[0005] The prior art provides various tools for conducting weld integrity tests on conduits. For example, U.S. Patent numbers 6,131,441 and 5,844,127 (the entire disclosures of which are incorporated herein by reference) teach weld testing tools that isolate a particular section of a pipe (such section including a weld) and subject the section to a high pressure fluid within a constrained annular space defined by the tool and the inner surface of the pipe. The pressure of the fluid within the annular space is monitored whereby any pressure drop signifies a leak in the weld.

[0006] US Patent number 6,463,791 (the entire disclosure of which is incorporated herein by reference) teaches an apparatus for testing welds used to secure nozzles. As shown in Figure 1 of this reference, the apparatus comprises a first seal plate that is placed on the inner surface of the vessel (for example) and a second seal plate that is secured to the outer, flange portion of the nozzle. In this manner, the nozzle volume is sealed and a pressurizing fluid is introduced therein. Once the volume is filled, the pressure is monitored as above and any leakage detected. Although this apparatus provides an accurate and efficient means of testing welds on nozzles, the size and weight of the apparatus makes it inconvenient for use on large nozzles.

[0007] Further, applicant's co-pending U.S. application, serial number 11/771,158 (publication number US 2008/0121044), provides tools for testing the integrity of welds on pipes and the like. The entire disclosure of such application is incorporated herein by reference.

[0008] There exists a need for more easily sealing a section of a long pipe for conducting the type of stress tests mentioned above. In addition, there exists a need for an apparatus that is capable of exerting axial stresses on welds during such testing so as to simulate a "worst case scenario". In particular, there is a need for an apparatus that can be easily mounted on an open end of a pipe so as to effectively seal the pipe opening and maintain such seal during high pressurization of the pipe. Such apparatus would not subject the pipe to any damage or otherwise cause weakness thereto.

SUMMARY OF THE INVENTION

[0009] In one aspect, the present invention generally provides an apparatus for sealing an open end of a pipe comprising:

[0010] - at least one generally annular shaped clamp for being frictionally secured to an outer surface of the pipe, adjacent and spaced from the open end thereof, the at least one clamp including a means for circumferentially gripping the outer surface of the pipe and preventing relative axial movement there-between;

[0011] - a sealing plate, adapted to cover the open end of the pipe, the sealing plate including a means for sealing the open end of the pipe;

[0012] - an urging means for urging the sealing plate axially towards the at least one clamp and against the open end of the pipe.

[0013] In another aspect, the invention provides an apparatus as above and wherein:

[0014] - the at least one clamp is comprised of at least two clamp sections, adapted to be joined together to form an annular body adapted to fit over the exterior surface of the pipe;

[0015] - each of the clamp sections including connecting flanges, provided at opposite ends of the sections, the flanges having a plurality of bolt holes;

[0016] - a plurality of second connecting elements for connecting flanges of adjacent clamp sections and for tightening each clamp section towards adjacent clamp sections for forming said annular shaped clamp.

[0017] In another aspect, the invention provides an apparatus as above and wherein the at least one clamp includes:

[0018] - a generally annular body having an inner diameter surface, at least a portion of the inner diameter surface including a first ramp extending from a first end to a second end of the annular body, the annular body having an inner diameter that is greater at the first end than at the second end;

[0019] - a generally annular gripper ring, coaxial with the annular body, the gripper ring being comprised of two or more sections, and having an inner surface with an inner diameter for engaging the outer surface of the pipe, and an outer surface, at least a portion of the outer surface of the gripper ring including a second ramp, the second ramp extending from a first end of the gripper ring to a second end of the gripper ring, the second ramp being oppositely directed to the first ramp, wherein the second end of the gripper ring is insertable

within an annular space between the first end of the annular body and the outer wall of the pipe; and,

[0020] - a means for urging the gripper ring and the main body towards each other for forcing the second ramp under the first ramp, whereby, when the apparatus is in use, the first ramp bears against the second ramp wherein the inner diameter of the gripper ring is reduced resulting in a frictional engagement between the gripper ring and the outer surface of the pipe.

[0021] In another aspect, the invention provides a method for sealing a section of a pipe having an open end, the method comprising:

[0022] - positioning at least one external clamp circumferentially over the outer surface of the pipe at a location spaced away from the open end, the at least one clamp being frictionally secured to the pipe surface so as to prevent relative axial movement between the clamp and the pipe;

[0023] - positioning a sealing plate against the open end of the pipe, for covering the open end, the sealing plate including a groove adapted to receive the open end of the pipe;

[0024] - connecting the sealing plate to at least one of the at least one clamps;

[0025] - forcing the sealing plate axially towards the at least one clamp and forming a seal between the open end of the pipe and the sealing plate.

[0026] In another aspect, the invention provides a method as above and wherein the at least one clamp comprises a generally annular body formed of at least two sections, and wherein the step of securing the external clamp circumferentially over the outer surface of the pipe comprises connecting the at least two sections together and tightening the sections to cause frictional engagement between the at least one clamp and the pipe outer surface.

[0027] In another aspect, the invention provides a method as above and wherein the at least one clamp comprises: a generally annular body having an inner surface, a portion of the inner surface comprising a first ramp; and, a generally annular gripping ring formed of at least two sections, said gripper ring including an outer surface, a portion of the outer surface comprising a second ramp; the method comprising:

[0028] - coaxially positioning the annular body and the gripper ring over a pipe such that the first and second ramps are oppositely oriented, wherein the second ramp of the

We Claim:

1. An apparatus for sealing an open end of a pipe comprising:

- at least one generally annular shaped clamp for being frictionally secured to an outer surface of the pipe, adjacent and spaced from the open end thereof, the at least one clamp including a means for circumferentially gripping the outer surface of the pipe and preventing relative axial movement there-between;

- a sealing plate, adapted to cover the open end of the pipe, the sealing plate including a means for sealing the open end of the pipe;

- an urging means for urging the sealing plate axially towards the at least one clamp and against the open end of the pipe.

2. The apparatus of claim 1, wherein the sealing plate includes a groove for receiving the open end of the pipe, the groove including the sealing means for forming a seal between the groove and the open end of the pipe.

3. The apparatus of claim 1, wherein the urging means comprises a plurality of first connecting elements extending between the at least one clamp and the sealing plate, wherein said first connecting elements force the sealing plate towards the at least one clamp and against the open end of the pipe to form a sealing engagement between the sealing plate and the open end of the pipe.

4. The apparatus of claim 3, wherein:

- the at least one clamp includes a circumferential flange having a diameter greater than the pipe;

- the sealing plate includes a circumferential flange having a diameter greater than the pipe;

- and wherein the first connecting elements comprise sealing bolts with associated nuts, the circumferential flanges of the at least one clamp and the sealing plate including a plurality of bolt holes for receiving the sealing bolts.

5. The apparatus of claim 1, wherein;

- the at least one clamp is comprised of at least two clamp sections, adapted to be joined together to form an annular body adapted to fit over the exterior surface of the pipe;

- each of the clamp sections including connecting flanges, provided at opposite ends of the sections, the flanges having a plurality of bolt holes;

- a plurality of second connecting elements for connecting flanges of adjacent clamp sections and for tightening each clamp section towards adjacent clamp sections for forming said annular shaped clamp.

6. The apparatus of claim 5, wherein said clamp sections include a sealing flange, extending along at least a portion of the length thereof, wherein, when said clamp sections are assembled, said sealing flanges form a generally circumferential flange on the respective at least one clamp.

7. The apparatus of claim 6, wherein the urging means comprises a plurality of first connecting elements extending between the circumferential sealing flange of the at least one clamp and the sealing plate, wherein said first connecting elements force the sealing plate towards the sealing flange of the at least one clamp and against the open end of the pipe to form a sealing engagement between the sealing plate and the open end of the pipe.

8. The apparatus of claim 1 further comprising an internal reinforcement assembly for insertion within the pipe and for radially bracing the wall of the pipe.

9. The apparatus of claim 8, wherein the radial reinforcement assembly comprises a hub and a plurality of arms extending radially outwardly from the hub to the inner wall of the pipe, when said assembly is in use.

10. The apparatus of claim 9, wherein the length of said arms is adjustable.

11. The apparatus of claim 7 further comprising radial reinforcement assembly for insertion within the pipe and for bracing the wall of the pipe.

12. The apparatus of claim 11, wherein the radial reinforcement assembly comprises a hub and a plurality of arms extending radially outwardly from the hub to the inner wall of the pipe, when said assembly is in use.

13. The apparatus of claim 12, wherein the lengths of said arms are independently adjustable.

14. The apparatus of claim 1, wherein the sealing plate includes at least one port for connection to a pressurizing means, a monitoring means or a combination thereof, for pressurizing, venting or monitoring the interior of the pipe.

15. The apparatus of claim 1, wherein the at least one clamp includes:

- a generally annular body having an inner diameter surface, at least a portion of the inner diameter surface including a first ramp extending from a first end to a second end of the annular body, the annular body having an inner diameter that is greater at the first end than at the second end;

- a generally annular gripper ring, coaxial with the annular body, the gripper ring being comprised of two or more sections, and having an inner surface with an inner diameter for engaging the outer surface of the pipe, and an outer surface, at least a portion of the outer surface of the gripper ring including a second ramp, the second ramp extending from a first end of the gripper ring to a second end of the gripper ring, the second ramp being oppositely directed to the first ramp, wherein the second end of the gripper ring is insertable within an annular space between the first end of the annular body and the outer wall of the pipe; and,

- a means for urging the gripper ring and the main body towards each other for forcing the second ramp under the first ramp, whereby, when the apparatus is in use, the first ramp bears against the second ramp wherein the inner diameter of the gripper ring is reduced resulting in a frictional engagement between the gripper ring and the outer surface of the pipe.

16. The apparatus of claim 15, wherein the means for urging the gripper ring comprises a plurality of bolts provided on the annular body, said bolts being arranged to apply an axial force against the first end of the gripper ring.

17. The apparatus of claim 15, wherein the means for urging the gripper ring comprises:

- a generally annular clamping ring, coaxial with the annular body and the gripper ring, and, when the apparatus is in use, positioned adjacent to the first end of the gripper ring; and,

- a plurality of connecting elements extending between the annular body and the clamping ring for forcing the annular body and clamping ring towards each other, whereby

the first end of the gripper ring is pressed by clamping ring thereby forcing the second end of the gripper ring under the first end of the first ramp of the annular body.

18. The apparatus of claim 17, wherein a plurality of annular bodies is provided in association with a plurality of gripper rings.

19. The apparatus of claim 17, wherein the connecting elements comprise bolts and associated nuts, wherein tightening of the nuts forces the annular body and clamping ring towards each other.

20. The apparatus of claim 15, wherein the sealing plate includes at least one port for connection to a pressurizing means, a venting means, a monitoring means or a combination thereof, for pressurizing, venting or monitoring the interior of the pipe.

21. The apparatus of claim 15 further comprising an internal reinforcement assembly for insertion within the pipe and for radially bracing the wall of the pipe.

22. The apparatus of claim 21, wherein the radial reinforcement assembly comprises a hub and a plurality of arms extending radially outwardly from the hub to the inner wall of the pipe, when said assembly is in use.

23. The apparatus of claim 22, wherein the length of said arms is adjustable.

24. A method for sealing a section of a pipe having an open end, the method comprising:

- positioning at least one external clamp circumferentially over the outer surface of the pipe at a location spaced away from the open end, the at least one clamp being frictionally secured to the pipe surface so as to prevent relative axial movement between the clamp and the pipe;
- positioning a sealing plate against the open end of the pipe, for covering the open end, the sealing plate including a groove adapted to receive the open end of the pipe;
- connecting the sealing plate to at least one of the at least one clamps;
- forcing the sealing plate axially towards the at least one clamp and forming a seal between the open end of the pipe and the sealing plate.

25. The method of claim 24 further comprising pressurizing the interior of the pipe.

26. The method of claim 24 further comprising positioning a radial reinforcement assembly within the pipe, at a location corresponding to the at least one clamp, for radially supporting the wall of the pipe.

27. The method of claim 24, wherein the at least one clamp comprises a generally annular body formed of at least two sections, and wherein the step of securing the external clamp circumferentially over the outer surface of the pipe comprises connecting the at least two sections together and tightening the sections to cause frictional engagement between the at least one clamp and the pipe outer surface.

28. The method of claim 24, wherein the at least one clamp comprises: a generally annular body having an inner surface, a portion of the inner surface comprising a first ramp; and, a generally annular gripping ring formed of at least two sections, said gripper ring including an outer surface, a portion of the outer surface comprising a second ramp; the method comprising:

- coaxially positioning the annular body and the gripper ring over a pipe such that the first and second ramps are oppositely oriented, wherein the second ramp of the gripper ring is insertable between the first ramp of the annular body and the outer wall of the pipe;
- forcing the gripper ring against the annular body to cause radial compression of the gripper ring and frictional engagement of the gripper ring over the pipe outer surface; and,
- forming a sufficient clamping force between the gripper ring and the pipe surface to prevent relative axial movement between the at least one clamp and the pipe.

29. The method of claim 28, wherein the step of forcing the gripper ring comprises urging the gripper ring by a plurality of bolts connected to the annular body.

30. The method of claim 28, wherein the step of forcing the gripper ring comprises coaxially providing a generally annular clamping ring adjacent the gripper ring and opposite to the annular body, and urging the clamping ring against the gripper ring.

31. The method of claim 30 wherein the step of urging the clamping ring comprises tightening of connecting elements connected between the clamping ring and the annular body.

32. The method of claim 31 further comprising pressurizing the interior of the pipe.

33. The method of claim 31 further comprising positioning a radial reinforcement assembly within the pipe, at a location corresponding to the at least one clamp, for radially supporting the wall of the pipe.

[0005] The prior art provides various tools for conducting weld integrity tests on conduits. For example, U.S. Patent numbers 6,131,441 and 5,844,127 (the entire disclosures of which are incorporated herein by reference) teach weld testing tools that isolate a particular section of a pipe (such section including a weld) and subject the section to a high pressure fluid within a constrained annular space defined by the tool and the inner surface of the pipe. The pressure of the fluid within the annular space is monitored whereby any pressure drop signifies a leak in the weld.

[0006] US Patent number 6,463,791 (the entire disclosure of which is incorporated herein by reference) teaches an apparatus for testing welds used to secure nozzles. As shown in Figure 1 of this reference, the apparatus comprises a first seal plate that is placed on the inner surface of the vessel (for example) and a second seal plate that is secured to the outer, flange portion of the nozzle. In this manner, the nozzle volume is sealed and a pressurizing fluid is introduced therein. Once the volume is filled, the pressure is monitored as above and any leakage detected. Although this apparatus provides an accurate and efficient means of testing welds on nozzles, the size and weight of the apparatus makes it inconvenient for use on large nozzles.

[0007] Further, applicant's co-pending U.S. application, serial number 11/771,158 (publication number US 2008/0121044), provides tools for testing the integrity of welds on pipes and the like. The entire disclosure of such application is incorporated herein by reference.

[0008] There exists a need for more easily sealing a section of a long pipe for conducting the type of stress tests mentioned above. In addition, there exists a need for an apparatus that is capable of exerting axial stresses on welds during such testing so as to simulate a "worst case scenario". In particular, there is a need for an apparatus that can be easily mounted on an open end of a pipe so as to effectively seal the pipe opening and maintain such seal during high pressurization of the pipe. Such apparatus would not subject the pipe to any damage or otherwise cause weakness thereto.

SUMMARY OF THE INVENTION

[0008a] The invention is defined in the independent claims. Some optional features of the invention are defined in the dependent claims.

[0009] In one exemplary technique, there is provided an apparatus for sealing an open end of a pipe comprising:

[0010] - at least one generally annular shaped clamp for being frictionally secured to an outer surface of the pipe, adjacent and spaced from the open end thereof, the at least one clamp including a means for circumferentially gripping the outer surface of the pipe and preventing relative axial movement there-between;

[0011] - a sealing plate, adapted to cover the open end of the pipe, the sealing plate including a means for sealing the open end of the pipe;

[0012] - an urging means for urging the sealing plate axially towards the at least one clamp and against the open end of the pipe.

[0013] In another exemplary technique, there is provided an apparatus as above and wherein:

[0014] - the at least one clamp is comprised of at least two clamp sections, adapted to be joined together to form an annular body adapted to fit over the exterior surface of the pipe;

[0015] - each of the clamp sections including connecting flanges, provided at opposite ends of the sections, the flanges having a plurality of bolt holes;

[0016] - a plurality of second connecting elements for connecting flanges of adjacent clamp sections and for tightening each clamp section towards adjacent clamp sections for forming said annular shaped clamp.

[0017] In another exemplary technique, there is provided an apparatus as above and wherein the at least one clamp includes:

[0018] - a generally annular body having an inner diameter surface, at least a portion of the inner diameter surface including a first ramp extending from a first end to a second end of the annular body, the annular body having an inner diameter that is greater at the first end than at the second end;

[0019] - a generally annular gripper ring, coaxial with the annular body, the gripper ring being comprised of two or more sections, and having an inner surface with an inner diameter for engaging the outer surface of the pipe, and an outer surface, at least a portion of the outer surface of the gripper ring including a second ramp, the second ramp extending from a first end of the gripper ring to a second end of the gripper ring, the second ramp being oppositely directed to the first ramp, wherein the second end of the gripper ring is insertable

within an annular space between the first end of the annular body and the outer wall of the pipe; and,

[0020] - a means for urging the gripper ring and the main body towards each other for forcing the second ramp under the first ramp, whereby, when the apparatus is in use, the first ramp bears against the second ramp wherein the inner diameter of the gripper ring is reduced resulting in a frictional engagement between the gripper ring and the outer surface of the pipe.

[0021] In another exemplary technique, there is provided a method for sealing a section of a pipe having an open end, the method comprising:

[0022] - positioning at least one external clamp circumferentially over the outer surface of the pipe at a location spaced away from the open end, the at least one clamp being frictionally secured to the pipe surface so as to prevent relative axial movement between the clamp and the pipe;

[0023] - positioning a sealing plate against the open end of the pipe, for covering the open end, the sealing plate including a groove adapted to receive the open end of the pipe;

[0024] - connecting the sealing plate to at least one of the at least one clamps;

[0025] - forcing the sealing plate axially towards the at least one clamp and forming a seal between the open end of the pipe and the sealing plate.

[0026] In another exemplary technique, there is provided a method as above and wherein the at least one clamp comprises a generally annular body formed of at least two sections, and wherein the step of securing the external clamp circumferentially over the outer surface of the pipe comprises connecting the at least two sections together and tightening the sections to cause frictional engagement between the at least one clamp and the pipe outer surface.

[0027] In another exemplary technique, there is provided a method as above and wherein the at least one clamp comprises: a generally annular body having an inner surface, a portion of the inner surface comprising a first ramp; and, a generally annular gripping ring formed of at least two sections, said gripper ring including an outer surface, a portion of the outer surface comprising a second ramp; the method comprising:

[0028] - coaxially positioning the annular body and the gripper ring over a pipe such that the first and second ramps are oppositely oriented, wherein the second ramp of the

What is claimed is:

1. An apparatus for sealing an open end of a pipe comprising:

at least one generally annular shaped clamp having an inner diameter adapted to be provided over an outer surface of the pipe, the clamp including a means for circumferentially gripping the outer surface of the pipe and preventing relative axial movement there-between;

a sealing plate, adapted to cover and seal the open end of the pipe;

an urging means for urging the sealing plate axially towards the clamp and against the open end of the pipe when said apparatus is in use;

the clamp comprising at least two clamp sections adapted to be joined together;

each of the clamp sections including connecting flanges, provided at opposite ends of respective clamp sections;

a plurality of first connecting elements for connecting the opposed flanges of adjacent clamp sections, when the apparatus is in use, and for tightening adjacent clamp section together;

each of the clamp sections including a sealing flange extending along at least a portion of the length thereof, wherein, when said clamp sections are assembled, said sealing flanges form a generally circumferential flange on the clamp.

2. The apparatus of claim 1, wherein the sealing plate includes a groove for receiving the open end of the pipe, the groove including a sealing means for forming a seal between the groove and the open end of the pipe.

3. The apparatus of claim 1, wherein the urging means comprises a plurality of second connecting elements extending between the generally circumferential flange of the clamp and the sealing plate, wherein, when said apparatus is in use, said second connecting elements are adapted to force the sealing plate in a direction towards the generally circumferential flange and against the open end of the pipe to form a sealing engagement between the sealing plate and the open end of the pipe.

4. The apparatus of claim 1 further comprising an internal reinforcement assembly for insertion within the pipe and for radially bracing the wall of the pipe.

5. The apparatus of claim 4, wherein the radial reinforcement assembly comprises a hub and a plurality of arms extending radially outwardly from the hub to the inner surface of the pipe wall, when said assembly is in use.

6. The apparatus of claim 5, wherein the length of each of said arms is adjustable.

7. The apparatus of claim 1, wherein the sealing plate includes at least one port for connection to a pressurizing means, a monitoring means or a combination thereof, for pressurizing, venting or monitoring the interior of the pipe.

8. The apparatus of claim 1, wherein the clamp includes:

a generally annular body having an inner diameter surface, at least a portion of the inner diameter surface including a first ramp extending from a first end to a second end of the annular body, the annular body having an inner diameter that is greater at the first end than at the second end;

a generally annular gripper ring, coaxial with the annular body, the gripper ring being comprised of two or more sections, and having an inner surface with an inner diameter for engaging the outer surface of the pipe, and an outer surface, at least a portion of the outer surface of the gripper ring including a second ramp, the second ramp extending from a first end of the gripper ring to a second end of the gripper ring, the second ramp being oppositely directed to the first ramp, wherein the second end of the gripper ring is insertable within an annular space between the first end of the annular body and the outer wall of the pipe; and,

a means for urging the gripper ring and the annular body towards each other for forcing the second ramp under the first ramp, whereby, when the apparatus is in use, the first ramp bears against the second ramp wherein the inner diameter of the gripper ring is reduced resulting in a frictional engagement between the gripper ring and the outer surface of the pipe.

9. The apparatus of claim 8, wherein the means for urging the gripper ring comprises a plurality of bolts provided on the annular body, said bolts being arranged to apply an axial force against the first end of the gripper ring.

10. The apparatus of claim 8, wherein the sealing plate includes at least one port for connection to a pressurizing means, a venting means, a monitoring means or a combination thereof, for pressurizing, venting or monitoring the interior of the pipe.

11. The apparatus of claim 8 further comprising an internal reinforcement assembly for insertion within the pipe and for radially bracing the wall of the pipe.

12. The apparatus of claim 11, wherein the radial reinforcement assembly comprises a hub and a plurality of arms extending radially outwardly from the hub to the inner surface of the pipe wall, when said assembly is in use.

13. The apparatus of claim 12, wherein the length of each of said arms is adjustable.

14. A method for sealing a section of a pipe having an open end, the method comprising:

securing at least one external clamp circumferentially over the outer surface of the pipe at a location spaced away from the open end, the clamp being frictionally secured to the pipe surface so as to prevent relative axial movement between the clamp and the pipe;

positioning a sealing plate against the open end of the pipe, for covering and sealing the open end of the pipe;

connecting the sealing plate to the clamp;

forcing the sealing plate axially towards the clamp and forming a seal between the open end of the pipe and the sealing plate;

wherein the clamp comprises a generally annular body formed of at least two sections, and wherein the step of securing the clamp over the outer surface of the pipe comprises connecting and tightening the at least two sections together to cause frictional engagement between the clamp and outer surface of the pipe.

15. The method of claim 14 further comprising pressurizing the interior of the pipe.

16. The method of claim 14 further comprising positioning a radial reinforcement assembly within the pipe, at a location corresponding to the clamp, for radially supporting the wall of the pipe.

17. The method of claim 14, wherein the clamp comprises: a generally annular body having an inner surface, a portion of the inner surface comprising a first ramp; and, a generally annular gripping ring formed of at least two sections, said gripper ring including an outer surface, a portion of the outer surface comprising a second ramp; the method comprising:

coaxially positioning the annular body and the gripper ring over a pipe such that the first and second ramps are oppositely oriented, wherein the second ramp of the gripper ring is insertable between the first ramp of the annular body and the outer wall of the pipe;

forcing the gripper ring against the annular body to cause radial compression of the gripper ring and frictional engagement of the gripper ring over the pipe outer surface; and,

forming a clamping force between the gripper ring and the pipe surface to prevent relative axial movement between the clamp and the pipe.

18. The method of claim 17, wherein the step of forcing the gripper ring comprises urging the gripper ring by a plurality of bolts connected to the annular body.