

INTERNAL RESTRAINT DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority from US application number 61/092,715, filed August 28, 2008, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to clamping or restraining devices that are capable of being anchored or clamped within the interior of pipes.

BACKGROUND OF THE INVENTION

[0003] It is common for testing tools to be utilized for testing the integrity of pipes or welds provided on pipes. In addition, various isolation tools are known, which are used to isolate a particular section of a pipe from another. Examples of such tools are provided in U.S. Patent Numbers 5,844,127 and 6,131,441 (the entire contents of these patents being incorporated herein by reference). In use, tools such as these are inserted within a pipe and anchored against the interior wall of the pipe. With the tools of the aforementioned patents, the anchoring step is achieved by means of bolts and the like that deform resilient annular rings such that the rings deform radially outwardly against the pipe wall. The tools, once positioned and anchored are able to withstand a high degree of displacement pressure.

[0004] Notwithstanding the anchoring force provided by the aforementioned tools themselves, it may be advisable to provide, for additional safety, a further clamp or restraint device within the pipe to restrain the tool in the event that pressure is built up adjacent the tool. As will be understood by persons skilled in the art, in situations where the pressure exceeds the anchoring force of the tool, the tool may be violently ejected from the pipe. Thus, a restraint device would offer an additional support in such circumstances.

[0005] It is also known in the art to provide internal clamps to maintain two pipes in axial alignment while welding such pipes together. Examples of such internal clamps are provided in U.S. Patent Numbers: 4,463,938; 5,816,475; and 5,875,955 (the entire contents of these patents being incorporated herein by reference). The devices described in these patents comprise complex mechanical mechanisms that are designed to be anchored

1 against the interior walls of adjacent pipes so as to hold such pipes in abutting arrangement.
2 A welding process can then be applied to join the pipe ends together.

3 **[0006]** Another issue faced with known internal clamping devices is that they often result
4 in damage to the internal wall of the pipe in which they are used. That is, many of the known
5 clamps utilize shoes that are biased against the internal pipe wall and which are provided
6 with teeth to engage such wall. The teeth provide an added anchoring force to prevent
7 translational movement of the device within the pipe. However, as will be understood, once
8 the device is removed, the marks left by such teeth would result in damage to the pipe
9 interior and in some cases lead to a region of weakness.

10 **[0007]** The devices known in the art comprise either cumbersome and/or complex
11 mechanisms or are not easily adaptable for use with testing or isolation tools or result in
12 damage to the pipe. Thus, there exists a need for an improved internal pipe clamp or
13 restraint device.

14 **SUMMARY OF THE INVENTION**

15 **[0008]** In one aspect, the present invention provides a restraint device that is adapted to
16 be anchored within the interior of a pipe.

17 **[0009]** In one aspect, the invention provides a restraint device for anchoring within a
18 pipe having an inner diameter, the device comprising:

19 **[0010]** - first and second end plates, said end plates being adapted to be coaxially
20 aligned when in use;

21 **[0011]** - urging means provided on one or both end plates for urging said end plates
22 together;

23 **[0012]** - a plurality of shoes provided between the end plates;

24 **[0013]** - the shoes being adapted to be moved radially outwardly as the end plates
25 are urged together.

26 **[0014]** In another aspect, the invention provides a restraint system comprising one or
27 more of the devices of the invention wherein the one or more devices are positioned within a
28 pipe adjacent to a pipe plug or isolation tool.

1 **[0015]** In another aspect, the invention provides a method of restraining a pipe plug or
2 isolation tool comprising: securing the pipe plug or isolation tool within a pipe at a desired
3 position; and securing a restraint device as described hereinabove within the pipe adjacent to
4 said plug or tool.

5 **[0016]** In a further aspect, the invention provides an assembly for isolating an internal
6 segment of a pipe, the assembly comprising:

7 **[0017]** - a shaft having a first end and a second end;

8 **[0018]** - a first boss connected to the first end of the shaft;

9 **[0019]** - a sleeve slidably and coaxially provided over the shaft, the sleeve having a first
10 end and a second end, wherein the first end of the sleeve is directed to the first end of the
11 shaft;

12 **[0020]** - a second boss secured to the first end of the sleeve;

13 **[0021]** - first and second annular bodies provided between the first and second bosses,
14 the first annular body positioned adjacent the first boss and the second annular body
15 positioned adjacent the second boss;

16 **[0022]** - a first resilient sealing member positioned between the first boss and the first
17 annular body and a second resilient sealing member positioned between the second boss and
18 the second annular body;

19 **[0023]** - a plurality of shoes provided between the first and second annular bodies, the
20 shoes being adapted to be urged radially outwards when the device is in use;

21 **[0024]** - a nut, provided at the second end of the shaft for urging the sleeve towards the
22 first end of the shaft.

23 **[0025]** In another aspect, the invention provides an assembly for isolating an internal
24 segment of a pipe, the assembly comprising:

25 **[0026]** - a first boss and a second boss;

26 **[0027]** - an annular body provided between the first and second bosses;

27 - a first and second resilient sealing members positioned on opposite ends of the
28 annular body and between the respective first or second boss;

1 [0029] - a plurality of tie rods extending from the first boss towards the second boss,
2 the tie rods being adapted to extend through the inner diameter of the annular body and
3 through a plurality of bolt holes provided on said second boss;

4 [0030] - a plate provided adjacent the second boss on a side opposite to the annular
5 body, the plate including a plurality of bolt holes through which the tie rods are extendable;

6 [0031] - a plurality of shoes provided between the second boss and the plate; and,

7 [0032] - a plurality of first nuts provided for engaging the tie rods on a side of the
8 plate opposite the shoes for urging the plate in a direction towards the first boss.

9 BRIEF DESCRIPTION OF THE DRAWINGS

10 [0033] These and other features of the invention will become more apparent in the
11 following detailed description in which reference is made to the appended drawings wherein:

12 [0034] Figure 1 is a cross sectional view of a restraint device according to an aspect of
13 the invention positioned within a pipe.

14 [0035] Figure 2 is an end view of the device of Figure 1 taken along the line 2-2.

15 [0036] Figure 3 is a cross sectional view of a restraint device according to an aspect of
16 the invention positioned within a pipe and shown in use with an isolation tool as known in the
17 art.

18 [0037] Figure 4 is a cross sectional view of two restraint devices of Figure 1 in tandem
19 use within a pipe.

20 [0038] Figure 5 is a cross sectional view of a restraint device according to another
21 aspect of the invention positioned within a pipe.

22 [0039] Figure 6 is an end view of the device of Figure 5 taken along the line 6-6.

23 [0040] Figure 7 is a cross sectional view of a restraint device according to an aspect of
24 the invention positioned within a pipe and shown in use with a pipe plug as known in the art.

25 [0041] Figures 8 and 9 are partial cross sectional views of another embodiment of the
26 invention incorporating pipe isolation and gripping mechanisms.

1 **[0042]** Figures 10 and 13 are partial cross sectional views of another embodiment of the
2 invention incorporating pipe isolation and gripping mechanisms.

3 **[0043]** Figure 11 is an exploded view of the device of Figure 10.

4 **[0044]** Figure 12 is an end view of the device of Figure 10 taken along the line 12-12.

5 DETAILED DESCRIPTION OF THE INVENTION

6 **[0045]** As used herein, the terms “clamp” or “restraint device” or “restraining device” will
7 be understood to have the same meaning. That is, these terms will be used to refer to the
8 present invention, which is adaptable to be inserted within a pipe and to be frictionally
9 anchoring there-within, against the internal wall of such pipe. The invention will be described
10 with reference to various aspects thereof. It will be understood that a number of
11 modifications of the device will be possible in relation to the size of the device, which, in turn,
12 relates to the size of the pipe in which the device is to be used.

13 **[0046]** One aspect of the present invention is illustrated in Figure 1. As shown, the
14 device 10 of the invention is provided within a pipe 12. The device 10 is shown in the
15 engaged position wherein the device 10 is anchored against the interior wall of the pipe.
16 The device comprises first and second, generally circular end plates 14 and 16, respectively.
17 When the device is in use, as shown in Figure 1, the end plates 14 and 16 are arranged in
18 coaxial alignment with the longitudinal axis of the pipe 12. The end plates 14 and 16 have
19 internal faces 18a and 18b, respectively, that face each other, and oppositely directed
20 external faces 20a and 20b, respectively. The end plates 14 and 16 are provided with outer
21 edges 22a and 22b, respectively. The outer edges 22a and 22b are generally circular in end
22 view (such as shown in Figure 2). As illustrated in Figure 1, the diameter of the internal
23 faces 18a and 18b is less than the diameter of the outer faces 20a and 20b. This is
24 achieved by providing each of the outer edges 22a and 22b with a bevel, 21a and 21b,
25 respectively, which extends from or near the external faces 20a and 20b towards the internal
26 faces 18a and 18b, respectively.

27 **[0047]** As will be understood, and as shown in Figure 1, the end plates 14 and 16 of the
28 device 10, are sized so as to be slidably introduced into a pipe 12 to be tested. That is, the
29 maximum diameter of the end plates is less than the inner diameter of the pipe 12.

30 **[0048]** The device 10 of the invention further includes a plurality of circumferentially
31 spaced shoes or “gripper plates” 24. In the embodiment of the invention illustrated in

Figures 1 and 2, six such shoes, 24a to 24f, are shown. However, it will be understood by persons skilled in the art that any number of such shoes may be provided and that such number may relate to the size of the shoes and the size of the circumference of the device itself. For example, in some cases, two or three shoes or gripper plates may be used depending on the need. For example, as will be appreciated, larger diameter devices may require a larger number of shoes as compared to smaller diameter devices. It will also be understood that in such larger diameter devices, the same number shoes may be used although of larger sizes. It will be understood that the invention is not limited to any number of shoes.

[0049] As shown in Figures 1 and 2, the shoes 24 are generally curved structures having an outer surface 26 that is adapted for abutting against the interior wall of the pipe 12 and an oppositely directed inner surface 28, directed towards the interior of the pipe 12. The shoes 24 also include opposite lateral edges 30 that comprise bevels and which are complementary to, or adapted to cooperate with, the bevels 21a and 21b provided on the end plates 14 and 16. The beveled edges 30 on the shoes result in the outer surface 26 having a greater width (i.e. the measurement from one edge to the opposite edge measured along the longitudinal axis of the device when in use) than the inner surface 28.

[0050] In one aspect, the outer surface 26 of the shoes 24 may be provided with grooves 32 as shown in Figure 1. As will be appreciated by persons skilled in the art, such grooves 32 would serve to assist the frictional engagement of the device against the pipe inner wall as described further below. As will also be appreciated by persons skilled in the art upon reviewing the present description, the outer surface 26 of the shoes 24 may be provided with any type of coating, additive, covering etc. that would assist in reinforcing the frictional engagement of the shoes with the pipe internal wall when the device is in use and engaged within a pipe. In one example, some or all of the aforementioned grooves 32 may be provided with an O-ring or other type of device or material. In addition, it will be understood that the degree of frictional contact can also be increased by increasing the surface area of the outer surfaces 26 of the shoes 24.

[0051] The shoes or gripper plates 24 may be made of any material. In one example, the shoes 24 are made of aluminum in order to reduce the weight of the device. The plates 14 and 16 may preferably be formed of a stronger material. The use of aluminum as the material for forming the shoes 24 is also preferred as the shoes would minimize the marking or damage to the inner wall of the tube 12. The invention will be understood to encompass various materials for forming the shoes 24 and/or the plates 14 and 16. For example, if the

1 restraint device is to be used in plastic pipes, lighter materials may be used as the amount of
2 anchoring force involved would generally be less than those encountered with metal pipes.
3 Thus, for example, when the restraint device 10 is used with plastic pipes, the entire device
4 may be formed of aluminum.

5 **[0052]** As shown in Figures 1 and 2, the device 10 further includes a plurality of bolts 34.
6 In one aspect, the bolts 34 are generally circumferentially spaced around the circumference
7 of the device (e.g. around the end plate 16). The bolts are provided through bolt holes 36
8 provided in the second end plate 16 and extend through to a threaded apertures 38 provided
9 in the first end plate 14. In the embodiment shown, the apertures 38 include threading that
10 is complementary to threading provided on the bolts 34 whereby the bolts 34 can be
11 tightened by engaging the apertures 38. It will be understood that the threading in apertures
12 38 can be replaced by using a fixed nut (not shown) on the opposite face 20a of the plate 14.
13 In another embodiment, the bolts 34 can be replaced with threaded shafts (not shown),
14 permanently fixed to the plate 14, with threaded ends of such shafts being inserted through
15 the boltholes on plate 16 and wherein separate nuts are used to engage the shafts. In either
16 of these examples, it will be understood that the purpose of the bolts is to urge the two plates
17 14 and 16 towards each other. Thus, the invention is not limited to any one means for
18 achieving this. In addition, it will be understood that a variety of such urging means may be
19 provided. As shown, the bolt holes 36 in the second end plate 16 may be include wells to
20 receive the heads of the bolts 34. In such case, the outer face 20b of the end plate 16 would
21 have a planar surface. As discussed further below, such planar surface may be preferred
22 where a testing or isolation tool is to be abutted there-against.

23 **[0053]** A method of using the device will now be discussed in relation to the aspect of
24 the invention illustrated in Figures 1 and 2. In use, the components of the device, namely,
25 the end plates 14 and 16, the shoes 24 and the bolts 34 may be inserted into the pipe
26 individually and joined later. In a preferred aspect, however, such components are first
27 loosely combined or joined outside of the pipe. In such arrangement, the end plates 14 and
28 16 are relatively spaced away from each other. As will be understood, in such loose
29 arrangement, the shoes 24 are moveable radially so that the maximum outer diameter of the
30 device 10 is less than the inner diameter of the pipe 12. In this way, the device 10 can be
31 slidably introduced into the pipe 12 and positioned at a desired location therein. Once in
32 position, the bolts 34 are tightened, whereby the end plates 14 and 16 are urged towards
33 each other. As will be understood and as shown in Figure 1, this process causes the shoes
34 24 to be forced radially outwardly from the device 10 and towards the inner surface of the
35 pipe 12. Such radial outward force is attributed to the cooperating and oppositely directed

1 bevels on the end plates and the shoes. As will be understood, as the plates 14 and 16 are
2 urged towards each other, the respective beveled edges 21a, 21b of the plates bear against
3 the opposing beveled edges 30 of the shoes 24a-d. Due to opposed orientation of the
4 bevels, urging of the plates 14 and 16 towards each other (achieved by tightening the bolts
5 34) causes the shoes 24a-d to be urged radially outward. As the bolts 34 are further
6 tightened, the shoes are tightly biased against the pipe inner wall thereby forming a tight
7 frictional contact there-between.

8 **[0054]** In a preferred embodiment of the invention, the bolts 34 are provided in a
9 generally equal, circumferentially spaced manner about the plates 14, 16. This arrangement
10 serves to evenly distribute the urging force applied to the end plates 14 and 16 and, thereby,
11 resulting in the shoes being evenly displaced in a radially outward direction. In a further
12 preferred embodiment of the method of the invention, the bolts 34 are tightened in
13 circumferentially opposite pairs so as to achieve an even circumferential distribution of
14 forces applied to the end plates. In this way, the plates 14 and 16 are urged together evenly
15 thereby preventing one or both plates from "tilting" within the pipe. That is, the plates 14 and
16 16 are maintained in a generally perpendicular arrangement with respect to the longitudinal
17 axis of the pipe 12. It will be understood that this arrangement is not a limitation of the
18 invention but merely a preference. It will also be understood that at least some deviation
19 from a true perpendicular arrangement will occur.

20 **[0055]** As will be understood, the bolts 34 provide a means for urging the plates 14 and
21 16 towards each other. It will therefore be appreciated that while the bolts 34 provide a
22 simple and effective embodiment for such urging means, the invention is not limited by this
23 one embodiment. For example, in another embodiment, the bolts 34 may be replaced with
24 hydraulic or pneumatic devices that also serve the same purpose. In one example, hydraulic
25 rams or jacks can be used to force the plates together. In another example, the plates can
26 be urged together using magnetic devices. In the latter instance, one or both of the plates
27 14, 16 can be provided with a magnetic device, such as an electromagnet, which can be
28 actuated when the device 10 is in position. Such magnetic devices (not shown) will cause
29 the plates 14 and 16 to be forced together in the same manner as the bolts 34. In a further
30 embodiment, a threaded rod or shaft may be affixed to one of the end plates, such as the
31 first end plate, and such rods may extend through and beyond the second end plate.
32 Cooperating nuts, with or without a bearing plate, may then be used to urge the end plates
33 together. The invention is not limited to the specific urging means disclosed herein. The
34 characteristic of such urging means is the ability to cause the plates 14 and 16, or opposite

ends of the device 10, to be urged together and, thereby, to cause radially outward displacement of the shoes or gripper plates 24.

[0056] Figure 1 illustrates the first end plate 14 as having a generally annular ring shape. That is, the first end plate 14 includes a central opening 31. In a similar manner, the second end plate 16 may also be provided in the form of an annular ring. As will be understood, the use of such rings would reduce the overall weight of the device, which would be particularly desirable where the device 10 is designed for use with pipes of large diameter.

[0057] As shown in Figure 2, one or both of the end plates, 14 and 16, may be provided with one or more slots 40 adapted to receive and retain bolts provided on a testing or isolation tool or the like. In one aspect, the slots 40 are provided with a keyhole shape whereby the head of one or more bolts (not shown) may be inserted into a larger portion of the slot 40 and, once circumferentially rotated about the axis of the device 10, the head is received within the smaller portion of the slot 40. In this manner, the bolts are retained within the slot 40 and prevented from being axially separated therefrom. Thus, any tool or other such apparatus attached to the bolts is prevented from being axially separated from the restraint device. As will be understood, this type of engagement is common and various modifications of same will be apparent to persons skilled in the art. It will also be understood that such linking of the restraint device to other apparatus is only one aspect of the invention and that the invention is not limited so any such linked arrangement.

[0058] Figure 3 illustrates the restraint device 10 according to one use. As shown, the restraint device 10 is positioned within a pipe 12 and anchored thereto in the manner described above. By way of example, a testing or isolation tool such as that taught in U.S. Patent No. 6,131,441 (the entire contents of which are incorporated herein by reference), is shown at 50. In the example illustrated in Figure 3, the tool 50 is used to isolate an internal section of the pipe 12 from an end 52 thereof, to which a flange 54 is being attached by welding 57. It will be understood that it may be desired or necessary to isolate a given section or segment of a pipe for any variety of other reasons. Primarily, isolation tools such as that shown at 50 can be used to prevent fumes, combustible vapors etc. contained or generated within the pipe 12 from reaching the welding region where the heat from the welding procedure may result in ignition of such fumes and cause an explosion. In another aspect, an isolation tool 50 may also or alternatively be used to prevent heat generated by the welding process from being conducted over the length of the pipe 12. For example, as taught in US 6,131,441, the isolation tool may be provided with a cooling water flow to act as a thermal barrier. In order to increase safety to operators, personnel and surrounding

equipment, the restraint device 10 may be used with such testing or isolation tools in order to provide an anchor within the pipe to maintain such testing or isolation tool in place. For example, in some cases, during use of a testing or isolation tool 50, fumes within the pipe 12 may become pressurized to a dangerous level and, for this reason, the restraint device 10 of the invention may be provided as a further anchor or restraint for the tool 50. In other words, the device 10 serves to restrain the tool 50 from being axially displaced within the pipe.

[0059] It will be understood that the restraint device 10 of the invention can be used with any type of isolation or testing tool as would be known to persons skilled in the art. The examples herein, depicting specific tools (such as the tool of US 6,131,441), are provided solely for the purpose of illustrating how the invention may be used. The apparatus of method of the invention is not restricted to any isolation or testing tool. Clearly, as will be understood, the present invention serves in one aspect to provide added safety where such testing or isolation tools are used.

[0060] As will be understood, providing the restraint device upstream (i.e. opposite to the pipe opening) of the testing or isolation tool 50, serves to prevent axial displacement of the tool 50 in the upstream direction. In some cases, the testing or isolation tool 50 may be connected to the restraint device 10 thereby preventing axial movement of the tool 50 in the downstream direction as well. For example, in one aspect, as shown in Figure 3, the testing or isolation tool 50 may be provided with a locking plate 56 extending from the tool toward the interior of the pipe. The locking plate may be provided with axially extending bolts 51, the heads 53 of which can be received and locked within the aforementioned slots 40 provided on the end plate of the device 10. As discussed previously, in this arrangement, the tool 50 and the restraint device 10 are linked or locked together thereby preventing axial separation. As discussed above, the linking of the bolt heads 53 into the slots 40 is accomplished by first positioning and securing the restraint device 10 within the pipe, followed by insertion of the tool 50 having the locking plate 56 attached thereto. The bolt heads 53 of the locking plate 56 are then inserted into the wide portions of the slots 40 and the tool 50 and locking plate 56 are rotated circumferentially in order to cause the bolts 51 to be received within the narrow portions of the slots 40 thereby locking the tool 50 to the restraint device 10. At this point, the testing or isolation tool 50 can then be secured to the pipe in the usual manner. It will be appreciated that any other means can be used to secure the tool 50 to the restraint device 10. For example, the two devices may simply be connected together by chains, hooks, cables and the like. In either case, it will be understood that such connection means serves to prevent axial separation of the tool 50 and the restraint device 10 when both are installed within a pipe 12.

1 **[0061]** Figure 4 illustrates a further aspect of the invention wherein two devices 10 and
2 110 are utilized in tandem. For convenience, elements of the device 110 that are common
3 with device 10 are identified with the prefix "1". Thus, as shown both the devices 10 and 110
4 include first end plates 14 and 114, respectively, and second end plates 16 and 116,
5 respectively. As will be understood, the use of two restraint devices such as 10 and 110
6 doubles the anchoring force provided in the pipe 12. As discussed above, a similar result
7 may be achieved by using the device with shoes 24 of a larger width so as to increase the
8 contact surface area between the shoes and the pipe inner surface. However, the use of
9 two devices 10 and 110 would achieve the same result but with minimizing the weight for
10 each of the components. In other words, rather than having sets of large shoes, for
11 example, the use of two devices allows the use of more but smaller shoes. In using the
12 devices as shown in Figure 4, it will be easily understood that one of the device 10 will be
13 first installed within the pipe and, following this, the second device 110 will be similarly
14 installed. It will also be understood that any number of such devices can be used to provide
15 a cumulative anchoring force. It will further be understood that each of the device 10, 110
16 (or other number, if applicable) can each be of a different size.

17 **[0062]** Figures 5 and 6 illustrate the device of the invention according to another aspect.
18 In these figures, like elements are referred to with the reference numerals used above with
19 respect to Figure 1 but with the numeral "2" added as a prefix for clarity. As shown, the
20 device 210 is constructed essentially in the same manner as the device 10 described above.
21 However, as shown in Figure 5, the device 210 is provided with a boss 300 coaxially aligned
22 with the end plates 214 and 216 and positioned there between when the device 210 is in the
23 assembled state. In one example, as shown in Figure 5, the boss 300 comprises a generally
24 annular shaped body having an outer diameter that is less than the inner diameter of the
25 pipe 12 so that the boss 300, as with the end plates 214 and 216, can be coaxially aligned
26 within the interior of the pipe and slidably positioned at a desired location therein. The outer
27 end 302 of the boss 300, forming the larger diameter thereof, is provided with oppositely
28 directed beveled edges, 301 and 303, adjacent each face 297 and 299, respectively,
29 whereby the outer diameter of the boss 300 at its external faces is less than the diameter at
30 a central portion of the boss 300. As shown in Figure 5, the device 210 includes shoes 224
31 that are provided in pairs, wherein one of the pairs is identified with " ' ". Thus, a first pair of
32 shoes is shown at 224a and 224a' while a second pair of shoes is shown at 224d and 224d'.
33 The beveled edges 301 and 303 provided on the boss 300 are adapted to be
34 complementary to the bevels of the shoes provided on opposite sides of the boss 300. For
35 example, as shown in Figure 5, the bevels 301 and 303 of the boss 300 are adapted to be

1 complementary to the bevels 305 and 307, respectively. As shown, the bevel 305 is
2 provided on the shoe 224a while the bevel 307 is provided on the shoe 224a'. Each of
3 shoes 224a and 224a' etc., will be understood to have a further bevel on the edges opposite
4 to the boss 300, for engaging the respective end plates 214 and 216.

5 **[0063]** As will be understood, the restraint device 210 illustrated in Figures 5 and 6 will
6 be installed within the pipe 12 in a similar manner as described above. That is, the device
7 210 will include some means for urging the end plates 214 and 216 together. In one
8 embodiment, such means comprises bolts 234 that extend from one of the end plates (e.g.
9 216) to cooperatively threaded boltholes 238 provided the other of the end plates (e.g. 214).
10 As will be understood, as the bolts 234 are tightened, the plates 214 and 216 are urged
11 towards each other in the axial direction. To assist in this process, the bolts may be
12 tightened in a sequence wherein bolts that are circumferentially opposite one another are
13 tightened so as to prevent one plate from tilting within the pipe. As the bolts 234 are
14 tightened, the end plates 214 and 216 force the various shoes 224 and 224' to be urged
15 together and thereby "sandwiching" the boss 300. In this process, the oppositely directed
16 and complementary bevels described above cause the shoes 224 and 224' to be forced
17 radially outwardly and thereby against the inner wall of the pipe 12. Tightening of the bolts
18 234 may continue until the desired anchoring force is achieved between the restraint device
19 210 and the wall of the pipe 12. As discussed above, the use of bolts 234 as the urging
20 means is only one embodiment of the invention and various other such urging means may
21 be used such as hydraulic rams or jacks, magnetic devices etc.

22 **[0064]** As will be understood, the device 210 of Figure 5 serves to provide an added
23 anchoring force against the inner surface of the pipe by increasing, i.e. doubling, the contact
24 area of the shoes or gripper plates. Thus, the effective force offered by the "double" device
25 210 would be greater than that offered by the "single" device 10 shown in Figure 1. It will be
26 understood that various other modifications of the device of the invention may be possible to
27 achieve similar results. For example, it would be possible to provide a "triple" device.
28 Alternatively, any combination of the various forms of the invention described above may be
29 made depending upon the needed anchoring force.

30 **[0065]** In another aspect, not shown in the drawings, the device shown in Figure 5 may
31 be used in butt welding adjacent pipe segments together according to the methods
32 described in the patents mentioned above. For example, the restraint device 210 of Figure
33 5 may be provided at the junction of two pipes, wherein the device is positioned within the
34 interior of each pipe portion. It will be understood that the pipes would be axially aligned in

1 order to be welded together. The restraint device 210 would be positioned so as to allow the
2 joint between the pipes to lie over the boss 300. Once the restraint device 210 is in position,
3 the bolts 234 may be tightened so as to anchor the device 210 within each pipe segment.
4 Once the device 210 is so anchored, a welding operation may be performed to join the
5 abutting ends of the pipes together. In this example, the device 210 would therefore serve to
6 maintain the pipe segments in the desired orientation until the welding process is completed.
7 At such time, the device may be loosened and removed.

8 **[0066]** Figure 7 illustrates another use of the restraint device of the invention. As
9 shown, a restraint device 10 as described previously, is provided within a pipe 12. As
10 illustrated, the restraint device 10 includes the same structure as that shown in Figure 1,
11 comprising a pair of opposed end plates 14 and 16 with a plurality of shoes or gripper plates
12 24 provided there-between. An urging means, such as a plurality of bolts 34, serve to urge
13 the plates 14 and 16 axially towards each other. One aspect illustrated in Figure 7 is the
14 elongated versions of the shoes 24. As will be understood, and as discussed above, the
15 invention is not limited to any size of the elements of the device. In Figure 7, it will be seen
16 that, in order to accommodate the longer shoes or gripper plates 24, the bolts 34 are made
17 longer as well.

18 **[0067]** In a manner similar to that discussed above with respect to Figure 3, the restraint
19 device 10 shown in Figure 7 is used in combination with other pipe testing or isolation tools.
20 As shown, Figure 7 illustrates the use of the restraint device 10 with a pipe plug 51 as known
21 in the art. Such plug may, for example, be the same as the isolation tool described earlier.
22 The plug 51 may be any tool or device that is used to seal a portion of a pipe from the
23 remainder of the pipe. In the example shown in Figure 7, the plug 51 serves to seal off an
24 end portion of a pipe from the balance thereof. For this purpose, the plug 51 is inserted a
25 certain distance into the pipe and secured in place according to the appropriate protocol.
26 Such placement creates a sealed-off section 60 of the pipe 12. As shown, the pipe 12
27 includes a flange 62 as is typically the case. A blind flange 64 is then provide opposite the
28 flange 62 opening and secure thereto using bolts and the like as is commonly known. The
29 blind flange 64 is essentially a plate that is used to cover the flange 62 opening. As will be
30 known, gaskets etc. can be used to create a sealed volume 63 within the pipe 12 extending
31 from the blind flange 64 to the plug 51. The blind flange 64 preferably includes one or more
32 ports, such as ports 66a and 66b that extend through the blind flange 64 and into the sealed
33 volume 63. The ports are used to pressurize the sealed volume 63 whereby monitoring of
34 the pressure is conducted in order to assess the integrity of the weld 68 securing the flange
35 62 to the pipe 12. As will be understood, in conducting such a weld test, the pressure to

1 which the sealed volume 63 is subjected would generally be high. As such, the risk of axial
2 displacement of the plug 51 can be minimized by using the restraint device 10 as described
3 herein. As a further reinforcement, the plug 51 may be secured to the blind flange 64 using
4 a tether 69 or the like. In one example, the tether 69 comprises a chain attached to the blind
5 flange 64 and the plug 51. However, it will be understood that any other version of a tether
6 may be used. Due to the pressure created in the sealed volume 63, it will be understood
7 that the plug 51 will only be forced to move axially upstream within the pipe 12. For this
8 reason, the use of a locking plate as discussed with reference to Figure 3 would not be
9 necessary since the plug 51 would not be urged to move downstream of the restraint device
10 10.

11 **[0068]** A further aspect of the invention is shown in Figures 8 and 9, wherein a gripping
12 mechanism having the above described characteristics is combined with a testing or
13 isolation tool. As shown in Figure 8, a testing or isolation assembly 300 comprises a testing
14 or isolation tool 302. Hereinafter, these two terms will be referred to as "isolation assembly"
15 and "isolation tool" only for convenience. This use of nomenclature is not intended to limit
16 the invention in any way to one tool or another. The isolation assembly 300 also includes a
17 restraint mechanism 304 and the entire assembly is adapted for insertion within a pipe 12.
18 The isolation assembly comprises a shaft 306, the first or upstream end 305 of which is
19 connected to a first boss 308. The shaft 306 may be secured to the first boss 308 by any
20 known means such as welding, threading etc. A second boss 310 is slidably and coaxially
21 provided over the shaft 306 and positioned downstream, i.e. away from the first boss 308,
22 on the shaft 306. As will be understood, the first and second bosses 308, 310 have a
23 generally circular outer surface so as to allow insertion into a cylindrical pipe 12. In one
24 aspect, the bosses 308 and 310 are annular in shape. A sleeve 312 is then coaxially and
25 slidably provided over the shaft 306, wherein the sleeve 312 is provided downstream of the
26 second boss 310. In a preferred embodiment, as shown in Figure 8, the second boss 310 is
27 secured to the upstream end of the sleeve 312. In one embodiment, the boss 310 is
28 secured to the sleeve by welding. The isolation assembly further includes a nut 314
29 provided downstream of the sleeve 312. The nut is adapted to engage a second or
30 downstream end 307 of the shaft 306, which end is provided with threading that is
31 complementary to that on the nut 314. In one embodiment, a collar 315 may also be
32 provided between the nut 314 and the sleeve 312. It will be understood that the collar may
33 form part of the sleeve 312 itself.

34 **[0069]** The isolation assembly further includes two generally annular shaped bodies
35 comprising a first annular body 316 and a second annular body 318. The first annular body
36 316 is positioned adjacent the

1 first boss 308 and downstream thereof while the second annular body 318 is positioned
2 between the first annular body 316 and second boss 310. As shown in Figure 8, the annular
3 bodies 316 and 318 are slidably provided over the shaft 306.

4 **[0070]** The isolation assembly 300 further includes a pair of resilient sealing members
5 319 and 320 which may comprise, for example, O-rings. As shown in Figure 8, the first
6 sealing member 319 is provided coaxially and over the shaft 306 and positioned between the
7 first boss 308 and the first annular body 316. The second sealing member 320 is provided
8 coaxially over the shaft 306 and positioned between the first annular body 316 and the
9 second boss 310. The sealing members 319 and 320 are sized to have an outer diameter
10 that is less than the inner diameter of the pipe 12. However, the sealing members 319 and
11 320, due to their resilient nature, are designed or adapted to be expandable to be forced
12 against the inner wall of the pipe 12 when in use. This aspect is discussed further below.

13 **[0071]** As will be understood from the above description and Figure 8, as the nut 314 is
14 tightened over the shaft 306, the nut is forced to bear against the sleeve 312 whereby the
15 sleeve 312 is urged axially over the shaft 306 in the upstream direction. Due to its
16 connection to the sleeve 312, the second boss 310 is similarly urged in a direction towards
17 the first boss 308. As the bosses 308 and 310 are urged towards each other in this manner,
18 it will be understood that the elements positioned there-between, the sealing members 319
19 and 320 and the annular bodies 316 and 318, will also be urged together. Once the
20 individual elements of the assembly 300 are brought into contact, further tightening of the nut
21 314 results in compression and, therefore radially outward deformation of the resilient
22 sealing members 319 and 320. In particular, it will be noted that the first sealing member
23 319 is compressed between the first boss 308 and the first annular body 316 while the
24 second sealing member 320 is compressed between the second annular body 318 and the
25 second boss 310. The elements of the assembly 300 will be understood to be adapted so
26 as to allow the sealing members 319 and 320 to form a desired amount of sealing force
27 against the inner wall of the pipe 12 so as to prevent axial displacement of the assembly 300
28 within the pipe 12. As will be understood, the sealing members 319 and 320 create a
29 separation within the pipe separating the sections upstream and downstream of the
30 assembly 300. In a preferred embodiment, the first boss 308 may be provided with a central
31 aperture (not shown) opening into a bore (also not shown) provided axially through the shaft
32 306. In this way, any fumes etc. contained or built up in the upstream section of the pipe 12
33 may be safely vented through the assembly 300. Further, although not shown, the
34 downstream end 307 of the shaft 306 may include a gauge connected to the bore for
35 measuring the pressure of the upstream portion of the pipe 12. In this way, venting of any

fumes etc. would be allowed only when a critical pressure is reached. As will be understood this feature offers added safety to operators where the fumes are noxious. Additional details of the use of the isolation assembly 300, as described above, will be apparent to persons skilled in the art in view of applicant's previous patent number US 6,131,441.

[0072] The isolation assembly 300 may be adapted for creating a further seal using a pressurized fluid as also taught in US patent 6,131,441. In this regard, the sleeve 312 may be provided with one or more ports 321 and 322 that open into an annular space 324 formed between the outer wall of the shaft 306 and the inner wall of the sleeve 312. It will be understood that, for this purpose the shaft and sleeve will be sized accordingly to provide the required separation and volume of the annular space 324. The second boss 310 will also be provided with an inner diameter that allows the annular space 324 to be in fluid communication with the volume 323 within the pipe 12 constrained by the two bosses 308 and 310. In this arrangement, a pressurized fluid may be introduced into one of the ports 321 or 322 in order to fill the annular space 324 and the volume 323 between the bosses 308 and 310, when the assembly 300 is in use within a pipe 12. As will be appreciated, for this purpose, it is preferred to use two ports so as to allow venting of any air during the initial filling operation. In operation, the assembly 300 is positioned within the pipe 12 at a desired location and the sealing members 319 and 320 are deformed to form the required seals with the pipe 12. The volume 323 between the bosses is then filled with the fluid (as described previously) and the pressure therein raised to the required level. As will be understood, the pressurized fluid thereby forms a further seal to prevent passage of any fumes from one side of the assembly 300 to the other, when in use within the pipe 12. As known in the art, such as from US patent number 6,131,441, the pressurized volume 323 may also be used to pressure test a weld or other such feature on the pipe 12. In such case, the assembly 300 is positioned in the pipe with the section forming the volume 323 positioned in the region of the weld to be tested. Monitoring the pressure within the volume 323 provides an indication of any defects in the weld in the manner known in the art.

[0073] The restraint tool 304 of the isolation assembly 300 will now be discussed. As shown in Figure 8, the annular bodies 316 and 318 are preferably provided with beveled outer diameters 326 and 328, respectively. In this embodiment, the bevel 326 of the first annular body 316 is formed with a reducing outer diameter at the downstream end thereof, wherein the reduction in diameter increases in the downstream direction (i.e. the downstream end of the annular body 316 has the smallest outer diameter). The bevel 328 of the second annular body 318 is formed with a reducing diameter in the upstream direction (i.e. the upstream end of the annular body 318 has the smallest outer diameter). It will be

1 understood that end of the annular bodies 316 and 318 abutting the sealing members 319
2 and 320 will have a sufficient surface area to engage the sealing members. In this regard,
3 as shown in Figure 8, the ends of the annular bodies adjacent the sealing members may be
4 provided with at least a portion that is not beveled at its outer diameter.

5 **[0074]** The assembly 300 preferably further includes a plurality of shoes or gripper
6 plates 330 that are provided between the annular bodies 316 and 318. As discussed in the
7 foregoing disclosure, the shoes 330 are provided on the assembly in a manner that enables
8 them to be urged radially outwardly against the inner wall of the pipe 12. By urging the
9 shoes in this manner and to a desired force, causes the shoes to "grip" the inner wall of the
10 pipe 12. As will be understood from the embodiment illustrated in Figure 8, the shoes 330
11 are forced radially outwardly by virtue of the bevels 326 and 328. More particularly, as the
12 nut 314 is tightened, and the bosses 308 and 310 are urged towards each other, the annular
13 bodies 316 and 318 are similar urged towards each other as described above. In this
14 process, due to the orientation of the bevels 326 and 328, the shoes 330 are urged radially
15 outwardly and, thereby, forced against the inner wall of the pipe 12. To further assist in this
16 process, and as illustrated in Figure 8, the shoes 330 may be provided with cooperating
17 bevels on their radially inward surfaces, which engage the bevels 326 and 328 provided on
18 the annular bodies 316 and 318. As will be understood, any number of shoes or gripper
19 plates 330 may be provided depending on the need and weight restrictions etc. In other
20 words, more shoes may be included if more gripping force is required or if the size of the
21 shoes needs to be reduced to facilitate handling. In one example, three shoes may be
22 provided, each preferably being equidistantly spaced over the circumference of the
23 assembly 300.

24 **[0075]** In situations where the shoes or gripper plates 330 are used in combination with
25 the pressurization of the volume 323, it will be understood that the pressurizing fluid will also
26 assist in forcing the shoes radially outwardly.

27 **[0076]** In Figure 8, the angles of the bevels 326 and 328 are shown as being dissimilar.
28 Accordingly, the corresponding bevels on the shoes 330 are also dissimilar. It will be
29 understood that such arrangement is only one embodiment of the invention and is not a
30 limitation. The variable bevel angles results in different frictional forces to be applied by the
31 shoes 330. Thus, if one end of the shoes is required to be forced against the pipe wall to a
32 greater degree than the opposite end, a different "lift" angle can be used.

1 [0077] As also shown in Figure 8, the shoes or gripper plates 330 may be provided with
2 one or more circumferential grooves 332 within which sealing members such as O-rings 333
3 may be incorporated. As discussed previously, the provision of such sealing members
4 allows for additional gripping forces to be provided by the shoes.

5 [0078] Figure 9 illustrates the same assembly as in Figure 8 but with a few modifications
6 to illustrate some other possible embodiments. In Figure 9, elements that are identical with
7 those shown in Figure 8 are identified with like reference numerals. Elements that are
8 similar but different are identified with the same reference numerals but with the suffix "a".

9 [0079] As shown in Figure 9, the bosses 308a and 310a may be provided in one
10 embodiment with a beveled outer edge corresponding to the location of the respective
11 sealing members 319 and 320. In this manner, the sealing members are maintained in
12 position and are directed radially outwardly during deformation. It will be understood that
13 similar bevels may be provided on the outer edges of the annular bodies 316a and 318a.
14 Figure 9 also illustrates an embodiment wherein the bevels 326a and 328a provided on the
15 annular bodies 316a and 318a are of the same angle. In a further embodiment, Figure 9
16 illustrates shoes, or gripper plates, 330a lacking the cooperating beveled inner diameters
17 shown in Figure 8. In this case, the inner surfaces of the shoes 330a are generally flat as
18 with previously described embodiments. However, it will be understood that the function of
19 the shoes 330a will still be the same due to the bevels on the annular bodies.

20 [0080] Figures 10 to 13 illustrate a further embodiment of the invention that is suitable
21 for larger diameter pipes. In particular, Figures 10 to 13 illustrate a variation to the
22 combination testing/isolation and gripper assembly shown in Figures 8 and 9. As shown in
23 Figures 10 and 12, the assembly 400 includes a first, upstream boss 402 and a second,
24 downstream boss 404. As before, the terms "upstream" and "downstream" are used for
25 convenience, in terms of the assembly when installed in a pipe and in use. The assembly
26 400 further includes an annular body 406 positioned between the two bosses 402 and 404.
27 As illustrated in Figure 10, the bosses 402, 404 and the annular body 406 are axially aligned.
28 First and second resilient sealing members 408 and 410 are co-axially provided, wherein the
29 first sealing member 408 is provided between the first boss 402 and the annular body while
30 the second sealing member 410 is provided between the annular body 406 and the second
31 boss 404. In the embodiment shown in Figure 10, the opposite ends of the annular body
32 406 are each preferably provided, at the outer edges thereof, with a bevel for receiving the
33 respective resilient sealing member and for directing its deformation radially outwardly (as
34 discussed further below). In similar manner, bevels may be provided along the outer

1 circumferential edge of the respective bosses for achieving the same result. It will be
2 understood that such bevels can be provided on one or both of the opposing faces of the
3 bosses and annular body.

4 **[0081]** On the downstream side of the second boss 404 (i.e. the side opposite the
5 annular body), a plurality of shoes or gripper plates are provided. In the embodiment shown
6 in Figures 10 to 13, two shoes, 412 and 414 are shown. It will be understood that any
7 number of such shoes or gripper plates may be utilized. Downstream of the shoes 412 and
8 414, a front plate 416 is coaxially provided on the assembly 400. In one preferred
9 embodiment as illustrated in Figures 10 to 13, the shoes 412 and 414 are provided with
10 beveled inner diameters 418 and 420, respectively, wherein the thinner edges of the shoes
11 are facing downstream, away from the second boss 404. In addition, according to one
12 embodiment, the front plate 416 is provided with beveled outer diameter wherein the outer
13 diameter on the upstream side (i.e. adjacent the shoes 412 and 414) is the smallest. As
14 shown particularly in Figure 10, this arrangement of bevels on the shoes 412, 414 and the
15 front plate 416 preferably allows the front plate to slide over the downstream portions of the
16 shoes. In particular, as shown in Figure 10, the bevel of the front plate 416 is allowed to
17 pass over the beveled portions of the shoes 412, 414, whereby such portions of the shoes
18 are sandwiched between the outer diameter of the front plate 416 and the inner wall of the
19 pipe 12.

20 **[0082]** The first boss 402 is provided with a plurality of tie rods 422 that are generally
21 circumferentially equidistantly spaced. The tie rods 422 are sized and positioned to extend
22 through the inner diameters of the sealing members 408, 410, and the annular body 406.
23 The second boss 404 and the front plate 416 are provided with a plurality of bolt holes
24 adapted to receive the rods there-through. The downstream ends 424 of the rods 422 are
25 provided with threaded sections adapted to receive cooperating nuts 426.

26 **[0083]** Figure 13 illustrates a further embodiment where an additional set of nuts 427
27 are provided on the rods 422 wherein such nuts 427 are positioned to bear against the
28 second boss 404.

29 **[0084]** In operation, the assembly 400 is preferably pre-assembled in a loose manner
30 and inserted into the pipe 12. Once positioned in the desired location, the nuts 426 are
31 tightened, thereby urging all elements of the assembly together. In the result, the sealing
32 members 408 and 410 are deformed radially outwardly against the inner wall of the pipe 12.

1 In this regard, it will be appreciated that the additional nuts 427 as shown in Figure 13 would
2 be preferred in order to first establish the seals formed by sealing members 408 and 410.

3 **[0085]** As will be understood, tightening of the nuts 426 in either of the embodiments of
4 Figures 10 or 13, will result in the front plate 416 urging the shoes 412 and 414 radially
5 outward against the inner wall of the pipe 12. As discussed previously, such urging creates a
6 gripping force between the shoes 412, 414 and the pipe inner wall, thereby serving to anchor
7 the assembly 400 within the pipe.

8 **[0086]** The assembly 400 is also provided with at least one port, connected to the annular
9 body 406. In the preferred embodiment, as discussed previously, the assembly 400 is
10 provided with two ports shown as 428 and 430. The ports are fluidly connected to radially
11 extending openings 432, 433 through the annular body 406, as shown in Figure 11. The
12 annular body 406 is provided with at least one portion that is of smaller outer diameter than
13 the inner diameter of the pipe 12. In this way, when the assembly 400 is positioned and
14 secured in place, an annular space is created bounded by the two sealing members 408, 410,
15 the pipe inner wall, and the outer diameter of the annular body 406. Such annular space is
16 shown at 434 in Figures 10 and 14. As will be understood, in such arrangement, the ports 428
17 and 430 are fluidly connected to the annular space 434 via the openings 432 and 433,
18 respectively.

19 **[0087]** In operation, once at least the resilient sealing members 408 and 410 are secured
20 in place, and preferably after the shoes or gripping plates 412, 414 are also secured, a
21 pressurized fluid is introduced into one of the ports 428, 430. The other of the ports serves to
22 vent air during the filling process. Such fluid then enters and fills the annular space 434. The
23 pressure within the annular space 434 is then increased (by increasing the fluid pressure),
24 thereby creating a further seal within the pipe as discussed above.

25 **[0088]** In a preferred embodiment a vent is provided through the assembly 400 for the
26 same purpose as discussed above, namely to allow escape of any fumes etc. within the pipe
27 on the upstream side of the assembly 400. As shown in Figures 11 and 12, in order to
28 achieve such venting, the first boss 402 may be provided with an aperture 436, preferably at
29 an axial centre thereof. The second boss 404 and the front plate 416 are preferably of an
30 annular shape thereby avoiding the need for any vent hole etc. Although not shown, the
31 assembly 400 may include a vent pipe connected to the aperture 436 to direct any vented
32 gases, fumes etc. further downstream away from the assembly and any operators nearby.

1 As discussed above, a valve may also be provided on such vent pipe whereby any venting is
2 done only when the upstream pressure within the pipe 12 reaches a threshold value.

3 **[0089]** It will be understood that the "gripper" portion of the assembly 400 shown in
4 Figures 10 to 13 can be used with any known plug, testing or isolation tool known in the art.
5 In other words, since the "gripper" mechanism comprises the plurality of shoes or gripper
6 plates, 412, 414 and the front plate, which forms the urging means for forcing the shoes
7 against the pipe wall, these elements can be used in conjunction with, for example, the
8 isolation tools described in US patent numbers 5,884,127 and 6,131,441. In such case, all
9 that would be needed are the shoes 412, 414 and the front plate 416 and the nuts 426. This
10 feature of the invention can be seen in Figure 13. In this case, it can be observed that the
11 isolation tool is formed with the bosses 402, 404, the sealing members 408, 410, the annular
12 body 496 and the nuts 428. In such case, the gripper mechanism is formed by adding to
13 such isolation too, the shoes 412, 414, the front plate 416 and the nuts 426. In this way, the
14 gripper mechanism is "retrofitted" onto an existing isolation tool.

15 **[0090]** In a similar manner, the gripper mechanism can be incorporated onto any other
16 plug or isolation assembly. In cases where tie rods are not available for receiving the front
17 plate 416 and nuts 426, the necessary rods can be provided either temporarily or
18 permanently on the downstream part of the plug. For example, such rods can be welded to
19 the face of any known plug or isolation tool.

20 **[0091]** It will also be understood that apart from the above mentioned "retrofitting", it
21 would similarly be possible to utilize the restraint devices shown in, for example, Figures 1 to
22 7 to provide the required "gripping" feature.

23
24 **[0092]** Although the invention has been described with reference to certain specific
25 embodiments, various modifications thereof will be apparent to those skilled in the art
26 without departing from the purpose and scope of the invention as outlined in the claims
27 appended hereto. All examples provided herein are included solely for the purpose of
28 illustrating the invention and are not intended to limit the invention in any way. All drawings
29 provided herein are solely for the purpose of illustrating various aspects of the invention and
30 are not intended to be drawn to scale or to limit the invention in any way.

WE CLAIM:

1. A restraint device for anchoring within a pipe having an inner diameter, and adapted to frictionally engage the inner surface of the pipe, the device comprising:
 - first and second end plates, said end plates being adapted to be coaxially aligned when in use;
 - urging means provided on the end plates for urging said end plates together, wherein said urging means comprises a plurality of bolts extending between the end plates, said bolts being generally equally circumferentially spaced about the end plates;
 - a plurality of shoes provided between the end plates;
 - the shoes being adapted to be moved radially outwardly as the end plates are urged together; and
 - at least one annular boss positioned between the end plates and wherein said shoes are provided in two sets, with a first set of shoes being provided on one end of the annular boss and a second set of shoes being provided on an opposite end of the annular boss.
2. The device of claim 1 wherein the shoes comprise curved plates having an outer surface for engaging the inner wall of the pipe.
3. The device of claim 2 wherein the shoes are generally equidistantly circumferentially spaced on the device.
4. The device of claim 3 wherein opposed faces of first and second end plates include a beveled outer edge for engaging the plurality of shoes.
5. The device of claim 4 wherein the plurality of shoes have an inner surface directed radially away from said shoe outer surface and wherein said inner surface includes oppositely beveled edges to engage said beveled edges of the end plates.
6. The device according to any one of claims 1 to 5 wherein the first end plate comprises an annular body having a central opening.

7. The device according to any one of claims 1 to 6 wherein said bolts extend through openings provided in the second end plate and engage cooperatively threaded bores in the first end plate.
8. The device according to any one of claims 1 to 7 wherein said device is adapted to engage a pipe plug or isolation tool.
9. The device of claim 8 wherein said boss includes an outer diameter with oppositely directed bevels for engaging respective shoes.
10. The device of claim 8 or 9 wherein the plurality of bolts extend through openings provided in the boss.
11. A restraint system comprising one or more of the devices according to any one of claims 1 to 10, wherein said one or more devices are combined with one or more of a pipe plug or isolation tool.
12. A method of restraining a pipe plug or isolation tool comprising:
 - securing the pipe plug or isolation tool within a pipe at a desired position;
 - and securing a restraint device according to any one of claims 1 to 10 within the pipe adjacent to said plug or tool.
13. The method according claim 12 further comprising connecting said restraint device to the pipe plug or isolation tool.