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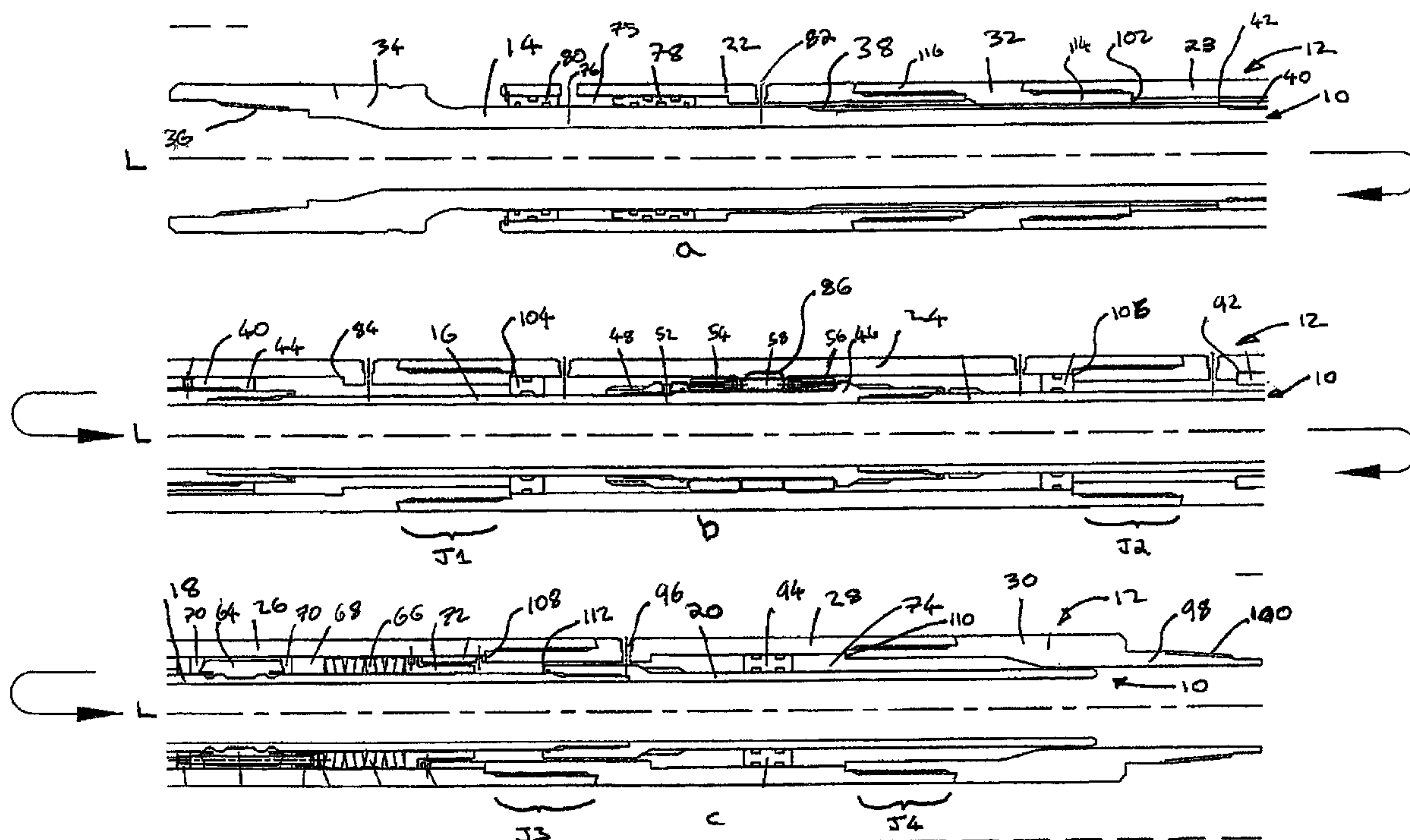
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(54) Titre : APPAREIL ET METHODE DE RACCORDEMENT

(54) Title: CONNECTION APPARATUS AND METHOD



(57) Abrégé/Abstract:

A connection apparatus adapted to allow connection of one substantially tubular member to another substantially tubular member. The connection apparatus comprises a male connecting member (114) and a female connecting member (116). A co-operable attachment mechanism (118, 120) is provided on the male and female connecting members (114, 116). The male and female connecting members (114, 116) each comprise at least one primary surface (142) adapted to form a primary joint and further each comprise at least one secondary surface (140) adapted to form a secondary joint. The at least one primary surface (142) can be adapted to form a primary load bearing shoulder joint (128). The at least one secondary surface (140) is adapted to form a secondary load bearing shoulder joint (130). The connection apparatus typically provides a double shoulder high torque connection for downhole tubulars. A double acting hydraulic jar is also disclosed.

1 ABSTRACT, Fig. 6

2

3 Connection Apparatus and Method

4

5 A connection apparatus adapted to allow connection
6 of one substantially tubular member to another
7 substantially tubular member. The connection
8 apparatus comprises a male connecting member (114)
9 and a female connecting member (116). A co-operable
10 attachment mechanism (118, 120) is provided on the
11 male and female connecting members (114, 116). The
12 male and female connecting members (114, 116) each
13 comprise at least one primary surface (142) adapted
14 to form a primary joint and further each comprise at
15 least one secondary surface (140) adapted to form a
16 secondary joint. The at least one primary surface
17 (142) can be adapted to form a primary load bearing
18 shoulder joint (128). The at least one secondary
19 surface (140) is adapted to form a secondary load
20 bearing shoulder joint (130). The connection
21 apparatus typically provides a double shoulder high
22 torque connection for downhole tubulars. A double
23 acting hydraulic jar is also disclosed.

24

1 "Connection Apparatus and Method"

2

3 The present invention relates to connection
4 apparatus and particularly, but not exclusively, to
5 a double shoulder high torque connection used to
6 connect tubular members in a drill string such as
7 tubular members which connect together to form the
8 outer housing of a downhole tool.

9

10 Threaded connection joints such as tapered pin and
11 box joints are used widely in the drilling industry
12 to allow a series of tubulars and components which
13 make up downhole tools and which are connected on
14 the drilling rig to form a drill string for
15 insertion into the borehole.

16

17 Standard connection joints for drill strings
18 typically comprise a tapered male member (pin) on
19 the lower end of one tubular member which may be
20 inserted into a tapered female member (box) on the
21 upper end of another tubular member such that a
22 single shoulder is provided into which a reasonable

1 amount of torque can be applied. However, the
2 weakness created in the drill string at the drill
3 pipe and tool component connections has the
4 disadvantage of creating deformation of the joint
5 and/or drill string when a large torsional load is
6 placed upon it.

7
8 In recent years it has become known to use tapered
9 thread double shoulder connections in drill pipe
10 joints, such as the eXtremeTM Torque Connection XTTM
11 drill pipe tool joint offered by Grant Prideco of
12 Houston, TX, USA, which allow higher levels of make
13 up torque to be applied to the drill pipe
14 connections which are required for extended reach
15 and/or horizontal drilling and other extreme
16 drilling applications. However, hitherto, it has
17 not been possible to provide similarly high levels
18 of make up torque to downhole tool component
19 connections. Hence, conventional downhole tool
20 component connections constitute low torque
21 connections which denigrates the torque rating of
22 the whole drill string.

23
24 According to the first aspect of the present
25 invention, there is provided connection means
26 adapted to allow connection of one substantially
27 tubular member to another substantially tubular
28 member, the connection means comprising:-

29 a male connecting member;
30 a female connecting member; and
31 co-operable attachment means provided on the
32 male and female connecting members;

1 wherein the male and female connecting members
2 each comprise at least one primary surface adapted
3 to form a primary joint and further each comprise at
4 least one secondary surface adapted to form a
5 secondary joint.

6
7 According to the first aspect of the present
8 invention, there is also provided a male connecting
9 member for a substantially tubular member which is
10 arranged for connection to a female connecting
11 member of another substantially tubular member, the
12 male connecting member comprising:-

13 an attachment means co-operable with an
14 attachment means provided on the female connecting
15 member;

16 and at least one primary surface adapted to
17 form a primary joint with at least one primary
18 surface provided on the female member; and

19 at least one secondary surface adapted to form
20 a secondary joint with at least one secondary
21 surface provided on the female member.

22
23 According to the first aspect of the present
24 invention, there is also provided a female
25 connecting member for a substantially tubular member
26 which is arranged for connection to a male
27 connecting member of another substantially tubular
28 member, the female connecting member comprising:-

29 an attachment means co-operable with an
30 attachment means provided on the male connecting
31 member;

1 and at least one primary surface adapted to
2 form a primary joint with at least one primary
3 surface provided on the male member; and
4 at least one secondary surface adapted to form
5 a secondary joint with at least one secondary
6 surface provided on the male member.

7
8 Typically, the tubular member connects with another
9 tubular member in accordance with the first aspect
10 of the present invention to form at least part of
11 the outer housing of a downhole tool for
12 incorporation into a string of downhole tubulars
13 such as drill string.

14
15 Typically, an end the male member is adapted for
16 insertion into an end of the female member.

17
18 Preferably, the at least one primary surface is
19 adapted to form a primary load bearing shoulder
20 joint and more preferably, the at least one
21 secondary surface is adapted to form a secondary
22 load bearing shoulder joint. Typically, the primary
23 and secondary joints are formed between the male and
24 female connecting members when the male and female
25 connecting members are connected to one another.

26
27 Typically, the co-operable attachment means of the
28 male and female connecting members retain the
29 primary surface of the male connecting member in
30 abutment with the primary surface of the female
31 connecting member.

32

1 Typically, the co-operable attachment means of the
2 male and female connecting members retain the
3 secondary surface of the male connecting member in
4 abutment with the secondary surface of the female
5 connecting member.

6
7 Preferably, the co-operable attachment means of the
8 male and female connecting members retain the
9 primary and secondary surfaces of the male
10 connecting member in abutment with the respective
11 primary and secondary surfaces of the female
12 connecting member, typically in order to create the
13 respective primary and secondary joints between the
14 male and female members. More preferably, at least
15 one of the primary and secondary joints at least
16 partially resist rotation of one of the connecting
17 members with respect to the other in at least one
18 direction.

19
20 This has the advantage that embodiments of the
21 invention provide a pair of butting surfaces
22 (between each pair of primary and secondary
23 surfaces) between the male and female members which
24 resist rotation of the members with respect to one
25 another.

26
27 Preferably, the attachment means comprises a thread
28 on the male member which is co-operable with a
29 corresponding thread on the female member. More
30 preferably the thread forces the or each primary
31 and/or secondary surface of the connecting members
32 into abutment with the corresponding surface of the

1 other connecting member. Preferably, the thread
2 provided on the male and female members comprises a
3 substantially parallel thread which typically
4 comprises a longitudinal axis which is substantially
5 parallel to a longitudinal axis of the respective
6 tubular member. This provides the advantage that
7 the attachment means has a minimised radial extent
8 which means that the inner bore of the connection
9 members is substantially unrestricted at the
10 location of the connection members. Optionally in
11 alternative embodiments, the thread provided on the
12 male and female members may comprise a linearly
13 tapered thread which is at an angle to the central
14 longitudinal axis of the respective tubular member,
15 where the thread angle is typically arranged with
16 one end of the thread radially closer to the central
17 longitudinal axis of the connecting members than the
18 other end of the thread.

19

20 Preferably, the primary surface of the female member
21 is located radially outwardly of the secondary
22 surface; the secondary surface of the female member
23 is located closer to the central longitudinal axis
24 of the female connecting member than the primary
25 surface.

26

27 Preferably, the primary surface of the male member
28 is located radially outwardly of the secondary
29 surface; the secondary surface of the male member is
30 located closer to the central longitudinal axis of
31 the male connecting member than the primary surface.

32

1 Typically, the respective attachment means of the
2 male and female members are located in between the
3 respective primary and secondary surfaces.
4

5 Preferably, the primary surface of the female member
6 comprises a longitudinally outermost end of the
7 female member and may be provided at an end of the
8 female member which is longitudinally and radially
9 outer of the female member attachment means.

10 Typically, the secondary surface of the female
11 member is distal of the longitudinally outermost end
12 of the female member and may be provided radially
13 and longitudinally inner of the female member
14 attachment means.
15

16 Preferably, the secondary surface of the male member
17 comprises a longitudinally outermost end of the male
18 member and may be provided at an end of the male
19 member which is radially inner and longitudinally
20 outer of the male member attachment means.

21 Typically, the primary surface of the male member is
22 distal of the longitudinally outermost end of the
23 male member and may be provided radially outer and
24 longitudinally inner of the male member attachment
25 means.
26

27 Preferably, the primary surface of the male member
28 comprises an at least partially tapered end which
29 typically forms a shoulder portion and which may
30 comprise a tapered portion angled with respect to an
31 axis perpendicular to the longitudinal axis of the
32 male member. The said tapered portion of the male

1 member primary surface shoulder portion is
2 preferably angled, from radially innermost to
3 outermost, in the direction toward the rest of the
4 male connecting member and which more preferably is
5 angled, from radially innermost to outermost, in the
6 direction toward the male member attachment means.
7 The said tapered angle may be in the region of 1
8 degree to 45 degrees and is preferably in the region
9 of 10 to 20 degrees.

10

11 Preferably, the primary surface of the female member
12 comprises a female shoulder portion and which may
13 comprise a tapered portion angled with respect to an
14 axis perpendicular to the longitudinal axis of the
15 female member. The said tapered portion of the
16 female member primary surface shoulder portion is
17 preferably angled, from radially innermost to
18 outermost, in the direction toward the rest of the
19 female connecting member and which more preferably
20 is angled, from radially innermost to outermost, in
21 the direction toward the female member attachment
22 means, preferably by a substantially similar angle
23 as that of the tapered portion of the male member
24 primary surface shoulder portion such that the
25 female member, and more preferably, the
26 longitudinally outermost end of the female member is
27 typically substantially prevented from moving
28 radially outward when connected to the male member.

29

30 Preferably, the secondary surface of the male member
31 comprises an at least partially tapered end which
32 typically forms a shoulder portion and which may

1 comprise a tapered portion angled with respect to an
2 axis perpendicular to the longitudinal axis of the
3 male member. The said tapered portion of the male
4 member secondary surface shoulder portion is
5 preferably angled, from radially innermost to
6 outermost, away from the rest of the male connecting
7 member and which more preferably is angled, from
8 radially innermost to outermost, away from the male
9 member attachment means. The said tapered angle may
10 be in the region of 1 degree to 45 degrees and is
11 preferably in the region of 10 to 20 degrees.

12
13 Preferably, the secondary surface of the female
14 member comprises a female shoulder portion and which
15 may comprise a tapered portion angled with respect
16 to an axis perpendicular to the longitudinal axis of
17 the female member. The said tapered portion of the
18 female member secondary surface shoulder portion is
19 preferably angled, from radially innermost to
20 outermost, away from the rest of the female
21 connecting member and which more preferably is
22 angled, from radially innermost to outermost, away
23 from the female member attachment means, preferably
24 by a substantially similar angle as that of the
25 tapered portion of the male member such that the
26 male member, and more preferably, the longitudinally
27 outermost end of the male member is typically
28 substantially prevented from moving radially inward
29 when connected to the female member.

30
31 Preferably, the primary and secondary surfaces of
32 the male and female connecting members further

1 comprise support means which may further comprise a
2 support platform or ledge adapted to support the
3 respective longitudinally outermost ends of the male
4 and female members when the connection means is
5 engaged such that the male member is substantially
6 prevented from moving radially outward and the
7 female member is preferably substantially prevented
8 from moving radially inward. The support means is
9 typically provided in the form of a surface, which
10 may be a platform or ledge and which is preferably
11 arranged to lie on an axis substantially parallel or
12 co-axial to the longitudinal axis of the respective
13 male and female connecting members.

14

15 Preferably, the support means of the primary surface
16 of the male member is arranged radially inwardly of
17 and longitudinally outwardly of the male member
18 primary surface tapered portion and is further
19 arranged radially outwardly of and longitudinally
20 inwardly of the male member attachment means.

21 Preferably, the support means of the secondary
22 surface of the male member is arranged radially
23 outwardly of and longitudinally inwardly of the male
24 member secondary surface tapered portion and is
25 further arranged radially inwardly of and
26 longitudinally outwardly of the male member
27 attachment means.

28

29 Preferably, the support means of the primary surface
30 of the female member is arranged radially inwardly
31 of and longitudinally inwardly of the female member
32 primary surface tapered portion and is further

1 arranged radially outwardly of and longitudinally
2 outwardly of the female member attachment means.
3 Preferably, the support means of the secondary
4 surface of the female member is arranged radially
5 outwardly of and longitudinally outwardly of the
6 female member secondary surface tapered portion and
7 is further arranged radially inwardly of and
8 longitudinally inwardly of the female member
9 attachment means.

10

11 The combined effect of the support means and tapered
12 surfaces has the advantage that they substantially
13 prevent movement (such as buckling when the
14 connection means is being made up to high levels of
15 torque) of the male and female connection members in
16 the radial direction.

17

18 Optionally, the male connection member may be
19 provided on one end of a body member and the female
20 member provided on the other thereby creating a
21 double shouldered connection which is capable of
22 remaining engaged when a high torque is applied to
23 it. Alternatively, one of a male or female member
24 may be provided on one end of the member only, or in
25 a further alternative, either a male or female
26 member may be provided on each end of the body
27 member.

28

29 Typically, the substantially tubular members are
30 members which are included in or make up a drill
31 string and may be members provided on or in a
32 drilling jar, impact enhancing tool, drill pipe,

1 flow circulation tool, shock tools, thrusters and
2 bumper subs or other suitable tools, such as any
3 suitable Bottom Hole Assembly (BHA) tools.

4

5 According to a second aspect of the present
6 invention, there is provided a jar mechanism
7 comprising:-

8 an outer body member;

9 an inner body member movably mounted in the
10 outer body member; and

11 a releasable locking mechanism operable between
12 a locked configuration and an unlocked
13 configuration;

14 the releasable locking mechanism comprising a
15 locking member provided on one of the outer and
16 inner body members;

17 the locking member being engageable with a
18 locking formation provided on the other of the outer
19 and inner body members; wherein

20 the releasable locking mechanism is adapted to
21 permit the inner body member to be locked with
22 respect to the outer body member when in the locked
23 configuration and to allow the inner body member to
24 move with respect to the outer body member when in
25 the unlocked configuration.

26

27 Preferably, at least a portion of the releasable
28 locking mechanism, which may be the locking member,
29 is moveable in a radial direction between the locked
30 and unlocked configurations. Typically, the locking
31 member is biased, preferably by a biasing means,
32 into the locked configuration and more preferably,

1 the releasable locking mechanism comprises a first
2 angled surface utilised in the locked configuration
3 and a second angled surface utilised in the unlocked
4 configuration. Typically, the first and second
5 angled surfaces are provided on at least one of the
6 locking member and biasing means. Typically, the
7 biasing means comprises at least one moveable
8 member, which may be an annular ring, and a biasing
9 device such as a spring device. Preferably, the
10 spring device acts to bias the moveable member in a
11 direction of movement substantially parallel to a
12 longitudinal axis of the jar mechanism. Preferably,
13
14 Preferably, the locking member is held in the locked
15 configuration by the first angled surface which may
16 be an angled tapered surface typically angled with
17 respect to an axis perpendicular to the longitudinal
18 axis of the inner and outer members, the first
19 angled surface preferably being provided on the at
20 least one moveable member which may be a tapered
21 ring member.
22
23 Preferably, the locking member is held in the
24 unlocked position by a portion of the inner member
25 apart from the locking formation, said portion
26 preferably being the outer circumference of the
27 inner member. Preferably, the locking member is
28 held against the outer circumference of the inner
29 member by the second angled surface which is
30 preferably angled to a lesser degree than the first
31 tapered surface, the second angled surface

1 preferably being provided on the at least one
2 tapered ring member.

3
4 This provides embodiments of the invention with the
5 advantage that the locking member may be held in the
6 locked configuration with a relatively large force
7 due to the first (high angled) tapered surface, and
8 against the normal outer circumference of the inner
9 member when in the unlocked configuration with a
10 relatively weak force due to the second (low angled)
11 tapered surface. Such an arrangement reduces the
12 friction of each locking member acting upon the
13 inner member when in the unlocked configuration
14 whilst providing sufficient locking force when in
15 the locked configuration.

16
17 Preferably, the locking member comprises at least
18 one inwardly projecting member adapted to interact
19 with the locking formation on the inner member.
20 More preferably, a plurality of inwardly projecting
21 members are provided on the locking member.

22
23 Preferably, the locking formation on the inner
24 member comprises at least one groove adapted to
25 interact with the or each inwardly projecting member
26 provided on the locking member. More preferably, a
27 plurality of grooves are provided on the inner
28 member.

29
30 Preferably, a pair of tapered ring members are
31 provided on either side of the locking member.

32

1 Typically, a plurality of locking members are
2 provided, preferably spaced apart around the
3 circumference of the inner member.
4

5 An embodiment of the present invention will now be
6 described, by way of example only, with reference to
7 the accompanying drawings, in which:-
8

9 Fig. 1A is a cross sectional view of the upper
10 third of a drilling jar in accordance with the
11 second aspect of the present invention which
12 employs the connection means in accordance with
13 the first aspect of present invention;

14 Fig. 1B is a cross sectional view of the middle
15 third of a drilling jar in accordance with the
16 second aspect of the present invention which
17 employs the connection means in accordance with
18 the first aspect of present invention;

19 Fig. 1C is a cross sectional view of the lower
20 third of a drilling jar in accordance with the
21 second aspect of the present invention which
22 employs the connection means in accordance with
23 the first aspect of present invention;

24 Fig. 2 is a detailed cross sectional view of the
25 locking mechanism located on the lower third of
26 the drilling jar of Fig. 1C;

27 Fig. 3 is a detailed cross sectional view of the
28 metering mechanism located on the middle third
29 of the drilling jar of Fig. 1B;

30 Fig. 4A is a cross sectional view of a female
31 end connector in accordance with the first
32 aspect of the present invention;

1 Fig. 4B is a further cross sectional view of a
2 female end connector in accordance with the
3 first aspect of the present invention;
4 Fig. 4C is a detailed view of the internal screw
5 thread of the female connector of Figs. 4A and
6 4B;
7 Fig. 5A is a cross sectional view of a male end
8 connector to be used in conjunction with the
9 female end connector of Fig. 4 in accordance
10 with the first aspect of the present invention;
11 Fig. 5B is a further cross sectional view of a
12 male end connector to be used in conjunction
13 with the female end connector of Fig. 4 in
14 accordance with the first aspect of the present
15 invention;
16 Fig. 5C is a detailed view of the external screw
17 thread of the male connector of Figs. 5A and 5B;
18 and
19 Fig. 6 is a detailed schematic diagram of a
20 parallel threaded shoulder joint in accordance
21 with the first aspect of the present invention.

22
23 With reference to Figs. 4, 5 and 6, one embodiment
24 of a connection means in accordance with the first
25 aspect of the present invention will now be
26 described; in this embodiment the connection means
27 is incorporated into a drilling jar. The connection
28 means comprises an inner or male pin 114 which when
29 connected resides within an outer or female box 116.
30 A threaded portion 118 is provided on the outer
31 circumference of the pin 114 and is formed such that
32 it co-operates with a corresponding threaded portion

1 120 formed on the inner circumference of the box
2 116. As shown in Figs. 4c and 5c, the threaded
3 portions 118, 120 typically comprise a V-shaped
4 profile but could, in alternative embodiments,
5 comprise square form, buttress, trapezoidal or acme
6 type threads.

7
8 The threaded portions 118 and 120 are at or near
9 parallel with the longitudinal axis L of the
10 apparatus upon which the connection means is
11 provided and thus are referred to as parallel
12 threads (as opposed to tapered threads commonly
13 used, for instance, in drill pipe connections). The
14 pin 114 has a shallow 'v' shaped or gull winged
15 shaped indentation 122, 124 on its longitudinally
16 outermost end face (i.e. the leftmost portion of the
17 pin shown in Fig. 6) which comprises a tapered wall
18 122 and a flat wall 124 as shown in Fig. 6 and which
19 will provide a secondary shoulder surface as will be
20 described subsequently. The tapered wall 122 is
21 angled with respect the perpendicular axis to the
22 longitudinal axis L of the male pin 114. As shown
23 in Fig. 6, the tapered wall 122 is angled at
24 approximately 15 degrees, from radially innermost to
25 outermost, away from the rest of the pin 114 (i.e.
26 the rest of the pin 114 to the right of the flat
27 wall 124) and so is angled, from radially innermost
28 to outermost, away from the parallel thread 118.

29
30 Pin 114 also has a box receiving shoulder 128 which
31 is distal of the tapered wall 122 and which is
32 located radially outer and longitudinally inner of

1 the thread 118, where the shoulder 128 will provide
2 a primary shoulder surface as will be described
3 subsequently. The shoulder 128 is angled with
4 respect the perpendicular axis to the longitudinal
5 axis L of the male pin 114 at approximately 15
6 degrees, from radially innermost to outermost,
7 toward the rest of the pin 114 (i.e. the rest of the
8 pin 114 to the left of the shoulder 128) and so is
9 angled, from radially innermost to outermost, toward
10 the parallel thread 118.

11
12 Accordingly, the thread 118 is located radially and
13 longitudinally between the shoulder 128 and the
14 tapered wall 122.

15
16 The outer box 116 has a single tapered face 126
17 which provides a primary shoulder surface and which
18 is angled with respect to an axis perpendicular to
19 the longitudinal axis L of the outer female box 116.
20 The tapered face 126 is angled at approximately 15
21 degrees, from radially innermost to outermost,
22 toward the rest of the outer female box 116 (i.e.
23 the rest of the box 116 to the left of the tapered
24 face 126) and so is angled, from radially innermost
25 to outermost, toward the parallel thread 120 by
26 substantially the same angle as that of the box
27 receiving shoulder 128. The outer box 116 also has
28 tapered pin receiving shoulder 130 which is distal
29 of the tapered face 126 and which is located
30 radially and longitudinally inner of the female
31 thread 120 and which will provide a secondary
32 shoulder surface. As shown in Fig. 6, the pin

1 receiving shoulder 130 is angled at approximately 15
2 degrees, from radially innermost to outermost, away
3 from the rest of the box 116 (i.e. the rest of the
4 box 116 to the right of the pin receiving shoulder
5 130) and so is angled, from radially innermost to
6 outermost, away from the parallel thread 120.

7 Thus the tapered pin receiving shoulder 130 is
8 provided with a substantially similar taper angle as
9 that of tapered wall 122.

10

11 Accordingly, the thread 120 is located radially and
12 longitudinally between the tapered face 126 and the
13 tapered pin receiving shoulder 130.

14

15 It should be noted that box 116 is at least equal
16 to, or preferably slightly longer than the length of
17 inner pin 114 as will be discussed subsequently.

18

19 As shown in Fig. 1a, the connection means may be
20 provided on both ends of a double shouldered spline
21 32. Each double shouldered spline 32 comprises a
22 pin 114 and box section 116 which respectively
23 connect to a box and pin section in accordance with
24 the first aspect of the present invention of another
25 component of the apparatus upon which the spline 32
26 is installed.

27

28 Referring to Fig. 6, pin 114 is screwed into the box
29 section 116 when the downhole tool is assembled and
30 threads 120 and 118 co-operate to cause tapered face
31 126 of the box 116 to abut against box receiving
32 shoulder 128 and thereby provides a primary

1 (external of the thread) shoulder junction. This
2 creates a metal to metal seal between the tapered
3 face 126 and the shoulder 128 and also provides a
4 primary shoulder between the pin 114 and box 116
5 into which torque can be delivered and stored.

6
7 Tapered wall 122 also abuts against pin receiving
8 shoulder 130 thereby creating a secondary (internal
9 of the thread) metal to metal seal between the
10 tapered face 126 and the shoulder 128 and also
11 providing a secondary shoulder joint between the pin
12 114 and box 116 into which torque can be delivered
13 and stored; however, as discussed previously, the
14 length of box 116 is manufactured such that it is at
15 least equal to that of pin 114, and is preferably
16 slightly longer (in the order of 0.15 mm) than the
17 length of pin 114. This ensures that the seal
18 created between face 126 and shoulder 128 is made
19 before the seal between wall 122 and shoulder 130
20 and thus the seal between face 126 and shoulder 128
21 is regarded as the primary shoulder joint and the
22 internal seal between the wall 122 and shoulder 130
23 is regarded as the secondary shoulder joint.

24
25 When the drill string is compressed when, for
26 example, downward jarring is required (or tensioned
27 when, for example, upward jarring is required) pin
28 114 is prevented from splaying inwardly toward the
29 longitudinal axis L of the apparatus upon which the
30 connection means is provided due to the abutment
31 between the tapers on wall 122 and shoulder 130.
32 The pin 114 is also prevented from diving outwardly

1 (away from the longitudinal axis L) due to a support
2 means in the form of support ledge 140 on the box
3 section 116, where the support ledge 140 is arranged
4 to lie on an axis substantially parallel and co-
5 axial to the longitudinal axis L of the female box
6 section 116. As shown in Fig. 6, the support ledge
7 140 is arranged radially outwardly of and
8 longitudinally outwardly of the pin receiving
9 shoulder 130 and is therefore located radially
10 inwardly of and longitudinally inwardly of the
11 female thread 120.

12
13 Box section 116 is prevented from splaying outwardly
14 away from the longitudinal axis L of the apparatus
15 due to the taper on wall 126 and shoulder 128. The
16 box 116 is also prevented from diving inwardly
17 (toward longitudinal axis L) due to a support ledge
18 142 on the pin section 114. As shown in Fig. 6, the
19 support ledge 142 is arranged radially inwardly of
20 and longitudinally outwardly of the male shoulder
21 128 and is therefore located radially outwardly of
22 and longitudinally inwardly of the male thread 118.

23
24 This provides a very secure joint which will
25 withstand very high torsional forces without the pin
26 114 or box 116 sections splaying or diving
27 inwardly/outwardly since the combined effect of the
28 support ledges 140, 142 and tapered surfaces 122,
29 130; 126, 128 substantially prevents movement of the
30 male pin 114 and female box 116 in the radial
31 direction. The joint created by the connection
32 means also discourages unintentional backing off

1 (i.e. unscrewing) of the components of the apparatus
2 upon which the connection means is provided since a
3 large rotational force would be required in order to
4 overcome the friction between the primary or
5 external shoulder joint 126; 128 (face 126 and wall
6 128) and secondary or internal shoulder joint 122;
7 130 (face 122 and wall 130) once the desired make up
8 torque has been applied to the connection.

9
10 The parallel arrangement of threaded portions 118
11 and 120 allow a secure connection to be created
12 between two tubulars whilst using a minimal amount
13 of borehole space/radial distance i.e. the joints do
14 not encroach on the internal bore more than
15 absolutely necessary since no taper is required on
16 the threaded portions 118 and 120.

17
18 In addition, the connection means prevents over
19 stretching of the pin 114 and box 116 sections
20 (which often occurs in standard tapered thread pin
21 and box joints) occurring both during connection of
22 the tubulars and during operation of the drill
23 string. Any tendency for the pin 114 or box 116 to
24 over stretch is avoided by the inability of the pin
25 114 and box 116 to increase in length due to the
26 respective shoulders 122; 130 and 126; 128.

27
28 Accordingly, the connection means permit a much
29 higher level of torque to be applied to itself when
30 screwing the connections together when compared to
31 conventional connections which is particularly
32 useful in extended reach/horizontal wells.

1

2 The connection means is not limited to use on the
3 spline 32 and indeed the jar apparatus shown in
4 Figs. 1a, 1b and 1c is provided with further joints
5 J1, J2, J3 and J4 which each have a similarly
6 tapered arrangement and threaded portions which are
7 substantially parallel to the longitudinal axis L of
8 the jar apparatus.

9

10 Use of the connection means on the drilling jar of
11 Figs. 1a, 1b and 1c will now be described, though as
12 previously stated the connection means is not
13 limited to use on a drilling jar and indeed it may
14 be used on virtually any tool or tubular where a
15 high torque connection between tubular members may
16 be required e.g. accelerators, drill pipe, flow
17 circulation tools, shock tools, thrusters and bumper
18 subs etc. and any other suitable BHA tools.

19

20 When viewed in conjunction with one another, Figs.
21 1A, 1B and 1C show a drilling jar as indicated by
22 the connecting arrows.

23

24 The drilling jar shown in Figs. 1A, 1B and 1C
25 comprises an internal body member or mandrel 10
26 surrounded by an external body member or housing 12.
27 The internal mandrel 10 is arranged such that it may
28 move axially with respect to the external housing 12
29 when it is required to do so.

30

31 The internal mandrel 10 is a substantially tubular
32 member which spans the majority of the length from

1 the upper to the lower end of the jar apparatus.
2 The internal mandrel 10 comprises an uppermost
3 connecting mandrel 14 connected at its lower end to
4 a meter mandrel 16, which leads on to a locking
5 mandrel 18 that finally connects to a lowermost end
6 mandrel 20.

7
8 The external housing 12 comprises an uppermost seal
9 housing 22 connected to an impact housing 23 which
10 leads on to a meter housing 24 connected to a lock
11 housing 26 which connects to a lower seal housing 28
12 which finally connects to a lowermost connecting
13 housing 30. Each of the housings 24, 26 and 28 are
14 connected via connection means in accordance with
15 the first aspect of the present invention and the
16 uppermost seal housing 22 is connected to the impact
17 housing 23 via the double shouldered spline 32
18 described previously, which is also in accordance
19 with the first aspect of the present invention.

20
21 The uppermost connecting mandrel 14 of the internal
22 mandrel 10 has a box section 34 provided with a
23 standard tapered thread portion 36 which allows
24 connection to a pin section of the lower end of an
25 upper portion of the drill string (not shown). The
26 outer circumference of the box section 34 decreases
27 in diameter in order to allow the connecting mandrel
28 14 to enter the external housing 12. Such box
29 sections are common in the industry and suitable box
30 sections include the HT-50 and XT56 connections
31 provided by Grant Prideco and the WT-58 provided by
32 Hydril. The mandrel 14 continues along the internal

1 bore of the housing 12 until it reaches an indented
2 portion 38 which comprises an arrangement of
3 longitudinally extending and circumferentially
4 spaced grooves which telescopically engage with
5 internally projecting splines mounted on the spline
6 32 to prevent rotation occurring between the
7 internal mandrel 10 and external housing 12. At the
8 lower portion of the connecting mandrel 14 a double
9 headed hammer 40 is secured to the outer
10 circumference of the mandrel 14. The hammer
11 comprises a collar 40 which has upper 42 and lower
12 44 impact surfaces and is manufactured such that it
13 may be removed for maintenance or replacement.

14

15 Referring to Fig. 3, the meter mandrel 16 has a
16 shoulder 46 and a raised diameter portion 50 formed
17 on the mandrel 16 and a locking plate 48 which is
18 attached to the mandrel 16 via a grub screw 52.
19 Situated between the shoulder 46 and the locking
20 plate 48 are upper meter valve 54, lower meter valve
21 56 and a spacer collar 58. Many suitable meter
22 valves are widely available; however, one-way valves
23 such as the Jeva Jet™ provided by The Lee Company,
24 USA are particularly suitable.

25

26 Referring to Fig. 2, the locking mandrel 18 has
27 circumferentially arranged locking grooves or rings
28 60 formed on its outer surface which are adapted to
29 selectively coincide with inwardly projecting
30 locking teeth 62 provided on a locking block 64. A
31 plurality of, such as six, locking blocks 64 are
32 equi-spaced around the annulus between the internal

1 mandrel 10 and external housing 12 in a cage like
2 structure and are bounded at each upper and lower
3 end by a respective inwardly facing tapered collar
4 70. The teeth 62 are held in the grooves 60 due to
5 an inward force created by the action of compression
6 springs 66 and pre-load spring 68 acting to push the
7 tapered collars 70 toward one another. The tapered
8 collars 70 are provided with a highly tapered
9 surface 70a and a shallow tapered surface 70b where
10 the highly tapered surface 70a is radially inner of
11 the shallow tapered surface 70b. The force exerted
12 on the locking block 64 by the compression springs
13 66 can be varied by either screwing in or out an
14 adjuster 72 which increases or decreases (as
15 desired) the inwardly acting force on the locking
16 block 64 due to the action of the tapered collars
17 70. The plurality of locking blocks 64 provided
18 around the circumference of the locking mandrel 18
19 are each held apart by a circumferential spacer
20 plate (not shown) and rods 73. This prevents the
21 locking blocks 64 from falling to one side of the
22 jar apparatus when e.g. the jar apparatus is placed
23 on its side on the rig for storage, or when the
24 apparatus is used in a highly deviated well.

25

26 The end mandrel 20 (shown in Fig. 1C) creates a
27 chamber 74 between the end mandrel 20 outer
28 circumference and the external housing 12 internal
29 circumference. The end mandrel 20 also provides
30 additional weight to be used in the jarring process.

31

1 The uppermost seal housing 22 of the external
2 housing 12 provides a fluid chamber 75 which is
3 provided with a moveable balance piston 78 and a
4 seal 80. A fluid port 76 which is open to the
5 surrounding wellbore is also provided through the
6 wall of the uppermost seal housing 22. A plug 82 is
7 provided on the seal housing 22 to obturate another
8 part but which is located below the balance piston
9 78, such that hydraulic fluid can be inserted into
10 the annulus between the external housing 12 and
11 internal mandrel 10. This arrangement prevents any
12 pressure differential from building up across the
13 wall of jar apparatus since any increase in pressure
14 below the piston 78 will be compensated for by the
15 piston 78 moving upwardly and any decrease in
16 pressure below the piston 78 will be compensated for
17 by the piston 78 moving downward. This has the
18 advantage of preventing build up of pressure (which
19 may damage or otherwise adversely affect operation
20 of the tool) in the apparatus whilst avoiding
21 hydraulic fluid in the apparatus from mixing with
22 the oil/other material surrounding the apparatus.

23
24 The impact housing 23 is provided with an internal
25 shoulder 84 which is positioned such that it
26 provides an anvil 84 against which the lower impact
27 surface 44 of the hammer 40 may impact. A shoulder
28 is provided on the spline 32 to provide an anvil
29 against which the upper impact surface 42 of the
30 hammer 40 may impact.

31

1 The meter housing 24 (best shown in Fig. 3) has a
2 restricted portion 86 which projects inwardly from
3 the internal circumference of the housing 24. The
4 restricted portion 86 is positioned such that it
5 coincides with the spacer collar 58 when the
6 apparatus is in a neutral position i.e. the internal
7 mandrel 10 has not been moved with respect to the
8 external housing 12. The chamber created between
9 the meter housing 24 and the meter mandrel 16 is
10 filled with hydraulic fluid which is retained within
11 this chamber due to the presence of plugs (not
12 shown) in ports 88 and end seals 90 provided in the
13 chamber as seen in Fig. 3.

14

15 The lock housing 26 has a shoulder 92 which provides
16 a point against which the compression spring
17 arrangement 66 may act.

18

19 The lower seal housing 28 provides a fluid chamber
20 74 which has a moveable balance piston 94 located
21 therein. A plug 96 is also provided on the seal
22 housing 22. This arrangement prevents any pressure
23 differential from building up across the wall of
24 apparatus by providing a similar compensation system
25 to that previously described for the upper seal
26 housing 22.

27

28 The lowermost connecting housing 30 has a pin
29 section 98 provided with a standard tapered thread
30 portion 100 which allows connection to a box section
31 of the upper end of a lower portion of the drill
32 string (not shown).

1
2 It should be noted that a series of inwardly
3 protruding shoulders 102, 104, 106, 108 and 110 are
4 created by the connection means provided between
5 each of the components making up the external
6 housing 12 and outwardly projecting shoulders 42 and
7 112 are also created on the internal mandrel 10 by
8 the connections between each of the components
9 making up the internal mandrel 10.

10
11 In operation, the jar apparatus is installed in the
12 drill string prior to inserting the drill string
13 downhole. In the event that the drill string
14 becomes stuck downhole due to, for example, the
15 drill bit becoming lodged in the formation being
16 drilled, the jar apparatus can be brought into
17 operation by the operator in order to free the drill
18 bit from the formation.

19
20 Depending upon the nature of the jam between the
21 drill bit and the formation, the operator may chose
22 to jar the apparatus (and hence the drill string) in
23 the upward or the downward direction, or a
24 combination of both.

25
26 Starting from the neutral position, as shown in Fig.
27 3, in order to jar the drill string in the upward
28 direction, the upper portion of the drill string is
29 pulled upwardly by the operator via the drilling rig
30 (not shown). This exerts an upward force on the
31 internal mandrel 10 with respect to the external
32 housing 12 (which is prevented from moving upwardly

1 due to the stuck drill string (not shown)). When
2 the upward force is greater than the lock setting
3 force (which could be in the region of many tonnes)
4 set by the compression springs 66, the locking block
5 64 moves outwardly until the locking teeth 62
6 disengage from the locking grooves 60. In this
7 regard, the highly tapered surfaces 70a of the
8 tapered collars 70 result in a relatively large
9 force being required to move the locking block 64
10 outwardly; however, once the locking block 64 has
11 moved outwardly it is held between shallow tapered
12 surfaces 70b which gently push the locking block 64
13 inwardly due to the action of the compression
14 springs 66. This arrangement has the great
15 advantage that it reduces friction on the locking
16 mandrel 18 since the locking blocks 64 around the
17 circumference of the locking mandrel 18 only grip
18 the locking mandrel 18 lightly as the locking
19 mandrel moves axially along the jar apparatus. With
20 the locking block 64 moved outwardly, the internal
21 mandrel 10 is now able to move with respect to the
22 external housing 12.

23
24 The upward movement of the internal mandrel 10
25 pushes the upper 54 and lower 56 meter valves and
26 the spacer collar 58 along the chamber 47 (which is
27 filled with hydraulic fluid) due to the shoulder 46
28 on the meter mandrel 16; however when the front end
29 132 of meter valve 56 reaches the restricted portion
30 86, the hydraulic fluid in the left hand side (as
31 shown in Fig. 3) of chamber 47 is unable to pass
32 around the outside of the meter valve 56. It should

1 be noted that the dimension of the spacer collar 58
2 is such that hydraulic fluid may freely pass there
3 around. In order for the internal mandrel 10 to
4 continue travelling upwardly the hydraulic fluid in
5 the left hand side as viewed in Fig. 1 must pass
6 through the meter valve 56 in order to equalise the
7 pressure differential between the left and right
8 hand side of chamber 47. As will be understood by
9 the skilled reader, forcing hydraulic fluid through
10 a meter in this way requires very large forces to be
11 exerted on the meter 56 by the shoulder 46. This
12 force is provided by using the drilling rig to pull
13 upon the internal mandrel 10 via the drill string.
14 The force on the meter 56 must be maintained until
15 the back end 134 of the meter valve 56 has passed or
16 cleared the restricted portion 86 of the outer
17 housing 12. At this point the hydraulic fluid
18 (which will always tend to take the least path of
19 resistance) will once again be able to freely pass
20 between the other diameter of the meter 56 and
21 internal diameter of the external housing 12. The
22 sudden decrease in force required to move the
23 mandrel 10 upwardly results in the mandrel
24 accelerating upwardly at high speed.

25
26 When the upper impact surface 42 of the double
27 headed hammer 40 reaches the inwardly protruding
28 shoulder 102 the inner mandrel 10 is stopped due to
29 the impact between surface 42 and hammer 40. This
30 causes the momentum of the inner mandrel 10 to be
31 transferred to the outer housing 12. In this
32 regard, the weight provided by the lowermost end

1 mandrel 20 acts to increase the force exerted on the
2 outer housing 12 due to the impact. The transfer of
3 force to the outer housing 12 assists removal of the
4 stuck drill bit from the formation.

5
6 Starting from the neutral position as shown in Fig.
7 3, in order to jar the drill string in the downward
8 direction, the upper portion of the drill string is
9 pushed downwardly by the operator via the drilling
10 rig (not shown). This exerts a downward force on
11 the internal mandrel 10 with respect to the external
12 housing 12 (which is prevented from moving
13 downwardly due to the stuck drill bit (not shown)).
14 In a similar way to that previously described for
15 the upward movement of the drill string, when the
16 downward force is greater than the predetermined
17 force set by the compression springs 66, the locking
18 block 64 allows movement of the internal mandrel 10
19 with respect to the external housing 12. The
20 downward movement of the internal mandrel 10 pushes
21 the upper 54 and lower 56 meter valves and the
22 spacer collar 58 down the chamber 47 due to the
23 locking plate 48 on the meter mandrel 16. When the
24 front end 136 of meter valve 54 reaches the
25 restricted portion 86, the hydraulic fluid in the
26 right hand side (as shown in Fig. 3) of chamber 47
27 is unable to pass around the outside of the meter
28 valve 54. Therefore, in order for the internal
29 mandrel 10 to continue travelling downwardly, the
30 hydraulic fluid in the right hand side must pass
31 through the meter valve 54 in order to equalise the
32 pressure differential between the right and left

1 hand side of chamber 47. As previously described,
2 the downward force on the meter 54 must be
3 maintained until the back end 138 of the meter valve
4 54 has passed the restricted portion 86 of the outer
5 housing 12. At this point the hydraulic fluid will
6 once again be able to freely pass between the outer
7 diameter of the meter 54 and internal diameter of
8 the external housing 12. The sudden decrease in
9 force required to move the mandrel 10 downward
10 results in the mandrel accelerating downwardly at
11 high speed.

12
13 When the lower impact surface 44 of the double
14 headed hammer 40 reaches the inwardly protruding
15 shoulder or anvil 84 the inner mandrel 10 is stopped
16 due to the impact between surface 44 and hammer 40.
17 This causes the momentum of the inner mandrel 10 to
18 be transferred to the outer housing 12. Again, the
19 weight provided by the lowermost end mandrel 20 acts
20 to increase the force exerted on the outer housing
21 12 due to the impact. The transfer of force to the
22 outer housing 12 assists removal of the stuck drill
23 bit from the formation.

24
25 It should be noted that once the jar apparatus has
26 been operated in either the upward or downward
27 direction, the operator can return each valve 54, 56
28 through the restricted portion 86 in order to create
29 a further impact; however in this regard, the fluid
30 can bypass the upper 54 and lower 56 meter valves by
31 travelling along respective bypass passages 54a, 56a
32 (which are blocked by respective metal to metal

1 seals 54b, 56b when in the jarring mode).

2 Thereafter, the locking block 64 will engage with
3 the locking grooves 60 on the internal mandrel when
4 the mandrel reaches the neutral position. This
5 effectively allows the jarring procedure to be
6 restarted from the neutral position when desired.

7

8 Modifications and improvements may be made to the
9 foregoing without departing from the scope of the
10 present invention. For instance, the parallel
11 threads 118, 120 could in certain circumstances, be
12 replaced by linearly tapering threads if, for
13 instance, increasing the radial extent of the
14 connection was acceptable in a given downhole tool
15 or other tubular member. It should also be noted
16 that the outer circumference of the tubular members
17 described herein, whilst nearly always being
18 circular in cross section, need not be so since they
19 could have, for instance, a square, hexagonal or
20 other cross section, particularly in the areas in
21 between the connection means.

22

1 CLAIMS

2

3 1. A connection apparatus adapted to allow
4 connection of one substantially tubular member to
5 another substantially tubular member, the connection
6 apparatus comprising:-

7 a male connecting member;

8 a female connecting member; and

9 co-operable attachment mechanism provided on
10 the male and female connecting members;

11 wherein the male and female connecting members
12 each comprise at least one primary surface adapted
13 to form a primary joint and further each comprise at
14 least one secondary surface adapted to form a
15 secondary joint.

16

17 2. A connection apparatus according to claim 1,
18 wherein the at least one primary surface is adapted
19 to form a primary load bearing shoulder joint.

20

21 3. A connection apparatus according to either of
22 claims 1 or 2, wherein the at least one secondary
23 surface is adapted to form a secondary load bearing
24 shoulder joint.

25

26 4. A connection apparatus according to any preceding
27 claim, wherein the co-operable attachment mechanism
28 of the male and female connecting members retain the
29 primary and secondary surfaces of the male
30 connecting member in abutment with the respective
31 primary and secondary surfaces of the female
32 connecting member, thereby providing the respective

1 primary and secondary joints between the male and
2 female members.

3

4 5. A connection apparatus according to any preceding
5 claim, wherein a pair of butting surfaces are
6 provided between each pair of primary and secondary
7 surfaces and between the male and female members to
8 resist rotation of the members with respect to one
9 another.

10

11 6. A connection apparatus according to any preceding
12 claim, wherein the attachment mechanism comprises a
13 thread on the male member which is co-operable with
14 a corresponding thread on the female member.

15

16 7. A connection apparatus according to claim 6,
17 wherein the thread urges the or each primary and/or
18 secondary surface of the connecting members into
19 abutment with the corresponding surface of the other
20 connecting member.

21

22 8. A connection apparatus according to claim 6 or
23 claim 7, wherein the thread provided on the male and
24 female members comprises a thread having a
25 longitudinal axis which is substantially parallel to
26 a longitudinal axis of the respective tubular
27 member.

28

29 9. A connection apparatus according to any of claims
30 6 to 8, wherein the thread provided on the male and
31 female members comprises a linearly tapered thread
32 that is at an angle to the central longitudinal axis

1 of the respective tubular member, with one end of
2 the thread radially closer to the central
3 longitudinal axis of the connecting members than the
4 other end of the thread.

5
6 10. A connection apparatus according to any
7 preceding claim, wherein the attachment mechanism
8 has a minimised radial extent such that the inner
9 bore of the connection members is substantially
10 unrestricted at the location of the connection
11 members.

12
13 11. A connection apparatus according to any
14 preceding claim, wherein the primary surface of the
15 female member is located radially outwardly of the
16 secondary surface such that the secondary surface of
17 the female member is located closer to the central
18 longitudinal axis of the female connecting member
19 than the primary surface.

20
21 12. A connection apparatus according to any
22 preceding claim, wherein the primary surface of the
23 male member is located radially outwardly of the
24 secondary surface such that the secondary surface of
25 the male member is located closer to the central
26 longitudinal axis of the male connecting member than
27 the primary surface.

28
29 13. A connection apparatus according to any
30 preceding claim, wherein the respective attachment
31 mechanism of the male and female members are located

1 in between the respective primary and secondary
2 surfaces.

3
4 14. A connection apparatus according to any
5 preceding claim, wherein the primary surface of the
6 female member comprises a longitudinally outermost
7 end of the female member and is provided at an end
8 of the female member which is longitudinally and
9 radially outer of the female member attachment
10 mechanism, and wherein the secondary surface of the
11 female member is distal of the longitudinally
12 outermost end of the female member and is provided
13 radially and longitudinally inner of the female
14 member attachment mechanism.

15
16 15. A connection apparatus according to any
17 preceding claim, wherein the secondary surface of
18 the male member comprises a longitudinally outermost
19 end of the male member and is provided at an end of
20 the male member which is radially inner and
21 longitudinally outer of the male member attachment
22 mechanism, and wherein the primary surface of the
23 male member is distal of the longitudinally
24 outermost end of the male member and is provided
25 radially outer and longitudinally inner of the male
26 member attachment mechanism.

27
28 16. A connection apparatus according to any
29 preceding claim, wherein the primary surface of the
30 male member comprises a tapered portion angled with
31 respect to an axis perpendicular to the longitudinal
32 axis of the male member and wherein the tapered

1 portion is angled, from radially innermost to
2 outermost, and wherein the tapered portion is angled
3 in the direction toward the male member attachment
4 mechanism.

5
6 17. A connection apparatus according to any
7 preceding claim, wherein the primary surface of the
8 female member comprises a tapered portion angled
9 with respect to an axis perpendicular to the
10 longitudinal axis of the female member, wherein the
11 tapered portion is angled from radially innermost to
12 outermost wherein the tapered portion is angled in
13 the direction toward the female member attachment
14 mechanism, and wherein the tapered portion is angled
15 by a substantially similar angle as that of the
16 tapered portion of the male member primary surface
17 shoulder portion.

18
19 18. A connection apparatus according to any
20 preceding claim, wherein the longitudinally
21 outermost end of the female member is substantially
22 prevented from moving radially outward when
23 connected to the male member.

24
25 19. A connection apparatus according to any
26 preceding claim, wherein the secondary surface of
27 the male member comprises a shoulder portion,
28 wherein the shoulder portion comprises a tapered
29 portion angled with respect to an axis perpendicular
30 to the longitudinal axis of the male member, wherein
31 the tapered portion of the male member secondary
32 surface shoulder portion is angled from radially

1 innermost to outermost; and wherein the shoulder
2 portion is angled away from the male member
3 attachment mechanism.

4
5 20. A connection apparatus according to claim 19,
6 wherein the secondary surface of the female member
7 comprises a female shoulder portion, wherein the
8 female shoulder portion comprises a tapered portion
9 angled with respect to an axis perpendicular to the
10 longitudinal axis of the female member, wherein the
11 tapered portion is angled from radially innermost to
12 outermost; wherein the tapered portion is angled
13 away from the female member attachment mechanism and
14 wherein the tapered portion is angled by a
15 substantially similar angle as that of the tapered
16 portion of the male member.

17
18 21. A connection apparatus according to any
19 preceding claim, wherein the longitudinally
20 outermost end of the male member is substantially
21 prevented from moving radially inward when connected
22 to the female member.

23
24 22. A connection apparatus according to any
25 preceding claim, wherein the primary and secondary
26 surfaces of the male and female connecting members
27 further comprise a support surface, wherein the
28 support surface is adapted to support the respective
29 longitudinally outermost ends of the male and female
30 members when the connection apparatus is engaged
31 such that the male member is substantially prevented
32 from moving radially outward and the female member

1 is substantially prevented from moving radially
2 inward.

3

4 23. A connection apparatus according to claim 22,
5 wherein the support surface is arranged to lie on an
6 axis substantially parallel or co-axial to the
7 longitudinal axis of the respective male and female
8 connecting members.

9

10 24. A connection apparatus according to claim 23,
11 wherein the support surface of the primary surface
12 of the male member is arranged radially inwardly of
13 and longitudinally outwardly of the male member
14 primary surface tapered portion and is further
15 arranged radially outwardly of and longitudinally
16 inwardly of the male member attachment mechanism,
17 and wherein the support surface of the secondary
18 surface of the male member is arranged radially
19 outwardly of and longitudinally inwardly of the male
20 member secondary surface tapered portion and is
21 further arranged radially inwardly of and
22 longitudinally outwardly of the male member
23 attachment mechanism.

24

25 25. A connection apparatus according to either of
26 claims 23 or 24, wherein the support surface of the
27 primary surface of the female member is arranged
28 radially inwardly of and longitudinally inwardly of
29 the female member primary surface tapered portion
30 and is further arranged radially outwardly of and
31 longitudinally outwardly of the female member
32 attachment mechanism, and wherein the support

1 surface of the secondary surface of the female
2 member is arranged radially outwardly of and
3 longitudinally outwardly of the female member
4 secondary surface tapered portion and is further
5 arranged radially inwardly of and longitudinally
6 inwardly of the female member attachment mechanism.

7

8 26. A connection apparatus according to any
9 preceding claim, wherein the male connection member
10 is provided on one end of a body member and the
11 female member provided on the other thereby creating
12 a double shouldered connection which is capable of
13 remaining engaged when a high torque is applied to
14 it.

15

16 27. A connection apparatus according to any
17 preceding claim, wherein the substantially tubular
18 members are members which are included in, or make
19 up, drill string, and wherein the tubular members
20 are selected from the group consisting of: a
21 drilling jar, an impact enhancing tool, drill pipe,
22 a flow circulation tool, a shock tool, thrusters or
23 bumper subs which are suitable Bottom Hole Assembly
24 (BHA) tools.

25

26 28. A male connecting member for a substantially
27 tubular member which is arranged for connection to a
28 female connecting member of another substantially
29 tubular member, the male connecting member
30 comprising:-

1 an attachment mechanism co-operable with an
2 attachment mechanism provided on the female
3 connecting member;

4 and at least one primary surface adapted to
5 form a primary joint with at least one primary
6 surface provided on the female member; and

7 at least one secondary surface adapted to form
8 a secondary joint with at least one secondary
9 surface provided on the female member.

10

11 29. A female connecting member for a substantially
12 tubular member which is arranged for connection to a
13 male connecting member of another substantially
14 tubular member, the female connecting member
15 comprising:-

16 an attachment mechanism co-operable with an
17 attachment mechanism provided on the male connecting
18 member;

19 and at least one primary surface adapted to
20 form a primary joint with at least one primary
21 surface provided on the male member; and

22 at least one secondary surface adapted to form
23 a secondary joint with at least one secondary
24 surface provided on the male member.

25

26 30. A jar mechanism comprising:-

27 an outer body member;

28 an inner body member movably mounted in the
29 outer body member; and

30 a releasable locking mechanism operable between
31 a locked configuration and an unlocked
32 configuration;

1 the releasable locking mechanism comprising a
2 locking member provided on one of the outer and
3 inner body members;

4 the locking member being engageable with a
5 locking formation provided on the other of the outer
6 and inner body members; wherein

7 the releasable locking mechanism is adapted to
8 permit the inner body member to be locked with
9 respect to the outer body member when in the locked
10 configuration and to allow the inner body member to
11 move with respect to the outer body member when in
12 the unlocked configuration.

13

14 31. A jar mechanism according to claim 30, wherein
15 at least a portion of the releasable locking
16 mechanism is moveable in a radial direction between
17 the locked and unlocked configurations.

18

19 32. A jar mechanism according to claim 30 or claim
20 31, wherein the locking member is biased by a
21 biasing mechanism into the locked configuration.

22

23 33. A jar mechanism according to any of claims 30 to
24 32, wherein the releasable locking mechanism
25 comprises a first angled surface utilised in the
26 locked configuration and a second angled surface
27 utilised in the unlocked configuration, and wherein
28 the first and second angled surfaces are provided on
29 at least one of the locking member and biasing
30 mechanism.

31

1 34. A jar mechanism according to either of claims 32
2 or 33, wherein the biasing mechanism comprises at
3 least one moveable member, and a biasing device,
4 wherein the moveable member is an annular ring,
5 wherein the biasing device is a spring device.

6
7 35. A jar mechanism according to claim 34, wherein
8 the spring device acts to bias the moveable member
9 in a direction of movement substantially parallel to
10 a longitudinal axis of the jar mechanism.

11
12 36. A jar mechanism according to any of claims 31 to
13 35, wherein the locking member is held in the locked
14 configuration by the first angled surface which is
15 angled with respect to an axis perpendicular to the
16 longitudinal axis of the inner and outer members,
17 and wherein the first angled surface is provided on
18 the at least one moveable member.

19
20 37. A jar mechanism according to any of claims 32 to
21 36, wherein the locking member is held in the
22 unlocked position by a portion of the inner member,
23 and wherein said portion is the outer circumference
24 of the inner member.

25
26 38. A jar mechanism according to any of claims 34 to
27 37, wherein the locking member is held against the
28 outer circumference of the inner member by a second
29 angled surface which is angled to a lesser degree
30 than the first tapered surface, and wherein the
31 second angled surface is provided on the at least
32 one tapered ring member.

1 39. A jar mechanism according to any of claims 30 to
2 38, wherein the locking member comprises a plurality
3 of inwardly projecting members adapted to interact
4 with the locking formation on the inner member, and
5 wherein the locking formation on the inner member
6 comprises a plurality of grooves adapted to interact
7 with the or each inwardly projecting member provided
8 on the locking member.

9
10 40. A jar mechanism according to any of claims 30 to
11 39, wherein a pair of tapered ring members are
12 provided on either side of a plurality of locking
13 members which are provided spaced apart around the
14 circumference of the inner member.

15

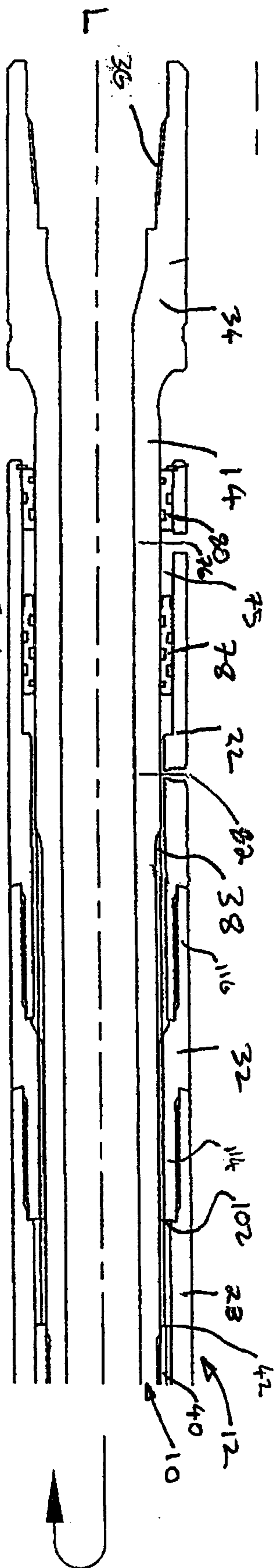


Fig. 1a

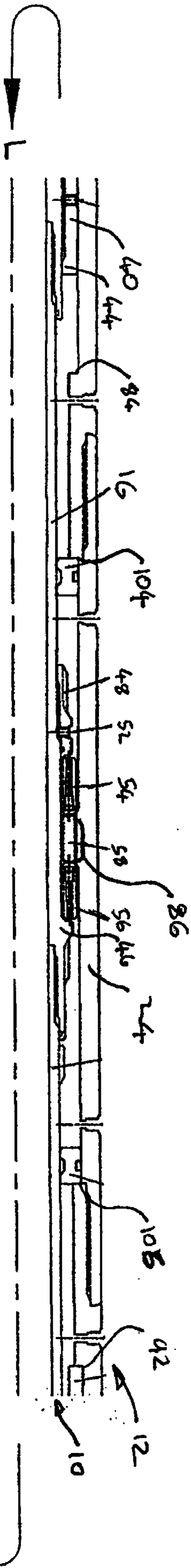


Fig. 1b

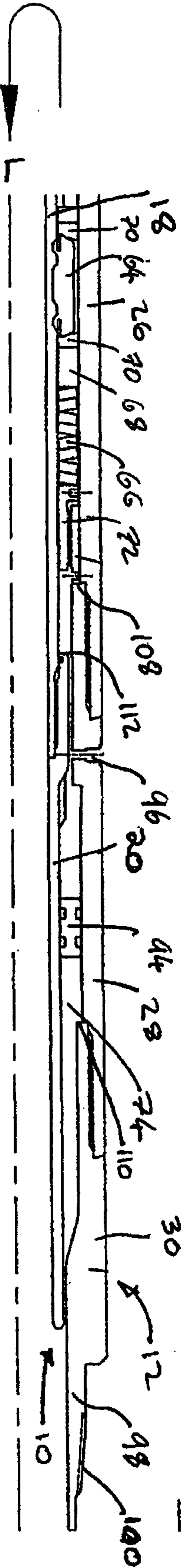


Fig. 1c

Fig. 1d

6 5/8 ULTIMAX TYPE J HYRDA-MECHANICAL JAR - DETAIL LAYOUT

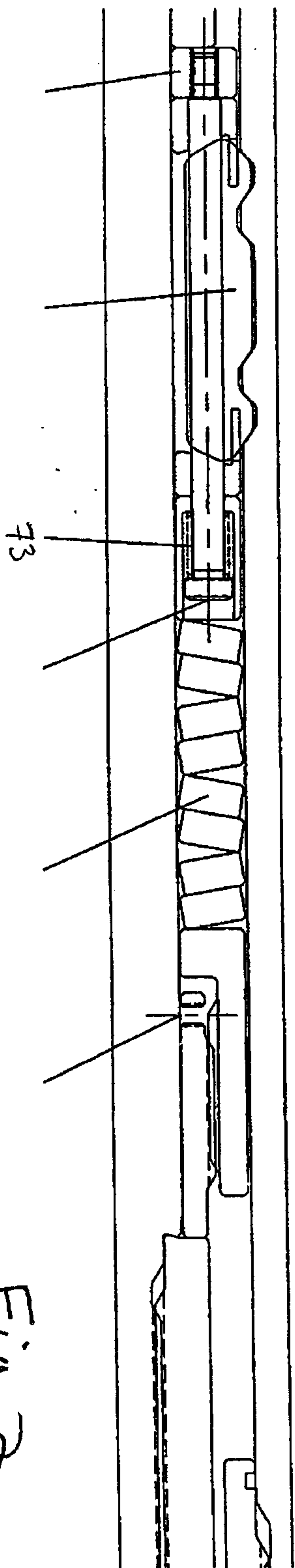
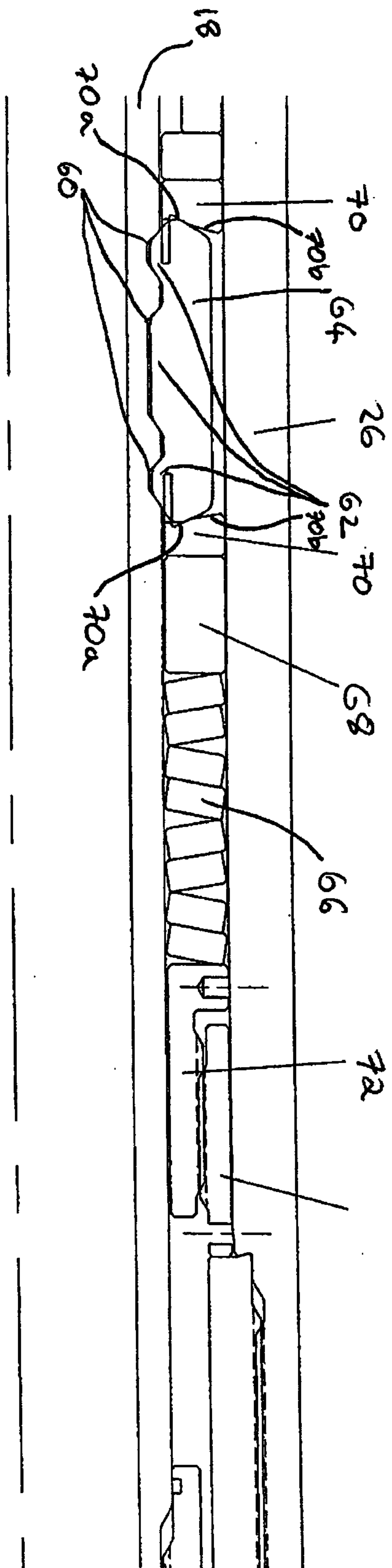


Fig 2

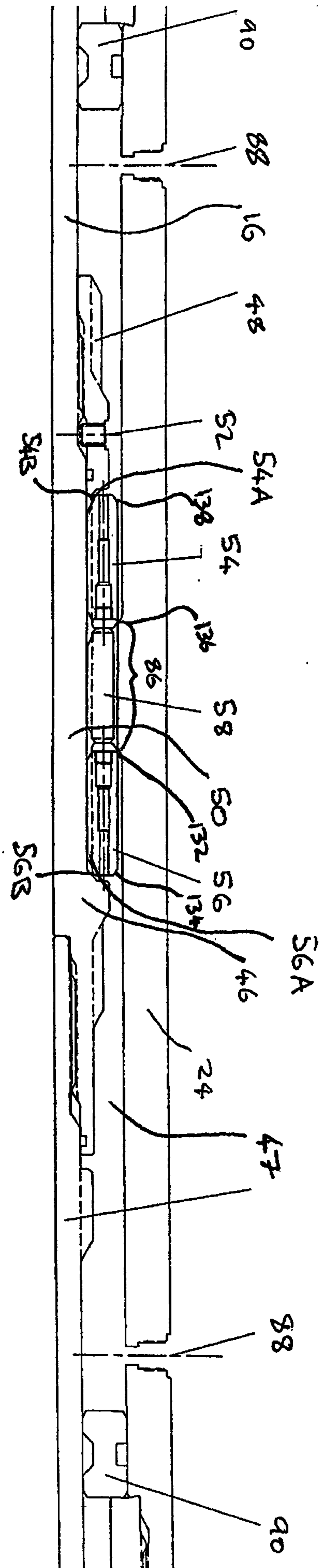


Fig 3

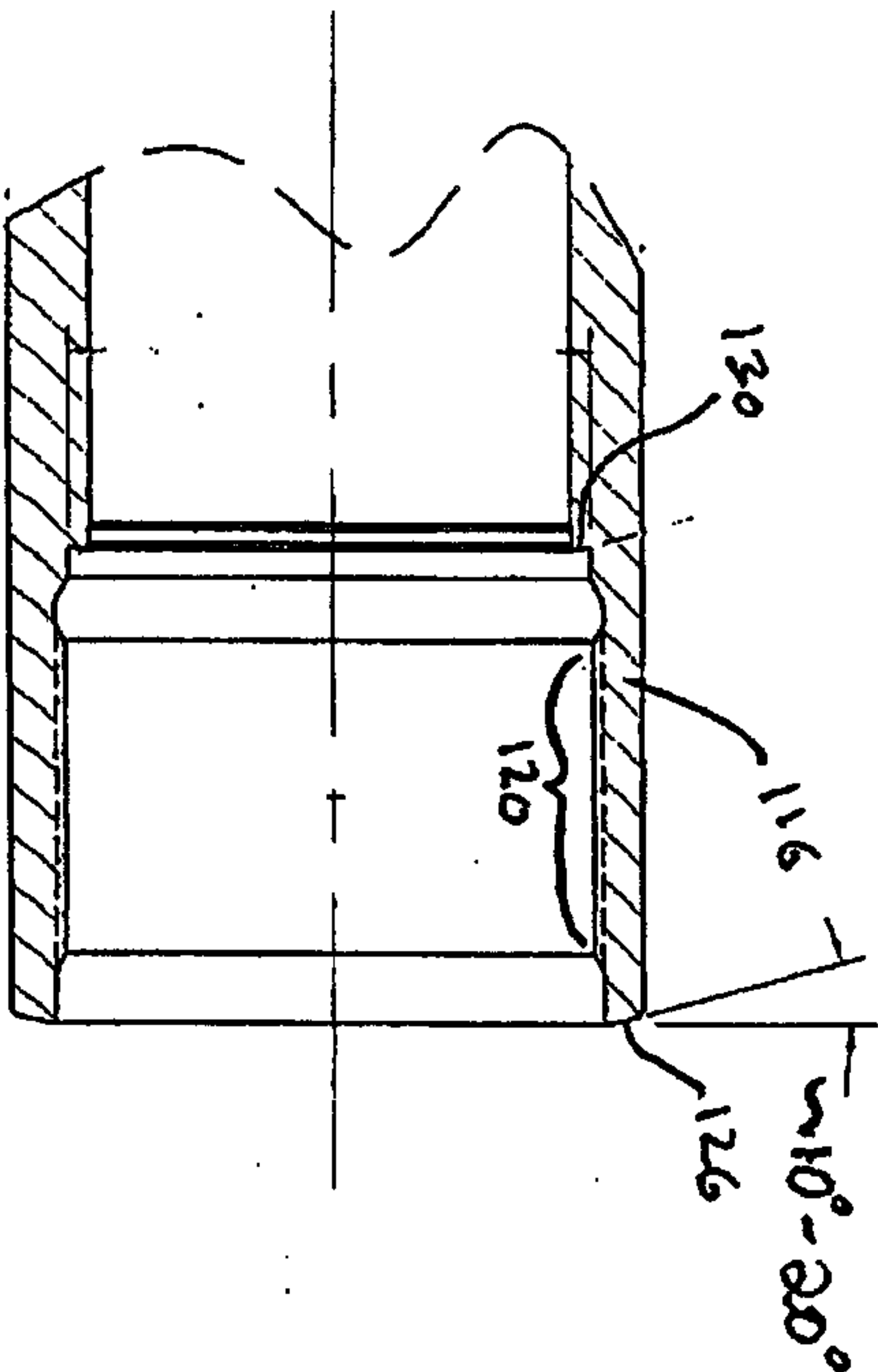


Fig 4a

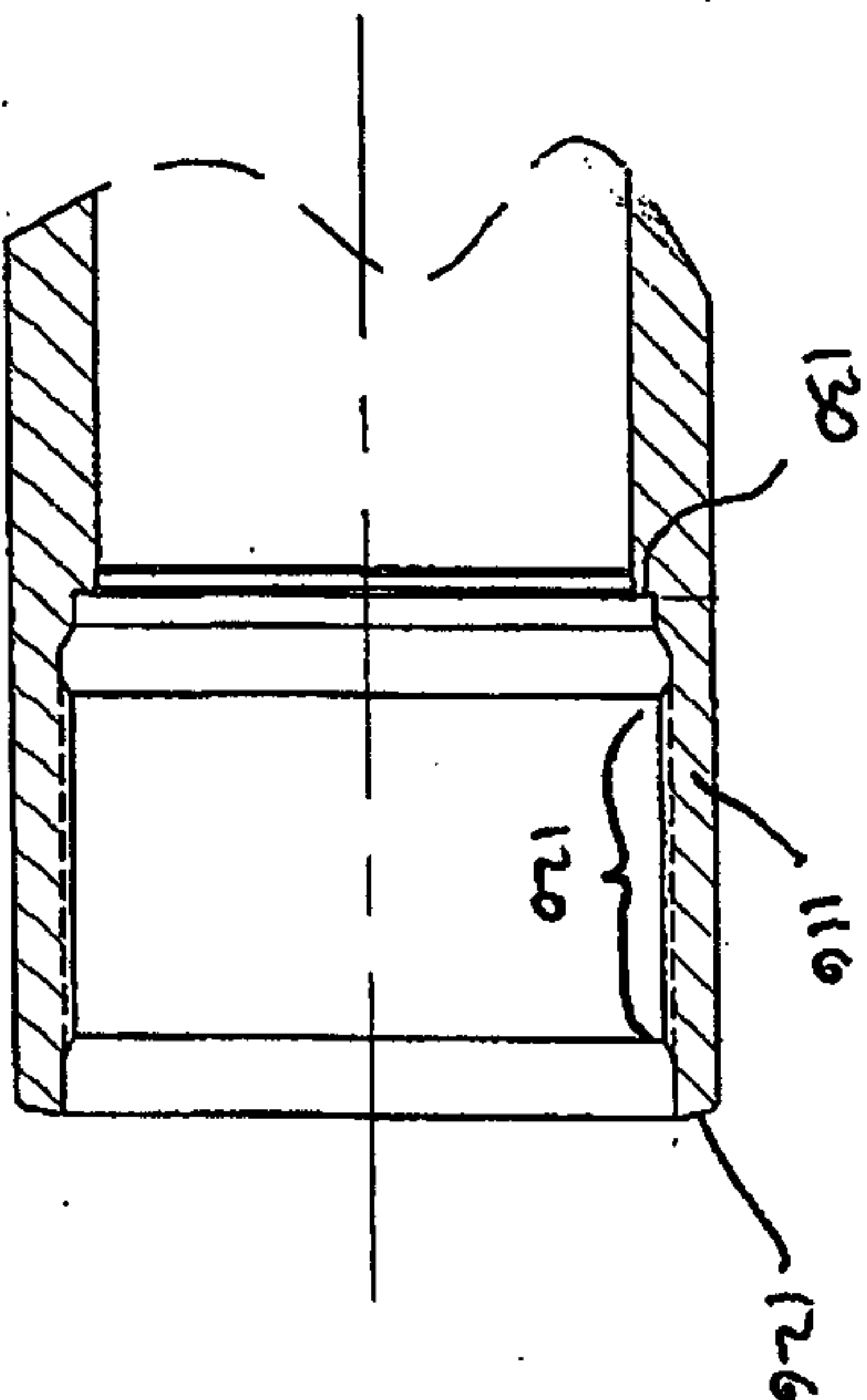


Fig 4b

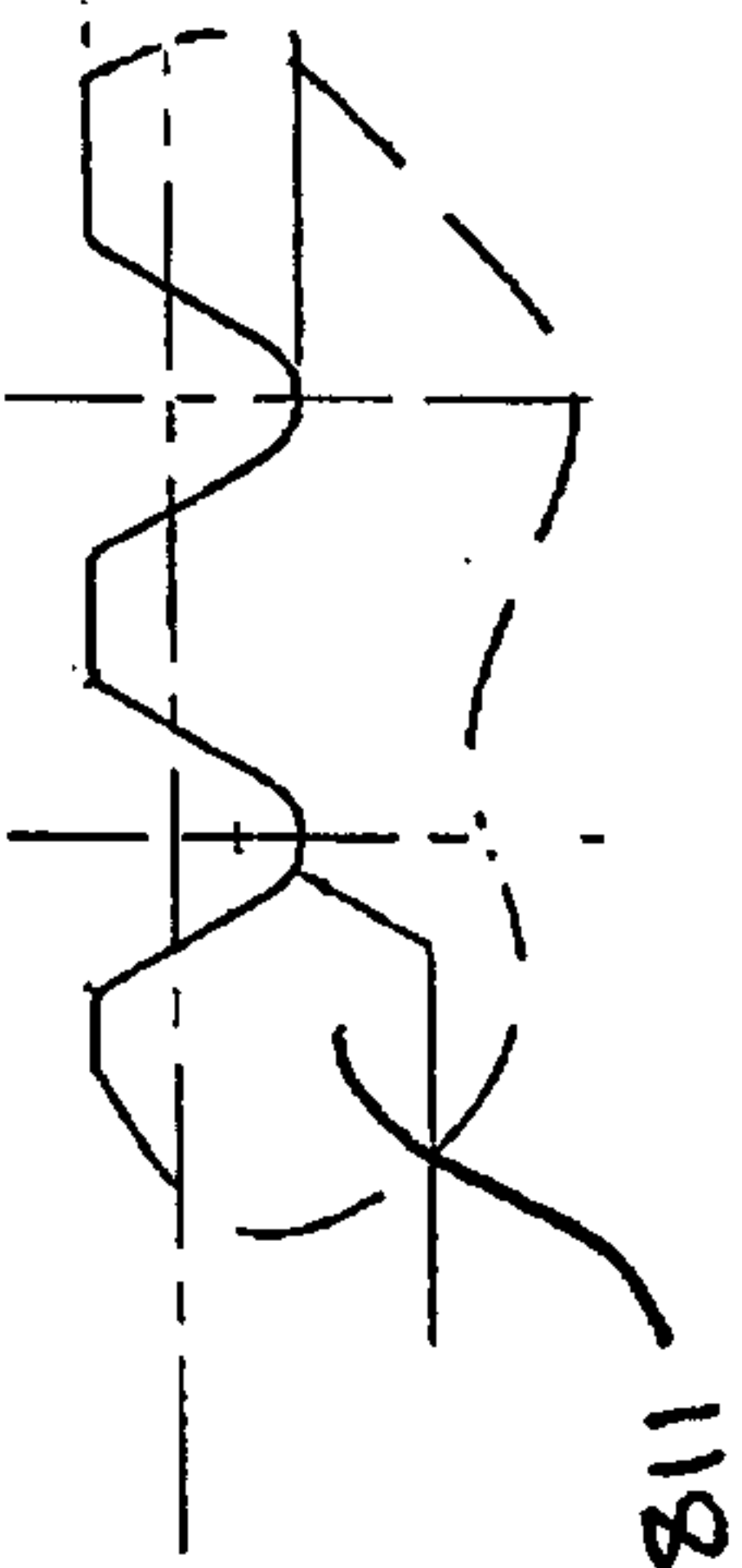


Fig 4c

- NOTES :
1. GLASS BEAD PEEN THREADS ALL OVER
 2. STAMP: PART NO./REV/PO NO.
 3. LUBRICATE AND PROTECT THREADS

DRAWING STANDARDS				UNLESS OTHERWISE STATED		Pellem Ltd Design and Manufacturing		TITLE / DESCRIPTION					
DRAWING UNITS Inches				TOLERANCES (U.O.S.)		1/ SURFACE FINISH .63 µl 2/ BREAK SHARP EDGES CORNDOWNS 3/ ALL FILLET RADIUS 0.031" 4/ ALL ANGLES 45° FROM HORIZONTAL		TYPE MD		NUMBER PD2000-0004 - 01		REV A	
SCALE 1 : 1				X ±0.125		MATERIAL SAE 4330 30-36 HRC		DRAWN BY/DATE CS / 18-12-03		SHEET 1 OF 1			
3RD ANGLE				X.X ±0.015		COATING PHOSPHATE AND OIL		CHECKED BY/DATE CS / 18-12-03					
				X.XX ±0.010				APPROVED BY/DATE		WEIGHT			
				X.XXX ±0.005									
				ANGULAR X ±5°									
				XX ±0.6°									
ORIGINAL RELEASE													
REASON FOR REVISION / CHANGE													
BY				CHECK									
DATE													
REV													
EON No													

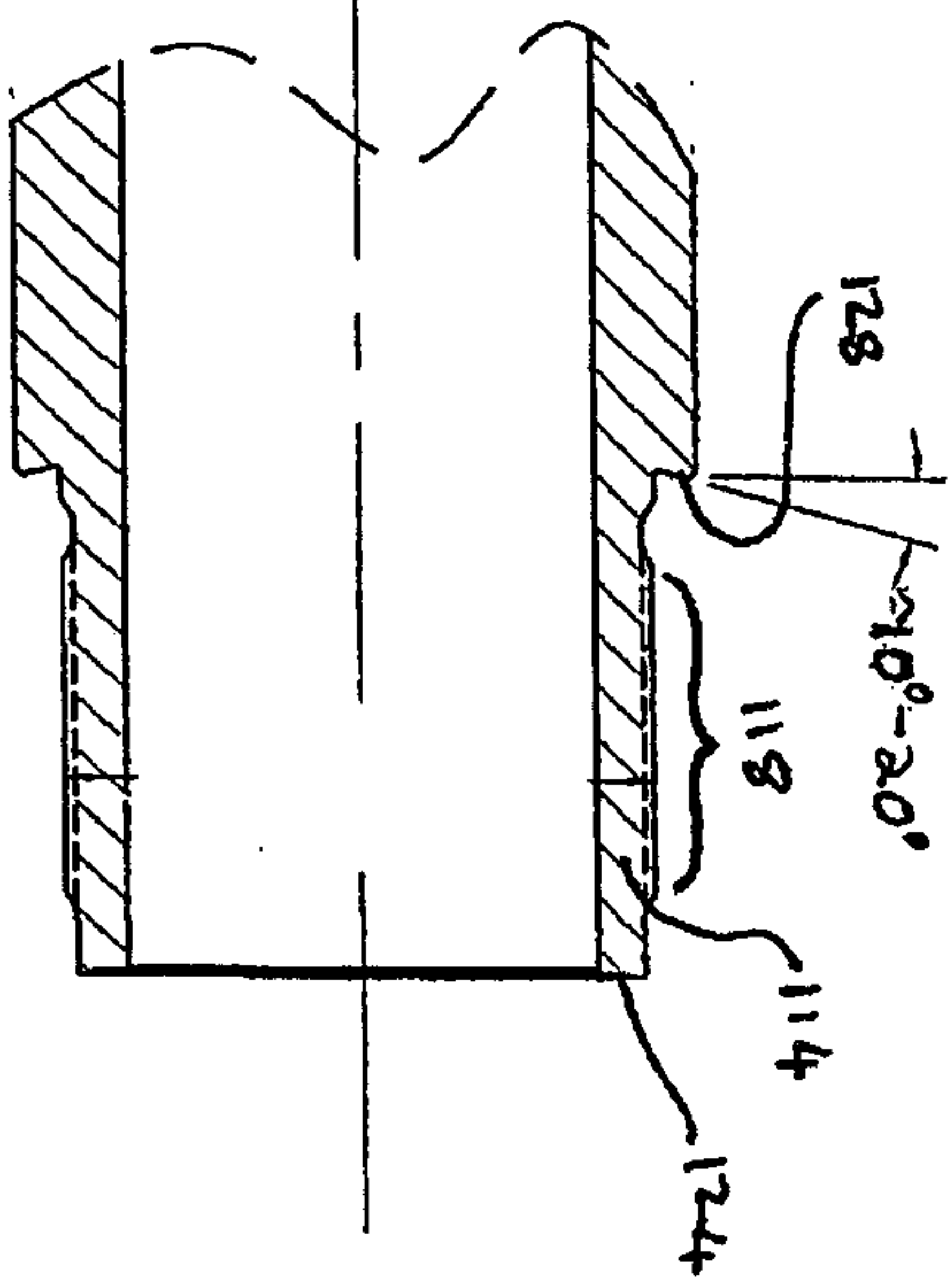
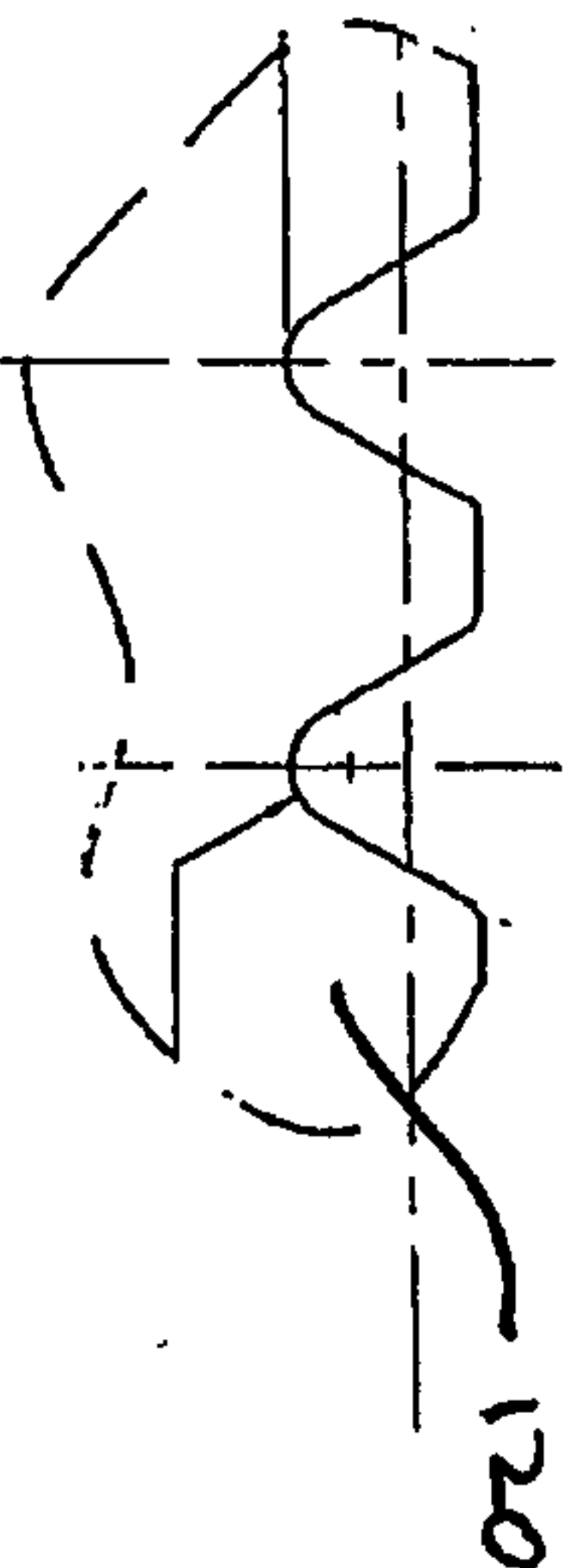


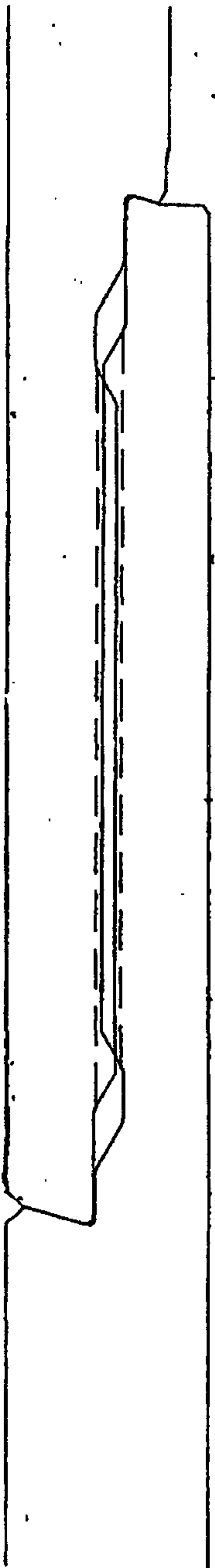
Fig 5b



557

- NOTES :
1. GLASS BEAD PEEN THREADS ALL OVER
 2. STAMP: PART NO./REV/PO NO.
 3. LUBRICATE AND PROTECT THREADS

				DRAWING STANDARDS	UNLESS OTHERWISE STATED 1/ SURFACE FINISH RA 6.3 μm 2/ BREAK SHARP EDGES 0.010x45° 3/ ALL FILED PARS 0.030 4/ ALL ANGLES 45° FROM HORIZONTAL 5/ TR 0.005	Pedern Ltd Design and Manufacturing	SHEET 1 OF 1	TITLE / DESCRIPTION MD PD2000-0003 - 01 A
				DRAWING UNITS Inches	TOLERANCES (U.O.S.)			REV
				SCALE: 1 : 1	X ±0.125 X.X ±0.015 X.XX ±0.010 X.XXX ±0.005	MATERIAL SAE AISI 30-38 HRc	CHECKED BY/DATE CS / 18-12-03	
				ISO ANGLE 	ANGULAR X 45° X.X ±0.07	COATING PHOSPHATE AND OIL	APPROVED BY/DATE CS / 18-12-03	
EEN No	REV	DATE	BY	CHECK	REASON FOR REVISION / CHANGE			
	A	18-12-03	CS	CS	ORIGINAL RELEASE			



10

Fig 6

