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Drilling head assembly with latching system and fluid retention mechanism

Abstract

A head assembly for a drilling operation. The assembly includes a retractor case comprising a retractor pin slot. The assembly includes a body that comprises a body pin slot, wherein an interior space of the body is configured to receive the retractor case. The assembly includes a latch ear coupled to the body, wherein at least a portion of the latch ear extends outward relative to the body. The assembly includes an expansion block at least partially disposed within an interior space defined by the retractor case. The assembly is such that a position of the expansion block along a longitudinal axis of the assembly determines whether the latch ear is in an extended position or a retracted position relative to the body sidewall.

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Background/Summary

TECHNICAL FIELD
(1) The disclosure relates generally to assemblies for use in a drilling operation.
BACKGROUND
(2) The disclosure relates generally to a head assembly for a drilling operation. The head assembly is a portion of the equipment needed to execute a drilling operation, and works in concert with a drill bit below, a core barrel above the drill bit, a head assembly above the core barrel, and an overshot that is introduced into the hole created by the drill bit. The overshot latches onto the head assembly, which in turn couples with the core barrel to lift the drilled earth from the formation out of the hole.
(3) Conventional, known wireline drilling operations include head assemblies that can perform their intended tasks, albeit with some inefficiencies and losses that have been considered unavoidable and accepted. The head assembly and some of its subcomponents experience a harsh environment in the newly drilled hole and are subject to wear due to friction, fracture, and deformation due to stress. Drilling operations with the conventional head assemblies also consume fluid, including water and/or drilling mud. Consuming less of these fluids translates directly to a more efficient drill, and therefore a more profitable endeavor. Thus, there are problems with conventional head assemblies that remain in need of a solution.
(4) The features and advantages of the disclosure will be set forth in the description, which follows, and in part will be apparent from the description, or may be learned by the practice of the disclosure without undue experimentation. The features and advantages of the disclosure may be

realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. Any discussion of documents, acts, materials, devices, articles or the like, which has been included in the specification is not to be taken as an admission that any or all of these matters form part of the prior art base or were common general knowledge in the field relevant to the disclosure as it existed before the priority date of each claim of this disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) Non-limiting and non-exhaustive implementations of the disclosure are described with reference to the following figures, wherein like reference numerals refer to like parts throughout the various views unless otherwise specified. Advantages of the disclosure will become better understood with regard to the following description and accompanying drawings where:

(2) FIG. **1** is a schematic cross-sectional illustration of a system for performing a drilling operation;

(3) FIG. **2**A is a straight-on side view of an assembly for performing a drilling operation;

(4) FIG. **2**B is a straight-on side view of an assembly for performing a drilling operation, wherein the assembly is rotated ninety degrees relative to the view illustrated in FIG. **2**A;

(5) FIG. **3**A is a wireframe straight-on side view of an assembly for performing a drilling operation;

(6) FIG. **3**B is a wireframe straight-on side view of an assembly for performing a drilling operation, wherein the assembly is rotated ninety degrees relative to the view illustrated in FIG. **3**A;

(7) FIG. **4** is a cross-sectional side view of an assembly for performing a drilling operation;

(8) FIG. **5** is an exploded perspective view illustrating components of a latch assembly and check valve assembly for an assembly for performing a drilling operation;

(9) FIG. **6**A is a straight-on exploded view of an assembly for performing a drilling operation;

(10) FIG. **6**B is a straight-on exploded view of an assembly for performing a drilling operation, wherein the assembly is rotated ninety degrees relative to the view illustrated in FIG. **6**A;

(11) FIG. **7** is a wireframe straight-on side view of components of a latch assembly and check valve assembly of an assembly for performing a drilling operation;

(12) FIG. **8** is a straight-on side view of components of a latch assembly of an assembly for performing a drilling operation;

(13) FIG. **9**A is a cross-sectional side view of components of a latch assembly and check valve assembly of an assembly for performing a drilling operation, wherein the latch assembly is in the unlatched configuration;

(14) FIG. **9**B is a cross-sectional side view of components of a latch assembly and check valve assembly of an assembly for performing a drilling operation, wherein the latch assembly is in the latched configuration;

(15) FIG. **10** is a schematic illustration of a latch ear to be utilized as a component of a latch assembly of an assembly for performing a drilling operation;

(16) FIG. **11** is a schematic illustration of an expansion block to be utilized as a component of a latch assembly of an assembly for performing a drilling operation;

(17) FIG. **12**A is a schematic illustration depicting interactions between a latch ear and an expansion block of a latch assembly of an assembly for performing a drilling operation, wherein the latch ear is in an unlatched configuration;

(18) FIG. **12**B is a schematic illustration depicting interactions between a latch ear and an expansion block of a latch assembly of an assembly for performing a drilling operation, wherein the latch ear is in a latched configuration;

(19) FIG. **13** is a cross-sectional exploded view of components of a check valve assembly portion of an assembly for performing a drilling operation;

(20) FIG. **14** is a wireframe straight-on side view of portions of a check valve assembly of an

assembly for performing a drilling operation;
(21) FIG. **15** is a straight-on side view of a piston shaft and piston cage to be utilized as a component of an assembly for performing a drilling operation;
(22) FIG. **16** is a wireframe straight-on wide view of a retention piston of a check valve assembly of an assembly for performing a drilling operation;
(23) FIG. **17** is a straight-on exploded side view of components of a check valve assembly portion of an assembly for performing a drilling operation;
(24) FIG. **18**A is a cross-sectional straight-on side view of components of a check valve assembly portion of an assembly for performing a drilling operation, wherein the check valve assembly is in the closed configuration;
(25) FIG. **18**B is a cross-sectional straight-on side view of components of a check valve assembly portion of an assembly for performing a drilling operation, wherein the check valve assembly is in the closed configuration;
(26) FIG. **19** is a cross-sectional straight-on side view of component of a tube cap assembly is a cross-sectional straight-on side view of components of a check valve assembly portion of an assembly for performing a drilling operation, wherein the check valve assembly is in the closed configuration;
(27) FIG. **20** is a cross-sectional and exploded straight-on side view of component of a tube cap assembly portion of an assembly for performing a drilling operation;
(28) FIG. **21**A is a schematic illustration of a tube cap piston and viscosity adjustment screw, wherein the viscosity adjustment screw is substantially fully screwed into the tube cap piston; and
(29) FIG. **21**B is a schematic illustration of a tube cap piston and viscosity adjustment screw, wherein the viscosity adjustment screw is only partially screwed into the tube cap piston.

DETAILED DESCRIPTION

(30) Disclosed herein are systems, methods, and devices for performing drilling operations. Specifically disclosed herein is an assembly for performing a drilling operation. The assembly disclosed herein includes at least a latch assembly portion, a check valve assembly portion, and a tube cap assembly portion.
(31) The latch assembly portion of the assembly described herein is configured to secure the assembly to a separate tube that surrounds the assembly during a drilling operation. The latch assembly described herein includes a retractor case comprising a retractor sidewall and a retractor pin slot disposed within the retractor sidewall, wherein the retractor sidewall defines a retractor interior space. The latch assembly includes a body comprising a body sidewall and a body pin slot disposed within the body sidewall, wherein the body sidewall defines a body interior space, and wherein the body interior space is configured to receive the retractor case. The latch assembly includes a latch ear coupled to the body, wherein at least a portion of the latch ear extends outward relative to the body sidewall. The latch assembly includes an expansion block at least partially disposed within the retractor interior space. The latch assembly is such that a position of the expansion block along a longitudinal axis of the assembly determines whether the latch ear is in an extended position or a retracted position relative to the body sidewall.
(32) The check valve assembly portion of the assembly described herein is configured to adjust the flow of fluid through the assembly. The assembly includes a body comprising a sidewall, wherein the sidewall defines a hollow interior comprising a fluid chamber, and wherein the hollow interior is aligned with a longitudinal axis of the assembly. The assembly includes a fluid retention piston disposed within the fluid chamber, wherein the fluid retention piston comprises a fluid port enabling a fluid to pass through the fluid retention piston. The assembly includes the check valve assembly disposed within the fluid retention piston, wherein the check valve assembly comprises: a valve bushing comprising a sidewall that defines a bushing interior space; a valve ball; and a valve spring. The check valve assembly is in a closed configuration when the valve ball is at least partially disposed within the bushing interior space and prevents fluid from flowing through the

bushing interior space.
(33) The tube cap assembly portion of the assembly described herein is configured to adjust the maximum viscosity of fluid permitted to flow through ports of the assembly. The tube cap assembly includes a tube cap piston comprising a threaded recess. The tube cap assembly includes a viscosity adjustment screw coupled to the tube cap piston, wherein a threaded portion of the viscosity adjustment screw is screwed into the threaded recess of the tube cap piston. The tube cap assembly includes a tube cap comprising a tube cap sidewall, wherein the tube cap further comprises a tube cap port disposed within the tube cap sidewall. The tube cap assembly is such that the tube cap piston and the viscosity adjustment screw are disposed within a hollow interior space defined by the tube cap sidewall. The tube cap assembly is such that a fluid passageway is formed in between the tube cap port and an exterior surface of the tube cap piston. The tube cap assembly is such that the threaded portion of the viscosity adjustment screw is threaded into or out of the threaded recess of the tube cap piston to adjust a size of the fluid passageway.
(34) In the following description of the disclosure, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific implementations in which the disclosure may be practiced. It is understood that other implementations may be utilized, and structural changes may be made without departing from the scope of the disclosure.
(35) Before the methods, systems, and devices that form this disclosure of a novel head assembly are disclosed and described, it is to be understood that this disclosure is not limited to the particular configurations, process steps, and materials disclosed herein as such configurations, process steps, and materials may vary somewhat. It is also to be understood that the terminology employed herein is used for the purpose of describing particular implementations only and is not intended to be limiting since the scope of the disclosure will be limited only by the appended claims and equivalents thereof.
(36) In describing and claiming the disclosure, the following terminology will be used in accordance with the definitions set out below.
(37) It must be noted that, as used in this specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise.
(38) As used herein, the terms "comprising," "including," "containing," "characterized by," and grammatical equivalents thereof are inclusive or open-ended terms that do not exclude additional, unrecited elements or method steps.
(39) As used herein, the phrase "consisting of" and grammatical equivalents thereof exclude any element, step, or ingredient not specified in the claim.
(40) As used herein, the phrase "consisting essentially of" and grammatical equivalents thereof limit the scope of a claim to the specified materials or steps and those that do not materially affect the basic and novel characteristic or characteristics of the claimed disclosure.
(41) Referring now to the figures, FIG. **1** is a schematic cross-sectional illustration of a system **100** for performing a drilling operation. The system **100** shown in FIG. **1** shows a schematic illustration of an exemplary drilling operation of system **100** drilling into substrate **106**. It will be appreciated by those of ordinary skill that the exemplary drilling operation is just one example of a drilling operation, and that other drilling operations are within the scope of this disclosure. The system **100** is utilized to drill into a substrate **106** such as dirt, rocks, and other materials, and is further used when extracting a substance such as oil, gas, or minerals from the substrate **106**. The system **100** includes an overshot **104** and a head assembly **102** disposed within the overshot **104**. An external force **108** may be applied to the head assembly **102** when executing the drilling operation.
(42) FIGS. **2**A and **2**B each illustrate a straight-on side view of a head assembly **102** for performing a drilling operation. In FIG. **2**B, the head assembly **102** is rotated 90 degrees about its longitudinal axis when compared with the illustration in FIG. **2**A. The head assembly **102** includes at least a latch assembly **202**, a check valve assembly **204**, and a tube cap assembly **206**. The head assembly

102 may include additional components or assemblies, and some components of the head assembly **102** may be utilized by two or more of the latch assembly **202**, the check valve assembly **204**, or the tube cap assembly **206**. As described herein, the head assembly **102** includes an "uphole end" that is located nearest the surface of a substrate during a drilling operation, and further includes a "downhole end" that is located deeper in the substrate relative to the uphole end. The latch assembly **202** is located at the uphole end of the head assembly **102**, and the tube cap assembly **206** is located at the downhole end of the head assembly **102**.

(43) The head assembly **102** includes an upper body **208** that comprises a cylindrical geometry. The upper body **208** includes a body pin slot **210**, which is an opening disposed in a sidewall of the cylindrical upper body **208**. The upper body **208** further includes a body pivot hole **212**, which is an opening disposed in a sidewall of the cylindrical upper body **208**. The upper body **208** encases components of the latch assembly **202** and is configured to interface with a retractor case (not illustrated in FIGS. **2**A-**2**B).

(44) The head assembly **102** includes at least one latch ear **214** as a component of the latch assembly **202**. As shown in FIG. **2**A, the head assembly may include two latch ears **214** that are diametrically opposed to one another relative to the cylindrical geometry of the upper body **208**. At least a portion of the latch ear **214** is disposed within a hollow inner space defined by the sidewall of the upper body **208**. The portion of the latch ear **214** that is visible in FIG. **2**A is configured to interface with the inner wall of a concentric tube surrounding the head assembly **102**.

(45) The latch ears **214** are pivotably connected to the upper body **208** and positioned within a latch ear opening (not shown) that is disposed through the sidewall of the upper body **208**. The latch ears **214** are selectively pivoted to expand or retract away from or toward cylindrical geometry of the upper body **208**. Expanding and retracting the latch ears **214** prevents or at least mitigates wear on the latch ears **214**, and further facilitates releasing the latch ears **214** such that the head assembly **102** may be pulled up from the drilling hole. Conventional designs of head assemblies comprising a latching mechanism do not have the ability to retract the latching mechanism. This results in the traditional head assemblies experiencing excessive wear when the latching mechanisms drag along an interior surface of the tube when the head assembly is removed from the tube.

(46) The check valve assembly **204** is formed where a downhole end of the upper body **208** interfaces with an uphole end of a lower body **218**. As discussed further herein, the check valve assembly **204** includes components for creating a valve that reacts to an external force to permit or block the flow of fluid. The upper body **208** includes an upper body fluid port **216** that permits fluid to flow into and out of an interior space defined by a sidewall of the upper body **208**. The lower body **218** includes a lower body fluid port **220** that permits fluid to flow into and out of an interior space defined by a sidewall of the lower body **218**.

(47) The fluid passageways defined through the head assembly **102** created by ports within the upper body **208** and lower body **218** cause fluid to flow through the head assembly **102** with laminar flow, rather than turbulent flow. In at least one implementation, the fluid flow is dominated by laminar flow, with some limited turbulence. With the laminar or laminar-dominated flow, the head assembly **102** can be run in-hole through the fluid in a more efficient manner than other known conventional head assemblies that do not achieve laminar flow. The turbulence causes wear and energy losses.

(48) The head assembly **102** further includes a spindle **222**, a shock absorber body **224**, and a tube cap **226**. The spindle **222** includes a shaft for receiving bearings to be attached to the head assembly **102** as a replaceable wear item. Additionally, the spindle **222** serves as a shock absorber when the latch assembly portion **202** is stopped at a landing ring located within a core barrel. The stopping forces are transferred to the head assembly **102** and then absorbed by a shock absorption spring disposed around the spindle **222**.

(49) The tube cap includes a tube cap port **228** that permits fluid to flow into and out of an interior space defined by a sidewall of the tube cap **226**. The spindle **222** is a shock-absorbing component

that prevents or mitigates damage to the head assembly **102** caused when the components of the drilling operation contact one another, such as when the head assembly **102** is lowered into the well and reaches the core barrel, or when an overshot is lowered to the head assembly **102** and strikes the retractor case (see, e.g., retractor case **302** first discussed in connection with FIGS. **3**A and **3**B).
(50) The head assembly **102** is designed such that the amount of fluid passing through the head assembly **102** can be controlled and adjusted during operation. In operation the procedure may be as follows. The head assembly **102** is lowered through the tube, and as it does so, at some point the head assembly **102** reaches the water table and begins to pass through the water which may also include mud, sand, debris, sediment, hydrocarbons, and other objects. The head assembly **102** eventually reaches the core barrel (not shown) below and interfaces with it. The core barrel and head assembly **102** connect securely together. The drilling operation can continue with the bit being below the core barrel. As the bit is operated, a fluid is pumped down to the head assembly **102** and through the head assembly **102** to lubricate and cool the drill bit. The fluid may comprise water, mud, or some combination thereof. By adjusting the flow of fluid through the head assembly **102**, an operator can retain more of the fluid that is below the head assembly **102**, and thereby reduce the amount of new fluid that must be pumped down into the well from above.
(51) FIGS. **3**A and **3**B illustrate wireframe straight-on side views of the head assembly **102**. Similar to the views illustrated in FIGS. **2**A-**2**B, the head assembly **102** depicted in FIG. **3**B is rotated 90 degrees about its longitudinal axis when compared with the illustration in FIG. **3**A. The wireframe views in FIGS. **3**A-**3**B illustrate the external components of the head assembly **102** in solid lines, and additionally illustrates internal components of the head assembly **102** with dotted lines.
(52) The head assembly **102** includes a retractor case **302** disposed within the upper body. **208**. The upper body **208** comprises a sidewall that defines a hollow interior space and a substantially cylindrical geometry. Similarly, the retractor case **302** includes a sidewall that defines a hollow interior space and a substantially cylindrical geometry. The diameters of the upper body **208** and the retractor case **302** are optimized such that the retractor case **302** can slide into the upper body **208**. In some implementations, the retractor case **302** interfaces with an overshot (not pictured) that is lowered down into a drilling hole and then attaches to the retractor case **302**. The retractor case **302** may include grooves, recesses, or other features that permit the overshot to be urged downward without actuating a tool or other moving part to secure the overshot to the retractor case **302**. The retractor case **302** includes a retractor pin slot (not shown) that matches with the body pin slot **210** of the upper body **208**. Thus, a single pin may be pushed through the overlapping retractor pin slot and body pin slot **210**.
(53) The latch assembly **202** of the head assembly **102** includes an expansion block **304** disposed within an interior space defined by the sidewall of the upper body **208**. The expansion block **304** is configured to interface with the latch ears **214** to cause the latch ears **214** to extend outward in a “latched” position or retract inward in an “unlatched” position. The expansion block **304** includes an expansion block pinhole **306** disposed through the expansion block **304**. The expansion block pinhole **306** is configured to receive a pin to pull the expansion block **304** upward toward the uphole end of the head assembly **102** or push the expansion block **304** down toward the downhole end of the head assembly **102**. The pin disposed through the expansion block pinhole **306** is also disposed through the body pin slot **210** and the retractor pin slot (not shown). Thus, the expansion block **304** can only slide along the longitudinal axis of the head assembly **102** from a downhole end of the body pin slot **210** (as shown in FIGS. **3**A-**3**B) and up to an uphole end of the body pin slot **210**. When the expansion block **304** is located at the downhole end of the body pin slot **210** (as shown in FIGS. **3**A-**3**B), then the expansion block **304** pressed on the latch ears **214** and causes the latch ears **214** to extend outward into the latched position. When the expansion block **304** is pulled up toward the uphole end of the body pin slot **210**, the latch ears **214** are allowed to rotate about the body pivot hole **212** and fall into the unlatched position.
(54) The expansion block **304** is attached to a piston shaft **308**, which is attached to a piston cage

(not shown). The piston cage (not shown) includes holes that permit fluid to flow into and out of the piston cage. When pressurized fluid flows through the piston cage, the pressurized flow is able to actuate the check valve assembly **204**. Some, but not all, components of the check valve assembly **204** are visible in FIGS. **3**A-**3**B. Specifically, FIGS. **3**A-**3**B illustrate portions of the valve spring **312** and retention piston **314**. These components will be further illustrated and discussed in subsequent figures. FIGS. **3**A-**3**B further illustrate threading **310** for attaching the lower body **218** to the upper body **208**. The threading enables the downhole end of the upper body **208** to be attached to the uphole end of the lower body **218**.
(55) The head assembly **102** further includes threading **316** within the spindle **222**. The threading **316** includes corresponding threading on the spindle **222** and the lower body **218**. The threading **316** is utilized to securely attach the spindle **222** to the lower body **218**. The head assembly **102** further includes threading **318** on the shock absorber body **224** and tube cap **226**. This threading **318** is utilized to attach the tube cap **226** to the shock absorber body **224**.
(56) The tube cap assembly **206** of the head assembly **102** includes a shock absorber **320**, which may include a compression spring configured to absorb a force along a longitudinal axis of the head assembly **102**. The tube cap assembly **206** further includes a tube cap piston **322** (only partially visible in FIGS. **3**A-**3**B) and a viscosity adjustment screw **324** that protrudes from a face of the tube cap piston **322**. The tube cap piston **322** and viscosity adjustment screw **324** are utilized to adjust the maximum fluid viscosity permitted to flow through the tube cap ports **228** of the tube cap **226**.
(57) FIG. **4** is a cross-sectional side view of the head assembly **102**. The top image in FIG. **4** illustrates where the cross-sectional slice is taken, and the bottom image in FIG. **4** illustrates the resultant cross-sectional view.
(58) FIG. **4** further illustrates the expansion block **304** disposed within an interior space defined by the sidewall of the upper body **208**. As shown, the expansion block **304** is attached to the piston shaft **308**, which is further attached to the fluid retention cage **402**. As shown, the fluid retention cage **402** comprises a diameter that is larger than diameter of the piston shaft **308**, and the fluid retention cage **402** includes numerous holes that permit fluid to flow into and out of the fluid retention cage **402**.
(59) The check valve assembly **204** of the head assembly **102** includes at least a valve bushing **404**, a valve ball **406**, the valve spring **312**, and the retention piston **314**. The piston cage is disposed within an interior space defined by the retention piston **314**. The valve bushing is also disposed within the interior space of the retention piston **314**, and the valve ball **406** is disposed within the interior space defined by the valve bushing **404**. Each of the valve spring **312** and the valve ball **406** is also disposed within the interior space defined by a sidewall of the retention piston **314**.
(60) The head assembly **102** additionally includes one or more spacers **408** disposed between the spindle **222** and the shock absorber body **224**. As shown in FIG. **4**, the spacers **408** may be sized such that the spacers **408** are disposed in between a rod of the spindle **222** and a sidewall of the shock absorber body **224**.
(61) The tube cap assembly **206** includes at least the tube cap **226**, tube cap port(s) **228**, tube cap piston **322**, viscosity adjustment screw **324**, and terminating tube cap **410**. As shown in FIG. **4**, the tube cap piston **322** is disposed within an interior space defined by the substantially cylindrical hollow geometry of the tube cap **226**. Additionally, the viscosity adjustment screw **324** is screwed into the tube cap piston **322**. The terminating tube cap **410** is attached to an open end of the tube cap **226** to close off the head assembly **102**.
(62) FIG. **5** is an exploded perspective view illustrating components of the latch assembly **202** and check valve assembly **204** of the head assembly **102**. FIG. **5** further illustrates components of the retractor case **302**, which is configured to interface with an overshot (not shown) during a drilling operation.
(63) The retractor case **302** includes a substantially cylindrical hollow geometry defined by a

sidewall. The retractor case **302** includes one or more latch channels **502** disposed within the sidewall forming the substantially cylindrical geometry. The latch channel **502** is configured to receive the latch ear **214** when the retractor case **302** is disposed within the upper body **208**. Thus, each of the one or more latch ears **214** can rotate about a pivot point because the latch channel **502** prevents the latch ear **214** from being obstructed by a sidewall of the retractor case **302**. The retractor case **302** additionally includes one or more retractor pin slots **504**. In most implementations, the retractor case **302** includes retractor pin slots **504** that are diametrically opposed to one another relative to the cylindrical geometry of the retractor case **302**.

(64) The upper body **208** includes one or more latch ear openings **506** disposed within a sidewall of the upper body **208**. In most implementations, the head assembly **102** includes two latch ears **214** that are diametrically opposed to one another, and therefore the upper body **208** similarly includes two latch ear openings **506** that are diametrically opposed to one another. The latch ear opening **506** is configured to receive the latch ear **214** and thus enable the latch ear to rotate about its pivot point **508**. The pivot point **508** of the latch ear **214** aligns with the body pivot hole **212** disposed within a sidewall of the upper body **208**.

(65) The latch assembly **202** includes the expansion block **304**, which is responsible for causing rotation of the latch ears **214** about their pivot points **508**. A pin (not shown) is disposed through a first body pin slot **210** on a first side of the upper body **208**, and through a first retractor pin slot **504** on a first side of the retractor case **302**, and through the expansion block pinhole **306**, and through a second retractor pin slot **504** on a second (opposite) side of the retractor case **302**, and through a second body pin slot **210** on a second (opposite) side of the upper body **208**. The combination of the pin and the pin slots **210**, **504** ensures that the expansion block **304** can only move from a downhole end of the pin slots **210**, **504** to an uphole end of the pin slots **210**, **504**.

(66) When the pin is located at the downhole end of the pin slots **210**, **504**, the expansion block **304** causes the latch ears **214** to extend outward in the latched position. When the latch ears **214** extend outward, at least a portion of the latch ears **214** will interface with a surrounding tube, such as the overshot **104** discussed in connection with FIG. **1**. When the pin is located at the uphole end of the pin slots **210**, **504**, the expansion block **304** no longer presses against the latch ears **214**, and the latch ears **214** are thus able to rotate about their pivot points **508** and inward toward the inner space of the upper body **208**. When the latch ears **214** rotate inward, they are in the unlatched position and will no longer interface with the surrounding tube. This enables the head assembly **102** to be pulled out of the surrounding tube without incurring considerable damage to the latch assembly **202**.

(67) The expansion block **304** is attached to the piston shaft **308** at an attachment point **510**. The piston shaft **308** is attached to the piston cage, and the piston cage is disposed within an interior space defined by the retention piston **314**. The retention piston **314** includes one or more check valve ports **512** disposed within a sidewall of the retention piston **314**. The check valve ports **512** enable fluid to flow into and out of the retention piston **314**. When the check valve assembly **204** is in the open position, fluid is permitted to flow out through the check valve ports **512**. When the check valve assembly **204** is in the closed position, fluid is prevented from flowing out through the check valve ports **512**.

(68) The head assembly **102** includes a float tension bushing **514** configured to be disposed around a portion of the retention piston **314**. The head assembly **102** additionally includes a landing shoulder **516** located within a mid-region of the head assembly **102**. The landing shoulder **516** interacts with a landing ring located within a core barrel during a drilling operation. The landing shoulder **516** stops the latch head assembly **202** portion of the head assembly **102** at the core barrel when the head assembly **102** is installed within the core barrel to perform the drilling operation. Following this, the retention piston **314** drops down to the float tension bushing **514** along with interacting parts attached to the piston shaft **308**, the latch ear **214**, and the pin slots **210**. This thereby locks the head assembly **102** into place within the core barrel.

(69) As shown in FIG. **5**, the lower body **218** includes threading **310** that corresponds with the threading **310** on the upper body **208**. When the exploded components illustrated in FIG. **5** are fully inserted, much of the check valve assembly **204** will be located at the overlapping point where the lower body **218** attaches to the upper body **208**.
(70) The lower body **218** includes lower body fluid ports **518** similar to the upper body fluid ports **216** associated with the upper body **208**. When the check valve assembly **204** is in the open position, fluid is permitted to flow out through the check valve ports **512** of the retention piston **314**, and further out through the lower body fluid ports **518** of the lower body **218**.
(71) FIGS. **6**A and **6**B are straight-on exploded side views of the head assembly **102**. Similar to the views illustrated in FIGS. **2**A-**2**B, and in FIGS. **3**A-**3**B, the head assembly **102** depicted in FIG. **6**B is rotated 90 degrees about its longitudinal axis when compared with the illustration in FIG. **6**A.
(72) As shown in FIGS. **6**A and **6**B, the check valve assembly **204** portion of the head assembly **102** additionally includes a roll pin **602**. The roll pin **602** is a consumable item that enables surrounding parts to be attached together.
(73) FIG. **6**B further illustrates the slot pin **604** and the pivot pin **606** of the latch assembly **202** portion of the head assembly **102**. The slot pin **602** is configured to be disposed through the body pin slot(s) **210** of the upper body **208**, through the retractor pin slot(s) **504** of the retractor case **302**, and further through the expansion block pinhole **306** of the expansion block **304**. The slot pin **604** slides up and down the pin slots **210**, **504** to adjust the linear position of the expansion block **304**. The pivot pin **606** is configured to be disposed through the body pivot hole **212** of the upper body **208**, and further though the pivot point **510** of the expansion block **304**. The latch ears **214** are configured to rotate about an axis located at the pivot point **510**. The rotational position of the latch ears **214** determines whether the latch ears are in a latched or unlatched position.
(74) FIG. **7** illustrates a wireframe straight-on side view of the check valve assembly **204** and latch assembly **202** portions of the head assembly **102**. As shown in FIG. **7**, the upper body **208** is attached to the lower body **218** by way of the threading **310**. The upper body **208** and lower body **218** each include corresponding threading serving as a fastening mechanism for releasably attaching the upper body **208** to the lower body **218**.
(75) In some implementations, and as shown in FIG. **7**, the downhole end of the body pin slot **210** is located at substantially the same longitudinal position as the body pivot holes **212**. The relative locations of the body pivot holes **212** and the body pin slot **210** are optimized to ensure the latch ears **214** will rotate in and out of the latched position or unlatched position.
(76) FIG. **8** illustrates a straight-on side view of the latch assembly **202** portion of the head assembly **102**. As shown in FIG. **8**, the length of the body pin slot **210** is substantially equivalent to the length of the retractor pin slot **504**. This ensures that a single slot pin (see **604** first illustrated at FIG. **6**B) can be disposed through each of the upper body **208** and the retractor case **302** and may slide back and forth along the longitudinal axis of the head assembly **102**.
(77) FIGS. **9**A and **9**B are cross-sectional side view of the latch assembly **202** and check valve assembly **204** portions of the head assembly **102**. FIG. **9**A illustrates wherein the latch assembly **202** is in an unlatched configuration, and FIG. **9**B illustrates wherein the latch assembly **202** is in a latched position.
(78) When the latch assembly **202** is in the unlatched configuration, as shown in FIG. **9**A, the expansion block **304** is pulled toward the uphole end of the head assembly **102**. When this occurs, the geometry of the expansion block **304** enables the latch ears **214** to rotate about the pivot point **508** and fall inward toward a center of the upper body **208**. When the latch ears **214** fall inward, they will no longer form an interference fit with a tube (not shown) that surrounds the head assembly **102**.
(79) When the latch assembly **202** is in the latched configuration, as shown in FIG. **9**B, the expansion block **304** is pulled toward the downhole end of the head assembly **102**. When this occurs, the geometry of the expansion block **304** forces the latch ears **214** to rotate about the pivot

point **508** such that a radial arm portion of the latch ears **214** extends radially outward relative to the cylindrical geometry of the upper body **208**, as shown in FIG. **9**B. When this occurs, the arm portion of each latch ear **214** will form an interference fit with the interior surface of a tube (not shown) that surrounds the head assembly **102**.

(80) FIG. **10** is a schematic illustration of a latch ear **214** to be utilized as a component of the latch assembly **202** portion of the head assembly **102**. The latch ear **214** includes the pivot point **508**, which is a hole disposed through the body of the latch ear **214**. The pivot point **508** is configured to receive the pivot pin (see **606** first illustrated at FIG. **6**B), and this enables the latch ear **214** to rotate about an axis of rotation centered on the pivot point **508**.

(81) The latch ear **214** includes a main body **1006**. When the latch ear **214** is in the latched configuration, the main body **1006** is oriented substantially parallel to a longitudinal axis of the head assembly **102**. The latch ear **214** includes a radial arm **1002** portion attached to the main body **1006**. When the latch ear **214** is in the latched configuration, the radial arm **1002** is located substantially perpendicular to the longitudinal axis of the head assembly **102**, and further extends substantially radially outward relative to the cylindrical geometry of the upper body **208**. The latch ear **214** additionally includes leg **1004** portion attached to the main body **1006**. The leg **1004** is located at an opposite end of the main body **1006** relative to the radial arm **1002**.

(82) The latch ear **214** includes a latching surface **1008** running along the main body **1006**. The latching surface **1008** is configured to interface with a corresponding surface of the expansion block **304**. The latch ear **214** includes an external longitudinal surface **1010** that is located opposite to the latching surface **1008** relative to the main body **1006**. The latch ear **214** includes a leg surface **1012** running along the internal side of the leg **1004**. The latch ear **214** includes a leg stop surface **1014** located at an edge of the leg **1004**.

(83) The bend of the leg **1004** relative to the main body **1006** forms interior-side angle **1018** and an exterior-side angle **1016**. The interior-side angle **1018** is from about 100 degrees to about 170 degrees. The exterior-side angle **1016** is measured as an exterior angle as shown in FIG. **10**, such that a first ray of the exterior-side angle **1016** runs along a surface of the leg **1004**, and a second ray of the exterior-side angle **1016** is parallel to the external longitudinal surface **1010** of the main body **1006**. The exterior-side angle **1016** is from about 20 degrees to about 60 degrees.

(84) FIG. **11** is a schematic illustration of the expansion block **304** to be utilized as a component of the latch assembly **202** portion of the head assembly **102**. The expansion block **304** includes the expansion block pinhole **306** that is configured to receive the slot pin (see **604** first illustrated at FIG. **6**B). The expansion block **304** further includes the attachment point **510** configured for attaching the expansion block to the piston shaft **308** (not shown in FIG. **11**).

(85) The expansion block **304** includes a first latching surface **1102** and a second latching surface **1104**. The first latching surface **1102** and the second latching surface **1104** are diametrically opposed to one another relative to the body of the expansion block **304**, as shown in FIG. **11**. The first latching surface **1102** is configured to press against a latching surface **1008** of a first latch ear **214**, and the second latching surface **1104** is configured to press against a latching surface **1008** of a second latch ear **214**. When the latching surfaces **1102**, **1104** of the expansion block **304** are pressing against corresponding latching surfaces **1008** of corresponding latch ears **214**, then the latching assembly **202** will be in the latched configuration, as shown in FIG. **9**B.

(86) The expansion block **304** includes a polygonal geometry and may specifically include an irregular octagonal geometry as shown in FIG. **11**. In alternative implementations, the expansion block **304** may include a quadrilateral geometry, pentagonal geometry, or hexagonal geometry. The number of sides on the expansion block **304** may be adjusted and optimized as needed depending on the implementation. The expansion block **304** comprises a convex polygonal geometry as shown in FIG. **11**. The expansion block **304** includes a plurality of convex exterior angles as shown in FIG. **11**, and may specifically include a first exterior angle **1106**, second exterior angle **1108**, third exterior angle **1110**, and fourth exterior angle **1112** as identified in FIG. **11**. The exterior angles of

the expansion block **304** are measured as shown in FIG. **11** and are specifically measured as the angle formed between a first side of the polygonal geometry, and another line that is formed by extending a second side that is adjacent to the first side.
(87) Each of the exterior angles **1106**, **1108**, **1110**, **1112** may include an angle from about 20 degrees to about 60 degrees. In an implementation, each of the exterior angles **1106**, **1108**, **1110**, **1112** is substantially identical. In a further implementation, one or more of the exterior angles **1106**, **1108**, **1110**, **1112** is substantially identical to the exterior-side angle **1016** of the latch ear **214**. In a further implementation, a sum of the interior-side angle **1018** of the latch ear **214**, and one of the exterior angles **1106**, **1108**, **1110**, **1112** of the expansion block **304**, is substantially equal to 180 degrees.
(88) Retracting the latch ears **214** is useful in many applications. A first application is when the head assembly is run in-hole. The latch ears **214** may be retracted (i.e., moved into the unlatched configuration) to prevent the latch ears **214** from dragging along the interior surface of a tube disposed around the head assembly **102**. Dragging any component causes wear which can lead to failure that may cause an expensive and time-consuming repair. A second useful application is to release the head assembly **102** from a latched configuration as the head assembly **102** and a core barrel (or any other equipment) is being pulled up and out of the hole. In some implementations, an overshot latches onto the retractor case **302** and thereby pulls on the head assembly **102**. Thus, pulling up on the retractor case **302** may cause the slot pin **604** to move up the pin slots **210**, **504**. The slot pin **604** is connected to the expansion block **304**, which moves uphole. Thus, moving the expansion block **304** uphole causes the expansion block **304** to retract the latching surface of the latch ears **214**. Accordingly, pulling on the retractor case **302** will cause the latch ears **214** to retract and enable an operator to lift the head assembly more easily **102** from the hole.
(89) FIGS. **12**A and **12**B are schematic illustration depicting interactions between the latch ear **214** and expansion block **304** of the latch assembly **202** portion of the head assembly **102**. FIG. **12**A illustrates wherein the latch ear **214** is in the unlatched configuration, with the expansion block **304** located toward the uphole end of the pin slot. FIG. **12**B illustrates wherein the latch ear **214** is in the latched configuration, with the expansion block **304** located toward the downhole end of the pin slot. The dotted lines in FIGS. **12**A and **12**B are included to provide context to the rotation of the latch ears **214** about the pivot points **508**.
(90) As shown in FIGS. **12**A and **12**B, the latch ears **214** are configured to rotate “inward” toward an interior space defined by the substantially cylindrical hollow geometry of the upper body **208**. When this occurs, the radial arm portions of the latch ears **214** are located nearer to the upper body **208**, and thus will no longer form an interference fit with a tube surrounding the head assembly **102**. The latch ears **214** are forced to rotate in the opposite direction when the expansion block **304** is disposed in between the diametrically opposed latch ears **214**, as shown in FIG. **12**B. This causes the radial arm portions of the latch ears **214** to form an interference fit with the tube surrounding the head assembly **102**.
(91) FIG. **13** is a cross-sectional exploded view of the check valve assembly **204** portion of the head assembly **102**. The top image in FIG. **13** illustrates the cross-sectional slice line made through the head assembly **102**, and the bottom image in FIG. **13** illustrates the resultant cross-sectional view.
(92) As shown in FIG. **13** the valve bushing **404** forms a bushing interior space **1302**. The bushing interior space **1302** is configured to receive the valve ball **406**. In some implementations, an interior diameter of the valve bushing **404** (i.e., a diameter of the bushing interior space **1302**) is substantially equal to a diameter of the valve ball **406**. Further as shown in FIG. **13**, the retention piston **314** forms a valve interior space **1304**. The size of the valve interior space **1304** is optimized such that the retention piston **314** receives each of the valve spring **312**, the valve bushing **404**, the valve ball **406**, and at least a portion of the fluid retention cage **402**. As discussed previously, the retention piston **314** includes a plurality of check valve ports **512** that permit fluid to flow into and

out of the interior space defined by the retention piston **314**.

(93) FIG. **14** illustrates a wireframe straight-on side view of portions of the check valve assembly **204** portion of the head assembly **102**. FIG. **15** is a straight-on side view of the piston shaft **308** and fluid retention cage **402**. FIG. **14** specifically illustrates how the fluid retention cage **402** is partially disposed within an interior space defined by the retention piston **314**. FIGS. **14** and **15** further illustrate that the fluid retention cage **402** includes a plurality of cage holes **1402** disposed through a sidewall of the fluid retention cage **402**. The cage holes **1402** permit fluid to flow into and out of the fluid retention cage **402**.

(94) FIG. **16** is a wireframe straight-on side view of the retention piston **314** of the check valve assembly **204** portion of the head assembly **102**. The dotted lines in FIG. **16** illustrate where other components of the check valve assembly **204**, like the valve spring **312**, valve bushing **404**, and fluid retention cage **402** would approximately be located within an interior space defined by the retention piston **314**.

(95) The retention piston **314** includes a barrel portion **1602**, a valve portion **1604**, and an end portion **1606**. The retention piston **314** further includes a roll pin **1608** that is configured to attach the piston shaft **308** to the piston.

(96) FIG. **17** is a straight-on exploded side view of components of the check valve assembly **204** portion of the head assembly **102**. The check valve assembly **204** is configured to be in an open position or a closed position, depending on the current location of the valve ball **406** within the retention piston **314**. Each of the valve spring **312**, valve bushing **404**, and valve ball **406** is configured to be disposed within an interior space defined by the retention piston **314**. When the check valve assembly **204** is in the closed configuration, the position of the valve ball **406** blocks the flow of fluid through the check valve ports **512**. When the check valve assembly **204** is in the open configuration, the position of the valve ball **406** permits the flow of fluid through the check valve ports **512**.

(97) FIGS. **18**A and **18**B are cross-sectional straight-on side views of components of the check valve assembly **204** portion of the head assembly **102**. FIG. **18**A illustrates wherein the check valve assembly **204** is in the closed configuration, and thus prevents fluid from flowing through the valve bushing **404** and out through check valve ports **512** of the retention piston **314**. FIG. **18**B illustrates wherein the check valve assembly **204** is in the open configuration, and thus permits fluid to flow through the valve bushing **404** and out through the check valve ports **512** of the retention piston **314**.

(98) As shown in FIGS. **18**A and **18**B, the valve bushing **404** rests on an end of the valve spring **312** and is located uphole relative to the valve spring **312**. Additionally, the valve ball **406** rests on an end of the valve spring **312** and is located uphole relative to the valve spring **312**. In some implementations, the valve spring **312** fits into an interior space defined by the valve bushing **404**, such that the valve ball **406** rests on an end of the valve spring **312** even when the check valve assembly **204** is in the open configuration. The valve ball **406** is given some clearance to move freely within the retention piston **314**, such that debris may be washed out of the head assembly **102** and retention piston **314** during operation.

(99) As disclosed in connection with FIG. **13**, the valve bushing **404** comprises a bushing interior space **1302**. In an implementation, the diameter of the bushing interior space **1302** is substantially equal to a diameter of the valve ball **406**. Thus, when the valve ball **406** is disposed within the valve bushing **404**, the exterior surface of the valve ball **406** forms a tight interference fit with an interior surface of the bushing interior space **1302**. This tight interference fit may be fluid-tight and thus prevent the flow of fluid through the bushing interior space **1302**. Thus, when the valve ball **406** is disposed within the valve bushing **404** as shown in FIG. **18**A, fluid is prevented from flowing through the valve bushing **404**, and the check valve assembly **204** is thereby in the closed configuration.

(100) The check valve assembly **204** may be opened during a drilling operation by applying an

external force to the valve ball **406**. This external force is typically applied by pumping pressurized fluid into the interior space defined by the various components of the head assembly **102**. If the force applied by the pressurized fluid exceeds a valve threshold, then the pressurized fluid will cause the valve to open. In one implementation, the pressurized fluid will create sufficient force to overcome the valve spring's **312** neutral position allowing the valve ball **406** to slide through the valve bushing **404**. When the valve ball **406** passes through the valve bushing **404**, fluid is then permitted to flow through the valve bushing **404**, flow around the valve ball **406**, and flow out through the check valve ports **512**. Thus, the check valve assembly **204** is in the open configuration. In one implementation, the check valve assembly **204** is in the open configuration when the valve ball **406** is located downhole relative to the valve bushing **404**. In another implementation, the check valve assembly **204** is in the open configuration when the valve ball **406** is located uphole relative to the valve bushing **404**.

(101) The check valve assembly **204** may be closed during a drilling operation by ceasing to apply the external force, or by decreasing the external force such that the magnitude of the external force fails to satisfy the valve threshold. When the force applied by the pressurized fluid fails to meet the valve threshold, then the valve spring **312** will decompress to its neutral position and the valve ball **406** will return to its resting position within and with respect to the valve bushing **404** as illustrated in FIG. **18**A. In one implementation, the valve ball **406** moves toward the uphole end of the head assembly **102** into the closed configuration when the valve spring **312** returns to its neutral position. In another implementation, the valve ball **406** moves toward the downhole end of the head assembly **102** into the closed configuration when the valve spring **312** returns to its neutral position. The valve ball **406** is positioned back to its resting state and held in place by gravitational forces within the bushing interior space **1302** defined by the valve bushing **404** into a closed position.

(102) FIG. **19** is a cross-sectional straight-on side view of components of the tube cap assembly **206** portion of the head assembly **102**. The top image in FIG. **19** illustrates where the cross-sectional slice is taken within the tube cap assembly **206**, and the bottom image in FIG. **19** illustrates the cross-sectional view.

(103) As shown in the cross-sectional view, the spindle **222** is located adjacent to the shock absorber body **224**, and a shaft of the spindle **222** is disposed within the shock absorber **320**. Thus, the shaft of the spindle **222** is also disposed through a hollow space defined by the shock absorber body **224**.

(104) In the view illustrated in FIG. **19**, the viscosity adjustment screw **324** is fully screwed into the tube cap piston **322**. This enables the tube cap piston **322** to be fully disposed against a viscosity adjustment wall **1902** located within the tube cap. When the tube cap piston **322** is fully disposed against the viscosity adjustment wall **1902** as shown in FIG. **19** (because the viscosity adjustment screw **324** is not creating additional space between a face of the tube cap piston **322** and a face of the viscosity adjustment wall **1902**), then the viscosity permitted to flow through the tube cap assembly **206** portion is maximized. As shown in FIG. **19**, the placement of the tube cap piston **322** against the viscosity adjustment wall **1902** maximizes the openings of the tube cap ports **228**.

(105) FIG. **20** is a cross-sectional and exploded straight-on side view of components of the tube cap assembly **206** portion of the head assembly **102**. The tube cap assembly **206** includes several components located at a downhole end of the head assembly **102**. The tube cap assembly **206** specifically includes at least the tube cap **226**, tube cap piston **322**, viscosity adjustment screw **324**, and terminating tube cap **410**. The tube cap assembly **206** further includes a viscosity adjustment wall **1902** located within the tube cap **226**, and specifically located downhole relative to the tube cap ports **228** of the tube cap **226**. The viscosity adjustment wall **1902** is a fluid-tight surface formed in an interior space defined by the tube cap **226**.

(106) The uphole end of the viscosity adjustment screw **324** abuts against the viscosity adjustment wall **1902**. Thus, when the viscosity adjustment screw **324** is only partially screwed into the tube

cap piston **322**, then the maximum fluid viscosity permitted to pass around the tube cap piston **322** and through the tube cap ports **228** will be decreased. Likewise, when the viscosity adjustment screw **324** is further screwed into the tube cap piston **322**, and the tube cap piston **322** is thereby abutted directly against the viscosity adjustment wall **1902**, then the maximum fluid viscosity permitted to pass around the tube cap piston **322** and through the tube cap ports **228** will be maximized. The viscosity adjustment screw **324** is utilized to accommodate for changes in viscosity when the viscosity of the drill fluid is raised to slow down the movement of fluid, or when the viscosity of the drill fluid is lowered to increase the movement of fluid. Thus, viscous fluids will pass through the bodies more efficiently when the viscosity adjustment screw **324** is utilized to create a wider opening.

(107) FIGS. **21**A and **21**B are schematic illustrations of the tube cap piston **322** and viscosity adjustment screw **324** of the tube cap assembly **206** portion of the head assembly **102**. FIG. **21**A illustrates wherein the viscosity adjustment screw **324** is substantially fully screwed into the tube cap piston **322**, and thus, the maximum fluid viscosity permitted to flow through the tube cap assembly **206** is maximized. FIG. **21**B illustrates wherein the viscosity adjustment screw **324** is only partially screwed into the tube cap piston **322**, and thus, the maximum fluid viscosity permitted to flow through the tube cap assembly **206** is decreased relative to the configuration illustrated in FIG. **21**A.

(108) The tube cap piston **322** includes a larger diameter body **2110** and a smaller diameter body **2114**, wherein the smaller diameter body **2114** comprises a shorter diameter when compared with the larger diameter body **2110**. As shown in FIGS. **21**A-**21**B, the larger diameter body **2110** is located uphole relative to the smaller diameter body **2114**. The tube cap piston **322** additionally includes a larger diameter face **2106** that is located uphole relative to a smaller diameter face **2118**. As shown, the viscosity adjustment screw **324** is screwed into the tube cap piston **322** at the larger diameter face **324**. The tube cap piston **322** includes a chamfered edge **2116** disposed between the smaller diameter face **2118** and the smaller diameter body **2114**. Additionally, the tube cap piston **322** includes a chamfered edge **2112** disposed in between the smaller diameter body **2114** and the larger diameter body **2110**. Additionally, the tube cap piston **322** includes a chamfered edge **2108** disposed between the larger diameter body **2110** and the larger diameter face **2106**.

(109) The viscosity adjustment screw includes a shaft portion (i.e., the portion screwed into the tube cap piston **322**), and further includes a head **2102** portion. The system may additionally include a washer **2104** or spacer disposed in between the larger diameter face **2106** of the tube cap piston **322**, and the head **2102** of the viscosity adjustment screw **324**. As shown in FIGS. **21**A-**21**B, the tube cap piston **322** includes a threaded blind recess **2120** configured to receive the viscosity adjustment screw **324**.

(110) The tube cap piston **322** includes the viscosity adjustment screw **324** that protrudes from the larger diameter face **2106** (i.e., the uphole face) of the tube cap piston **322**. The viscosity adjustment screw is threaded into the tube cap piston **322**. The viscosity adjustment screw **324** has a threaded body that fits within the threaded blind recess **2120** in the tube cap piston **322**. The head **2102** portion of the viscosity adjustment screw **324** engages with the viscosity adjustment wall **1902** of the tube cap **226**. An operator may rotate the viscosity adjustment screw **324** and thereby cause the tube cap piston **322** to move in an uphole or downhole direction relative to the viscosity adjustment wall **1902** of the tube cap **226**. This thereby adjusts the size of the fluid passageway through the tube cap **226**. A larger passageway is better suited for fluids with high viscosity, and a smaller passageway is better suited for fluids with low viscosity.

(111) The tube cap piston **322** fits within the tube cap **226** and selectively blocks the tube cap ports **228**. Controlling the position and movement of the tube cap piston **322** allows the operator to control the fluid flow through the tube cap assembly **206** portion of the head assembly **102**. When the viscosity adjustment screw **324** is fully screwed into the threaded blind recess **2120** of the tube cap piston **322**, as shown in FIG. **21**A, or when the viscosity adjustment screw **324** is removed

altogether, then then tube cap piston **322** will be located nearest the viscosity adjustment wall **1902**, and the maximum fluid viscosity permitted to flow through the tube cap **226** will be maximized. By contrast, when the viscosity adjustment screw is only partially screwed into the threaded blind recess **2120** of the tube cap piston **322**, as shown in FIG. **21**B, then the maximum fluid viscosity permitted to flow through the tube cap **226** will be decreased.
(112) The tube cap piston **322** is a generally cylindrical member having a uniform cross-sectional shape. In some implementations, the tube cap piston **322** has a round outer profile. However, in other implementations, the tube cap **226** or the terminating tube cap **410** are configured with a non-round shape, such as a hexagonal geometry or other polygonal geometry. This may be implemented to prevent the tube cap piston **322** from rotating relative to the tube cap **226** or the terminating tube cap **410**.
(113) The head assembly **102** of the disclosure can be implemented in a core drilling operation according to the following procedures. There are three stages for the head assembly: descent, operation, and ascent. Beginning with the descent, the latch assembly **202** portion of the head assembly **102** is oriented in a descending position, with the expansion block **304** located toward the uphole end of the head assembly **102**. This causes the latch ears **214** to retract radially relative to the cylindrical body of the upper body **208**.
(114) In the operation stage, an operator may pump fluid down to the head assembly **102** to urge the valve ball **406** in the downhole direction until the valve ball **406** passes through the valve bushing **404**. When the valve ball **406** passes through the valve bushing **404**, additional fluid will be permitted to flow through the upper body **208** and into the lower body **218**.
(115) In the ascent stage, the retractor case **302** is pulled upward, which also pulls the expansion block **304** upward, and causes the latch ears **214** to retract. This facilitates releasing the head assembly **102** from a tube surrounding the head assembly **102**, and this thereby decreases wear on the latch ears **214** during ascent.
(116) It will be appreciated by those skilled in the art that, while several implementations are described and shown in the exemplary figures herein, one implementation may have any number of features shown. The figures shown herein are intended to be exemplary and non-limiting, and some figures show some features that other figures do not simply for clarity and readability. In other words, it is contemplated that one implementation of the disclosure may feature each and every feature disclosed, or an implementation may feature a subset combination of the features shown without departing from the scope of the disclosure.
(117) In various implementations, a stand for holding or otherwise housing reservoirs and tubes, hoses or lines may be located outside of the edifice. The stand may be a metal stand or made from another material and may be configured to fit inside the edifice for transport to a location.
(118) The foregoing description has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. Further, it should be noted that any or all of the aforementioned alternate implementations may be used in any combination desired to form additional hybrid implementations of the disclosure.
(119) Further, although specific implementations of the disclosure have been described and illustrated, the disclosure is not to be limited to the specific forms or arrangements of parts so described and illustrated. The scope of the disclosure is to be defined by the claims appended hereto, any future claims submitted here and in different applications, and their equivalents.
(120) In the foregoing Detailed Description, various features of the disclosure are grouped together in a single implementation for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed disclosure requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed implementation. Thus, the following claims are hereby incorporated into this Detailed Description by this reference, with

each claim standing on its own as a separate implementation of the disclosure.
(121) It is to be understood that the above-described arrangements are only illustrative of the application of the principles of the disclosure. Numerous modifications and alternative arrangements may be devised by those skilled in the art without departing from the spirit and scope of the disclosure and the appended claims are intended to cover such modifications and arrangements. Thus, while the disclosure has been shown in the drawings and described above with particularity and detail, it will be apparent to those of ordinary skill in the art that numerous modifications, including, but not limited to, variations in size, materials, shape, form, function and manner of operation, assembly and use may be made without departing from the principles and concepts set forth herein.
(122) Reference throughout this specification to “an example” means that a particular feature, structure, or characteristic described in connection with the example is included in at least one implementation or embodiment of the disclosure. Thus, appearances of the phrase “in an example” in various places throughout this specification are not necessarily all referring to the same implementation or embodiment.
(123) As used herein, a plurality of items, structural elements, compositional elements, and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on its presentation in a common group without indications to the contrary. In addition, various implementations, embodiments, and examples of the disclosure may be referred to herein along with alternatives for the various components thereof. It is understood that such implementations, embodiments, examples, and alternatives are not to be construed as de facto equivalents of one another but are to be considered as separate and autonomous representations of the disclosure.
(124) Although the foregoing has been described in some detail for purposes of clarity, it will be apparent that certain changes and modifications may be made without departing from the principles thereof. It should be noted that there are many alternative ways of implementing both the processes and apparatuses described herein. Accordingly, the implementations or embodiments are to be considered illustrative and not restrictive.
(125) Those having skill in the art will appreciate that many changes may be made to the details of the above-described implementations or embodiments without departing from the underlying principles of the disclosure. The scope of the disclosure should, therefore, be determined only by the following claims.
EXAMPLES
(126) The following examples pertain to further implementations or embodiments.
(127) Example 1 is an assembly. The assembly includes An assembly for performing a drilling operation in a substrate, the assembly comprising: a retractor case comprising a retractor sidewall and a retractor pin slot disposed within the retractor sidewall, wherein the retractor sidewall defines a retractor interior space; a body comprising a body sidewall and a body pin slot disposed within the body sidewall, wherein the body sidewall defines a body interior space, and wherein the body interior space is configured to receive the retractor case; a latch ear coupled to the body, wherein at least a portion of the latch ear extends outward relative to the body sidewall; and an expansion block at least partially disposed within the retractor interior space; wherein a position of the expansion block along a longitudinal axis of the assembly determines whether the latch ear is in an extended position or a retracted position relative to the body sidewall.
(128) Example 2 is an assembly as in Example 1, wherein the assembly comprises an uphole end and a downhole end that is located opposite to the uphole end; wherein the downhole end is located deeper in the substrate when at least a portion of the assembly is disposed within the substrate to perform the drilling operation.

(129) Example 3 is an assembly as in any of Examples 1-2, wherein the expansion block comprises a pin hole disposed therethrough; wherein the body pin slot comprises a body pin slot length extending along the longitudinal axis of the assembly; and wherein the body pin slot comprises a body pin slot uphole end corresponding with the uphole end of the assembly; and wherein the body pin slot comprises a body pin slot downhole end located at an opposite end of the body pin slot length relative to the body pin slot uphole end.
(130) Example 4 is an assembly as in any of Examples 1-3, further comprising a pin, wherein the pin is configured to be disposed through each of the body pin slot, the retractor pin slot, and the pin hole.
(131) Example 5 is an assembly as in any of Examples 1-4, wherein the expansion block is located at a maximum uphole expansion position when the pin abuts one or more of the retractor pin slot uphole end or the body pin slot uphole end.
(132) Example 6 is an assembly as in any of Examples 1-5, wherein the latch ear is in the retracted position relative to the body sidewall when the expansion block is located at the maximum uphole expansion position along the longitudinal axis of the assembly.
(133) Example 7 is an assembly as in any of Examples 1-6, wherein the expansion block is located at a maximum downhole expansion position when the pin abuts one or more of the retractor pin slot downhole end or the body pin slot downhole end.
(134) Example 8 is an assembly as in any of Examples 1-7, wherein the latch ear is in the extended position relative to the body sidewall when the expansion block is located at the maximum downhole expansion position along the longitudinal axis of the assembly.
(135) Example 9 is an assembly as in any of Examples 1-8, wherein the latch ear comprises: a latch ear body; a latch pivot hole disposed through the latch ear body; a latch ear radial extension, wherein the latch ear radial extension extends substantially radially outward relative to the body sidewall; and a latch ear expansion interface leg.
(136) Example 10 is an assembly as in any of Examples 1-9, wherein the latch ear radial extension is located at a latch downhole end of the latch ear, wherein the latch downhole end corresponds with the downhole end of the assembly; and wherein the latch ear expansion interface leg is located at a latch uphole end of the latch ear, wherein the latch uphole end is located opposite to the latch downhole end.
(137) Example 11 is an assembly as in any of Examples 1-10, wherein the retractor case is configured to engage with a tube to lift the assembly upward out of a hole formed in the substrate; and wherein the latch ear radial extension interfaces with an interior surface of the tube when the assembly is installed within the tube.
(138) Example 12 is an assembly as in any of Examples 1-11, wherein the body further comprises: a latch channel disposed within the body sidewall, wherein the latch channel is configured to receive the latch ear body; and a body pivot hole disposed within the body sidewall; wherein the latch pivot hole aligns with the body pivot hole when the latch ear body is disposed within the latch channel; and wherein a latch axis of rotation is formed at the aligned body pivot hole and latch pivot hole such that the latch ear rotates about the latch axis of rotation when the latch ear body is disposed within the latch channel.
(139) Example 13 is an assembly as in any of Examples 1-12, wherein the expansion block comprises an expansion body that comprises a polygonal geometry; wherein the polygonal geometry comprises at least one exterior interface angle that is less than 45 degrees; and wherein the exterior interface angle is configured to interface with the latch ear expansion interface leg.
(140) Example 14 is an assembly as in any of Examples 1-13, wherein latch ear comprises an interface angle defined by a first angle arm extending along a surface of the latch ear body, and a second angle arm extending along a surface of the latch ear expansion interface leg; and wherein the interface angle is greater than 90 degrees.
(141) Example 15 is an assembly as in any of Examples 1-14, wherein a sum of the exterior

interface angle of the expansion block and the interface angle of the latch ear is equal to about 180 degrees.
(142) Example 16 is an assembly as in any of Examples 1-15, further comprising a fluid retention piston coupled to the expansion block.
(143) Example 17 is an assembly as in any of Examples 1-16, wherein the assembly comprises two latch ears; wherein each of the two latch ears is coupled to the body and extends outward relative to the body sidewall; and wherein the two latch ears are positioned on the body sidewall that the two latch ears are diametrically opposed to one another.
(144) Example 18 is an assembly as in any of Examples 1-17, wherein the expansion block comprises a surface that is substantially aligned with a longitudinal axis of the assembly.
(145) Example 19 is an assembly as in any of Examples 1-18, wherein the latch ear comprises a latching surface; wherein, in response to the latch ear being disposed in the extended position, the latching surface of the latch ear forms an interference fit with an interior surface of a tube when the assembly is disposed within the tube for performing the drilling operation; and wherein, in response to the latch ear being disposed in the retracted position, the latching surface of the latch ear is radially narrow sufficient to avoid contacting the interior surface of the tube when the assembly is disposed within the tube.
(146) Example 20 is an assembly as in any of Examples 1-19, wherein the latch ear is rotatably coupled to the body at a pivot point, and wherein the pivot point is located at substantially a center of a length of the latch ear.
(147) Example 21 is an assembly as in any of Examples 1-20, wherein the assembly includes a body comprising a sidewall, wherein the sidewall defines a hollow interior comprising a fluid chamber, and wherein the hollow interior is aligned with a longitudinal axis of the assembly. The assembly includes a fluid retention piston disposed within the fluid chamber, wherein the fluid retention piston comprises a fluid port enabling a fluid to pass through the fluid retention piston. The assembly includes a valve assembly disposed within the fluid retention piston, wherein the valve assembly comprises: a valve bushing comprising a sidewall that defines a bushing interior space; a valve ball; and a valve spring. The assembly is such that the valve assembly is in a closed configuration when the valve ball is at least partially disposed within the bushing interior space and prevents fluid from flowing through the bushing interior space.
(148) Example 22 is an assembly as in any of Examples 1-21, wherein the assembly comprises an uphole end and a downhole end that is located opposite to the uphole end; wherein the downhole end is located deeper in the substrate when at least a portion of the assembly is disposed within the substrate to perform the drilling operation; and wherein the spring is located nearer the downhole end relative to the ball.
(149) Example 23 is an assembly as in any of Examples 1-22, wherein the valve assembly is in an open configuration when the fluid is permitted to flow through the bushing interior space.
(150) Example 24 is an assembly as in any of Examples 1-23, wherein the valve spring is located nearer the downhole end relative to the valve bushing and the valve ball.
(151) Example 25 is an assembly as in any of Examples 1-24, wherein the valve ball is located nearer the downhole end relative to the valve bushing when the valve assembly is in the open configuration.
(152) Example 26 is an assembly as in any of Examples 1-25, wherein the valve ball is disposed within the bushing interior space when the valve assembly is in the closed configuration.
(153) Example 27 is an assembly as in any of Examples 1-26, wherein the valve bushing comprises an interior bushing diameter defined as a diameter of the bushing interior space; wherein the valve ball comprises a ball diameter; and wherein the interior bushing diameter is substantially equivalent to the ball diameter such that the fluid is prevented from flowing through the bushing interior space when the valve ball is disposed within the valve bushing.
(154) Example 28 is an assembly as in any of Examples 1-27, wherein a maximum volumetric flow

rate through the fluid chamber is adjusted by opening or closing the valve assembly.

(155) Example 29 is an assembly as in any of Examples 1-28, wherein the valve assembly transitions from the closed configuration into an open configuration in response to the valve ball experiencing an external force that exceeds a valve threshold force; and wherein the external force moves from the uphole end of the assembly toward the downhole end of the assembly.

(156) Example 30 is an assembly as in any of Examples 1-29, wherein the valve assembly transitions from the closed configuration into the open configuration in response to the valve ball moving from being at least partially disposed within the bushing interior space, to being located nearer the downhole end of the assembly relative to the valve bushing; and wherein the valve ball is disposed in between the valve spring and the valve bushing when the valve assembly is in the open configuration.

(157) Example 31 is an assembly as in any of Examples 1-30, wherein the valve ball comprises a ball diameter; and wherein the valve threshold force is substantially equivalent to a magnitude of force required to compress the valve spring a compression distance that is substantially equal to the ball diameter.

(158) Example 32 is an assembly as in any of Examples 1-31, wherein a restoring force applied by the valve spring on the valve ball urges the valve ball toward the uphole end of the assembly; and wherein the valve assembly transitions from the open configuration to the closed configuration in response to the restoring force applied by the valve spring on the valve ball exceeding the external force applied on the valve ball.

(159) Example 33 is an assembly as in any of Examples 1-32, wherein the external force comprises pressurized fluid pumped into the assembly from the uphole end toward the downhole end.

(160) Example 34 is an assembly as in any of Examples 1-33, wherein the fluid flows through the fluid chamber with laminar flow.

(161) Example 35 is an assembly as in any of Examples 1-34, wherein the body comprises: an upper body comprising an upper sidewall defining a substantially cylindrical geometry, wherein the upper sidewall defines an upper hollow interior; one or more upper body ports disposed within the upper sidewall, wherein the one or more upper body ports permit the fluid to pass into and out of the upper hollow interior; a lower body comprising a lower sidewall defining a substantially cylindrical geometry, wherein the lower sidewall defines a lower hollow interior; and one or more lower body ports disposed within the lower sidewall, wherein the one or more lower body ports permit the fluid to pass into and out of the lower hollow interior.

(162) Example 36 is an assembly as in any of Examples 1-35, wherein at least a portion of the upper sidewall is overlapped with at least a portion of the lower sidewall to form the fluid chamber of the body; and wherein the fluid passes into and out of the fluid chamber through one or more of: the one or more upper body ports; or the one or more lower body ports.

(163) Example 37 is an assembly as in any of Examples 1-36, wherein at least a portion of the upper sidewall is overlapped with at least a portion of the lower sidewall to form the fluid chamber of the body; and wherein the fluid enters and exits the assembly through the fluid port of the fluid retention piston, and further through one or more of the one or more upper body ports or the one or more lower body ports.

(164) Example 38 is an assembly as in any of Examples 1-37, further comprising: a fluid retention shaft; and a fluid retention cage attached to the fluid retention shaft, wherein the fluid retention cage comprises a plurality of fluid cage ports enabling the fluid to pass into and out of the fluid retention cage; wherein the fluid retention cage is located nearer the downhole end of the assembly relative to the fluid retention shaft.

(165) Example 39 is an assembly as in any of Examples 1-38, wherein the fluid retention piston comprises a cylindrical piston body comprising a piston diameter; wherein the piston diameter of the cylindrical piston body is greater than a cage diameter of the fluid retention cage; wherein the cylindrical piston body is configured to receive the fluid retention cage.

(166) Example 40 is an assembly as in any of Examples 1-39, wherein a position of the valve ball along a longitudinal axis of the assembly indicates whether the valve assembly is in the closed configuration or is in an open configuration; wherein the valve assembly is in the closed configuration when the valve ball forms a fluid-tight fit against an interior wall of the valve bushing, such that the fluid is prevented from passing through the bushing interior space; and wherein the valve assembly is in the open configuration when the valve ball is located in between the valve spring and the valve bushing, such that the fluid is permitted to flow through the bushing interior space, around the valve ball, and through the fluid port.
(167) Example 41 is an assembly as in any of Examples 1-40, wherein a restoring force applied by the valve spring on the valve ball causes the valve assembly to transition from an open configuration to the closed configuration.
(168) Example 42 is an assembly as in any of Examples 1-41, wherein the assembly includes a tube cap piston comprising a threaded recess. The assembly includes a viscosity adjustment screw coupled to the tube cap piston, wherein a threaded portion of the viscosity adjustment screw is screwed into the threaded recess of the tube cap piston. The assembly includes a tube cap comprising a tube cap sidewall, wherein the tube cap further comprises a tube cap port disposed within the tube cap sidewall. The assembly is such that the tube cap piston and the viscosity adjustment screw are disposed within a hollow interior space defined by the tube cap sidewall. The assembly is such that a fluid passageway is formed in between the tube cap port and an exterior surface of the tube cap piston. The assembly is such that the threaded portion of the viscosity adjustment screw is threaded into or out of the threaded recess of the tube cap piston to adjust a size of the fluid passageway.
(169) Example 43 is an assembly as in any of Examples 1-42, further comprising a terminating tube cap located at a downhole end of the assembly; wherein the downhole end of the assembly is located deeper in the substrate when at least a portion of the assembly is disposed within the substrate to perform the drilling operation; and wherein a uphole end of the assembly is located opposite to the downhole end of the assembly.
(170) Example 44 is an assembly as in any of Examples 1-43, wherein the tube cap further comprises a viscosity wall disposed within the hollow interior space defined by the tube cap sidewall; wherein the viscosity adjustment screw comprises the threaded portion and further comprises a head portion; and wherein the head portion interfaces with the viscosity adjustment wall.
(171) Example 45 is an assembly as in any of Examples 1-44, wherein the tube cap piston comprises larger diameter body located nearer the uphole end of the assembly; and wherein the tube cap piston comprises a smaller diameter body located neared the downhole end of the assembly.
(172) Example 46 is an assembly as in any of Examples 1-45, wherein the tube cap piston further comprises: a larger diameter face located at the uphole end of the tube cap piston; and a smaller diameter face located at the downhole end of the tube cap piston.
(173) Example 47 is an assembly as in any of Examples 1-46, wherein a diameter of the larger diameter body is greater than a diameter of the larger diameter face; and wherein the tube cap piston comprises a chamfered edge extending from an edge of the larger diameter body to an edge of the larger diameter face.
(174) Example 48 is an assembly as in any of Examples 1-47, wherein a diameter of the smaller diameter body is greater than a diameter of the smaller diameter face; and wherein the tube cap piston comprises a chamfered edge extending from an edge of the smaller diameter body to an edge of the smaller diameter face.
(175) Example 49 is an assembly as in any of Examples 1-48, wherein the tube cap piston comprises a piston chamfered edge configured to form an interference fit with a corresponding chamfered edge of the tube cap.

(176) Example 50 is an assembly as in any of Examples 1-49, wherein partially unscrewing the threaded portion from the threaded recess of the tube cap piston increases the size of the fluid passageway; and wherein increasing the size of the fluid passageway enables higher viscosity fluids to flow through the fluid passageway.
(177) Example 51 is an assembly as in any of Examples 1-50, wherein screwing the threaded portion further into the threaded recess of the tube cap piston decreases the size of the fluid passageway; and wherein decreasing the size of the fluid passageway prevents higher viscosity fluids from flowing through the fluid passageway.
(178) Example 52 is an assembly as in any of Examples 1-51, wherein the fluid passageway permits fluids comprising a flow rate from about one quart per 28 seconds, to about one quart per 100 seconds, to pass through the fluid passageway when the threaded portion of the viscosity adjustment screw is fully threaded into the threaded recess of the tube cap piston.
(179) Example 53 is an assembly as in any of Examples 1-52, wherein a maximum fluid viscosity permitted to pass through the fluid passageway is a flow rate of up to about one quart per 65 seconds.
(180) Example 54 is an assembly as in any of Examples 1-53, further comprising a spindle; wherein the spindle comprises a shock absorption spring; and wherein the shock absorption spring is disposed within the hollow interior space defined by the tube cap sidewall.
(181) Example 55 is an assembly as in any of Examples 1-54, wherein the shock absorption spring prevents or mitigates damage to the assembly when one or more of: the assembly is lowered into the substrate and contacts a core barrel; or an overshot is lowered into the substrate and contacts a retractor case of the assembly.
(182) Example 56 is an assembly as in any of Examples 1-55, wherein the tube cap piston is exchangeable, and wherein the size of the fluid passageway is further adjustable based on a size of the tube cap piston.

Claims

1. An assembly for performing a drilling operation in a substrate, the assembly comprising: a retractor case comprising a retractor sidewall and a retractor pin slot disposed within the retractor sidewall, wherein the retractor sidewall defines a retractor interior space; a body comprising a body sidewall and a body pin slot disposed within the body sidewall, wherein the body sidewall defines a body interior space, and wherein the body interior space is configured to receive the retractor case; a latch ear coupled to the body, wherein at least a portion of the latch ear extends outward relative to the body sidewall; and an expansion block at least partially disposed within the retractor interior space; wherein a position of the expansion block along a longitudinal axis of the assembly determines whether the latch ear is in an extended position or a retracted position relative to the body sidewall.
2. The assembly of claim 1, wherein the assembly comprises an uphole end and a downhole end that is located opposite to the uphole end; wherein the downhole end is located deeper in the substrate when at least a portion of the assembly is disposed within the substrate to perform the drilling operation.
3. The assembly of claim 2, wherein the expansion block comprises a pin hole disposed therethrough; wherein the body pin slot comprises a body pin slot length extending along the longitudinal axis of the assembly; and wherein the body pin slot comprises a body pin slot uphole end corresponding with the uphole end of the assembly; and wherein the body pin slot comprises a body pin slot downhole end located at an opposite end of the body pin slot length relative to the body pin slot uphole end.
4. The assembly of claim 3, further comprising a pin, wherein the pin is configured to be disposed through each of the body pin slot, the retractor pin slot, and the pin hole.

5. The assembly of claim 4, wherein the expansion block is located at a maximum uphole expansion position when the pin abuts one or more of the retractor pin slot uphole end or the body pin slot uphole end.
6. The assembly of claim 5, wherein the latch ear is in the retracted position relative to the body sidewall when the expansion block is located at the maximum uphole expansion position along the longitudinal axis of the assembly.
7. The assembly of claim 4, wherein the expansion block is located at a maximum downhole expansion position when the pin abuts one or more of the retractor pin slot downhole end or the body pin slot downhole end.
8. The assembly of claim 7, wherein the latch ear is in the extended position relative to the body sidewall when the expansion block is located at the maximum downhole expansion position along the longitudinal axis of the assembly.
9. The assembly of claim 2, wherein the latch ear comprises: a latch ear body; a latch pivot hole disposed through the latch ear body; a latch ear radial extension, wherein the latch ear radial extension extends substantially radially outward relative to the body sidewall; and a latch ear expansion interface leg.
10. The assembly of claim 9, wherein the latch ear radial extension is located at a latch downhole end of the latch ear, wherein the latch downhole end corresponds with the downhole end of the assembly; and wherein the latch ear expansion interface leg is located at a latch uphole end of the latch ear, wherein the latch uphole end is located opposite to the latch downhole end.
11. The assembly of claim 10, wherein the retractor case is configured to engage with a tube to lift the assembly upward out of a hole formed in the substrate; and wherein the latch ear radial extension interfaces with an interior surface of the tube when the assembly is installed within the tube.
12. The assembly of claim 9, wherein the body further comprises: a latch channel disposed within the body sidewall, wherein the latch channel is configured to receive the latch ear body; and a body pivot hole disposed within the body sidewall; wherein the latch pivot hole aligns with the body pivot hole when the latch ear body is disposed within the latch channel; and wherein a latch axis of rotation is formed at the aligned body pivot hole and latch pivot hole such that the latch ear rotates about the latch axis of rotation when the latch ear body is disposed within the latch channel.
13. The assembly of claim 12, wherein the expansion block comprises an expansion body that comprises a polygonal geometry; wherein the polygonal geometry comprises at least one exterior interface angle that is less than 45 degrees; and wherein the exterior interface angle is configured to interface with the latch ear expansion interface leg.
14. The assembly of claim 13, wherein latch ear comprises an interface angle defined by a first angle arm extending along a surface of the latch ear body, and a second angle arm extending along a surface of the latch ear expansion interface leg; and wherein the interface angle is greater than 90 degrees.
15. The assembly of claim 14, wherein a sum of the exterior interface angle of the expansion block and the interface angle of the latch ear is equal to about 180 degrees.
16. The assembly of claim 1, further comprising a fluid retention piston coupled to the expansion block.
17. The assembly of claim 1, wherein the assembly comprises two latch ears; wherein each of the two latch ears is coupled to the body and extends outward relative to the body sidewall; and wherein the two latch ears are positioned on the body sidewall that the two latch ears are diametrically opposed to one another.
18. The assembly of claim 1, wherein the expansion block comprises a surface that is substantially aligned with a longitudinal axis of the assembly.
19. The assembly of claim 1, wherein the latch ear comprises a latching surface; wherein, in response to the latch ear being disposed in the extended position, the latching surface of the latch

ear forms an interference fit with an interior surface of a tube when the assembly is disposed within the tube for performing the drilling operation; and wherein, in response to the latch ear being disposed in the retracted position, the latching surface of the latch ear is radially narrow sufficient to avoid contacting the interior surface of the tube when the assembly is disposed within the tube.

20. The assembly of claim 1, wherein the latch ear is rotatably coupled to the body at a pivot point, and wherein the pivot point is located at substantially a center of a length of the latch ear.