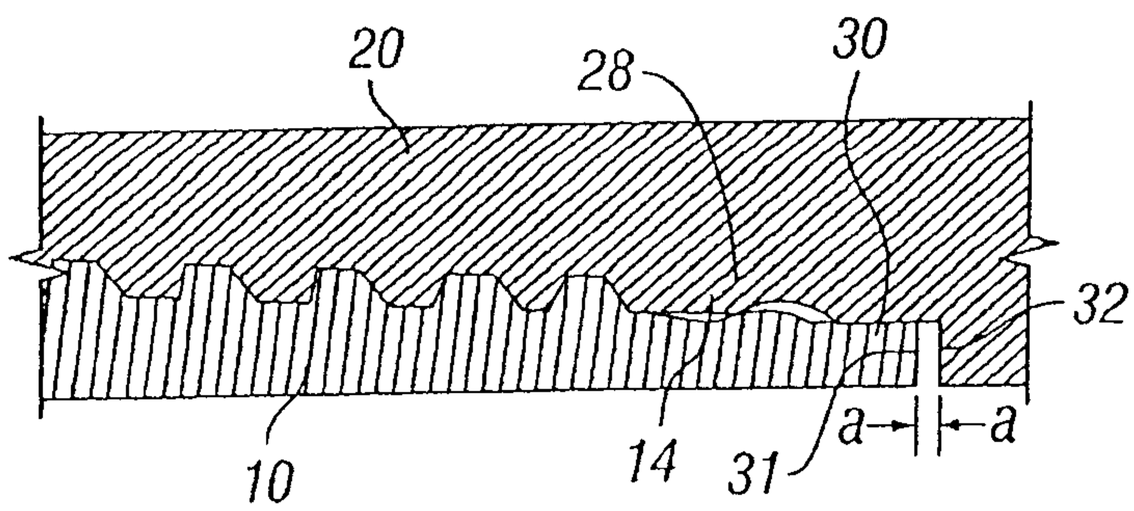


FIG. 3

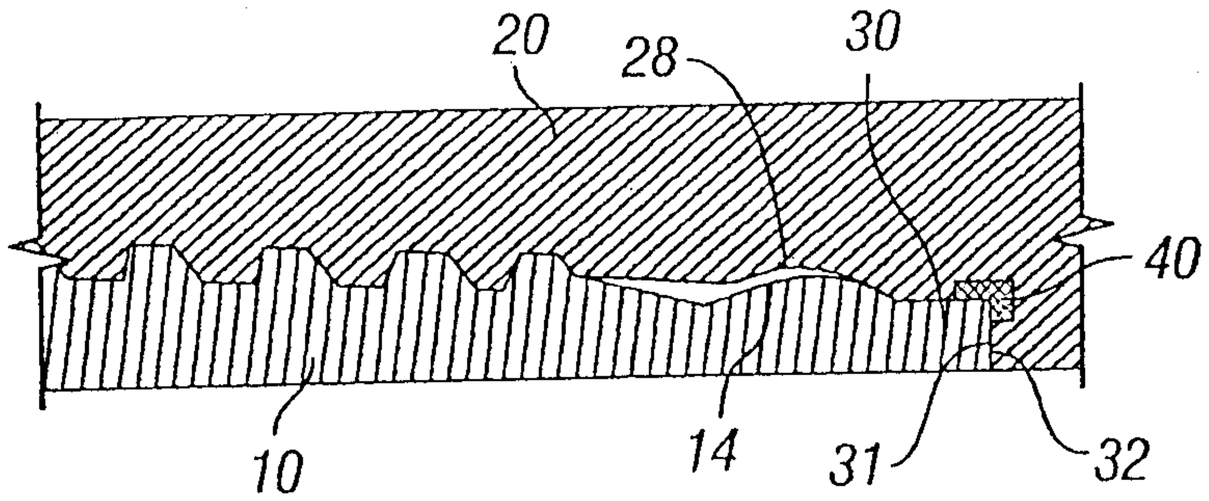


FIG. 4

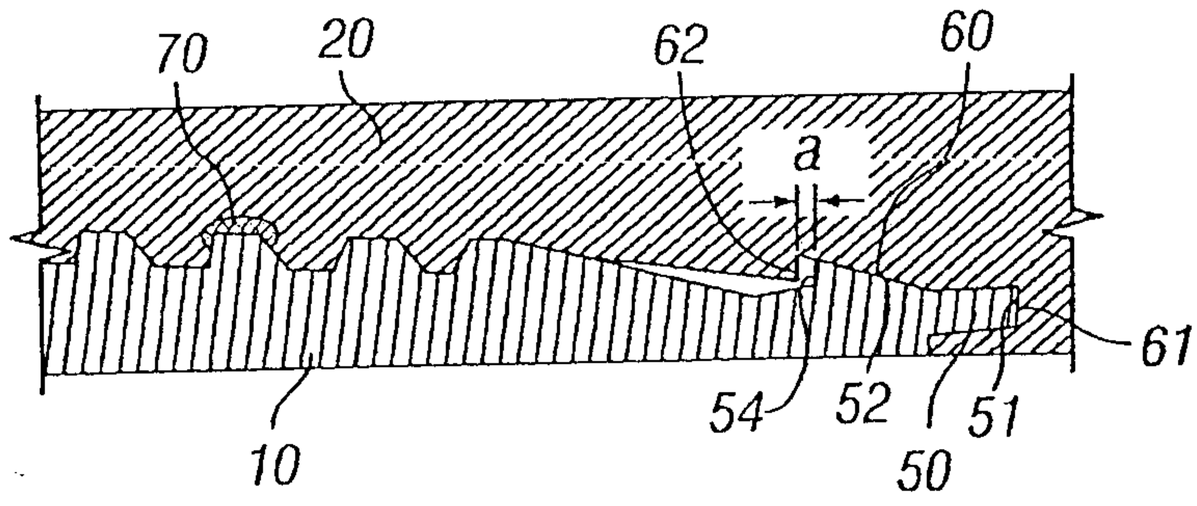


FIG. 5

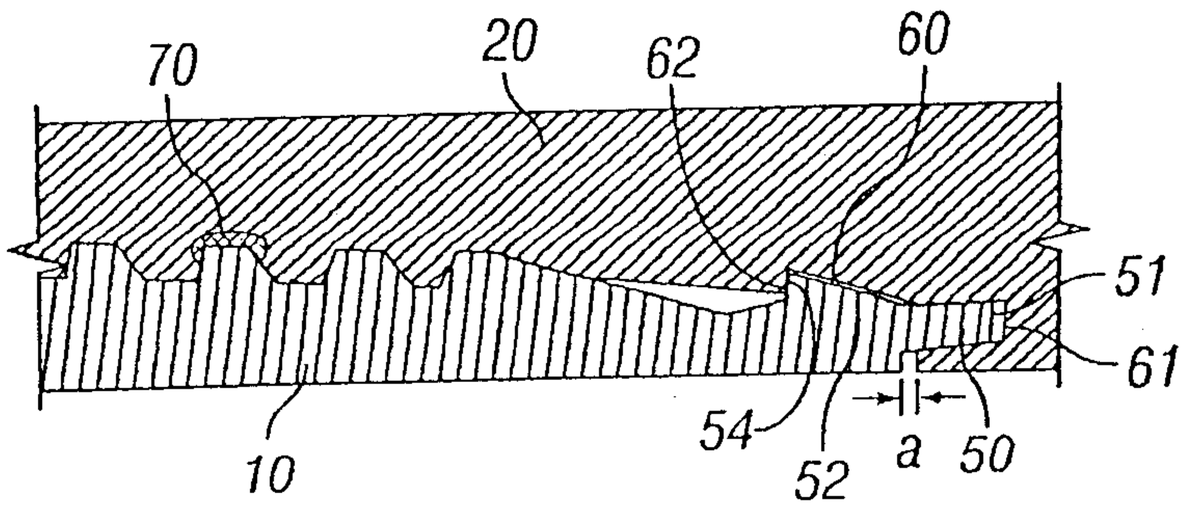


FIG. 6

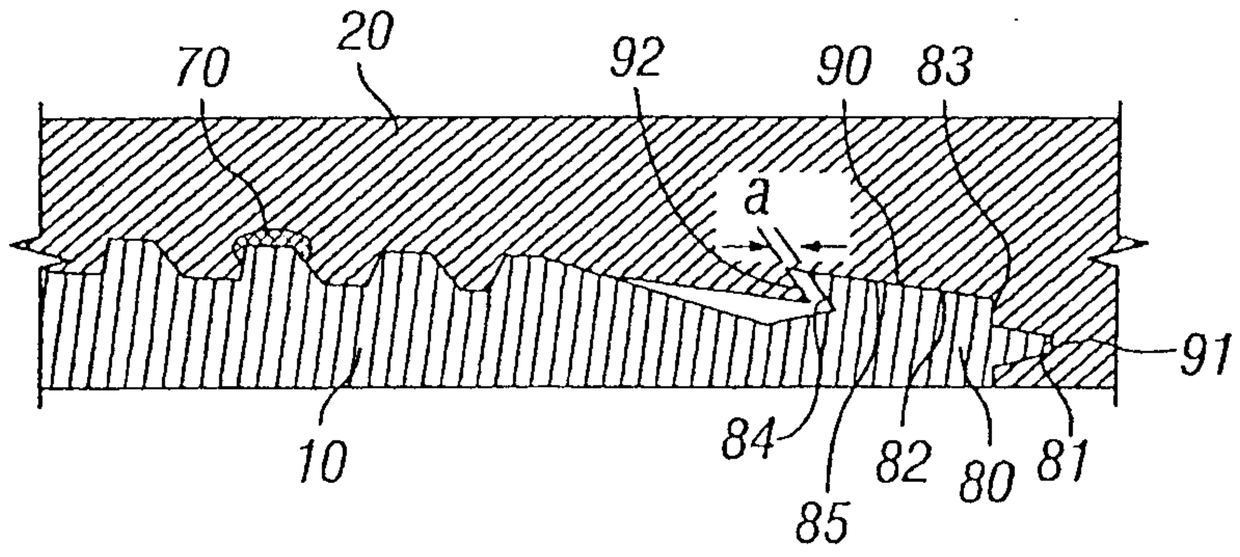

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FIG. 7

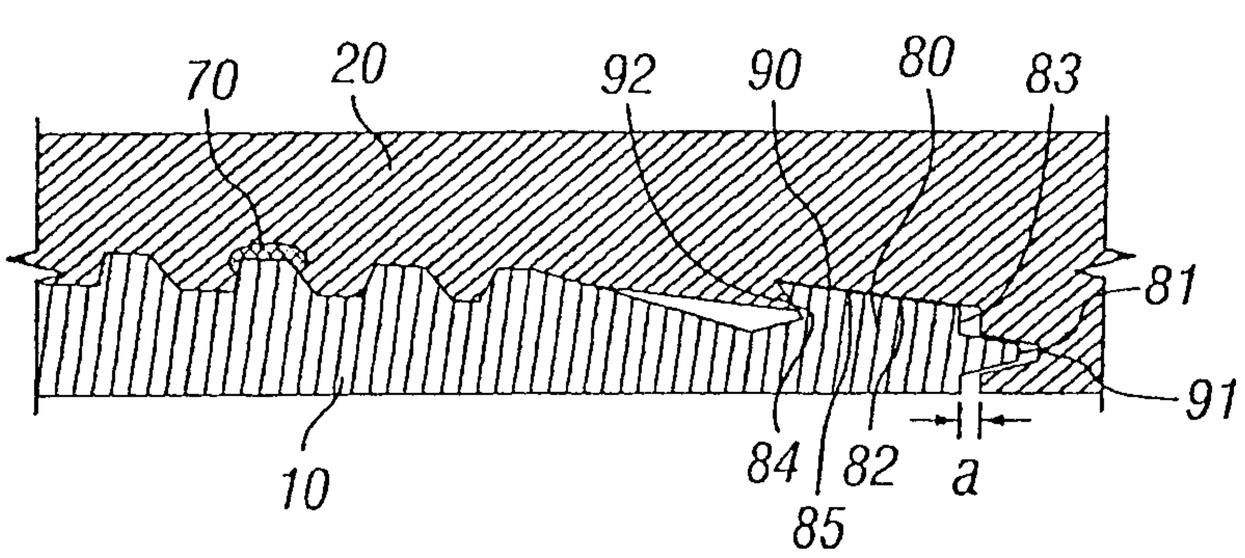
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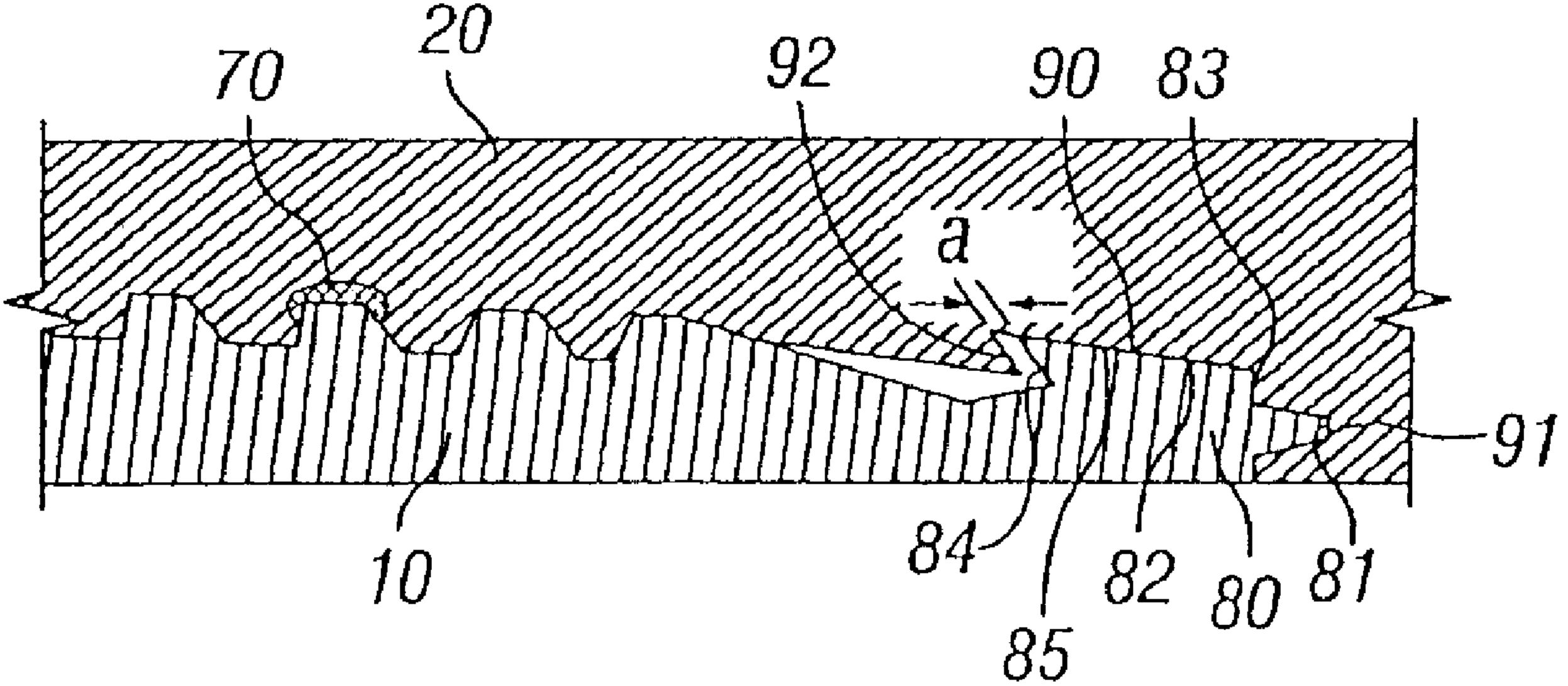
FIG. 8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