

SUPERINTENDENCIA DE INDUSTRIA Y COMERCIO	
RAD: 14-114249- -2	FECHA: 2015-07-02 11:00:39
DEP: 2020 DIRECCION DE NUEVAS CREACIONES	EVE: 378 FASE NACIONAL INCLUIDO CAPITULO I
TRA: 11 PCT-PATENTE DE INVENCION CAPITULOS I Y II	FOLIOS: 7
ACT: 430 REQUERSOLICITA	

DIRECCIÓN DE NUEVAS CREACIONES

2020
Bogotá, D.C.,

Abogado(a)/Señor(a)
SILVANA MARÍA LÓPEZ DÍAZ

Asunto: Radicación: 14-114249- -2
Trámite: 11
Evento: 378
Actuación: 430
Oficio: 7488
Folios: 7

Patente de Invención	X			Patente de Modelo de Utilidad	
Vía Nacional					
Vía PCT (Fase Nacional)	X	Capítulo I	X	Capítulo II	
No. Solicitud Internacional	PCT/US2012/067732				
Fecha de Presentación Internacional	04/12/2012				

Como resultado del examen de fondo realizado, con fundamento en el Artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se comunica:

1. Documentos estudiados

Descripción:	Rad. N° 14-114249-00000-0000	27/Mayo/2014
Reivindicaciones:	Rad. N° 14-114249-00000-0000	27/Mayo/2014
Dibujos:	Rad. N° 14-114249-00000-0000	27/Mayo/2014
Prioridad:	US 13/343,874	05/Enero/2012

2. Análisis de la Prioridad

Se acepta la reivindicación de prioridad porque ésta solicitud fue presentada dentro del plazo establecido (Art. 9 D 486) y su contenido técnico corresponde con el de la prioridad reivindicada.

3. Objeto de la invención

De acuerdo con lo establecido en el numeral 1.2.2.2 del Capítulo Primero del Título X de la Circular Única para efectos del examen de patentabilidad, se tendrá en cuenta la tasa pagada por el solicitante al momento de comenzar el examen para las reivindicaciones adicionales; esto es que cuando la solicitud contenga más de diez (10) reivindicaciones y

no se haya pagado la tasa complementaria, sólo se estudiarán las cubiertas por la tasa pagada. Por lo tanto, se estudiarán las reivindicaciones 1 a 18.

Título de la solicitud: “Herramienta de caída para taponado de fondo de pozo” (Fl. 1).

El problema planteado en esta solicitud, consiste en lograr una herramienta de caída para taponado de fondo de pozo, con la que se pueda reducir el tiempo y los recursos necesarios en las operaciones de taponado y perforación.

Para resolver este problema técnico, la solicitud en estudio propone una herramienta de caída para taponado que comprende un cuerpo que define una cámara, un tapón alojado en la cámara y un cuerpo con el que se puede permitir la comunicación entre la cámara y un espacio anular.

El objeto de la presente solicitud se relaciona con la Clasificación Internacional de Patentes (CIP): E 21 B 23/06, 33/12.

4. De la solicitud de patente

Reivindicaciones (Art 30 D 486, Art 22 PCT)

El capítulo reivindicatorio no es claro porque:

- Las reivindicaciones 7, 13 y 14, y las expresiones: “...y que se puede accionar para selectivamente permitir comunicación entre la cámara y un espacio anular por lo menos definido parcialmente por el cuerpo, el tapón se puede mover en el espacio anular cuando se permite la comunicación” (reivindicación 1), “...que se bloquea selectivamente por el elemento.” (reivindicación 3), “...la tapa se dispone para evitar que el tapón salga de la cámara.” (reivindicación 5), “...que permite que las fuerzas ejercidas sobre la tapa se transfieran al elemento para mover el elemento dentro del cuerpo.” (reivindicación 6), “...dispuesto de forma operativa para fijar la herramienta de aislamiento en una estructura de fondo de pozo, el mecanismo de anclaje se conecta inicialmente a la herramienta de aislamiento y se desconecta de la misma después de fijación...”, “...configurado para dejar caer un tapón, el tapón se dispone de forma operativa (...) mediante la herramienta de aislamiento.” (reivindicación 11), “...par permitir el aislamiento mediante la herramienta de aislamiento.” (reivindicación 15); describen funciones, efectos, ventajas o resultados a alcanzar, los cuales no son aspectos susceptibles de patente. Para mayor claridad, el producto reclamado se debe definir técnicamente mediante sus características estructurales. Se sugiere al solicitante eliminar las reivindicaciones y las expresiones citadas.
- El término “por lo menos” (reivindicaciones 1, 5, 6, 12, 16, 17), es impreciso, por lo cual no permite distinguir la invención del estado de la técnica. Se sugiere sustituirlo por un término preciso o un rango concreto.
- No es clara la dependencia entre la reivindicación 9 y la reivindicación 1, toda vez que en la reivindicación 9 se reclama el ensamble de pozo en su totalidad y en la reivindicación 1 se reclama solamente la herramienta de caída para taponado. Con el fin de superar esta objeción de claridad, se sugiere al solicitante reemplazar la

expresión: *“la herramienta de la reivindicación 1”*, por las características constructivas de la herramienta.

- La expresión *“más pequeño”* (reivindicación 8), es relativo y no permite hacer una comparación con el estado de la técnica. Se sugiere eliminarlo o remplazarlo por un termino concreto.

5. Determinación del Estado de la Técnica

El estado de la técnica se determinó con base en fecha de presentación de la solicitud de prioridad: enero 05 de 2012, y se encontraron los siguientes documentos que anticipan el objeto de esta solicitud:

Ítem	Documento	Título	Fecha de Publicación
D1	US 2004/0055753	'Downhole ball dropping apparatus'	25/Marzo/2004
D2	US 7'624.810	'Ball dropping assembly and technique for use in a well'	01/Diciembre/2009

El documento D1¹ divulga un mecanismo de liberación de bola que es montado cerca de un asiento. La bola o bola son mantenidas fuera del flujo circulante. Altas ratas de circulación posiciona un puerto exterior en posición para permitir que la bola o bolas sean empujadas por un resorte (resumen).

El documento D2² divulga una técnica en la que un objeto es liberado para permitir que el objeto fluya hacia un asiento en el camino del flujo para impedir la comunicación del fluido, de tal manera que la herramienta pueda ser accionada en respuesta de la comunicación de fluido impedida (resumen).

6. Examen de Patentabilidad (Art 14 D486)

Novedad (Art 16 D486)

La reivindicación 1: *“Una herramienta de caída para taponado, que comprende: un cuerpo que define una cámara; un tapón alojado inicialmente en la cámara; y un elemento dispuesto con el cuerpo...”* (Ver página 11 del radicado N° 14-114249-00000-0000).

Comparación de las características técnicas esenciales, con las del estado de la técnica:

Características esenciales	D1	D2
Una herramienta de caída para taponado caracterizada por:	Aparato para tirar una bola de pozo caracterizado por:	Ensamble para dejar caer una bola caracterizado por:
Un cuerpo que define una cámara.	Un alojamiento (10) (Fig. 1; Párr. [0009]).	La bola (260) es alojada en un bolsillo lateral (220) del alojamiento (227) (Figs. 8 y 9; Col. 5, líneas 50 a 55).
Un tapón alojado inicialmente en la cámara.	Las bolas (22) y (24) son retenidas por la superficie inclinada (26) (Fig. 1; Párr.	

1 <https://docs.google.com/viewer?url=patentimages.storage.googleapis.com/pdfs/US20040055753.pdf>

2 <https://docs.google.com/viewer?url=patentimages.storage.googleapis.com/pdfs/US7624810.pdf>

	[0009]).	
Un elemento dispuesto con el cuerpo.	El resorte (32) desplaza la camisa (30) para posicionar la salida (20) para dejar salir las bolas (22) y (24) con un empujón del resorte (28) (Figs. 1 a 3; Párr. [0009]).	Un pistón (230) reside en el bolsillo (220) hasta que el ensamble (40) es accionado (Figs. 8 y 9; Col. 5, líneas 55 a 57).

De acuerdo con la tabla anterior, las características esenciales de la herramienta de la reivindicación 1 habían sido divulgadas previamente en los documentos D1 y D2, por lo tanto, la materia reivindicada no es nueva.

Asimismo, los documentos D1 y D2 divulgan las características de las reivindicaciones dependientes así:

- Reivindicación 2: Las bolas (22) y (24) (D1. Fig. 1; Párr. [0009]). La bola (260) (D2: Figs. 8 y 9; Col. 5, líneas 50 a 55).
- Reivindicación 3: La salida (20) (D1: Figs. 1 a 3; Párr. [0009]). Una salida por donde pasa la bola (260) cuando es liberada (D2: Figs. 8 y 9).
- Reivindicación 4: Una camisa (30) deslizante (D1: Figs. 1 a 3; Párr. [0009]).
- Reivindicaciones 5 y 6: El resorte (32) desplaza la camisa (30) para posicionar la salida (20) para dejar salir las bolas (22) y (24) con un empujón del resorte (28) (D1: Figs. 1 a 3; Párr. [0009]).El bolsillo (220) es creado por una tapa (224) dispuesta en la abertura radial (205) del alojamiento (227). El pistón (230) es sostenido en su posición retenida por un pasador de seguridad (250) que asegura el pistón (230) a la tapa (224) (D2: Figs. 8 y 9; Col. 5, líneas 52 a 54).
- Reivindicaciones 8 y 10: El alojamiento (10) comprende un asiento de bola montado en el portador de pelota (16) o en otro alojamiento en comunicación con el alojamiento (10) (D1: Figs. 1 a 3; Párr. [0008]). El ensamble que deja caer la bola (40) es accionado y deja caer la bola en la pasaje (30), la bola fluye in el pasaje (30) hasta que alcanza un asiento de válvula que es parte, por ejemplo, de la herramienta (42) (D2: Col. 3, líneas 5 a 12). El ensamble también comprende el elemento anular de sellado (46) o el sello (54) (D2: Fig. 5).
- Reivindicación 9: El alojamiento (10) es conectado en la rosca (12) a un equipo de pozo (D1: Figs. 1 a 3; Párr. [0008]8). Una sarta de perforación que (30) incluye un ensamble que deja caer una bola (40) (D2: Col. 2, líneas 42 a 44).

La reivindicación 11: “*Un ensamble de fondo de pozo que comprende: una herramienta de aislamiento; un mecanismo de anclaje dispuesto de forma operativa para fijar la herramienta de aislamiento...*” (Ver página 12 del radicado N° 14-114249-00000-0000).

Comparación de las características técnicas esenciales, con las del estado de la técnica:

Características esenciales	D1	D2
Un ensamble de fondo de pozo caracterizado por:	Aparato para tirar una bola de pozo caracterizado por:	Ensamble para dejar caer una bola caracterizado por:
Una herramienta de aislamiento.	El alojamiento (10) comprende un asiento de bola montado en el portador de pelota (16) o en otro alojamiento en comunicación con el alojamiento (10) (D1: Figs. 1 a 3; Párr. [0008]).	Un asiento de válvula que es parte, por ejemplo, de la herramienta (42) (D2: Col. 3, líneas 5 a 12). El ensamble también comprende el elemento anular de sellado (46) o el sello (54) (D2: Fig. 5).
Un mecanismo de anclaje.	Rosca (12) (Figs. 1 a 3; Párr. [0008]).	Un mecanismo de anclaje (Figs. 8 y 9).
Una herramienta de caída para taponado acoplada con el mecanismo de anclaje.	El alojamiento 10 comprende la camisa (30) y el resorte (32) y el portador de bolas (16) (Figs. 1 a 3; Párr. [0008]).	Una herramienta de caída para taponado acoplada con el mecanismo de anclaje (Figs. 2, 8 y 9).

De acuerdo con la tabla anterior, las características esenciales del ensamble de la reivindicación 11 habían sido divulgadas previamente en los documentos D1 y D2, por lo tanto, la materia reivindicada no es nueva.

Asimismo, los documentos D1 y D2 divulgan las características de las reivindicaciones dependientes así:

- Reivindicación 12: Una sarta de perforación (30) (D2: Col. 2, líneas 5 a 7).

La reivindicación 15: “*Un método para realizar una operación fondo de pozo que comprende: hacer funcionar un ensamble de fondo de pozo en una estructura de fondo de pozo...*” (Ver página 13 del radicado N° 14-114249-00000-0000).

Comparación de las características técnicas esenciales, con las del estado de la técnica:

Características esenciales	D2
Un método caracterizado por:	Aparato para tirar una bola de pozo caracterizado por:
Hacer funcionar un ensamble de fondo de pozo en una estructura de fondo de pozo, el ensamble de fondo de pozo incluye un mecanismo de anclaje, una herramienta de aislamiento y una herramienta de caída para taponado.	Hacer funcionar un ensamble de fondo de pozo en una estructura de fondo de pozo, el ensamble de fondo de pozo incluye un mecanismo de anclaje, una herramienta de aislamiento (42), (44), (46) y una herramienta de caída para taponado (40) (Fig. 1).
Fijar la herramienta de aislamiento en la estructura de fondo de pozo con el mecanismo de anclaje.	Fijar la herramienta de aislamiento en la estructura de fondo de pozo con el mecanismo de anclaje (Figs. 1 a 4).
Desconectar el mecanismo de anclaje de la herramienta de aislamiento.	Desconectar el mecanismo de anclaje de la herramienta de aislamiento (Fig. 5).
Desplegar un tapón de la herramienta de	Desplegar un tapón de la herramienta de

caída para taponado.	caída para taponado (Fig. 6B, paso 114; Fig. 9).
Enganchar el tapón con la herramienta de aislamiento.	El ensamble que deja caer la bola (40) es accionado y deja caer la bola en la pasaje (30), la bola fluye in el pasaje (30) hasta que alcanza un asiento de válvula que es parte, por ejemplo, de la herramienta (42) (D2: Col. 3, líneas 5 a 12).

De acuerdo con la tabla anterior, las características esenciales del método de la reivindicación 15 habían sido divulgadas previamente en los documentos D1 y D2, por lo tanto, la materia reivindicada no es nueva.

Asimismo, los documentos D1 y D2 divulgan las características de las reivindicaciones dependientes así:

- Reivindicación 16: Una salida por donde pasa la bola (260) cuando es liberada (D2: Figs. 8 y 9).
- Reivindicación 17: Un pistón (230) reside en el bolsillo (220) hasta que el ensamble (40) es accionado (D2: Figs. 8 y 9; Col. 5, líneas 55 a 57).
- Reivindicación 18: El ensamble que deja caer la bola (40) es accionado y deja caer la bola en la pasaje (30), la bola fluye in el pasaje (30) hasta que alcanza un asiento de válvula que es parte, por ejemplo, de la herramienta (42) (D2: Col. 3, líneas 5 a 12).

Las reivindicaciones 7, 13 y 14 fueron afectadas en el numeral 4 de esta comunicación.

7. Conclusión

Los requisitos de Patentabilidad de la presente solicitud están afectados así:

Ítem	Documento	Reivindicaciones afectadas	Requisito que afecta
D1	US 2004/0055753	1 a 15	Novedad/Nivel Inventivo
D2	US 7'624.810	1 a 18	Novedad/Nivel Inventivo

En cumplimiento del artículo 45 de la Decisión 486 de la Comisión de la Comunidad Andina, se le indica que debe dar respuesta dentro del término de sesenta (60) días contados a partir del día siguiente de la fecha de notificación de la presente comunicación. En caso de no dar respuesta al presente requerimiento, o si a pesar de la respuesta subsistieran los impedimentos para la concesión, se denegará la patente.

Se invita al solicitante se sirva indicar, si así lo considera, su renuncia al término faltante de sesenta (60) días para dar respuesta a este requerimiento y presentarla por escrito.

Finalmente, se le recuerda al solicitante que si como respuesta a este requerimiento llegara a modificar el capítulo reivindicatorio y éste contenga más de diez (10) reivindicaciones, no pagará la tasa de modificación voluntaria pero sí la correspondiente al pago por reivindicación adicional.

Notifíquese el presente oficio conforme a lo dispuesto en el numeral 5.2, literal e), del capítulo quinto del título primero de la Circular Única No. 10 de 2001.



JOSÉ LUIS SALAZAR LÓPEZ
Director de Nuevas Creaciones (c)

El anterior requerimiento fue notificado por fijación en lista, de fecha 2015-07-07

Elaboró: Monica Andrea Gutierrez Almonacid
Revisó: Rachid Ponce Vergel



US 20040055753A1

(19) **United States**(12) **Patent Application Publication****Davis et al.**(10) **Pub. No.: US 2004/0055753 A1**(43) **Pub. Date: Mar. 25, 2004**(54) **DOWNHOLE BALL DROPPING APPARATUS****Publication Classification**(76) Inventors: **John P. Davis**, Cypress, TX (US);
Gerald D. Lynde, Houston, TX (US)(51) **Int. Cl.⁷** **E21B 34/06; E21B 34/10**(52) **U.S. Cl.** **166/318; 166/317**

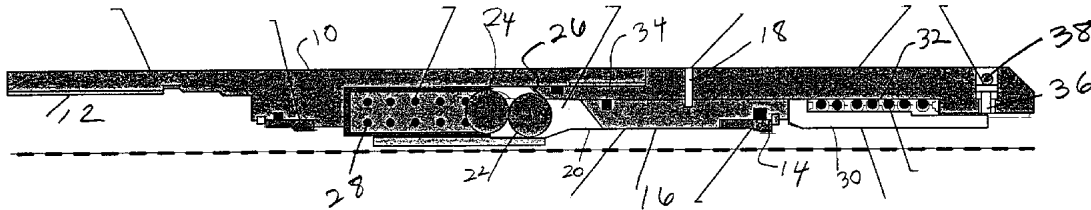
Correspondence Address:

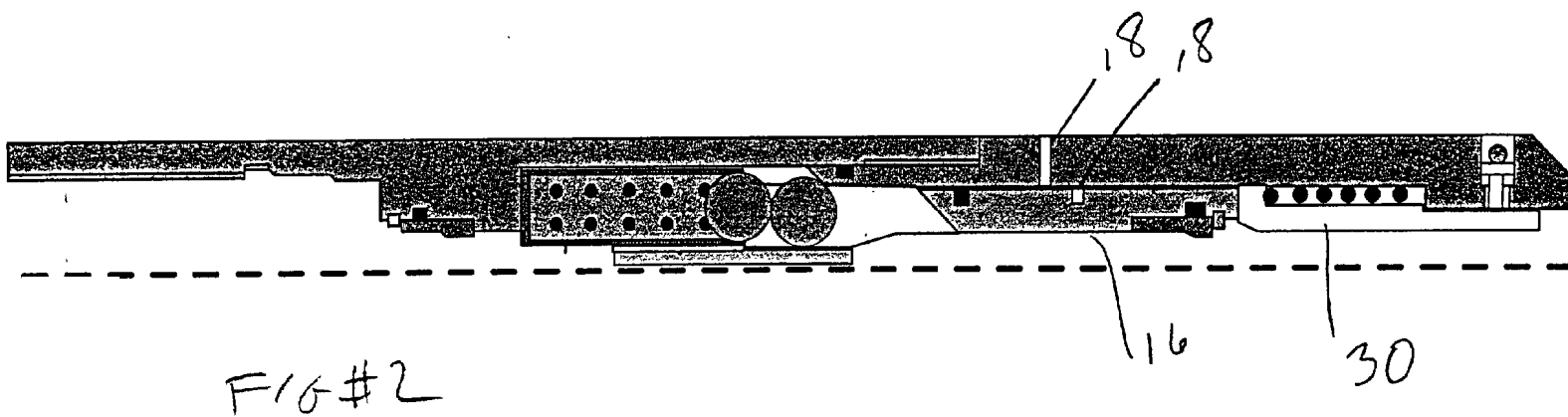
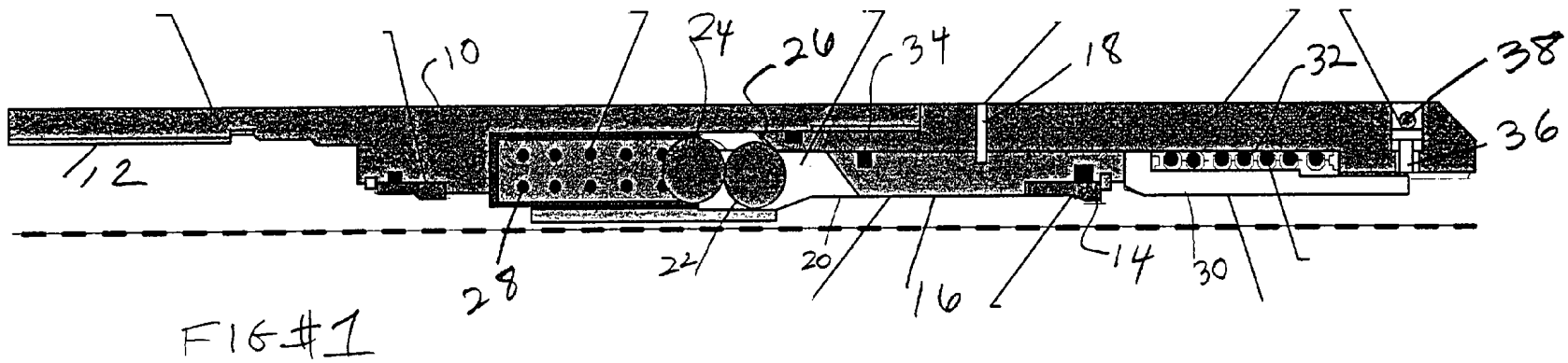
Richard T. Redano**Duane Morris LLP****Suite 500****One Greenway Plaza****Houston, TX 77046 (US)**

(57)

ABSTRACT

A ball release mechanism is mounted near the intended seat. The ball or balls are kept out of the circulating stream. High circulation rates followed by curtailment of circulation places an outlet port in position to allow the ball or balls to be pushed out by a spring. The spring or one of the balls prevents the return of an ejected ball back into the protected pocket. The ball is delivered to the seat without circulation.

(21) Appl. No.: **10/254,104**(22) Filed: **Sep. 24, 2002**



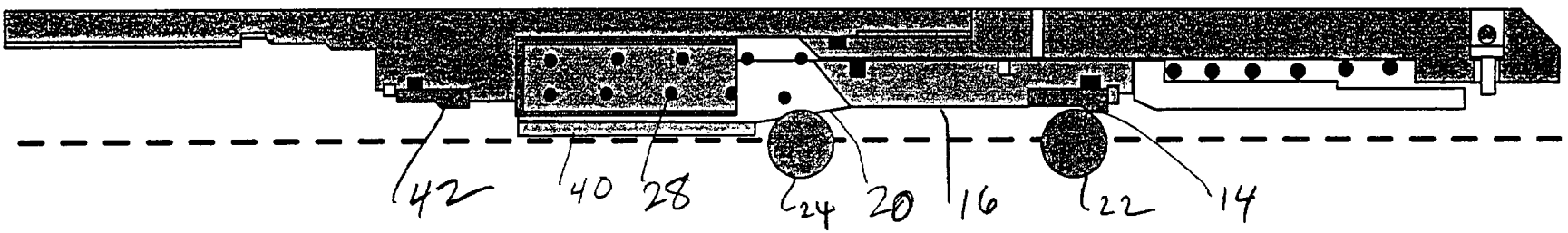


FIG #3

DOWNHOLE BALL DROPPING APPARATUS

FIELD OF THE INVENTION

[0001] The field of the invention is a ball release device and more particularly a device that is mounted near the hole bottom with the stored ball or balls protected until release after circulation.

BACKGROUND OF THE INVENTION

[0002] Most prior ball release devices store the ball in the fluid stream and use circulation to transport it to the seat. Several problems can occur with this design. The ball may not release because the carrier gets clogged with debris from the mud. The carrier can become worn resulting in premature release of the ball. The ball is released during high circulation. It can slam against a seat and create high pressure spikes that can damage other equipment. The high circulation rates around the ball can erode parts of it causing it to not hold pressure even if it lands on the ball seat. Some examples of prior designs that have the ball in the circulating path are U.S. Pat. Nos. 6,390,200; 6,220,360; and 5,960,881. U.S. Pat. No. 4,171,019 shows a cement float shoe with a ball in a side pocket such that it can be displaced against a ball seat if the flow direction reverses. Balls have been used to fix a range of motion of a sleeve valve member, as shown in U.S. Pat. No. 4,406,335.

[0003] What the prior devices lacked is addressed by the present invention. The ball is retained near its intended seat near the bottom of the hole. It is retained out of the flowing stream. The ball discharge procedure is such that ball release occurs after circulation is stopped and not during circulation. Once the ball is released it is prevented from reentering its original storage location. These and other benefits of the present invention will be more apparent to those skilled in the art from a review of the description of the preferred embodiment and the claims, which appear below.

SUMMARY OF THE INVENTION

[0004] A ball release mechanism is mounted near the intended seat. The ball or balls are kept out of the circulating stream. High circulation rates followed by curtailment of circulation places an outlet port in position to allow the ball or balls to be pushed out by a spring. The spring or one of the balls prevents the return of an ejected ball back into the protected pocket. The ball is delivered to the seat without circulation.

DETAILED DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a part section view of the tool during the run in;

[0006] FIG. 2 is the view of FIG. 1 in the circulation position;

[0007] FIG. 3 is the view of FIG. 2 with the ball released after circulation has ceased.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0008] Referring to FIG. 1, a housing 10 is connected at thread 12 to a string and downhole equipment (not shown). Housing 10 comprises a primary ball seat 14 preferably mounted on ball carrier 16 or in another housing in fluid

communication with housing 10. As illustrated, ball seat 14 provides resistance to circulation to move the ball carrier 16. However, that resistance can be from another constriction on ball carrier 16 with the ball seat in another housing in fluid communication with housing 10. In the preferred embodiment, the balls 22 and 24 drop less than a meter to get to ball seat 14. A shear pin 18 initially holds the ball carrier 16 to the housing 10. In the run in position, an outlet port 20 is so positioned that balls 22 and 24 cannot escape. Balls 22 and 24 are biased toward tapered surface 26 on ball carrier 16 by spring 28. Housing 10 further comprises a sleeve 30 biased by spring 32 toward ball carrier 16. A seal 34 seals between ball carrier 16 and housing 10. For run in, sleeve 30 holds in detent pin 36 against the bias of spring 38.

[0009] The operation of the tool will now be reviewed. Circulation is started through housing 10. As a result a net force is applied to ball carrier 16 shifting it down against sleeve 30 and compressing spring 32. While the restriction from ball seat 14 that causes ball carrier 16 to be displaced by circulation is shown at the lower end of the ball carrier 16, the actual restriction that causes the ball carrier 16 to shift can be located elsewhere on ball carrier 16, while the ball seat 14 can be in any other location below balls 22 and 24. The shear pin 18 is broken by movement of ball carrier 16. Balls 22 and 24 are held retained by tapered surface 26. Circulation is then stopped. Spring 32 displaces sleeve 30 to position outlet port 20 in alignment to let balls 22 and 24 escape with a push from spring 28. Ball 22 lands on primary ball seat 14, which is less than a meter away, while ball 24 is optional. Ball 24 keeps ball 22 near seat 14 because the upper end 40 of ball carrier 16 as well as spring 28 in its extended position help to maintain ball 24 in the position shown in FIG. 3. Spring 38 has pushed out detent pin 36 to prevent needless cycling of ball carrier 16 at a later time when circulation is resumed for other purposes.

[0010] A secondary ball seat 42 is provided to accept a ball dropped from the surface in a known manner, in the event ball 22 fails to seal or hold enough pressure against primary ball seat 14.

[0011] Those skilled in the art will appreciate that the present invention has many unique features. The ball or balls are stored out of the flowing path of mud and are less likely to be eroded or deformed by circulation. The balls are not released during circulation. Pressure spikes are eliminated as the balls are released from a location very close to the seat after circulation has stopped. There is no need to wait a long time for the ball to seat from the time of release, because the release point is so close to the ultimate seat location. This tool can be run below tools that would not be able to pass a ball. The tool is of particular advantage on a horizontal run. In the past, a ball dropped from the surface could land in many places short of the desired seat. This is particularly the case when running long lengths of screen to be expanded in a horizontal run. In the present invention, seating occurs almost immediately after release due to the close proximity between the release point and the seat. In the unlikely event of a failure of the tool, a secondary seat is provided to allow a backup ball to be dropped in the known manner. Alternatively, a plurality of balls of different sizes can be stored in the tool. Bigger balls can reuse Ball seat 14 after an initial ball expands the seat a given amount in a known manner. Alternatively, smaller balls can be subsequently released that will pass through seat 14 after the first ball is blown

through it and land on another seat further down. While the preferred embodiment has been shown with two balls, one ball or more balls can be used. They can be released all at once or one at a time such as by using a ratchet device actuated by cycling the circulation on and off. To do this the detent pin **36** could be eliminated. No rotation is required to operate the tool making it useful in deviated wells.

[0012] The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made without departing from the spirit of the invention.

We claim:

1. A ball dropping apparatus, comprising:

a housing having an uphole and a downhole end and a passage through it;

at least one obstructing member mounted in said housing;

said obstructing member selectively movable from an initial position where it is located outside of said passage to an obstructing position in said passage.

2. The apparatus of claim 1, further comprising:

a seat in one of said passage and a connected housing to the ball dropping apparatus, said obstructing member allowing pressure buildup at said uphole end of said housing when it is located on said seat.

3. The apparatus of claim 1, further comprising:

said obstructing member is selectively released by virtue of flow through said passage.

4. The apparatus of claim 3, wherein:

said obstructing member is selectively released only by the onset and subsequent cessation of flow through said passage.

5. The apparatus of claim 1, wherein:

said obstructing member in said initial position is disposed in a side compartment selectively accessible to said passage.

6. The apparatus of claim 5, further comprising:

a selectively movable carrier to hold said obstructing member in said side compartment, in a first position, and to allow release of said obstructing member from said side compartment, when placed in a second position.

7. The apparatus of claim 6, wherein:

said carrier further comprises a flow passage therethrough and wherein a primary seat is mounted in one of said flow passage and a housing connected to the ball dropping apparatus to receive said obstructing member.

8. The apparatus of claim 6, wherein:

said carrier is biased in a direction where said obstructing member will be allowed to exit said side compartment.

9. The apparatus of claim 8, wherein:

said carrier is initially secured to said housing with said bias overcome.

10. The apparatus of claim 9, wherein:

said carrier is mounted in said passage;

said initial securing of said carrier is broken with flow through said flow passage.

11. The apparatus of claim 10, wherein:

said obstructing member remains trapped in said side compartment while flow through said passage overcomes said bias on said carrier.

12. The apparatus of claim 11, wherein:

said obstructing member is released from said side compartment when said bias on said carrier shifts it, upon cessation of flow through said passage.

13. The apparatus of claim 12, wherein:

said carrier comprises an outlet opening that shifts into alignment with said obstructing member as a result of its movement under said bias.

14. The apparatus of claim 12, wherein:

said carrier is locked into position after being shifted by said bias.

15. The apparatus of claim 14, wherein:

said bias on said carrier comprises a spring protected from said passage by a sleeve, said sleeve initially covers a detent in said housing, whereupon when said sleeve is biased against said carrier to move it in a first direction, said detent emerges from said housing into said passage to prevent significant movement of said carrier in a second direction opposite said first direction.

16. The apparatus of claim 5, wherein:

said obstructing member is biased toward said passage from within said side compartment.

17. The apparatus of claim 6, further comprising:

a spring in said side compartment, said spring preventing reentry of said obstructing member into said side compartment.

18. The apparatus of claim 6, wherein:

said at least one obstructing member comprises a plurality of balls; and

a second of said balls prevents a first of said balls, that exits said side compartment, from reentering.

19. The apparatus of claim 2, wherein:

said obstructing member enters said passage within 1 meter of said seat.

20. The apparatus of claim 19, wherein:

said obstructing member comprises a ball; and

said housing comprises a backup seat for use if said ball fails to hold pressure against said seat.

* * * * *



US007624810B2

(12) **United States Patent**
Fould et al.

(10) **Patent No.:** **US 7,624,810 B2**
(45) **Date of Patent:** **Dec. 1, 2009**

(54) **BALL DROPPING ASSEMBLY AND
TECHNIQUE FOR USE IN A WELL**

5,183,114 A 2/1993 Mashaw et al.
5,224,044 A 6/1993 Tamura
5,921,318 A 7/1999 Ross

(75) Inventors: **Jeremie C. Fould**, Perth (AU); **Timothy M. O'Rourke**, Jakarta (ID); **Michael W. Rea**, Edmonton (CA); **Bryan C. Linn**, Pearland, TX (US)

(Continued)

(73) Assignee: **Schlumberger Technology Corporation**, Sugar Land, TX (US)

FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

RU	907225	2/1982
RU	1709078	1/1992
RU	2175713	11/2001
RU	2178065	1/2002
WO	WO03095794	11/2003
WO	WO04088091	10/2004

(21) Appl. No.: **11/962,308**

(22) Filed: **Dec. 21, 2007**

(65) **Prior Publication Data**

US 2009/0159297 A1 Jun. 25, 2009

OTHER PUBLICATIONS

(51) **Int. Cl.**

E21B 33/12 (2006.01)

E21B 33/00 (2006.01)

E21B 12/02 (2006.01)

(52) **U.S. Cl.** **166/387**; 166/332.5; 166/319;
166/374; 166/66; 175/39; 175/324

(58) **Field of Classification Search** 166/387,
166/325, 319, 332.5, 374, 66, 67, 328, 75.15;
188/67; 175/39, 324

See application file for complete search history.

Thomson et al., "Design and Installation of a Cost-Effective Completion System for Horizontal Chalk Wells where Multiple Zones require Acid Stimulation," OTC, May 1997.

Houston, TX, SPE 51177 (a revision of SPE 39150).

Primary Examiner—Jennifer H Gay

Assistant Examiner—Yong-Suk Ro

(74) *Attorney, Agent, or Firm*—James L. Kurka

(57) **ABSTRACT**

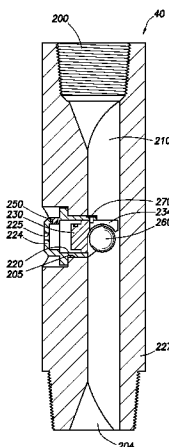
(56) **References Cited**

U.S. PATENT DOCUMENTS

3,011,548 A	12/1961	Holt	
3,054,415 A	9/1962	Baker et al.	
3,269,463 A	8/1966	Page, Jr.	
3,995,692 A	12/1976	Seitz	
4,064,937 A	12/1977	Barrington	
4,355,686 A	10/1982	Arendt et al.	
4,491,177 A *	1/1985	Baugh	166/75.15
4,729,432 A	3/1988	Helms	
4,823,882 A *	4/1989	Stokley et al.	166/387

A technique that is usable with a well includes running string that includes a tool and a flowable object that is held in a retained position within the string downhole in the well. After the string is run downhole in the well, the flowable object is released to permit the object to flow in and subsequently seat in a flow path of the string to impede fluid communication so that the tool may be actuated in response to the impeded fluid communication.

20 Claims, 11 Drawing Sheets



US 7,624,810 B2

Page 2

U.S. PATENT DOCUMENTS							
				6,997,263	B2	2/2006	Campbell et al.
				7,273,096	B2 *	9/2007	Den Boer et al. 166/66
5,960,881	A *	10/1999	Allamon et al. 166/291	2003/0019634	A1	1/2003	Henderson et al.
5,988,285	A	11/1999	Tucker	2004/0020652	A1	2/2004	Campbell et al.
6,059,032	A	5/2000	Jones	2004/0118564	A1	6/2004	Themig et al.
6,155,342	A	12/2000	O'Neal	2004/0221997	A1 *	11/2004	Giroux et al. 166/380
6,216,785	B1	4/2001	Achee, Jr. et al.	2006/0124310	A1	6/2006	Lopez de Cardenas et al.
6,302,199	B1 *	10/2001	Hawkins et al. 166/70	2006/0243455	A1	11/2006	Telfer et al.
6,334,486	B1	1/2002	Carmody				
6,634,429	B2	10/2003	Henderson et al.				
				* cited by examiner			

FIG. 2

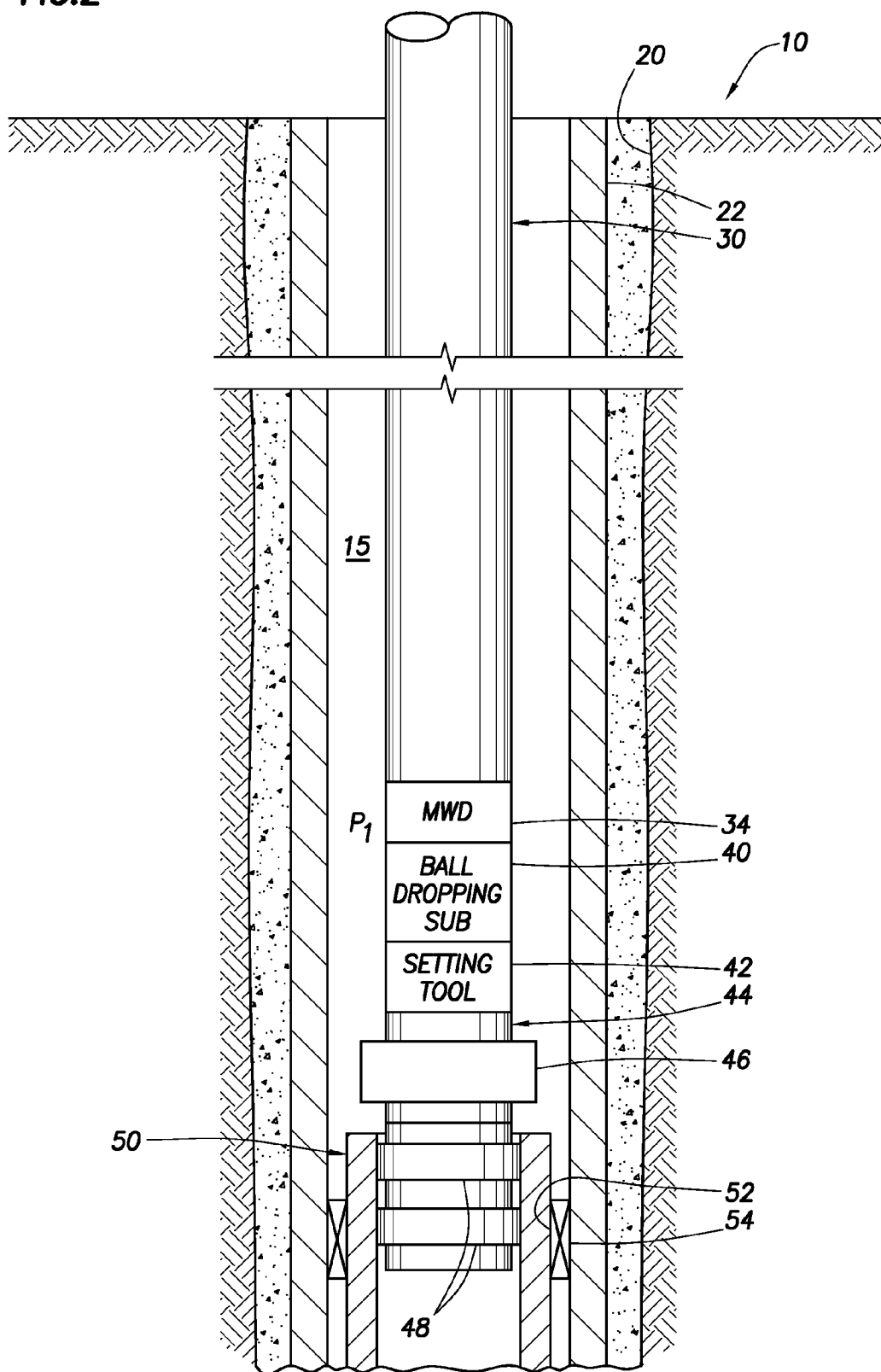


FIG. 3

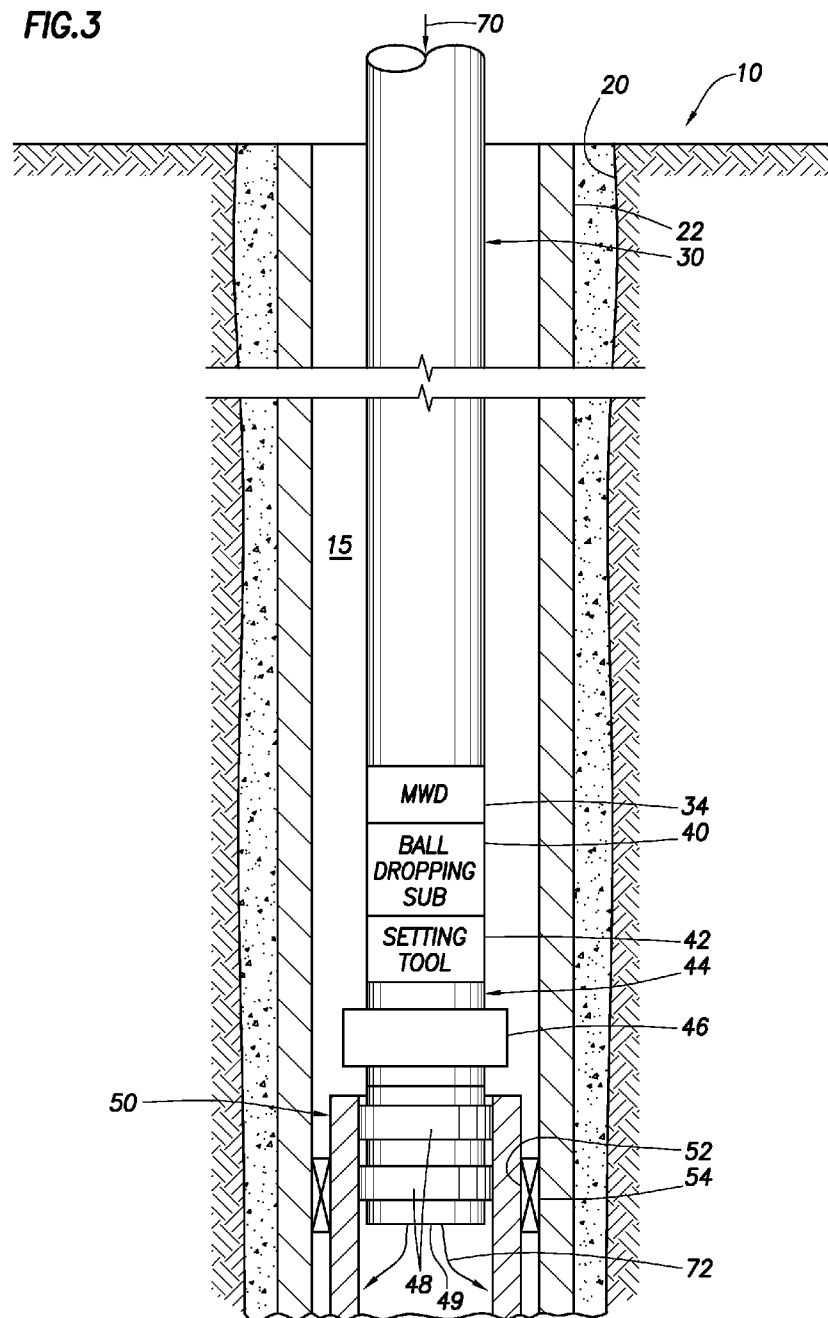
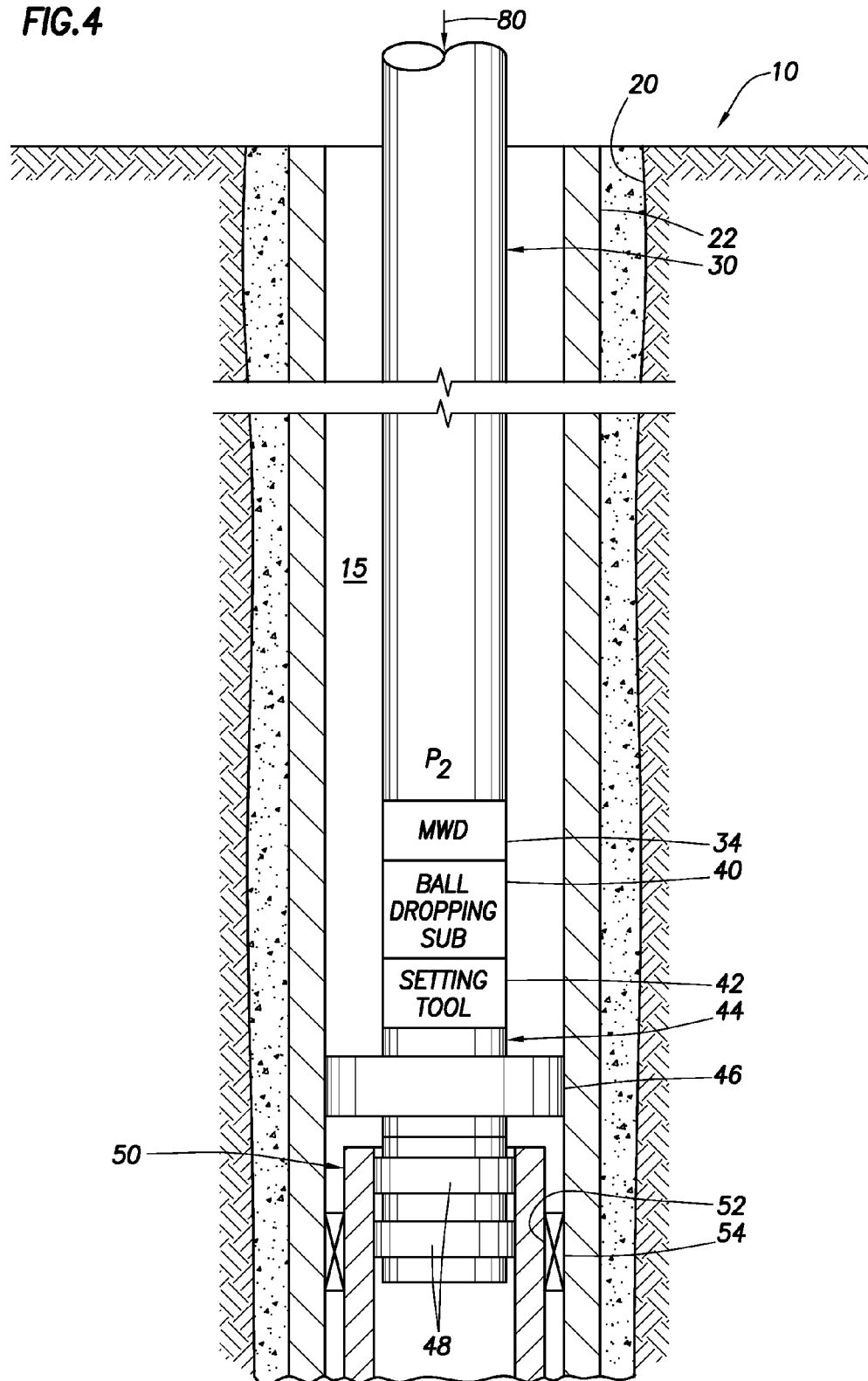


FIG. 4



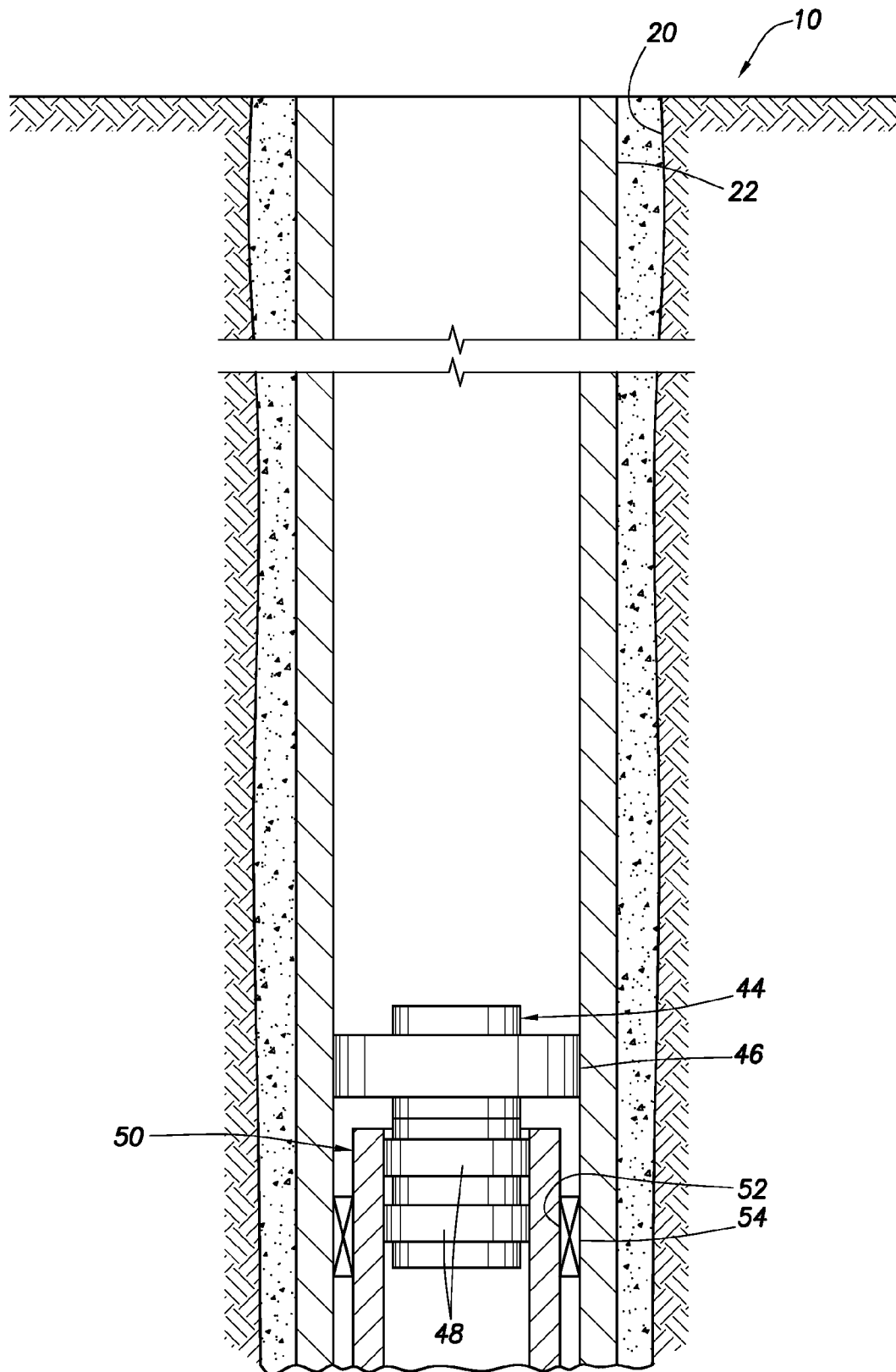


FIG. 5

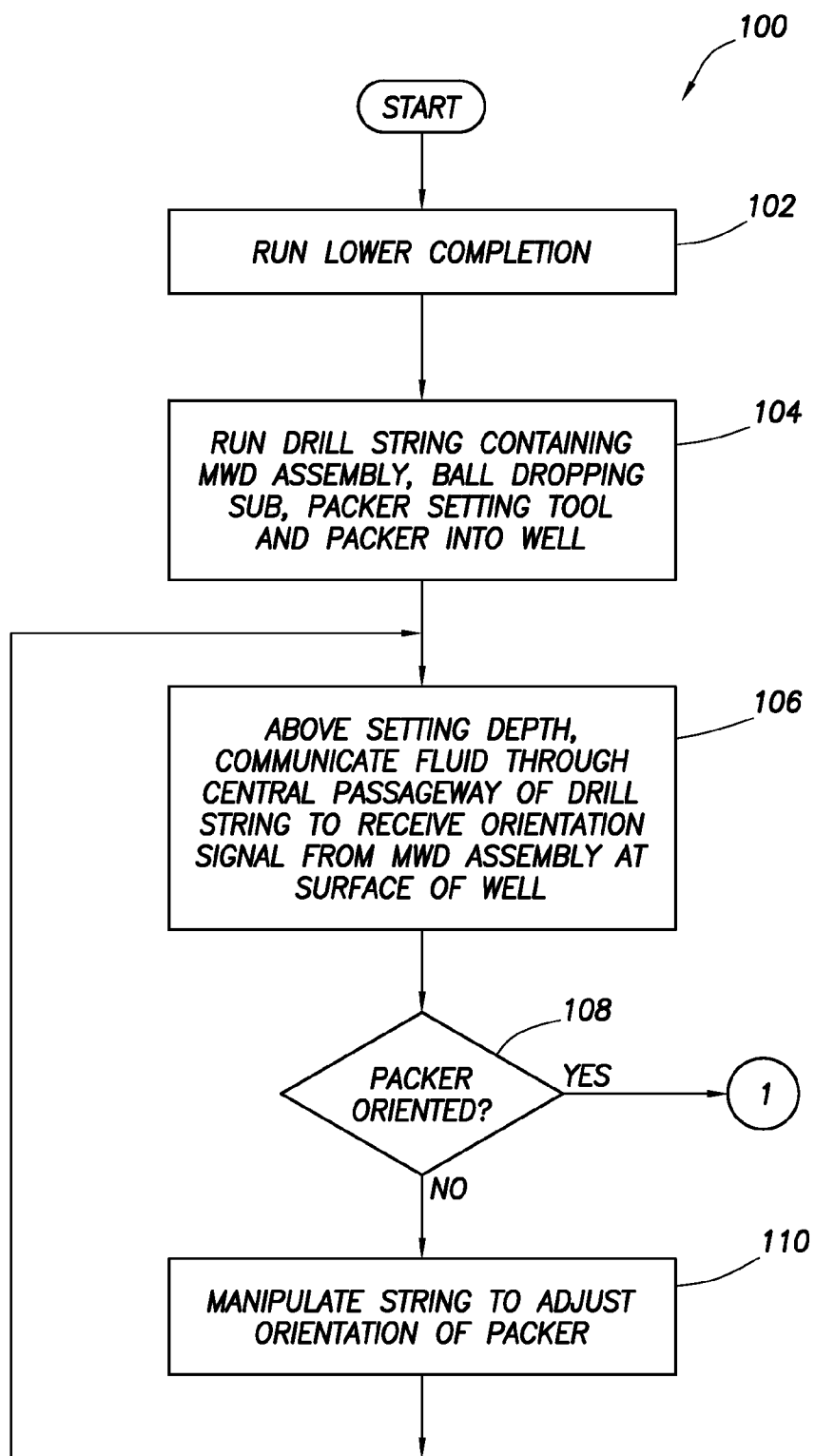
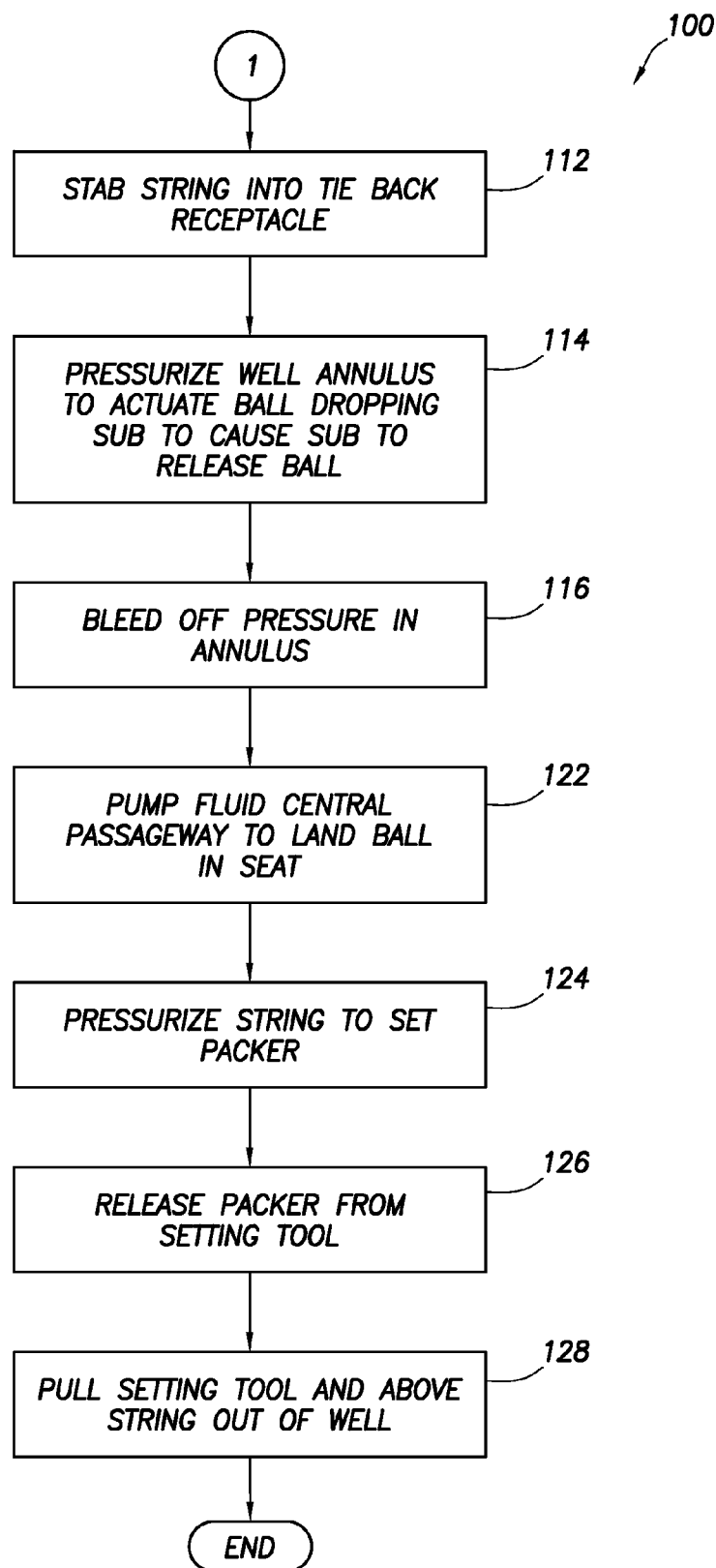


FIG. 6A

FIG. 6B



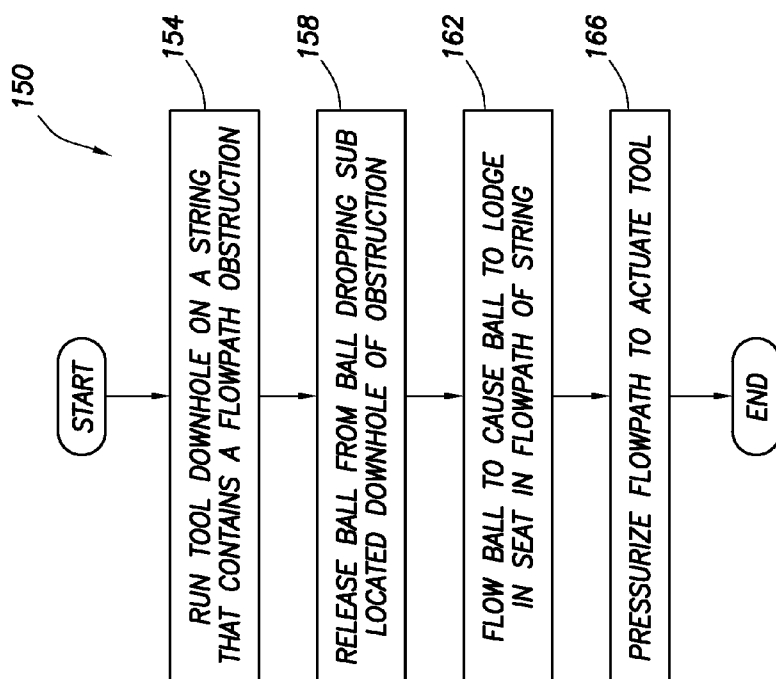
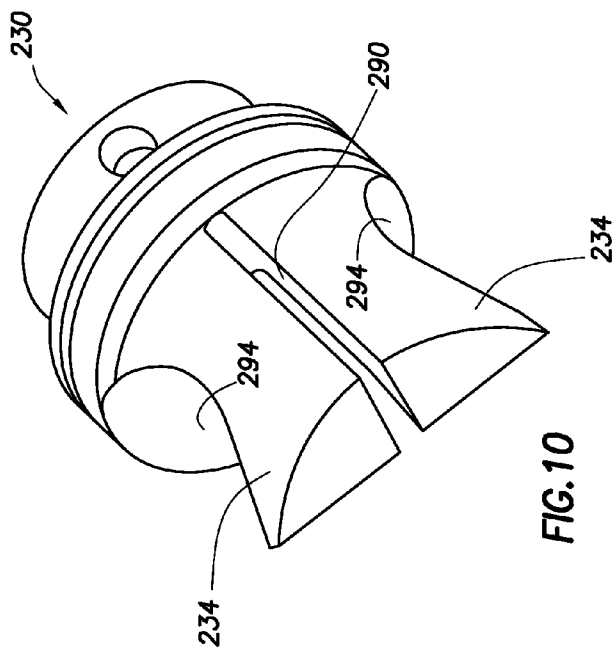


FIG.7



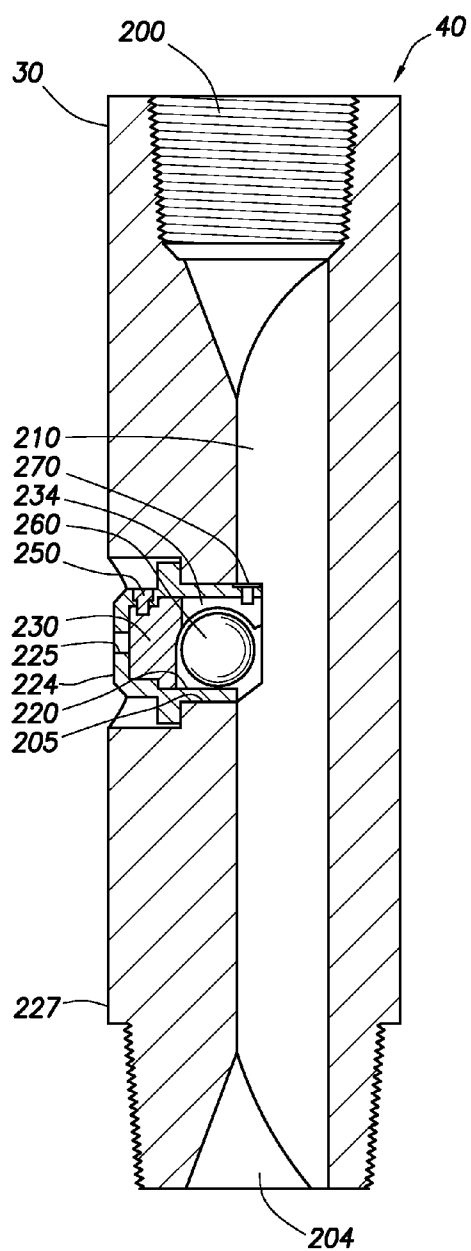


FIG. 8

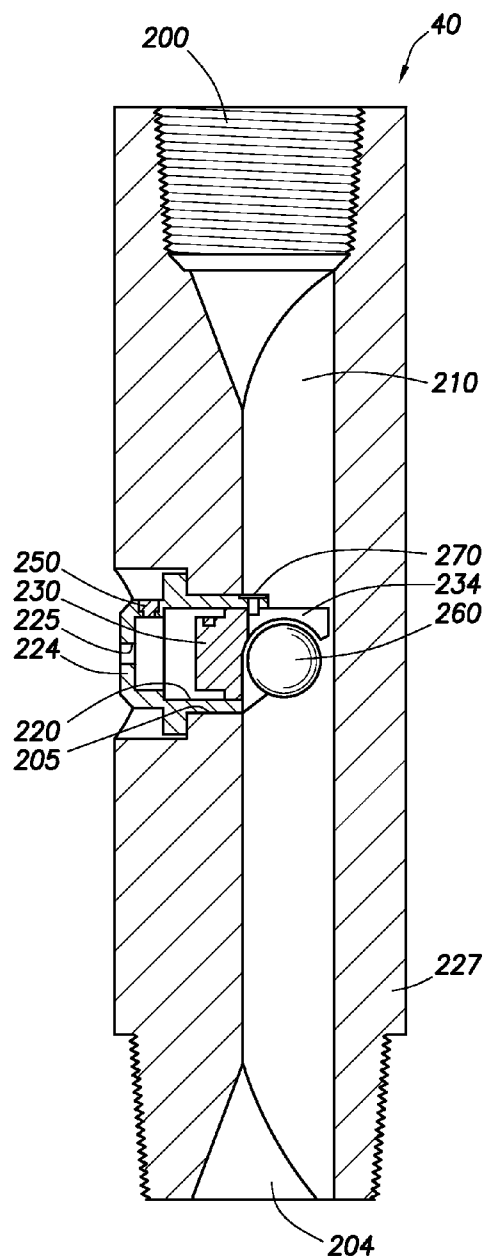
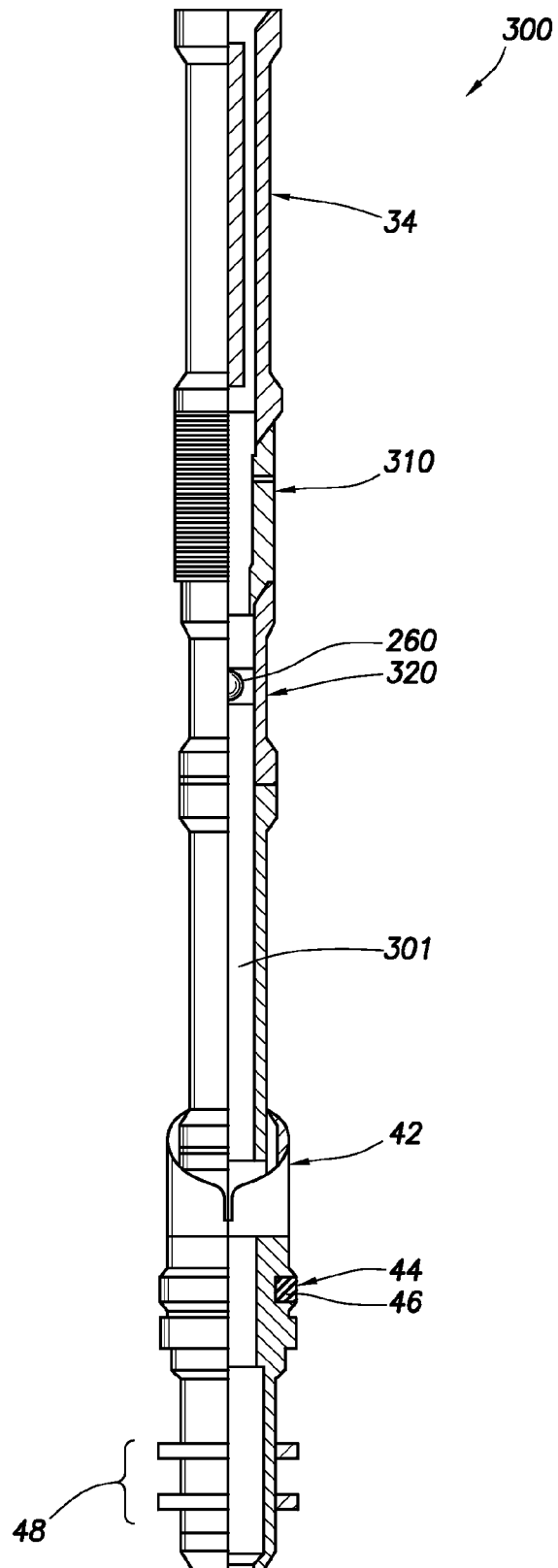
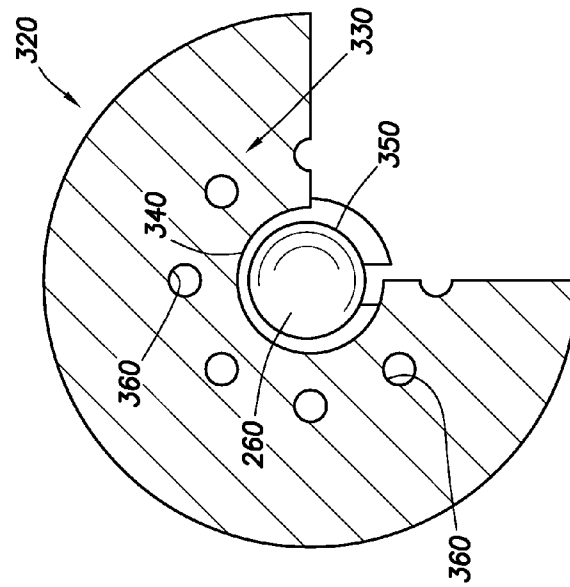
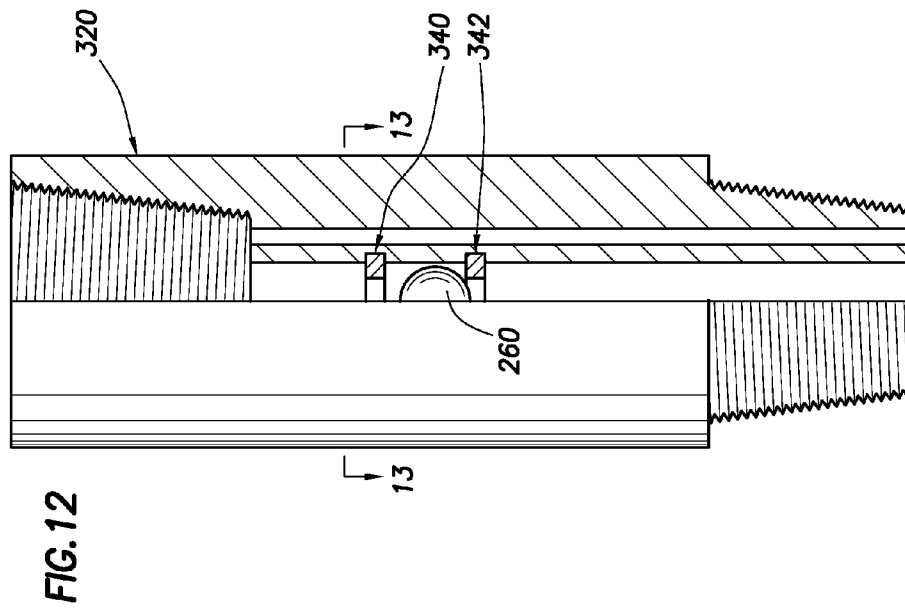


FIG. 9

FIG. 11





1

BALL DROPPING ASSEMBLY AND TECHNIQUE FOR USE IN A WELL

BACKGROUND

The invention generally relates to a ball dropping assembly and technique for use in a well.

Various tools (valves, chokes, packers, perforating guns, injectors, as just a few examples) typically are deployed downhole in a well during the well's lifetime for purposes of testing, completing and producing well fluid from the well. A number of different conveyance mechanisms may be used for purposes of running a particular tool into the well. As examples, a typical conveyance mechanism may be a coiled tubing string, a jointed tubing string, a wireline, a slickline, etc.

Once deployed in the well, a given tool may be remotely operated from the surface of the well for purposes of performing a particular downhole function. For this purpose, a variety of different wired or wireless stimuli (pressure pulses, electrical signals, hydraulic signals, etc.) may be communicated downhole from the surface of the well to operate the tool.

Another way to remotely operate a downhole tool is through the deployment of a ball from the surface of the well into a tubing string that contains the tool. More specifically, a ball may be dropped into the central passageway of the string from the surface of the well. The ball travels through the string and eventually lodges in a seat of the string to block fluid communication through the central passageway. As a result of the blocked fluid communication, the tubing string may be pressurized for purposes of actuating the tool. The above-described traditional approach of deploying a ball in the string to actuate a tool of the string assumes that, in general, no obstruction exists in the central passageway, which would prevent the ball from traveling from the surface of the well to the seat in which the ball lodges.

SUMMARY

In an embodiment of the invention, a technique that is usable with a well includes running string that includes a tool and a flowable object that is held in a retained position within the string downhole in the well. After the string is run downhole in the well, the flowable object is released to permit the object to flow in and subsequently seat in a flow path of the string to impede fluid communication so that the tool may be actuated in response to the impeded fluid communication.

In another embodiment of the invention, a technique that is usable with a well includes running a packer downhole in the well on a drill string and using a flow modulator of the drill string to communicate an orientation of the packer to the surface of the well. The packer is oriented in response to the communicated orientation, and downhole of the flow modulator, a flowable device is introduced into a central passageway of the string to impede fluid communication through the string. The packer is set in response to the impeded fluid communication.

In another embodiment of the invention, a system that is usable with a well includes a flowable object, a string and a retaining device. The string includes a flow path and a tool that is adapted to be actuated by the flowable object. The retaining device is located in the string and is adapted to retain the flowable object during a run in hole state of the string and be actuated to release the flowable object into the flow path to actuate the tool.

2

Advantages and other features of the invention will become apparent from the following description, drawing and claims.

BRIEF DESCRIPTION OF THE DRAWING

FIGS. 1, 2, 3, 4 and 5 are schematic diagrams of a well illustrating different phases of the well associated with running, orienting and setting an anchor packer in a single trip according to an embodiment of the invention.

FIGS. 6A and 6B depict a flow chart illustrating a technique to run, orient and set an anchor packer according to an embodiment of the invention.

FIG. 7 is a flow diagram depicting a technique to use a ball to actuate a downhole tool when an obstruction to the ball exists in a string that contains the tool according to an embodiment of the invention.

FIG. 8 is a cross-sectional view of a ball dropping sub before a ball of the sub is released according to an embodiment of the invention.

FIG. 9 is a cross-sectional view of the ball dropping sub depicting release of the ball according to an embodiment of the invention.

FIG. 10 is a perspective view of a piston of the ball dropping sub according to an embodiment of the invention.

FIG. 11 is a schematic diagram of a lower assembly of a drill string according to another embodiment of the invention.

FIG. 12 is a schematic diagram of a ball dropping sub of the lower assembly of FIG. 11 according to an embodiment of the invention.

FIG. 13 is a partial cross-sectional view taken along line 13-13 of FIG. 12 according to an embodiment of the invention.

DETAILED DESCRIPTION

Referring to FIG. 1, a tubular drill string 30 (a jointed drill string or a coiled tubing drill string, as non-limiting examples) may be deployed in a well bore 20 of a well 10 for purposes of running, orienting and setting an anchor packer 44 in a single downhole trip. In this regard, the drill string 30 may have been previously used for purposes of forming the wellbore 20, and the drill bit of the drill string 30 has been removed. The drill string 30 includes a lower assembly that includes a measurement while drilling (MWD) assembly 34; a ball dropping assembly, or sub 40; packer setting tool 42; and the packer 44. The MWD assembly 34 is used, as described further below, for purposes of communicating packer orientation data (data indicative of an azimuth of the packer 44, for example) to the surface of the well. Thus, after the packer 44 is run downhole in the vicinity of its setting depth, the drill string 30 may be rotated until the uphole signal communicated by the MWD assembly 34 indicates that the packer 44 is in the proper orientation. When this occurs, the packer setting tool 42 of the drill string 30 is remotely actuated (as described in more detail herein), which causes the tool 42 to set the packer 44, i.e., cause expansion of slips, or dogs, of the packer 44 and causes the radial expansion of one or more annular sealing elements 46 (one sealing element 46 being depicted in FIG. 1) of the packer 44.

Although the MWD assembly 34 is useful for purposes of communicating information related to the orientation of the packer 44 uphole to the surface of the well, the assembly 34 introduces a flow path obstruction for a flowable device (such as a ball, for example) that may otherwise be deployed from the surface of the well through the string 30 for purposes of actuating the packer setting tool 44. In other words, in conventional drill strings, the presence of the MWD assembly 34 prohibits the use of flowable devices, such as balls, for purposes of actuating devices downhole of the assembly 34, such as the packer setting tool 42. However, unlike conventional

3

drill strings, the drill string 30 includes the ball dropping sub 40, which is located below the MWD assembly 34 and thus, is located downhole from the obstruction that is created by the assembly 34.

As described herein, the ball dropping sub 40 is actuated by, for example, annulus pressure (i.e., pressure appearing in an annulus 15 that surrounds the string 30), and when actuated, the ball dropping sub 40 deploys a ball into the central passageway of the string 30. The deployed ball flows downhole in the string 30 until the ball lodges in a valve seat of the drill string 30 (a valve seat that is part of the packer setting tool 42, for example). The lodged ball blocks fluid communication through the central passageway of the string 30 downhole of the seat. Because the packer setting tool 42 is actuated via tubing conveyed pressure, fluid may be introduced into the drill string 30 from the surface of the well for purposes of pressurizing the string 30 to actuate the tool 42.

It is noted that FIG. 1 is merely an example of one of many possible strings that may contain a ball dropping sub, in accordance with many different contemplated embodiments of the invention. Although FIG. 1 depicts the wellbore 20 as being cased by a casing string 22, it is noted that the systems and techniques that are disclosed herein may likewise be used in connection with uncased wellbores.

For the particular example depicted in FIG. 1, a liner hanger 50 has been deployed as part of a lower completion in the wellbore 20, and as shown, the liner hanger 50 is mechanically and sealably (via a seal 54) connected to the inside of the casing string 22. In general, the liner hanger 50 includes a tie back receptacle 52, which is constructed to be stabbed by a lower end 49 of the drill string 30 such that annular seals 48 of the drill string 30 form a seal between the tie back receptacle 52 and the exterior of the drill string 30.

FIGS. 6A and 6B depict a technique 100 to run, orient and set the packer 44 in accordance with some embodiments of the invention; and FIGS. 1-5 depict various phases of the well 10 during the running, orienting and setting operations. Referring to FIG. 6A in conjunction with FIG. 1, the technique 100 includes running (block 102) a lower completion in the well 10. In this regard, the lower completion may include the liner hanger 50, which, in turn, has the tie back receptacle 52. The liner hanger 50 may be pressure tested from the backside before the drill string 30 is run downhole with the packer 44, in accordance with some embodiments of the invention. After the lower completion is run into the well 10, the drill string 30 is run into the well, pursuant to block 104 of the technique 100.

The technique 100 includes, pursuant to block 106, running the drill string 30 downhole such that above the setting depth, fluid is communicated through a primary flow path, or central passageway, of the drill string 30 for purposes of receiving an orientation signal from the MWD assembly 34 at the surface of the well 10. Using the orientation signal that is provided by the MWD assembly, the drill string 30 is manipulated (rotated, for example) at the surface of the well 10, pursuant to block 110, until it is determined (diamond 108) that the packer 44 has the intended orientation.

For the specific example depicted in FIG. 1, before the packer 44 reaches its setting depth but is in the vicinity thereof, the drill string 30 is suspended so that a bottom end 49 of the string 30 is above the tie back receptacle 52. In this position, the drill string 30 is rotated until the packer 44 has the appropriate orientation (e.g., azimuth). For purposes of orienting the packer 44, a fluid flow 60 is introduced at the surface of the well 10 into the central passageway of the drill string 30. The MWD assembly 34 modulates the flow 60 to encode information into the flow regarding the orientation of the packer 44. In this regard, the MWD assembly 34 includes a flow modulator for encoding the orientation into the flow and an orientation sensor, such as a gyroscope, for purposes

4

of determining the orientation. The resulting modulated flow 66 returns via the annulus 15 to the surface of the well 10.

More specifically, pursuant to block 106, when the drill string 30 is above the setting depth of the packer 44, fluid is communicated through the central passageway of the drill string 30 such that an orientation signal is received from the MWD assembly 34 at the surface of the well. Pursuant to diamond 108, a determination is made whether the packer 44 is properly oriented and if not, the drill string 30 is manipulated (block 110) to adjust the orientation of the packer 44. After the packer 44 is oriented, the flow 60 is halted, and the drill string 30 is stabbed into the tie back receptacle 52, as depicted in block 112 (see FIG. 6B) of the technique 100.

Referring to FIG. 6B in conjunction with FIG. 2, after the drill string 30 is stabbed into the tie back receptacle 52, the annular seals 48 of the drill string 30 complete a seal between the outside of the drill string 30 and the interior surface of the casing string 22. Thus, at this point, the annulus 15 above the liner hanger 50 is isolated from the region of the well below the hanger 50. Measures are then undertaken for purposes of setting the packer 44.

More particularly, in accordance with embodiments of the invention, the well annulus 15 is pressurized (block 114) to a certain pressure threshold (indicated by "P₁" in FIG. 2), which actuates the ball dropping sub 40, i.e., causes the ball dropping sub 40 to release a retained ball into the central passageway of the drill string 30. After the actuation of the ball dropping sub 40, the pressure in the annulus 15 is bled off, pursuant to block 116.

Referring to FIG. 6B in conjunction with FIG. 3, after the pressure in the annulus 15 is bled off, a fluid flow 70 is introduced at the surface of the well 10 for purposes of pumping the deployed ball through the central passageway of the drill string 30 so that the ball descends from the ball dropping sub 40 to a ball seat (not shown) located in the drill string 30 in proximity to or in the setting tool 42. Thus, fluid is pumped through the central passageway of the drill string 30 for purposes of landing the ball in a seat of the string 30, pursuant to block 122 of FIG. 6B. This ball catching seat may be introduced by the packer setting tool 42, in accordance with some embodiments of the invention.

FIG. 3 depicts the drill string 30 as being stabbed into the tie back receptacle 52 during the pumping of the flow 70 into the string 30, which results in an exit flow 72 from the lower end 49 of the string 30. It is noted that the flow 70 may be introduced at a relatively slow rate. However, depending on the particular well configuration, the ball may be landed on the seat by pulling the string 30 uphole to dislodge the seals 48 from the tie back receptacle 52 so that the flow 70 is introduced while the drill string 30 remains slightly above the liner hanger 50. Regardless, however, of whether the flow 70 is introduced while the drill string 30 stabbed into or pulled out of the tie back receptacle 52, the drill string 30 is returned to/left in the tie back receptacle 52 during the next phase, which is depicted in FIG. 4.

Referring to FIG. 6B in conjunction with FIG. 4, after the ball has landed in the seat in the central passageway of the drill string 30, a fluid flow 80 is introduced at the surface of the well for purposes of pressurizing the fluid inside the drill string 30 above a certain pressure threshold (called "P₂" in FIG. 4), pursuant to block 124 of FIG. 6B. The tubing pressurization, in turn, actuates the packer setting tool 42 to cause the setting tool 42 to set the packer 44. As can be appreciated by one of skill in the art, the setting of the packer 44 causes the slips, dogs, of the packer 44 to radially expand and grip the interior wall of the casing string 22 (assuming the wellbore 20 is cased) and causes the radial expansion of the seal element(s) 46.

Referring to 6B in conjunction with FIG. 5, after the packer 44 is set, the packer setting tool 42 is operated to release a

5

latch that secures the packer 44 to the setting tool 42 for purposes of releasing the packer 44 from the setting tool 42, pursuant to block 126. As a more specific example, in accordance with some embodiments of the invention, a predetermined mechanical movement of the drill string 30 may cause the setting tool 42 to release the packer 44.

Alternatively, the packer setting tool 42 may release the packer 42 in response certain wired and/or wireless stimuli that are communicated downhole from the surface of the well 10, as another non-limiting example. After the packer 44 is released from the packer setting tool 42, the setting tool 42 and the remaining part of the drill string above the setting tool 42 are pulled out of the well 10, pursuant to block 128, which leaves the packer 44 and liner hanger 50 in the well 10, as depicted in FIG. 5.

The packer 44 is an example of one of many possible tools that may be run downhole, oriented and actuated, in accordance with embodiments of the invention. For example, in accordance with other embodiments of the invention, the packer 44 may be replaced by an oriented perforating gun, whipstock, etc. Additionally, the techniques and systems that are described herein are likewise applicable to overcoming obstructions other than the obstruction introduced by a flow modulator. As another example, the drill string 30 may include a section that has a reduced inner diameter that is sufficiently small to prohibit a ball from passing through the section. Thus, many variations are contemplated and are within the scope of the appended claims.

Referring to FIG. 7, to summarize, a technique 150 may be used for purposes of using a flowable device, such as a ball, to actuate a downhole tool for the scenario in which the string that conveys the tool downhole has an obstruction in its flow path, which would otherwise limit the downhole travel of the ball. Pursuant to the technique 150, a tool is run downhole on a string that contains a flow path obstruction, pursuant to block 154. A ball is released (block 158) into the flow path from a ball dropping sub, which is located downhole of the obstruction. The ball is flowed (block 162) to cause the ball to lodge in a seat in the flow path of the string, and the flow path is pressurized to actuate the tool, pursuant to block 166.

FIG. 8 depicts a cross-section of the ball dropping sub 40, in accordance with some embodiments of the invention, before a ball 260 that is retained by the sub 40 is released into the central passageway of the string 30. As shown in FIG. 8, the ball dropping sub 40 includes a longitudinal eccentric flow path 210 (i.e., eccentric with respect to the central passageway of the string 30) that forms part of the central passageway of the drill string 3. The eccentric flow path 210 extends between openings 200 and 204 that are located on either end of the flow path 210 and are concentric with the central passageway of the string 30.

The eccentric flow path 210 allows for the eccentric positioning of the ball 260 before the ball 260 is released into the central passageway of the drill string 30. More specifically, the ball 260 is disposed in a side pocket 220 that is created by a cap 224 that is disposed in a radial opening 205 in a housing 227 of the sub 40. The radial opening 205 extends between the annulus of the well and the eccentric flow path 210. A piston 230 resides inside the pocket 220 and until the ball sub 40 is actuated, the piston 230 retains the ball 260 (as depicted in FIG. 8) to prevent the ball 260 from being released into the eccentric flow path 210. The piston 230 is held in its ball retaining position by a shear pin 250 that secures the piston 230 to the cap 224, which is secured to the housing 227. The piston 230 contains curved fingers 234 (one finger 234 being shown in FIG. 8) that extend partially around the ball 260 retain the ball 260 when the piston 230 is located in the pocket 220, as depicted in FIG. 8.

The cap 224 (which may have a test port 225) generally protects the piston 230 from the surrounding wellbore envi-

6

ronment. However, the cap 224 permits fluid communication between the annulus and the piston 230 so that upon the application of a sufficient force, which is exerted by the fluid in the annulus 15, the shear pin 250 shears to permit the piston 230 (and its fingers 234) to move into the eccentric flow path 210, as depicted in FIG. 9, to deploy the ball 260.

Referring to FIG. 9, when the piston 230 moves so that its fingers 234 extend into the flow path 210, the ball 260 is no longer retained in the pocket 220 but rather, is free to move down the eccentric flow path 210. For purposes of maintaining the correct orientation of the piston 230 (i.e., to ensure that the piston 230 does not rotate so that the fingers 234 are located below the ball 260, for example), the ball dropping sub 40 includes a pin 270 that is secured to the cap 224 and extends into a corresponding radial groove (not shown in FIGS. 8 and 9) of the piston 230. The pin 270 and groove arrangement permits linear but not rotational motion of the piston 230 with respect to the cap 224.

Referring to FIG. 10, fluid communication through the eccentric flow path 210 is maintained even after the fingers 234 move into the eccentric flow path 210. More specifically, as depicted in FIG. 10, the fingers 234 are separated by a space 290 that allows fluid being circulated through the drill string 30 to flow through the fingers 234 and push the ball 260 out of the fingers 234. Furthermore, the fingers 234 have curved indentations 294, which are designed to further facilitate the communication of fluid past the fingers 234 when the fingers 234 extend into the flow path 210.

Other embodiments are within the scope of the appended claims. For example, in accordance with other embodiments of the invention, the lower assembly of the drill string 30 may be replaced by a lower assembly 300, which is depicted in FIG. 11. In general, the lower assembly 300 includes the MWD assembly 34, the packer setting tool 42, the packer 44 and the seals 48. However, unlike the lower assembly described above, the lower assembly 300 includes a circulation valve 310 and a ball dropping sub 320 (located below the MWD assembly 34 and a circulation valve 310), which is constructed to centrally retain the ball 260 in a central passageway 301 of the drill string. As described below, the ball dropping sub 320 is constructed to release the ball 260 in response to pressure inside the central passageway 301, instead of in response to pressure in the annulus.

Referring to FIGS. 12 and 13, the ball dropping sub 320 includes an upper split ring 340 and a lower split ring 342, which, for the ball retaining state of the sub 320, are located above and below the ball 260, respectively, for purposes of retaining the ball 260 in a space 350 between the split rings 340 and 342. The space 350 is centrally disposed in a restricted flow section 330 that generally circumscribes the split rings 340 and 342 to limit the flow past the ball 260 when the ball 260 is retained in the space 350 and contains orifices 360 that are circumferentially disposed around the space 350.

Referring also to FIG. 11, the drill string (containing the lower assembly 300) is initially run downhole with the circulation valve 310 open. In other words, in this state, the circulation valve 310 directs the flow in the central passageway (which emerges from the MWD assembly 34) through its radial fluid communication ports and into the annulus of the well, where the flow returns to the surface of the well. Thus, during the orienting of the packer 44, part of the flow that is modulated by the MWD assembly 34 is routed through the radial circulation ports of the circulation valve 310 into the annulus, and this flow returns to the surface of the well.

Another part of the flow is communicated through the orifices 360. Due to the flow restriction that is imposed by the orifices 360, a given pressure exists above the retained ball 260, which causes a downward force to be exerted on the ball 260. However, the pressure is kept below the pressure that would otherwise force the ball 260 through the lower split

7

ring **342**, due to the fluid communication path that is provided by the open circulation valve **310**.

When the lower end of the drill string is stabbed into the tie back receptacle **52** and the packer **44** is in position to be set, the circulation valve **310** is closed. In this manner, as non-limiting examples, the drill string may be manipulated in a given manner, or wired or wireless stimuli may be communicated downhole for purposes of causing the circulation valve **310** to close off the flow through its radial fluid communication ports. Due to the restricted flow path, the pressure inside the central passageway **301** above the ball **260** increases, which produces a sufficient downward force to drive the ball **260** through the lower split ring **342**. Thus the closure of the circulation valve **310** causes the ball **260** to be released into the flow and descend downwardly through the central passageway into the valve seat associated with the packer setting tool **42**.

It is noted that the ball (or other flowable device) may be retained in various positions relative to the string's flow path. More specifically, depending on the particular embodiment of the invention, the ball (or other flowable device) may be retained entirely inside the flow path of the drill string, partially inside the flow path or entirely outside of the flow. Furthermore, in accordance with some embodiments of the invention, the systems and techniques that are described herein may apply to strings that do not contain an obstruction to the ball (or other flowable device). For example, the ball may be retained downhole in the string for purposes of minimizing the time needed to actuate a downhole tool. In this manner, reducing the time to deploy the ball by placing the initial position of the ball relatively close to the setting tool (i.e., removing the time otherwise incurred by deploying the ball from the surface of the well) may result in significant cost savings, in view of the relatively high costs associated with drilling rig services.

As other examples of additional embodiments of the invention, a Universal Bottom Hole Orientation (UBHO) sub and a gyroscope may be used in place of the MWD assembly **34** in accordance with other embodiments of the invention. The UBHO may have an internal diameter that is sufficient to allow the ball (or other flowable device) to pass through the UBHO, unlike the MWD assembly **34**. Therefore, the ball catching sub may be located above the UBHO, for example.

As yet additional examples, the systems and techniques that are disclosed herein may be used with a lower assembly that does not contain a tie back receptacle. For example, the lower zone may be plugged, and the drill string **30** may also be run plugged and thus, there may not be a need to tie back.

While the present invention has been described with respect to a limited number of embodiments, those skilled in the art, having the benefit of this disclosure, will appreciate numerous modifications and variations therefrom. It is intended that the appended claims cover all such modifications and variations as fall within the true spirit and scope of this present invention.

What is claimed is:

1. A method usable with a well, comprising:

running a string comprising a housing, a tool, and a flowable object held in a retained position within the housing of the string downhole in the well;

after the string is run downhole, pressurizing fluid outside the housing to release the flowable object to permit the object to flow in a flow path within the housing of the string until it is seated therein to impede fluid communication; and

actuating the tool in response to the impeded fluid communication.

2. The method of claim 1, wherein the string comprises an obstruction in the flow path sized to prevent the flowable

8

object when in the flow path from flowing past the obstruction, the method further comprising:

retaining the flowable object below the obstruction prior to the releasing of the flowable object.

3. The method of claim 2, wherein the string comprises a drill string and the obstruction is formed by a flow modulator of the drill string.

4. The method of claim 2, wherein the obstruction is formed by a pathway of a flow modulator, the method further comprising:

receiving a signal at the surface of the well generated by the flow modulator and being indicative of an orientation of the tool.

5. The method of claim 1, further comprising:

before actuation of the tool, manipulating the string to orient the tool.

6. The method of claim 5, wherein the tool comprises an oriented packer or an oriented perforating gun.

7. The method of claim 1, wherein the act of actuating the tool comprises pressurizing fluid in the primary flow path.

8. The method of claim 1, further comprising:

disposing the flowable device in a recess of a piston disposed in a pocket disposed in the housing of the string; and

securing the piston in position to retain the flowable device in the string.

9. The method of claim 8, wherein the act of releasing the flowable object comprises actuating the piston to deploy the flowable device in the flow path.

10. The method of claim 9, wherein the act of actuating the piston comprises exerting pressure on an outer surface via the pressurized fluid outside the housing.

11. A method usable with a well, comprising:

running a packer downhole in the well on a drill string;

using a flow modulator of the drill string to communicate an orientation of the packer to the surface of the well; orienting the packer in response to the communicated orientation;

downhole of the flow modulator, introducing a flowable device by pressurizing fluid outside a housing into a central passageway of the string to impede fluid communication through the string such that fluid inside the central passageway becomes pressurized; and

setting the packer in response to the pressurization from the impeded fluid communication.

12. The method of claim 11, further comprising:

stabbing the string into a tie back receptacle, wherein the act of introducing the flowable device into the central passageway comprises pressurizing an annular region that surrounds the string while the string is stabbed into the receptacle.

13. The method of claim 11, wherein the act of introducing the flowable object into the central passageway comprises closing a circulation valve upstream of the flowable device to increase a pressure on the flowable device.

14. The method of claim 11, further comprising:

circulating fluid through the central passageway to flow the flowable device into a seat of string.

15. A system usable with a well, comprising:

a flowable object;

a string comprising a housing defining a flow path therein, and a tool adapted to be actuated by the flowable object; and

a retaining device located in the housing of the string and comprising a piston, wherein an outer surface of the piston is in contact with fluid outside the housing,

9

the retaining device adapted to retain the flowable object during a run in hole state of the string, wherein the retaining device is actuated by fluid pressure acting on the outer surface of the piston to release the flowable object into the flow path, thereby impeding fluid flow in the flow path and pressurizing the fluid therein, to actuate the tool.

16. The system of claim 15, wherein the retaining device is located below an obstruction in the flow path sized to prevent the flowable object from flowing past the obstruction.

17. The system of claim 15, wherein the flowable object is adapted to lodge in a seat of the flow path when released, the system further comprising:

a setting tool adapted to respond to pressurization of the flow path when the flowable object is lodged in the seat to actuate the other tool.

18. The system of claim 15, wherein the tool comprises a packer, a whipstock or a perforating gun.

19. A system usable with a well, comprising:

a drill string comprising a flow modulator, a packer setting tool and a packer; and

a retaining device located in the string downhole of the flow modulator, the retaining device that selectively retains a flowable object outside of a central passageway of the string and release the flowable object into the central

10

passageway based on a pressure in an annular region outside of the retaining device exceeding a pressure threshold,

wherein the flowable object, after being released into the central passageway, lodges in a seat in the central passageway to block fluid flow and build fluid pressure therein, and

wherein the packer setting tool is actuated by the fluid pressure to set the packer.

20. A system usable with a well, comprising:

a drill string comprising a flow modulator, a packer setting tool and a packer;

a circulation valve adapted to be open and closed; and a retaining device located in the string downhole of the flow modulator, the retaining device adapted to selectively retain a flowable object and release the flowable object into a central passageway of the string in response to the circulation valve closing,

wherein the flowable object, after being released into the central passageway, lodges in a seat in the central passageway to block fluid flow and build fluid pressure therein,

wherein the packer setting tool is actuated by the fluid pressure to set the packer.

* * * * *