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3,346,059

RETRACTABLE WIRE LINE CORE BARREL

Filed March 31, 1965

2 Sheets-Sheet 1

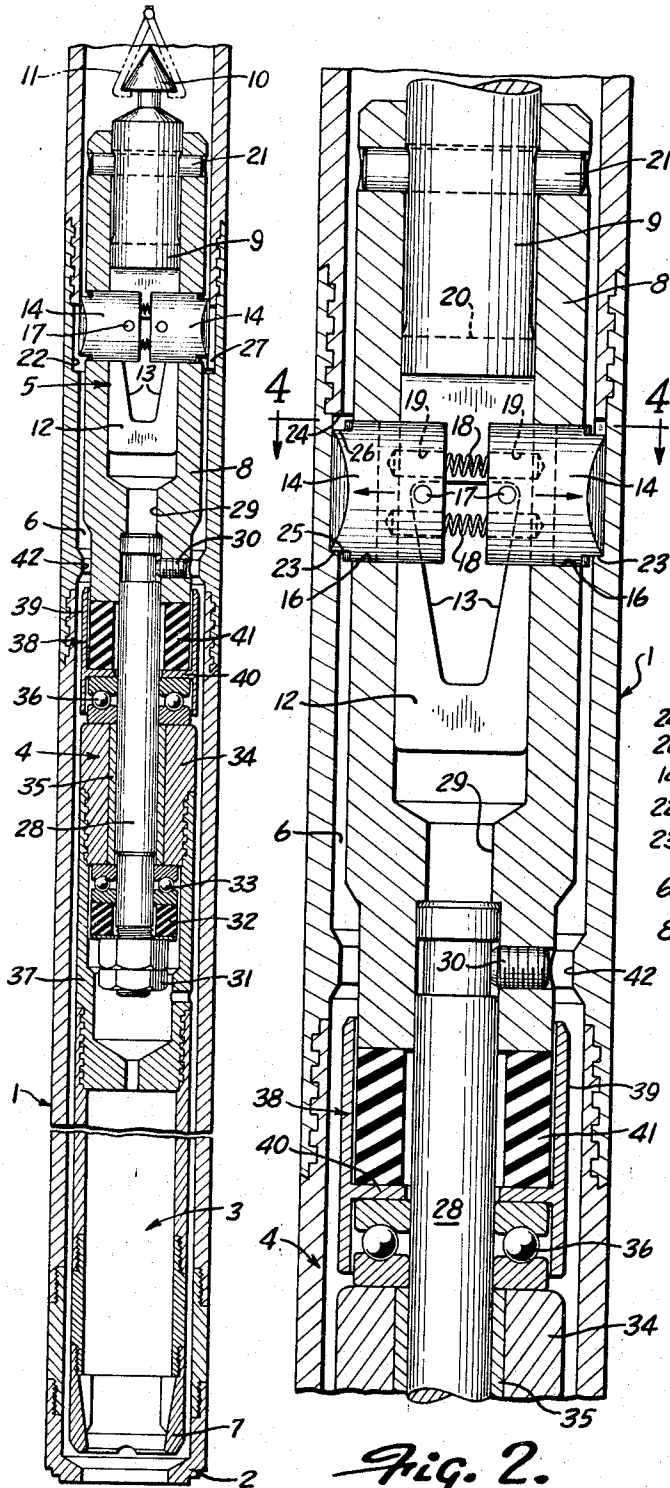


Fig. 1.

Fig. 2.

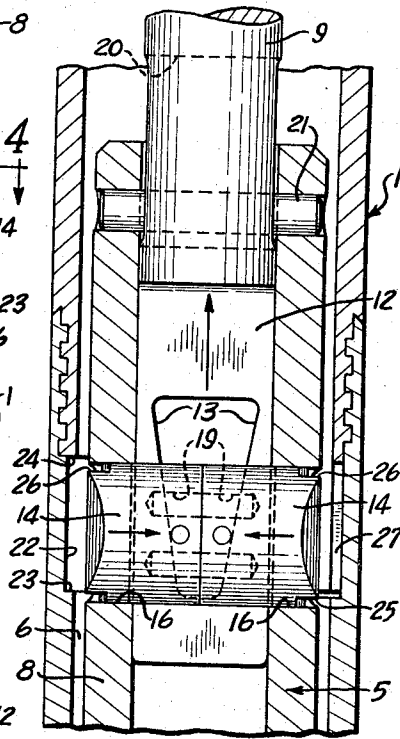


Fig. 3.

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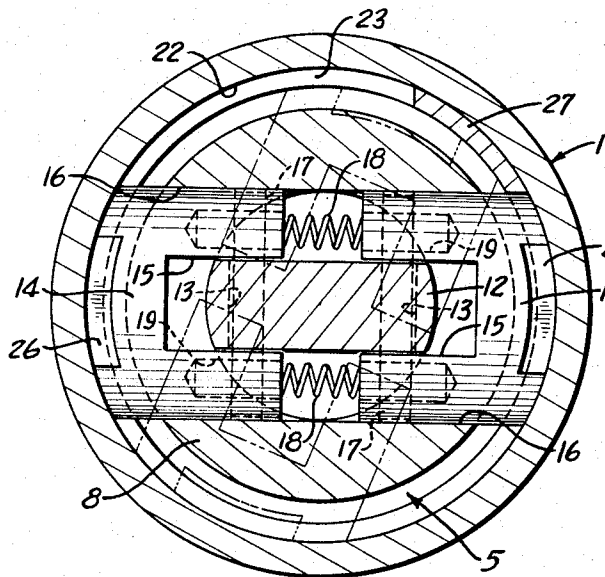


Fig. 4.

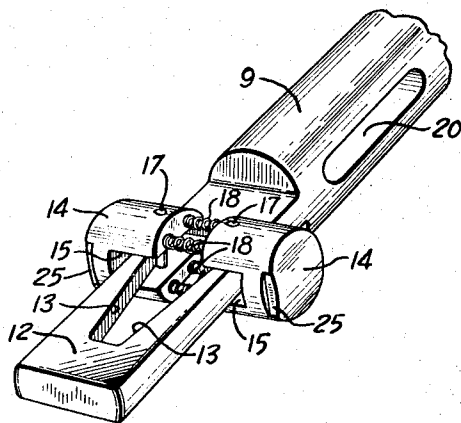


Fig. 5.

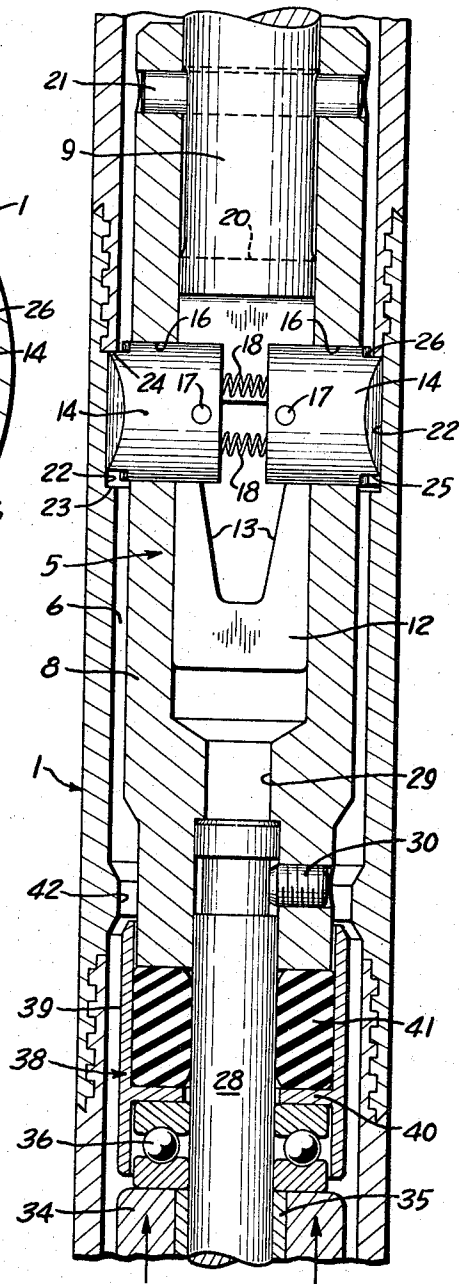


Fig. 6.

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RETRACTABLE WIRE LINE CORE BARREL
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ABSTRACT OF THE DISCLOSURE

A core barrel structure having an outer drill tube with a groove adapted to receive a pair of spring biased latch dogs mounted in a latch body forming a part of the inner core tube assembly. The latch dogs ride an inclined cam surface provided on a latch control bar slideable within the latch body. The outer drill tube has an annular reduced portion which acts together with a rigid metering sleeve to restrict downward fluid flow when jamming of the core occurs.

This invention relates to a retractable wire line core barrel, and more particularly to a core barrel having improved latching and valving means.

In the art of drilling into the earth for core samples by the wire line core barrel method, an inner tube is dropped down into an outer tube and hung from and locked to the latter in numerous ways. Some such devices include inwardly projecting shoulders in the outer tube that contact a shoulder on the inner tube, or springs, that catch the inner tube. Other designs provide no means of hanging the inner tube except when it hits the inner shoulder of the bit; this procedure often giving unsatisfactory results.

In addition, the inwardly projecting shoulder means of hanging the inner tube results in a smaller core size and a heavier face width of the cutting bit. This results in higher bit costs and slower penetration rates due to the fact that more ground must be cut in relation to the core received in any given hole size. Examples of such prior art constructions are disclosed in U.S. Patents 2,829,868 and 2,857,138.

The present invention is an improvement over that described above and disclosed in the aforesaid patents. Generally, in accordance with the invention, the outer drill tube is provided with a groove which is adapted to receive a pair of independently movable latch dogs mounted in a latch body forming a part of the inner core tube assembly. The latch dogs are biased outwardly and ride an inclined cam surface provided on a latch control bar slideable within the latch body. Further, in accordance with the invention, the outer drill tube is provided with an annular reduced portion which acts together with a metering sleeve to restrict the downward fluid flow when blocking or jamming of the core occurs within the inner core tube.

The accompanying drawings illustrate the best mode presently contemplated by the inventor for carrying out the invention.

In the drawings:

FIGURE 1 is a vertical section of a device constructed in accordance with the present invention and showing the position of the lowered core barrel just as locking is about to take place;

FIG. 2 is an enlarged view of a portion of the structure shown in FIGURE 1, with the latch in locked position;

FIG. 3 is a fragmentary view similar to FIG. 2 and showing the latch retracted as core retraction is begun;

FIG. 4 is a transverse section taken on line 4-4 of FIG. 2, and showing the latches in two positions relative to the driving lip;

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FIG. 5 is a fragmentary perspective of the latch bar and latches; and

FIG. 6 is a fragmentary view of the metering valve and showing it in an intermediate upward position.

As shown in the drawings, the invention is embodied in a mechanism which includes a generally hollow multi-sectioned rotatable outer drill tube 1 which extends from suitable rotary drive mechanism at the earth's surface to the lower drilling area. A suitable core-drilling bit 2 is attached to the lower end of tube 1. For receiving and retaining a core sample drilled with bit 2, a core barrel inner tube assembly is lowered into tube 1 and is retractable to remove a core sample to the surface. The inner tube assembly has substantially parallel walls and generally comprises a lower core lifter section 3, an intermediate bearing and valving section 4, and an upper latching section 5. All of these sections are secured together in a manner to be described to make a unitary assembly which may be lowered into and raised out of tube 1. All sections are of approximately the same outer diameter, which is such that a passageway or space 6 is formed between the outer tube and inner assembly to permit circulation of fluid therethrough.

Lower core lifter section 3 comprises a tubular core lifter case 7 secured at the bottom of the inner tube assembly. Case 7 is adapted to receive a core sample being drilled, and to grip and hold the sample for return to the surface.

In accordance with the invention, the inner tube assembly is adapted to be lockingly received within outer tube 1 so that the core lifter case 7 is suspended just above bit 2. For this purpose, latching section 5 comprises a tubular hollow latch body 8 connected in a manner to be described to intermediate section 4. A latch bar 9 is slideably disposed within body 8 and extends upwardly therefrom. Bar 9 comprises at its upper end a coupling spear 10 of reduced diameter which may be engaged by an overshot 11 lowered down to retract the inner assembly. The lower end of bar 9 within latch body 8 is formed to provide a flat portion 12 having a generally rectangular cut-out, the vertical sides of which form a pair of opposed downwardly converging inclined cam surfaces 13.

A pair of independently movable latches 14 of generally circular section are disposed for transverse actuation by cam surfaces 13. For this purpose, and as best shown in FIG. 5, each latch 14 is slotted, as at 15, for slideably mounting the latch over one side of cam flat 12 and extends radially outwardly therefrom and through an opening 16 in the wall of latch body 8. A latch pin 17 is mounted in each latch and extends across slot 15 on the inner cam side of the latch. Pins 17 are adapted to be biased against opposed cam surfaces 13 and to ride therealong to thereby extend and retract the latches. For this purpose, biasing means such as a plurality of springs 18 are set into opposed holes 19 in the inner ends of latches 14 and extend between the latter to bias them in a radially outward direction. This holds latch pins 17 against surfaces 13. Holes 19 should be deep enough to substantially completely receive springs 18 when latches 14 are retracted and the springs compressed. Although four springs 18 are shown, any other number may be used without departing from the spirit of the invention.

The intermediate portion of latch bar 9 is provided with a longitudinal slot 20, and a pin 21 extends through latch body 8 and the slot to hold the latter and bar 9 in relative position. In addition, as bar 9 telescopingly slides within body 8, the ends of slot 20 engage pin 21 to limit the telescoping travel of the bar.

When latch bar 9 is in down position relative to body 8, latches 14 are free to extend radially outward to a maximum position wherein their outer ends, if free, may

extend substantially beyond the outer wall of body 8. As bar 9 is moved upwardly relative to body 8, cam surfaces 13 and pins 17 cause the latches to retract radially against the force of spring 18 until their outer ends are substantially flush with the said outer wall.

When it is desired to dispose the core barrel inner core tube assembly within drill tube 1, the assembly is freely dropped, lowered, or pumped through tube 1 from the surface. During this time, and due to the weight of latch bar 9 and the force of springs 18, bar 9 will be in its lowermost position and cam surfaces 13 will permit latches 14 to be free to move to their outermost position. However, full extension of latches 14 is prevented by engagement by the outer latch ends with the inner surface of tube 1.

When the lower core lifter case 7 approaches to closely adjacent drill bit 2, the entire inner core assembly tube is halted in its downward or forward movement and locked into position. The position just prior to locking is shown in FIGURE 1, while the locked position is shown in FIG. 2. For this purpose, an annular locking groove 22 is disposed in the inner wall of drill tube 1. Groove 22 is provided with a lower annular landing shoulder 23 and a complimentary upper shoulder 24, and is of a height approximately the same as the diameter of latches 14. Due to the increased internal diameter of tube 1 afforded by groove 22, as the inner core tube assembly drops downwardly, latches 14 will move outwardly and be locked into the groove and thus hang the entire assembly from lower shoulder 23. The independent mounting of latches 14 permits individual action thereof and positive locking of at least one latch into groove in the event that the other latch is restricted, or for other reasons as more specifically described hereinafter. During drilling, fluid can easily pass downwardly around latches 14 since they are of relatively smaller diameter than latch body 8. The restriction in the fluid space caused by the latches is insufficient to decrease the efficiency of fluid flow.

In the event of upward pressures on the inner assembly during drilling, upper shoulder 24 will be engaged by the latches and prevent upward movement of the inner assembly.

A good fit between the right angle contour of both shoulders and the latches is accomplished by providing flat surfaces 25 and 26 on the lower and upper latch of the latches and permits a slight amount of play or edges, respectively. This reduces the vertical end diameter tolerance between the shoulder and latches.

During the operation of the drill, it is desirable to prevent rotation of latching section 5 relative to outer drill tube 1, and thus prevent wear of the latch ends. For this purpose, a vertical lip 27 is disposed in groove 22. Lip 27 is shown as extending downwardly into the groove from the adjacent upper threaded section of drill tube 1, although it may be formed as part of the groove itself. As shown in phantom in FIG. 4, when the inner tube assembly is lowered into the outer tube, one of the latches 14 may be prevented from opening, due to lip 27. However, the other latch, being independently movable, will enter groove 22 and lock the assembly in place. When tube 1 is rotatably driven, the still retracted latch 14 will ride off of lip 27 and move outwardly. Continued relative rotary motion will bring one of the latches into engagement with the lip, as shown in full lines in FIG. 4, and the outer tube and latching mechanism will thereafter rotate together.

When it is desired to retract the inner tube assembly, the overshot 11 is attached to spear 10 and pulls upwardly or rearwardly thereon. Bar 9 will slide upwardly within latch body 8, thereby retracting latches 14 inwardly from groove 22. When the latches are fully released therefrom and substantially flush with the outer wall of body 8 or the inner wall of tube 1, the entire assembly will be free to be raised out of the tube. See FIG. 3.

For purposes of interconnecting latch body 8 with the intermediate and lower portion of the inner tube assembly, a vertical central spindle 28 is secured into a hole 29 in the lower body portion, as by a tightening screw 30.

The lower end of spindle 28 is threaded to receive a lock nut 31 thereon. Above the lock nut on the spindle are disposed in succession; a spring washer 32, a lower rotary bearing 33, an inner tube cap 34, and associated sleeve bearing 35, an upper rotary bearing 36, and a valving or fluid metering mechanism. Cap 34 is attached to the lower portion of the inner tube assembly adjacent core lifter case 7 by an annular suspending sleeve 37 which passes downwardly around bearing 33, washer 32, and lock nut 31.

Upper bearing 36 permits all assembly structure therebeneath to remain relatively stationary while outer tube 1 rotates during drilling.

When a full core sample has been formed and it is desired to retrieve it, outer tube 1 is lifted upwardly at the surface. This will cause the core lifter section to grip the core and hold the inner core tube assembly stationary relative to upward travel of outer tube 1. This in turn will cause lower washer 32 to be compressed so that the load of breaking the core will be transferred to the inner surface of the bit and through the outer tube rather than on the latching mechanism. When drill bit 2 engages core lifter case 7, the core will snap off. The outer tube may be lifted further until it may be properly clamped at the surface. An overshot 11 may then be utilized to unlatch the latches and pull the inner core barrel assembly and core sample to the surface, as previously described.

It is advisable to be able to determine if excess resistance to the core entering the inner tube is being created during drilling. Most desirably, an instant indication to the operator at the surface is most helpful. An increase in back pressure on the downwardly flowing drilling fluid, which is directly correlative with upward pressure on the inner tube assembly, will accomplish this result since the pressure can be read on a meter.

In accordance with the invention, a rigid metering valve is provided to govern the downward fluid flow by opening and closing movement. For this purpose, an annular cylindrical valve sleeve 38 of rigid material such as metal is disposed on spindle 28 with its lower end telescoping over upper bearing 36. The upper annular edge of sleeve 38 is slightly tapered so that it merges into a radially outwardly facing valve surface 39 on the inner sleeve wall. An annular flange 40 extends radially inwardly from sleeve 38 and is supported by bearing 36. A sleeve-like washer 41 of suitable resilient compressible material is tightly mounted between flange 40 and the lower supporting end of latch body 8. As shown, washer 41 is spaced slightly from spindle 28 to permit expansion of the washer upon compression thereof.

When the inner tube assembly is in the position during normal drilling, valve surface 39 will be spaced longitudinally below an area of reduced diameter in the outer tube 1, as shown in FIGS. 1 and 2. This area forms an annular valve surface 42 which faces generally radially inwardly and compliments the outwardly facing surface 39 of sleeve 38.

When abnormal upward pressure occurs due to the core becoming blocked and which tend to lift the inner tube assembly and as best shown in FIG. 6, the latter will initially raise slightly until latches 14 tightly engage and lock against upper shoulder 24. This fixed stop prevents any further upward movement of the latching section 5. However, continued severe upward pressure on the lower end of the assembly will subsequently cause washer 41 to longitudinally compress, thereby permitting sleeve 38 to raise so that the area for fluid flow between surfaces 39 and 42 becomes more and more reduced and restricted. This occurrence is readable on a pressure meter at ground level and remedial action can be taken. In the event of a severe disturbance, surface 39 will come very close to

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and possibly telescope into surface 42 and come close to shutting off all fluid flow. However, tight contact between the surfaces is not desirable and some flow of fluid is necessary to prevent burning or overheating of bit 2.

The rigid nature of the metering valve substantially reduces wear and provides a more accurate measure of fluid pressure, since there can be substantially no excess leakage due to valve deformation.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In a core barrel, the combination comprising:
 - (a) an outer drill tube having a drill bit at its lower end and adapted to be rotatably driven at its upper end,
 - (b) said drill tube having an internal groove disposed above its lower end and forming lower and upper shoulders,
 - (c) said drill tube also having a portion of reduced diameter forming a rigid valve surface,
 - (d) and an inner tube assembly having substantially parallel walls throughout its length and adapted to be disposed within said drill tube near the bottom thereof,
 - (e) said inner tube assembly being of lesser outside diameter throughout than the inside diameter of said drill tube to provide a space for fluid flow therebetween, with said assembly comprising:
 - (1) a latch body having a tubular wall,
 - (2) radially movable latch means mounted to said latch body and extending through the wall thereof,
 - (3) means disposed within said latch body to bias said latch means radially outwardly against the inner wall of said drill tube so that said latch means will enter said groove and hang said assembly from said lower shoulder,
 - (4) means counteracting said biasing means for retracting said latch means from said groove to permit withdrawal of said assembly upwardly in said drill tube,
 - (5) a valve member having a rigid valve surface normally spaced from said first-named valve surface when said latch means is disposed in said groove,
 - (6) both said surfaces providing an area of restriction therebetween for the flow of fluid through said space,
 - (7) and resilient means disposed between said valve member and said latch body, said resilient means being compressible to permit said valve member to approach the said portion of reduced diameter of said drill tube so that said area of restriction is reduced,
 - (f) the construction being such that upward pressure on said inner tube assembly will initially cause said latch means to lock against the upper shoulder of said groove, and subsequently cause said resilient means to be compressed to thereby reduce the fluid restrictive space between said surfaces.
2. In a core barrel, the combination comprising:
 - (a) an outer drill tube having a drill bit at its lower end and adapted to be rotatably driven at its upper end,
 - (b) said drill tube having an internal groove disposed above its lower end and forming lower and upper shoulders,
 - (c) a tubular hollow latch body having a wall of lesser diameter than said drill tube and disposed there-within,
 - (d) a latch bar disposed within said latch body and slideable therewithin between first and second positions,

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- (e) the inner portion of said latch bar having a pair of longitudinally extending facing cam surfaces thereon,
 - (f) a pair of opposed latch dogs slideably mounted on said latch bar adjacent said cams, said latch dogs extending radially through the wall of said latch body for engaging the inner wall of said tube and said groove,
 - (g) means disposed in said latch body for biasing said latch dogs radially outwardly and against said cam surfaces,
 - (h) said cam surfaces converging toward one another so that when said latch bar is in the said first position said latch dogs are retracted within said latch body, and when said latch bar is in the said second position said latch dogs are extended so that they engage said drill tube,
 - (i) and a core lifter inner tube assembly connected to said latch body and normally disposed adjacent said drill bit when said latch dogs are in said grooves,
 - (j) said latch dogs normally hanging said latch body and said assembly from the said lower shoulder,
 - (k) the construction being such that said latch dogs lock against the upper shoulder of said groove when upward pressure is applied to said assembly.
3. The core barrel of claim 2 in which:
 - (a) a lip is disposed in said groove for driving engagement with at least one of said dogs,
 - (b) and said dogs are independently movable so that if one of said dogs is prevented from opening into said groove by said lip, the other dog may nevertheless open into said groove and be locked therein.
 4. In an inner core barrel tube assembly for use in a core barrel having an outer drill tube with an internal groove forming lower and upper shoulders:
 - (a) a tubular hollow latch body adapted to be disposed within said outer drill tube,
 - (b) a latch bar disposed within said latch body and telescopingly slideable therewithin between first and second positions,
 - (c) the inner portion of said latch bar having a pair of longitudinally extending facing cam surfaces,
 - (d) a pair of independently movable opposed latch members slideably mounted on said latch bar adjacent said cams, said latch members extending radially through said latch body for engagement of a drill tube,
 - (e) and spring means mounted between said latch members for biasing the latter outwardly and against said cam surfaces,
 - (f) said cam surfaces converging toward one another so that when said latch bar is in the said first position said latch members are retracted within said latch body, and when said latch bar is in the said second position said latch members are extended for engagement with a shoulder on a drill tube,
 - (g) said latch members being formed to engage the said lower shoulder of said groove to hangably support said inner tube assembly within said outer drill tube, or to alternately engage the said upper shoulder when upward pressure is applied to said assembly.
 5. In a core barrel, the combination comprising:
 - (a) an outer drill tube having a drill bit at its lower end and adapted to be rotatably driven at its upper end,
 - (b) said drill tube having a portion of reduced diameter forming a radially inwardly facing first rigid valve surface,
 - (c) an inner tube assembly supported within said drill tube and of lesser diameter than the latter to provide a space for fluid flow therebetween,
 - (d) a member mounted on said assembly and with said member having a radially outwardly facing second rigid valve surface spaced longitudinally from said first surface so that said surfaces provide a restrictive area for fluid flow therebetween,

- (e) and a resilient compressible washer connected to said member and with said washer being compressible longitudinally and expandable upon upward pressure on said assembly to thereby cause said member and said second surface to move toward said first surface so that said restrictive area is reduced.
6. In a core barrel, the combination comprising:
- (a) an outer drill tube having a drill bit at its lower end and adapted to be rotatably driven at its upper end,
 - (b) said drill tube having a portion of reduced diameter forming a first rigid valve surface,
 - (c) an inner tube assembly supported within said drill tube and of lesser diameter than the latter to provide a space for fluid flow therebetween,
 - (d) an upper and lower support forming part of said assembly,
 - (e) an annular sleeve mounted between said supports, said sleeve having a second rigid valve surface at its upper end which is spaced longitudinally from said first surface so that said surfaces provide an annular restrictive area for fluid flow therebetween,
 - (f) a radially inwardly extending flange on said sleeve and with said flange disposed adjacent said lower support,
 - (g) and a resilient member mounted between said flange and said upper support, said member being compressible longitudinally upon upward pressure on said assembly to thereby cause said sleeve and said second surface to move longitudinally toward said first surface so that said restrictive area is reduced.
7. In a core barrel, the combination comprising:
- (a) an outer drill tube having a drill bit at its lower end and adapted to be rotatably driven at its upper end,
 - (b) said drill tube having a portion of reduced diameter forming a first rigid valve surface,
 - (c) an inner tube assembly supported within said drill tube and of lesser diameter than the latter to provide a space for fluid flow therebetween,
 - (d) a body forming an upper portion of said assembly,
 - (e) a spindle extending downwardly from said latch body,
 - (f) a core lifter inner tube assembly suspended from said spindle and disposed adjacent said drill bit,
 - (g) bearing means mounted on said spindle beneath said body for providing relative rotation between the latter and said inner tube assembly,
 - (h) an annular sleeve mounted between said bearing means and said body, said sleeve having a second rigid valve surface at its upper end which is spaced longitudinally from said first surface so that said surfaces provide an annular restrictive area for fluid flow therebetween,
 - (i) a radially inwardly extending flange on said sleeve and with said flange supported on said bearing means,
 - (j) and a resilient sleeve mounted between said flange and said body, said sleeve being compressible longi-

- tudinally upon upward pressure on said inner tube assembly to thereby cause said sleeve and said second surface to move longitudinally toward said first surface so that said restrictive area is reduced.
8. In an inner core barrel tube assembly for use in a core barrel having an outer drill tube with an internal groove forming lower and upper shoulders:
- (a) a tubular hollow latch body adapted to be disposed within an outer drill tube,
 - (b) a latch bar disposed within said latch body and telescopically slideable therewithin between first and second positions,
 - (c) the inner portion of said latch bar having a pair of longitudinally extending facing cam surfaces,
 - (d) a pair of independently movable opposed latch members slideably mounted on said latch bar adjacent said cams, said latch members extending radially through said latch body for engagement of a drill tube,
 - (e) and spring means mounted between said latch members for biasing the latter outwardly and against said cam surfaces,
 - (f) said cam surfaces converging toward one another so that when said latch bar is in the said first position said latch members are retracted within said latch body, and when said latch bar is in the said second position said latch members are extended for engagement with a shoulder on a drill tube,
 - (g) said latch members being generally circular and of smaller diameter than said latch body,
 - (h) the upper and lower portions of said latch members being flat for engagement with a drill tube shoulder.
9. The apparatus of claim 8 in which said latch bar includes a longitudinal slot, and a pin extending through said latch bar and said slot to limit the sliding movement of the latch bar within the latch body.
10. The apparatus of claim 8 in which the inner cam end of said latch bar is generally flat and each latch member is slotted to fit over the flat portion thereof, and a pin extending across the slot of each said latch member and engaging the respective cam surface.

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