ABSTRACT

Apparatus, for attaching an object to a pipe having an internal ledge and releasing the object in response to the combination of both the landing of a closure member within said apparatus and the subsequent internal pressurization of the pipe, which includes a contractibly ledgered collar whose ledge is releasably restrained into interlocking engagement with the pipe ledge and which contracts upon landing of a closure member in a collar and subsequent internal pressurization of the pipe.
DOUBLE COLLET RELEASE MECHANISM

BACKGROUND OF THE INVENTION

This invention relates to releasable connections and has particular applicability to the launching of an oilwell cementing plug.

The use of cementing plugs in oilwell cementing operations is well known in the art. U.S. Pat. No. 2,438,992 discloses a well cementing apparatus utilizing two sequentially released cementing plugs. U.S. Pat. No. 3,364,966 also discloses an apparatus utilizing two sequentially released cementing plugs, and U.S. Pat. No. 3,545,542 also discloses an apparatus utilizing two sequentially released cementing plugs.

Problems have been encountered in the use of cementing plug launching devices, however, due to premature release of the cement plugs. Since by its very nature an oilwell cementing operation will result in the cementing plugs being cemented in the well at the end of the cementing operation, the cause of such premature release is especially difficult to determine. However, several probable causes have been isolated. One such problem is breakage of shear pins due to rotational forces on the plugs relative to the portion of the pipe to which they are attached. A second is the pressure surge described in U.S. Pat. No. 3,616,850 occurring upon landing of the closure member in their respective plugs.

Problems have also been encountered due to the failure of the cementing plugs to release at all. The cause of this has also been difficult to determine in that the evidence, as noted above, is cemented into the well and must be drilled out and thereby destroyed. However, a cause has been ascertained as being the "Brinelling" or embedding of steel balls, used as a part of current launching devices to avoid the rotational forces and pressure surge noted above, into the drill pipe. The use of such steel balls is explained in U.S. Pat. No. 3,796,260.

Thus, while multiple plug cementing works very satisfactorily when the cement plugs are properly released a more reliable release mechanism is needed.

The apparatus of this invention solves these problems and others.

SUMMARY OF THE INVENTION

This invention provides an apparatus, for controlled release of an object from a pipe having an internal ledge, which comprises a collar having a contractile external ledge restrained to interlock said internal pipe ledge by a sleeve disposed within said collar, said sleeve being moveable to a position not restraining said contractile ledge, said movement of said sleeve occurring upon landing of a closure member in said sleeve and subsequent pressurization of the pipe to a given pressure.

BRIEF DESCRIPTION OF THE DRAWINGS

The apparatus of this invention is more specifically and fully described with reference to the attached drawings which include:

FIG. 1, a schematic cross-sectional elevational view of a cementing plug system in which the apparatus of the invention can be used.

FIG. 2, a cut-away perspective view of a top plug launching apparatus embodying the invention.

FIGS. 2a, 2b, 2c and 2d are right side only schematic cross-sectional views of the apparatus of FIG. 2 in various stages of operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the general structure of a subsea casing cementing plug system 1 embodying the invention will be described.

System 1 comprises a rig portion 2 supported by a rig floor 3 above sea surface 4, an ocean portion 5 between rig floor 3 and an ocean floor 6, and a subsea portion 7 below ocean floor 6.

Rig portion 2 comprises a plug container 8, a top releasing plug 9, a retractable plunger 11, a releasing ball 12, a ball conduit 13, an extendable plunger 14, a cement inlet 15 and an upper portion of a drill pipe 17.

Top releasing plug 9 is contained within the top section 10 of plug container 8. A retractable plunger 11 releasably supports top releasing plug 9. Bottom releasing ball 12 is contained within a ball conduit 13 teed into the plug container 8 below plunger 11 and abutting an extendable plunger 14. Cement inlet 15 is preferably teed into plug container 8 below plunger 11, although cement inlet 15 could be located anywhere between plunger 11 and subsea portion 7. Drill pipe 16 extends downwardly from plug container 8.

Ocean portion 5 comprises the middle portion of drill pipe 16 and an installation tool 17 attached to the bottom of drill pipe 16.

Subsea portion 7 comprises a casing hanger 18, a cementing head adapter 19, top plug release mechanism 20, inner casing 21, outer casing 22, top cementing plug 23 and bottom cementing plug 24. Casing hanger 18 is affixed in the upper end of outer casing 22 and isolation tool 17 sealingly attached to casing hanger 18, thereby sealingly attaching drill pipe indirectly to subsea portion 7. Casing hanger 18 supports inner casing 21 within outer casing 22 leaving a casing annulus 25 therebetween. Cementing head adapter 19 hangs downwardly from isolation tool 17 and adapter 19 holds and supports top plug releasing assembly 20. Top plug releasing assembly 20 releasably holds top cementing plug 23, and top cementing plug 23 in turn releasably holds bottom cementing plug 24.

Referring now to FIG. 2, the structure of top plug releasing assembly 20, in the fully restrained position, will be described more fully. Releasing assembly 20 comprises a case 30, a bushing 40, a collar 50, a sleeve 60, a top cementing plug adapter 70, a shear member 80 and a swivel 90. In the fully restrained position shown in FIG. 2, case 30 internally supports a bushing 40 which retains and supports swivel 90 within case 30. Swivel 90 internally supports collar 50 and collar 50 internally supports adapter 70. Adapter 70 internally supports sleeve 60 by means of a shear member 80 connecting the inside surface of adapter 70 to the external surface of sleeve 60.

Case 30 is a cylinder with an axial bore 31 connecting an upper end 32 to a lower end 33. Upper internal threads 34 extend from upper end 32 downward a sufficient distance in case 30 to allow solid threaded connection of case 30 to cementing head adapter 19 of FIG. 1. An axial counterbore 35 of diameter greater than axial bore 31 extends upward from lower end 33 to a middle portion 36 of case 30 to produce an annular ledge 37. Ledge 37 can be tapered if desired. Lower in-
ternal threads 38 extend upwardly within the counterbore a sufficient distance to insure a solid threaded connection to bushing 40 as below described. A set screw 39 connects case 30 to bushing 40 so as to assure that bushing 24 will not be rotated out of engagement with case 30.

Bushing 40 is a cylinder having an axial bore 41 therethrough and an upper external recess 42. Bushing 40 also has an axial counterbore 43 extending downward from its upper end 44 to produce an annular ledge 45. Axial counterbore 43 is provided with a first groove 46 containing a first seal 47 to prevent fluid passage between collar 50 and bushing 40. Annular ledge 45 can be tapered if desired. External recess 42 is provided with a second groove 46a containing a second seal 47a to prevent fluid passage between case 30 and bushing 40. External recess 42 is further provided with a cavity 48 to receive set screw 39, and external recess is provided with external threads 49 corresponding to lower internal threads 38 of case 30. The upper end 44 of bushing 40 forms an annular bearing ledge when bushing 40 is threaded into case 30.

Swivel 90 comprises a race bearing 91 and a thrust bearing 92. Thrust bearing 92 is an annular band of substantially the same annular area as the annular bearing ledge formed by the upper end 44 of bushing 40 within case 30, and thrust bearing 92 is placed atop the upper end 44 of bushing 40. Race bearing 91 has an annular cross-section of substantially the same area as both thrust bearing 92 and upper end 44, and race bearing 91 rests rotatably atop thrust bearing 92. Race bearing 91 can be tapered if desired.

Collar 50 comprises an upper contractible ledge portion 51, an upper fingered portion 52, a middle body portion 53, a lower fingered portion 54 and a lower expandable ledge portion 55. Upper finger portion 52 is of sufficient length to reach from the upper inside rim of race bearing 91 down past thrust bearing 92 to just above groove 46 of bushing 40. Portion 52 is slotted and of reduced thickness to allow inward bending thereof. Lower fingered portion 54 is of sufficient length to reach from just below groove 46 down to recess 77 of top cementing plug adapter 70, as described below. Portion 54 is slotted and of reduced thickness to allow outward bending thereof. Body portion 53 connects portions 52 and 54 and covers seal 47 of bushing 40. Body portion 53 has an external diameter greater than the diameter of axial bore 41 but less than the diameter of counterbore 43 so that downward movement of body portion 53 is limited by annular shoulder 45. Contractible ledge portion 51 has an outer ledge 56 adapted to fit on the upper rim of race bearing 91 when restrained by flared end 61 of sleeve 60, as below described. Expandable ledge portion 55 has an inner ledge 57 adapted to fit within an external recess 77 of top cementing plug adapter 70 as described below. Expandable ledge portion 55 is inwardly restrained by axial bore 41 of bushing 40.

Top cementing plug adapter 70 is an annular cylinder having an upper section 71, a mid section 72 and a bottom section 73. An axial bore 74 extends through bottom section 73 while a counter bore 75, of diameter greater than axial bore 74, extends through upper section 71 and mid section 72 to form a lower internal annular shoulder 76. Mid section 72 is provided with an external recess 77 adapted to conform to the periphery of inner ledge 57 of expandable ledge portion 55 of collar 50. Upper section 71 of adapter 70 is provided with an external groove 71e holding a seal 71b. Seal 71b abuts body portion 53 of collar 50 so as to prevent fluid passage between collar 50 and adapter 70. Upper portion 71 also has a shear hole 81 to contain the adapter end 82 of shear member 80. Shear hole 81 is adjacent a corresponding shear recess 65 of sleeve 60, as below described. Mid section 72 of adapter 70 is provided with an internal recess 78 for reasons described below. Recess 78 produces an upper internal annular shoulder 76a and a further recess of lower internal annular shoulder 76b. Bottom section 73 is provided with external threads 79 adapted to receive corresponding threads of top cementing plug 23 of FIG. 1. Sleeve 60 is a cylinder having an axial bore 61 comprises an upper externally flared section 64. Flared end 62 is provided with a landing surface 65 adapted to sealingly receive the top release plug 9 of FIG. 1 in a conventional manner, thereby sealing axial bore 31 of case 30 from fluid passage in cooperation with seals 46, 46a, 71a described above and seal 66 below described. Flared end 62 has an external diameter just slightly less than the internal diameter of upper contractible ledge portion 51 of collar 50 so that flared end 62 abuts and expands through ledge portion 51. Lower section 64 is provided with a shear recess 65 adapted to receive the sleeve end 83 of shear member 80 so as to hold sleeve 60 in position with flared end 62 abutting ledge portion 51 of collar 50. Lower section 64 is also provided with an external seal groove 67 holding a seal 66 which abuts axial counterbore 75 of adapter 70 as to prevent fluid passage between adapter 70 and sleeve 60. Lower section 64 is further provided with an external lock recess 68 holding an expandable locking ring 69 adapted to expand into recess 78 as described below. Mid section 63 and lower section 64 have an external diameter slightly less than the diameter of axial counterbore 75 but greater than axial bore 74 so that downward movement of sleeve 60 within adapter 70 is limited by shoulder 76. Lower section 64 can be provided with an axial counterbore 69a to produce an annular latching shoulder 69a which can cooperate with top releasing plug to keep plug 9 in sealing position with landing surface 65 and axial bore 61 once top releasing plug has thumbed as below described.

Shear member 80 comprises a sleeve end 83, and an adapter end 82 and portions therebetween. Shear member is held by shear hole 81 in adapter 70 and shear recess 65 of sleeve 60 as previously described, so that sufficient downward force on sleeve 60 will shear the shear member 80 and thereby initiate release of top cementing plug 23 of FIG. 1 in the manner below described.

OPERATION

The operation of the apparatus of this invention will be described in terms of the preferred embodiment described above and shown in the attached drawings. This operation will be described with particular reference to FIGS. 2a–2d, which show top plug releasing mechanism 20 in four sequential stages of operation, those stages being the fully restrained stage of FIG. 2a, the sleeve released stage of FIG. 2b, the collar released stage of FIG. 2c and the adapter released position of FIG. 2d.

Referring to FIG. 1, mechanism 20 is put in the fully restrained position as has been previously described in
connection with FIG. 2. Once top plug releasing mechanism 20 has been constructed as described, and included in a cementing system as described above and shown in FIG. 1, plug release operation is commenced in conventional manner by dropping bottom plug releasing ball 13 through drill pipe 16 into a sealing position within bottom cementing plug 24 and pumping cement into drill pipe 16 via cement inlet 15. Continued pumping causes shearing of pins (not shown) holding bottom plug 24 to top cementing plug 23 and bottom plug 24 is released and passes downhole in a conventional manner. When sufficient cement has been pumped into drill pipe 16, top releasing plug 9 is dropped by retracting plunger 11 and ceasing pumping of cement and commencing pumping of a typical displacing fluid such as drilling mud.

Referring to FIGS. 1 and 2a, when top releasing plug 9 reaches landing surface 65 and latches, in conventional manner, to annular latching shoulder 69a, thereby sealing off axial bore 61 of sleeve 60 to fluid passage, the release operation of top plug releasing mechanism 20 begins. The mechanism will remain in the fully restrained position of FIG. 2a until a predetermined release pressure is reached in axial bore 31. When this release pressure has been reached a sufficient downward force is exerted on sleeve 60 to shear shear member 80, thereby releasing sleeve 60 to travel downward in adapter 70, as shown in FIG. 2b. This downward movement is limited by annular shoulder 76. Downward movement of sleeve 60 results in downward movement of flared end 62 with respect to contractible ledge portion 51 of collar 50. When flared end 62 passes below contractible ledge portion 51, portion 51 is no longer outwardly restrained by flared end 62 and can contract as portion 51 is forcibly pulled off of race bearing 91, as in FIG. 2b by the downward force of sleeve 60 on annular shoulder 76.

Referring to FIG. 2c, when sleeve 60 reaches shoulder 76 continued pressure in axial bore 31 causes sleeve 60 to push collar 50 downwardly within axial bore 43 (see FIG. 2c) thereby moving expandable ledge portion 55 downwardly out of axial bore 41 of bushing 40. This downward movement of collar 50 causes downward movement of adapter 70 since inner ledge 57 is restrained within recess 77 of adapter 70, as previously described until expandable ledge portion 55 moves completely out of axial bore 41 and expands outwardly, as shown in FIG. 2d.

Referring to FIG. 2d, when body portion 53 of collar 50 reaches annular ledge 45 of bushing 40 further downward movement of collar 50 is prevented. However, further downward movement of sleeve 60 and adapter 70 is not prevented by body portion 53 reaching annular ledge 45 since lower finger portion 54 of collar 50 has passed downwardly out of axial bore 41 and therefore finger portion 54 can bend outwardly in response to the downward force of the upper shoulder of recess 57 against fingered portion 55 to move inner ledge 57 out of recess 77 of adapter 70, thereby releasing adapter 70, sleeve 60 and top releasing plug 9 to pass downhole and opening axial bore 41 to fluid passage. While axial bore 41 may thus be opened to fluid passage, axial bore 61 of sleeve 60 is still sealed by top releasing plug 9 to prevent fluid passage through axial bore 61. Fluid passage around adapter 70 is prevented by the wipers of the top cementing plug 23 attached to threads 79 of adapter 70.

Referring again to FIG. 2a, race bearing 91 and 92 allows free rotation of collar 50 within bushing 40 thereby allowing rotation of adapter 70, which is initially held within collar 50 to rotate freely. Thus, plugs 23 and 24 are free to rotate relatively to cementing head adapter 19. This rotational freedom acts to prevent premature release of plug 23 caused by rotational forces tending to rotate plug 23 relative to cementing head adapter 19.

Referring again to FIGS. 1 and 2, during initial insertion of the subsurface portion 7 of cementing plug system 1 into inner casing 31, the wipers of plugs 23 and 24 tend to resist such insertion and thus cause an upward force upon adapter 70 of mechanism 20. This upward force on adapter 70 pushes expandable ledge portion 55 of collar 50 upward within axial bore 41 of bushing 40 and hence moves contractible ledge portion 51 upward in contact with annular ledge 37. Further upward movement of collar 50 is prevented by the contact between portion 51 and ledge 37. Portion 51 is outwardly restrained by flared portion 62 of sleeve 60 even during this upward movement, since shear member 80 attaches sleeve 60 to adapter 70 so that flared portion 62 moves upwardly with contractible ledge portion 51. An alternate means of limiting upward movement of collar 50 would be limiting upward movement of adapter 70 by shaping top cementing plug 23 so as to abut the lower edge of bushing 40 when attached to adapter 70, and thereby prevent adapter 70 from upward movement. Preventing upward movement of adapter 70 would prevent upward movement of collar 50, attached thereto.

While the apparatus of this invention has been described in terms of a top plug release mechanism for an oil well cementing plug system, it will be understood by those of ordinary skill in the art that the invention is in no way limited to such a mechanism, but has broad applicability to releasable conduit connections actuated by a closure member.

I claim:

1. Apparatus, for attaching an object to a pipe having an internal ledge and releasing the object in response to the combination of both the landing of a closure member within said apparatus and subsequent internal pressurization of the pipe, comprising:
   a. collar means, having a contractible partially continuous external ledge, for releasably interlocking with and partially continuously contacting said internal ledge of the pipe;
   b. sleeve means, having an axial bore, for receiving the closure member and outwardly restraining said contractible external ledge only until the closure member has been landed on said sleeve means and a given internal pressure has been sustained within the pipe, said sleeve means being at least partly disposed within said collar means;
   c. adapter means, attached to one of said collar and sleeve means, for supporting the object; and
   d. sealing means, between said closure member and the pipe, for internally sealing the pipe when the closure member has landed on said sleeve means.

2. Apparatus as recited in claim 1, further comprising:
   a. swivel means between the pipe and said adapter for allowing rotation of said adapter relative to the pipe.

3. The apparatus of claim 2, further comprising:
limit means, attached to the pipe, for preventing said collar means from moving completely out of said pipe.

4. The apparatus of claim 1, further comprising:
limit means, attached to the pipe, for preventing said collar means from moving completely out of said pipe.

5. The apparatus of claim 1, wherein:
said collar means also includes expandable lower internal ledge means for releasably interlocking with a portion of said adapter means.

6. The apparatus of claim 5, further comprising:
restraint means, connected to said pipe, for maintaining said internal ledge means engaged with said portion of said adapter until after said external ledge has been released from said internal ledge of said pipe.

7. The apparatus of claim 5, further comprising:
restraint means, connected to said housing, for maintaining said internal ledge means engaged with said portion of said adapter until after said external ledge has been released from said internal ledge of said pipe.

8. Apparatus as recited in claim 1, further comprising:
first restraint means, connected to said sleeve means and said adapter means, for releasably attaching said sleeve means to said adapter means and maintaining the position of said sleeve means with respect to said contractible ledge until the closure member has landed on said sleeve means and said given internal pressure has been reached within the pipe.

9. Apparatus as recited in claim 8, further comprising:
a. limit means, attached to the pipe, for limiting the downward movement of said collar within the pipe; and
b. release means, attached to said collar means, for fully releasing said adapter from said collar when full downward movement of said collar within the pipe has occurred.

10. Apparatus as recited in claim 9, wherein:
a. said collar means is a double collet spring having a contractible upper external ledge and an expandable lower internal ledge;
b. said limit means further comprises a second internal annular ledge on the pipe and a corresponding body portion of said double collet spring, said body portion having an outer diameter greater than the diameter of the internal rim of said second ledge of the pipe, whereby downward movement of said body portion brings said body portion into restraining contact with said second ledge of the pipe.

11. The apparatus of claim 9, wherein:
said limit means includes an annular shoulder of said pipe and a body portion of said collar means, said body portion being of an external diameter greater than the internal diameter of said annular shoulder and less than the internal diameter of a middle portion of the pipe immediately above said annular shoulder, whereby said collar means can move downward relative said pipe only until said body portion abuts said annular shoulder.

12. The apparatus of claim 9, wherein:
said limit means includes an annular shoulder of said housing a body portion of said collar means, said body portion being of an external diameter greater than the internal diameter of a middle portion of the housing immediately above said annular shoulder, whereby said collar means can move downward in said housing only until said body portion abuts said annular shoulder.

13. Apparatus, for attaching an object to a pipe having an internal ledge and releasing the object in response to the combination of both the landing of a closure member within said apparatus and the subsequent internal pressurization of the pipe, comprising:
a. a housing, which comprises:
i. an upper portion having a first axial bore therethrough,
ii. a lower portion having a second axial bore therethrough;
iii. a middle portion, between said upper and lower portions, having a third axial bore greater than said second axial bore, so that an internal annular shoulder is formed between said lower portion and said middle portion, and
iv. a bottom section, connected to said lower section, having a fourth axial bore of diameter less than said second axial bore so as to create an annular shoulder between said middle portion and said bottom section;
b. a collar, carried within said housing, which comprises:
i. a contractible upper external ledge, releasably supported by said annular shoulder of said housing,
ii. an expandable lower internal ledge, and
iii. a body portion connecting and separating said contractible upper external ledge to said expandable lower ledge;
c. a sleeve, carried within said collar, which comprises:
i. a landing surface,
ii. a restraint portion connected to said landing surface and expansively abutting said contractible upper ledge of said collar,
iii. a shearing portion connected to said restraint portion,
iv. a locking portion connected to said shearing portion, and
v. a pusher portion, connected to said shearing portion;
d. an adapter, carried within said collar, which comprises:
i. a shearing portion in alignment with said shearing portion of said sleeve,
ii. a recess portion connected to said shearing portion and externally recessed so as to conform to the periphery of said expandable lower internal ledge of said collar and receive said expandable lower internal ledge,
iii. a connector portion connected to said recess portion, and adapted to hold the object; and
iv. connecting member means, releasably affixing said sleeve in a first position within said adapter so that said adapter may assume a second position within said adapter.

14. Apparatus, as recited in claim 13, further comprising:
swivel means, between said contractible ledge of said collar and said first annular shoulder of said hous-
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ing, for allowing rotation of said collar relative to said housing.

15. Apparatus, as recited in claim 14, wherein:
said swivel means comprises an annular race bearing
and an annular thrust bearing.

16. The apparatus of claim 15, wherein:
said collar means also includes expandable lower in-
ternal ledge means for releasably interlocking with
a portion of said adapter means.

17. A well cementing plug apparatus for use in cement-
ing a casing in a well bore by flowing a fluid into the
casing, comprising:
a. a housing having an internal ledge;
b. means for connecting said housing to the casing,
with said housing extending longitudinally in the
casing, said housing having a passage therethrough
for the flow of fluid into said casing through said
housing;
c. a cementing plug, having a passage therethrough
for the flow of fluid from said housing passage into
said casing;
d. closure member means, in said fluid, for closing
said plug passage;
e. releasable means for connecting said plug to said
housing and releasing said plug means from said
housing in response to the pressure of said fluid in
said housing upon closing of said plug passage, said
releasable means comprising:
i. collar means, having a contractible partly contin-
uous external ledge, for releasable interlocking
with a partially continuously said internal ledge
of said housing,
ii. sleeve means, having an axial bore therethrough
for the flow of fluid through said sleeve means
and having a flared end for receiving the closure
member and outwardly restraining said contract-
ible external ledge of said collar means only until
the closure member has landed on said sleeve
means a certain fluid pressure is reached within
said housing, said sleeve means being at least
partly disposed within said collar means;
iii. adapter means, attached to one of said collar
and sleeve means, for supporting the plug;
iv. sealing means, between said closure member
and housing, for internally sealing the plug pas-
sage when the closure member has landed on
said sleeve means.

18. The apparatus of claim 17, further comprising:
limit means, attached to the housing, for preventing
the collar means from moving completely out of
said housing.

19. A well cementing plug apparatus, as recited in
claim 17, further comprising:
swivel means between the pipe and said adapter for
allowing rotation of said adapter relative to the
pipe.

20. The apparatus of claim 19, further comprising:
limit means, attached to said housing, for preventing
said collar means from moving completely out of
said housing.

21. A well cementing plug apparatus, as recited in
claim 19, further comprising:
first restraint means, connected to said sleeve means
and said adapter means, for releasably attaching
said sleeve means to said adapter means and main-
taining the position of said sleeve means with re-
spect to said adapter means until the closure mem-
ber has landed on said sleeve means and said given
internal pressure has been reached within the pipe.

22. A well cementing plug apparatus, as recited in
claim 21, further comprising:
a. limit means, attached to the pipe, for limiting the
downward movement of said collar within the pipe;
and
b. release means, attached to said collar means, for
fully releasing said adapter from said collar when
full downward movement of said collar within the
pipe has occurred.

23. A well cementing plug apparatus, as recited in
claim 22, wherein:
said collar means is a double collet spring having
a contractible upper external ledge and an expand-
able lower internal ledge;
said limit means further comprises a second inter-
nal annular ledge on the pipe and a corresponding
body portion of said double collet spring, said body
portion having an outer diameter greater than the
diameter of the internal rim of said second ledge of
the pipe, whereby downward movement of said body
portion brings said body portion into restraining
contact with said second ledge of the pipe.

24. A well cementing plug launching apparatus, for
delayed launching of a cementing plug in response to
the landing of a closure member in said apparatus and
subsequent internal pressurization of a conduit there-
above, comprising:
a. connector means for connecting said apparatus to
a conduit thereof;
b. a housing connected to said connector means, said
housing having an annular shoulder;
c. adapter means, attached to said plug, for support-
ing said plug, said adapter having an annular shoul-
der;
d. collar means, releasably connecting said adapter to
said housing, for releasing said adapter from said
housing in at least a distinct two-step sequential de-
layed response to sustained pressure in said conduit
following landing of said closure member in said
apparatus, said release means including:
i. first bendable finger means for releasably inter-
locking with said annular shoulder of said hous-
ing;
ii. second bendable finger means for releasably in-
terlocking with said annular shoulder of said adapter.

25. The apparatus of claim 24, further comprising:
limit means, attached to said housing, for preventing
said collar means from moving completely out of
said housing.

26. The apparatus of claim 24, further comprising:
restraint means, attached to said adapter means, for
restraining movement of said collar means until
said closure member has landed in said apparatus
and a predetermined pressure is reached within
said conduit.

27. The apparatus of claim 24, wherein:
said first bendable finger means includes a contract-
ible ledge, said contractible ledge being associated
with the first step of said two distinct steps of said
sequential response.

28. The apparatus of claim 27, wherein:
said second bendable finger means includes an ex-
pandable ledge, said expandable ledge being asso-
ciated with the second step of said two distinct
steps of said sequential response.