Sept. 12, 1967 L. A. LINDELOF 3,340,939

CORE LIFTER APPARATUS

Filed Aug. 27, 1965 2 Sheets-Sheet 1

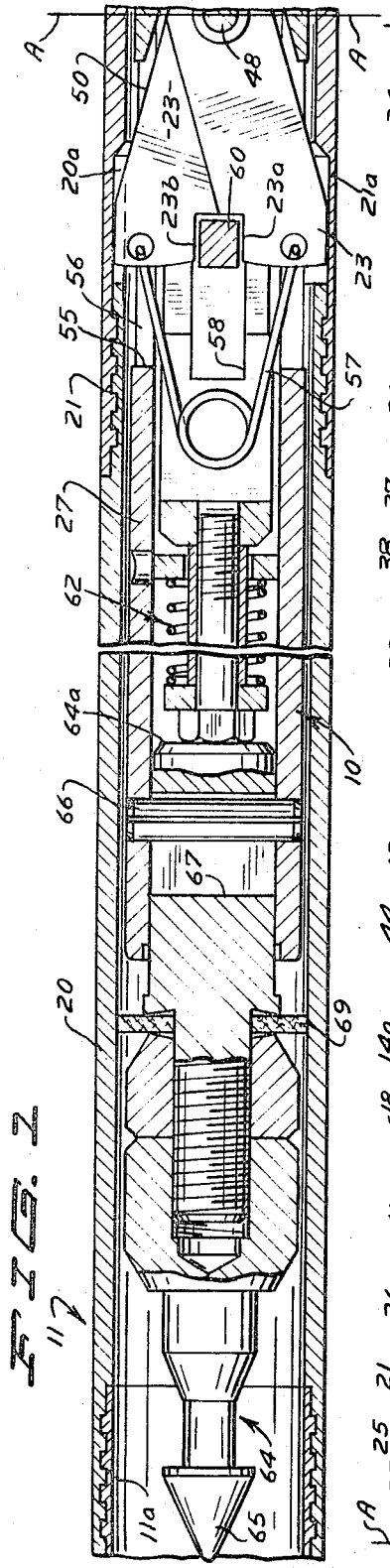


FIG. 2

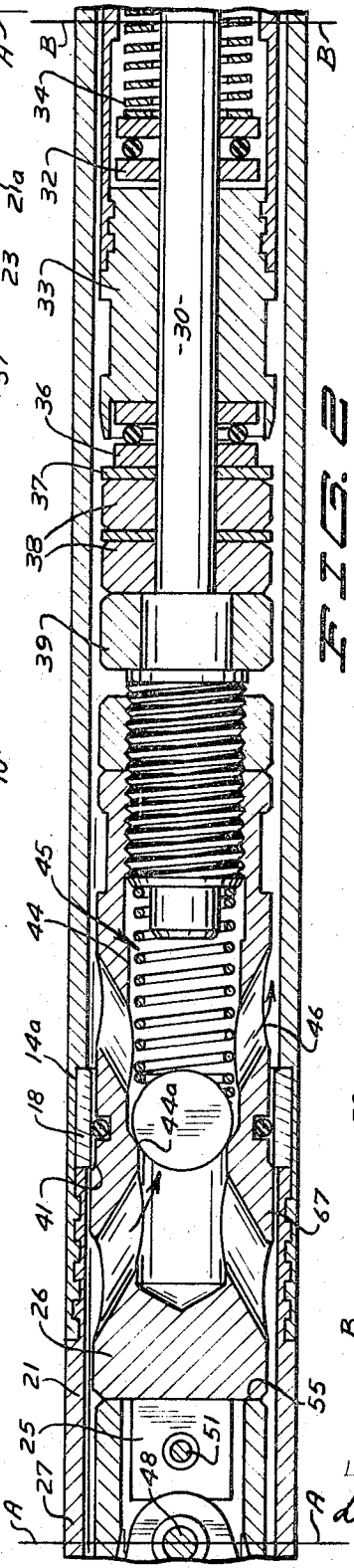
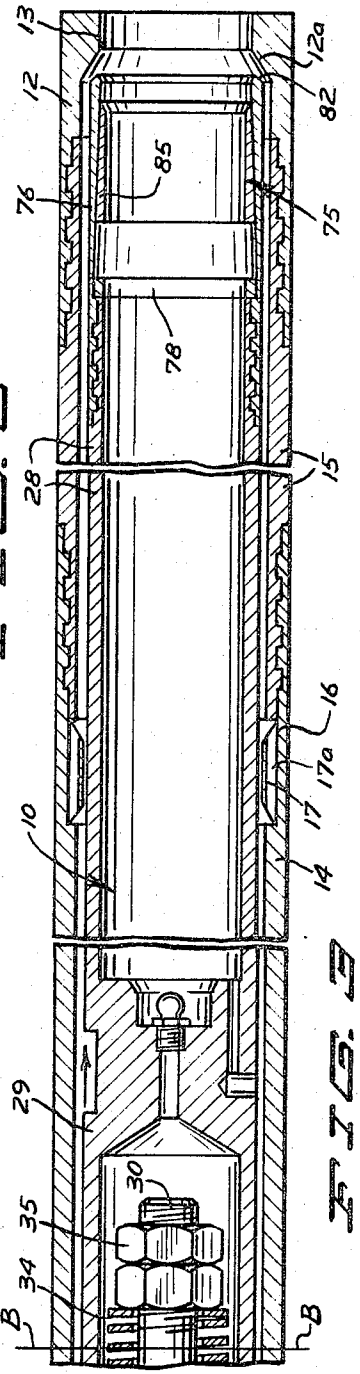


FIG. 3



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FIG. 4

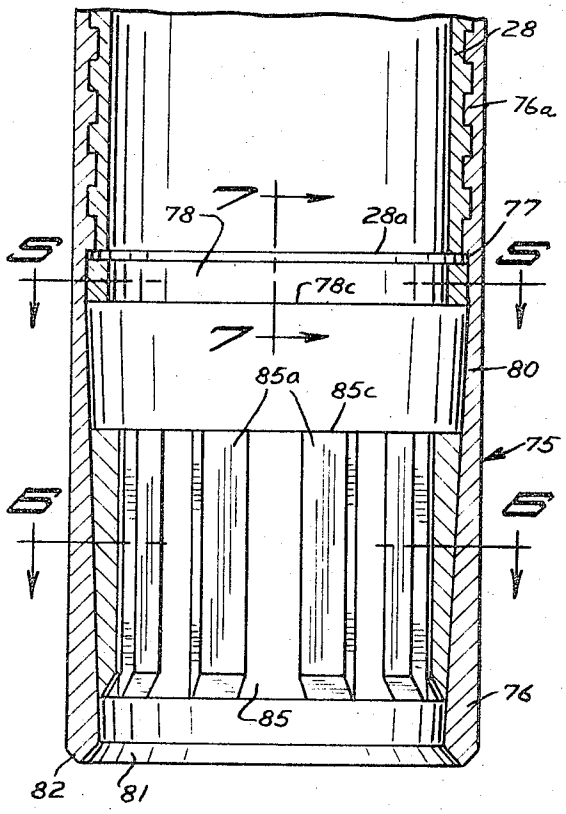
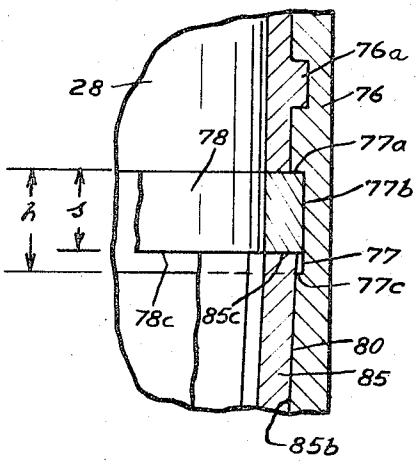


FIG. 7



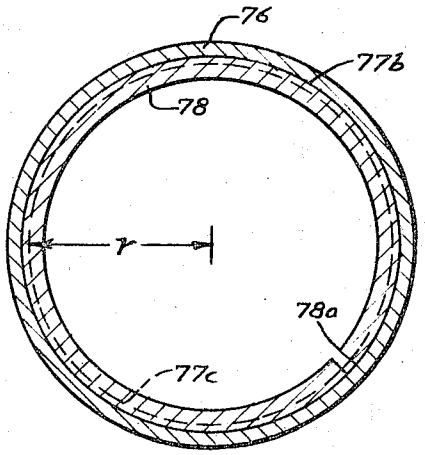


FIG. 5

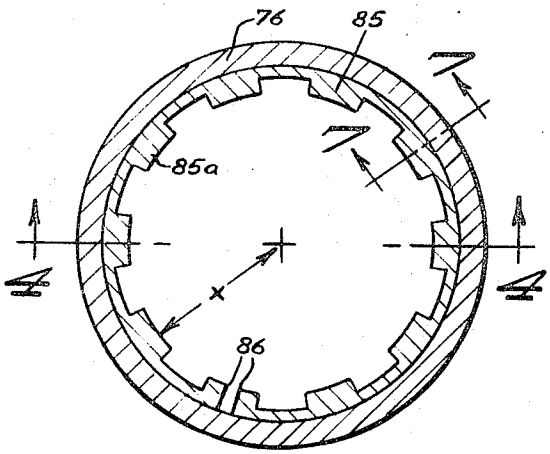


FIG. 6

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3,340,939

CORE LIFTER APPARATUS

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Filed Aug. 27, 1965, Ser. No. 483,102
9 Claims. (Cl. 175—246)

This invention relates to new and novel improvements in core lifter apparatus for core barrels used for taking a core sample from an earth formation. More particularly this invention relates to the provision of a hardened snap ring in a core lifter case to prevent a core lifter moving into the core receiving tube during the drilling operation.

In prior art core lifter apparatus having an axially movable core lifter in the core lifter case, the inner circumferential edge of the core receiving tube becomes worn. When such an edge becomes worn, relatively frequently the core lifter will be forced into the core receiving tube and will not properly grip the core when the core barrel assembly is retracted. In such cases the core is frequently lost. Also where the core lifter bears against a worn edge such as that of a core receiving tube, the edge is often worn such as that of a core receiving tube, the edge is often worn such that the core lifter can "cock" relative the central axis of the core receiving tube. Such cocking frequently results in poor core recovery since either the core will be gouged or the resistance to the movement of the core lifter relative the core is sufficiently great during the drilling operation to give a high pressure signal through conventional mechanism prior to the core receiving tube being filled with core. In order to overcome problems of the aforementioned nature, this invention has been made.

An object of this invention is to provide new and novel core lifter apparatus in core drilling and recovery equipment. Another object of this invention is to provide new and novel mechanism for limiting the movement of a core lifter in a core lifter case in one axial direction. A further object of this invention is to provide a removable hardened insert in a core lifter case to minimize the occurrences of misalignment of the core lifter relative the core lifter case during the core drilling operation. An additional object of this invention is to provide an easily replaceable member in a core lifter case for preventing movement of the core lifter out of said case and into the core receiving tube during the core drilling operation.

Other and further objects are those inherent in the invention herein illustrated, described and claimed and will become apparent as the description proceeds.

For purposes of facilitating the description of the invention, the term "inner" refers to that portion of the drill stem, or of the assembly, or an element of the assembly being described which in its position "for use" in the drill stem is located closer to core bit on the drill stem than any other portion of the apparatus being described, except where the term clearly refers to a transverse circumference, direction or diameter of the drill stem or other apparatus being described. The term "outer" refers to that portion of the drill stem, or of the assembly, or element being described which in its position "for use" in the drill stem is located closer to the mouth of the drill hole than any other portion of the apparatus being described, except where the term clearly refers to a transverse circumference, direction or diameter of the apparatus being described.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these

being indicative, however, of but a few of the various ways in which the invention may be employed.

The invention is illustrated in the drawings in which corresponding numerals refer to the same parts and in which:

FIGURES 1–3 with one arranged above the other with the axial center lines aligned and lines A—A of FIGURES 1 and 2 aligned, and lines B—B of FIGURES 2 and 3 aligned, form a composite longitudinal section through a core barrel inner tube assembly having the core lifter apparatus of this invention and the drill stem when the assembly is in a latched core taking position, portions of FIGURE 3 being broken away;

FIGURE 4 is an enlarged fragmentary longitudinal section view of the inner end of the core drilling apparatus of FIGURE 3, said view being generally taken along the line and in the direction of the arrows **4—4** of FIGURE 6 to more clearly show the core lifter apparatus of this invention;

FIGURE 5 is a transverse cross sectional view generally taken along the line and in the direction of the arrows **5—5** of FIGURE 4 to show the stop ring seated in the core lifter case;

FIGURE 6 is a transverse cross sectional view generally taken along the line and in the direction of the arrows **6—6** of FIGURE 4 to show the core lifter seated in the core lifter case, and

FIGURE 7 is a further enlarged fragmentary cross sectional view generally taken along the lines and in the direction of the arrows **7—7** of FIGURES 4 and 6 other than the core lifter is shown in a position abutting against the stop ring which in turn is shown abutting against the core receiving tube.

Referring now in particular to FIGURES 1–3, a wire line core barrel inner tube assembly will now be described, said assembly being generally designated **10**. Even though in FIGURES 1–3 the assembly **10** is illustrated generally in a horizontal condition, it is to be understood that it can be utilized when the drilling direction is vertically downwardly or inclined downwardly sufficiently that the assembly will fall to the bit end of the drill stem generally designated **11** in a manner described in U.S. Patent 2,829,868 to Pickard et al. or any desired direction including upwardly. The drill stem **11** is made up of sections of pipe coupled together and having an annular drill bit **12** mounted on the inner end thereof. The bit **12** has a central core receiving aperture **13**.

The portion of the drill stem attached to or extending inwardly of pipe section **11***a* is commonly referred to as the core barrel outer assembly and is provided for receiving and retaining the core barrel inner tube assembly **10**. The core barrel outer tube assembly is composed of a core barrel outer tube **14**, a reaming shell **15** threadedly connected to the inner end of the tube **14**, there being a hardened material such as diamonds (not shown) on the transverse outer reaming surface and on the annular drill bit **12** for drilling into earth formations from which the core sample is taken. The bit **12** is threadedly connected to the inner end of the reaming shell.

The reaming shell and outer tube cooperatively provide an annular recess **16** for seating a stabilizer ring **17** in position to aid in retaining the core barrel inner tube assembly **10** in a centralized condition within the core barrel outer tube assembly. Ring **17** has circumferentially spaced, axial grooves **17***a* to permit fluid to bypass said ring between the annular spaces between the inner tube and outer tube assemblies on axially opposite sides of the ring.

The outer end of the core barrel outer tube assembly includes a locking coupling **20** which connects said assembly to the adjacent pipe section **11***a* of the drill stem. At the opposite end of the coupling **20** from the aforemen-

tioned pipe section, a guide coupling **21** is threadedly connected. The inner end of the locking coupling in conjunction with the annular recess **21***a* of the guide coupling form a seat in the guide coupling against which the detents or latch dogs **23** of the core barrel inner tube assembly are seated for releasably retaining the assembly **10** adjacent the core bit. Also the inner end portion of the locking coupling has an inwardly projecting flange **20***a* that bears against a surface of a latch dog to cause said latch dog and other portions of the core barrel inner tube assembly to rotate with the drill stem when the latch dogs are in a latch seated position.

The opposite end of the guide coupling is threadedly connected to the outer end of the core barrel outer tube **14**, the core barrel outer tube having an annular recess **14***a* to receivably mount a landing ring **18** in abutting engagement with the guide coupling (see FIGURE 2). As may be noted, the landing ring forms a suspension shoulder in the core barrel outer tube. Since the core barrel outer tube is generally of a construction illustrated and explained in greater detail in U.S. Patent 3,120,282, issued Feb. 4, 1964, other than for the provision of the landing ring instead of a suspension flange, seating a ring **17**, and a substantially longer locking coupling, it will not be described in greater detail.

The core barrel inner tube assembly **10** includes a latch body **26** having a pair of detents or latches **23** and a latch insert block **25** mounted thereon, a latch release tube **27** for retracting said latches, a core sample receiving tube **28**, an inner tube cap **29** threaded into the outer end of the core barrel receiving tube, and a spindle **30** for connecting the cap to the inner end portion of the latch body for limited relative slidable movement.

A bearing **32** is mounted on the spindle in abutting engagement with the inner end of the bearing housing **33** which is also slidably mounted on said spindle and threadedly connected to cap **29**; there being provided a coil spring **34** that at one end abuts against said bearing and at the opposite end against a nut **35** threaded on the spindle whereby the bearing housing is rotatable and movably axially a limited amount relative the spindle. The bearing housing mounts the thrust bearing assembly **36** in abutting relationship with the metal spacer washer **37**, there being provided resilient shut off valve washers **38** on the spindle between washer **37** and an annular member **39** abutting against a shoulder formed on the spindle.

As may be noted from FIGURE 2, the latch body has a shoulder **41** seatable against the landing ring **18** for normally retaining the core barrel inner tube assembly out of contact with the drill bit during the drilling operation. To be mentioned is that all portions of the core barrel inner tube assembly axially inwardly of shoulder **41** are of diameters smaller than the minimum inside diameter of ring **18** in order that said portions may pass through the landing ring.

A fluid channel **44** is provided in the latch body to open to the annular spaces between the core barrel inner tube assembly and the core barrel outer tube assembly for bypassing drilling fluid around the landing ring when the core barrel inner tube assembly is in a latched core taking position. Mounted in channel **44** is a check valve assembly **45** to seat against valve seat **44***a* to substantially restrict flow of fluid in an axial direction from adjacent the core receiving tube toward the latch body, but to readily permit fluid flow through the channel in the opposite direction (arrow **46**).

A through pin **48** pivotally mounts the latch dogs **23** in side by side relationship in the latch body slots **50**, while pin **51** mounts the insert block on the latch body. The construction of the latches **23** and the mounting thereof on the latch body is generally the same as that described in U.S. Patent 3,103,981, granted Sept. 17, 1963.

Mounted on the outer reduced diameter portion of the latch body for slidable movement between a position abutting against the latch body shoulder **55** and a position axially spaced therefrom is the latch release tube **27**. Tube **27** has slots **56** through which the outer transverse corner portions of the latch dogs may extend to latchingly engage the latch seat **21***a*. A torsion spring **57** within slot **50** resiliently urges the latch dogs to pivot about through pin **48** to a position to latchingly engage the latch seat.

A right angle cut out **23***a* is provided in an outer corner of one of the latch dogs and an oppositely faced cut out **23***b* of the substantially same size is formed in the other latch dog, the cut outs being located to form a generally rectangular, open ended slot when the latch dogs are spread apart to a latching position such as illustrated in FIGURE 1. An axially elongated slot **58** is formed in the latch body on either side of the slot **50** to extend transversely thereto. A through pin **60** is extended through the slots **58**, and has its opposite ends mountingly retained within opposed apertures in the latch release tube so as to be moved therewith. The pin **60** in cross section is of a slightly smaller dimension than that necessary to retain edges of the latch dogs in abutting engagement with the peripheral wall of the guide coupling which forms the latch recess when the pin bears against opposite axial edges of the slots **23***a*, **23***b*. The slots **58** extend axially inwardly sufficiently such that when the pin **60** abuts against the inner edges thereof, the pin is located slightly axially outwardly of the transverse edges of slots **23***a*, **23***b* and the inner annular edge of the latch release tube abuts against the shoulder **55**. The length of the slots **58** limit the amount of axial movement of the latch release tube relative to the latch body. A sub-assembly **62** forms an interconnection between the latch body and the latch release tube for resiliently urging the latch release tube to move relative the latch body to a position abutting against shoulder **55**, but permitting movement of the latch release tube to retract the latches.

A plug, generally designated **64**, is slidably mounted in the outer end of the latch release tube by a pin **66** secured in said tube and extended through a slot **67** in the plug. The plug has a spear point **65** extending outwardly beyond the latch release tube.

The relative location of the pin **66**, the slot **67** in the plug, and the axial dimension of the slot **67** are such that when the latch release tube abuts against the latch body shoulder **55**, the pin **66** is a little outwardly of the inner transverse edge of the slot, and the inner surface **64***a* of the plug abuts against the sub-assembly **62** whereby the leather washer **69** may flex toward the latch release tube to permit fluid to bypass said plug. When the plug is permitted to move axially inwardly toward the latch body (latches **23** in a retracted condition), washer **69** extends generally radially in abutting relationship with the latch release tube to form a fluid seal between the plug and the inner peripheral wall of the drill stem to permit hydraulically propelling assembly **10** toward the bit end of the drill stem regardless of the drilling direction (upwardly, downwardly or any desired angle).

It is to be mentioned that other than the leather washer and the enlarged diametric portion **67** of the latch body, the maximum diameter of any portion of the core barrel inner tube assembly inwardly of said enlarged diametric portion is not greater than the maximum diameter of any portion of assembly outwardly of said enlarged diametric portion. Thus when assembly **10** is in the latched condition of FIGURES 1–3, pumping drilling fluid through the drill stem will flex washer **69** to cause it to flow to channel **44**, through channel **44** to bypass the landing ring **18** and thence through the grooves of the stabilizer ring **17** to pass through bit aperture **13**.

Referring now in particular to FIGURES 4–7 inclusive, the core lifter assembly generally designated **75**, will now be described. Assembly **75** includes a core lifter case **76**, having internal threads **76***a* at one end that form a matching fit with the external threads of the core receiving tube **28**. The case **76** has an annular groove or recess **77** that has a transverse annular edge **77***a* that is sub-

stantially coextensive with the inner annular edge **28***a* of inner tube **28** when the case is properly threaded on the inner tube. Mounted in recess **77** is a hardened resilient split steel snap ring **78** that is axially split at **78***a* and which is also referred to herein as a stop ring. The stop ring is substantially rectangular in longitudinal cross section through one arcuate portion thereof.

Recess **77** also has an axial surface **77***b* that is of a height *h* which is greater than the corresponding height *s* of the stop ring to permit limited axial movement of the stop ring in the recess. Recess **77** also has a transverse annular edge **77***c*, the minimum radial dimension *r* of edge **77***c* being substantially greater than the corresponding dimension of edge **77***a*. Since ring **78** in a relaxed condition has a greater outside radius than the radius of recess surface **77***b*; when the stop ring is seated in said recess, its outer axial edge will abut against surface **77***b* while edges **77***a*, **77***c* limit the axial movement of the stop ring relative the core lifter case.

The core lifter case has an axially elongated, gradually tapered axial inner surface **80** (for example, a taper of 2° 30′ in one embodiment of the invention) that at its outer end joins with the inner radial edge of surface portion **77***c*. The angle of taper of the surface **80** is such that if the tapered surface were extended, it would intersect surface **77***b* intermediate surfaces **77***a*, **77***c*. The inside diameter of the core lifter case at the intersection of surface **80** with recess edge **77***c* is accordingly greater than the inside diameter of, for example, the intersection of said taper surface with beveled surface **81** at the inner end of said case. The last mentioned diameter is only slightly greater than the diameter of the core bit aperture and is substantially the same as the inside diameter of the core receiving tube.

The core lifter case at its inner axial end has the beveled surface **81** that is of progressively increasing diameter in an axial direction toward the core bit aperture and a transverse outer beveled surface **82** of an angle of taper to form a mating fit with the inclined shoulder **12***a* of the core bit. Due to the provision of spring **34**, the core receiving tube and core lifter assembly can remain stationary in surrounding relationship to the core as the drill stem is retracted and thereby the latch body and spindle are initially retracted until beveled surface **82** abuts against shoulder **12***a*.

The core lifter case mounts for axial movement relative thereto a core lifter **85** for grippingly holding and breaking a core as the drill stem is retracted. That is, the core lifter comprises a resilient split spring steel ring having a plurality of circumferentially spaced, axially elongated ribs **85***a* that are adapted to grip and break off the core and retain the core in the inner tube as the core barrel inner tube assembly is retracted. The core lifter has a transverse outer axial conical surface **85***b* that is tapered to mate with the core lifter case surface **80**. Further the core lifter is longitudinally split at **86** so as to permit it to assume a shape of a smaller diameter in a conventional manner.

The general radius of curvature *x* of the transverse inner edges of the core lifter ribs, when the stop ring abuts against edge **77***a* and/or **28***a*, and core lifter transverse edge **85***c* abuts against the stop ring, is substantially the same as the inner radius of the core receiving tube and the inner radius of the stop ring seated in recess **77**.

Although the core lifter assembly has been described with reference to a particularly hydraulically propellable core barrel inner tube assembly, it is to be understood that this assembly may be advantageously used on conventional core barrel equipment, i.e. on gravity type wire line core barrel equipment, for example, such as disclosed in U.S. Patent 2,829,868 in place of the core lifter and core lifter case disclosed therein or hydraulically propellable wire line core barrel equipment such as disclosed in U.S. Patent 3,120,282.

The structure of the wire line core barrel inner tube assembly having been described, the operation thereof will now be set forth. For purposes of facilitating the description and operation of the inner tube assembly **10**, it will be assumed that the drill stem is extended into a hole in an earth formation in a generally vertical downward direction and that the core barrel inner tube assembly has been moved in the drill stem to a position that the suspension flange **41** of the latch body seats against the shoulder provided by the landing ring **18** and the outer corners of the latch dogs are opposite the latch seat in the drill stem. At this time, or upon slight rotation of the drill stem, the latch dogs pivot into the latch seat due to the resilient action of the spring **57**. This pivotal movement of the latch dogs spreads the axial extending edges of cut outs **23**, **23***b* sufficiently that the pin **60** can move therebetween. Either through the action of gravity and/or in conjunction with the resilient action of assembly **62**, the latch release tube is then forced to move relative to the latch body to position pin **60** in the cut outs **23***a*, **23***b* as illustrated in FIGURE 1. The movement of the locking pin **60** into the cut outs thereupon prevents the latch dogs from being retracted from the latch seat until the time that the latch release tube has been moved sufficiently axially outwardly relative the latch body that the pin **60** is clear of the cut outs **23***a*, **23***b*.

Normally at this time the core lifter case is axially spaced from the stop ring such as illustrated in FIGURE 4. Now the core drilling operation is started whereby the cutting of core is begun. Because of the annular shape of the core bit, an ever deepening hole is cut with a rod like core being produced. As the drilling continues the core barrel outer tube and core bit move relative the core whereby the core extends through the core bit aperture and thence into the core lifter case to abut against the adjacent surfaces of the core lifter. As the axial length of core increases, the core lifter case moves relative the core lifter until the core lifter abuts against the stop ring, and thence the stop ring and core lifter move relative the core lifter case until the stop ring abuts edge **77***a* and core lifter edge **85***c*. Thereafter the core lifter case, the core lifter, the stop ring and the core receiving tube move together as a unit relative the core.

After a core of a desired length has been cut, for example when a high pressure signal is provided at the surface through compression of the resilient shut-off washers **38**, the drilling is stopped and the drill stem is pulled outwardly a short distance. Pulling the drill stem outwardly results in the core lifter case moving axially relative the core and the core lifter whereby through the drag of the core lifter on the core, the core lifter is further axially spaced from edge **77***a* and is transversely compressed (due to tapered surfaces **80**, **85***b*) to grippingly hold the core and break the core. Now the core barrel inner tube assembly along with the core is retracted by a suitable overshot assembly (not shown).

Other than for the core lifter assembly, the description of the structure and operation of the core barrel inner tube assembly has not been set further in a detail since if considered necessary, it is believed that Ser. No. 414,218, filed Nov. 27, 1964, which is assigned to the same assignee as this application, would make the structure and operation of the remainder of the core barrel inner tube assembly **10** obvious.

Due to the provision of the stop ring there is provided a hardened surface against which the core lifter can abut. As a result there is provided the generally transverse surface **78***c* of the stop ring that does not become rounded or tapered through long use and accordingly does not provide an inclined surface that would allow the core lifter to cock relative the longitudinal axis L—L of the core receiving tube or to compress the core lifter such that it will move up into the receiving tube such as occurs with prior art core lifter apparatus.

That is the stop ring provides a hardened, generally planar annular surface **78***c* against which the core lifter

surface 85c abuts during the core taking operation. Further, in the event the stop ring after considerable use becomes worn or damaged, it may be easily replaced without removing the core lifter from the core lifter case, the stop ring advantageously being provided with a couple of "flats" (not shown) in its transverse outer surface to facilitate the insertion of a screw driven for removing the stop ring from recess 77.

As many widely apparently different embodiments of the invention may be made without departing from the spirit and scope thereof, it is to be understood I do not limit myself to the specific embodiment herein.

What is claimed is:

1. For core drilling apparatus that includes an axially elongated core receiving tube having a central axis, a core lifter assembly that includes a core lifter case connected to one axial end of said tube to extend axially outwardly thereof, said case having an annular recess adjacent said tube that extends axially away from said end, a stop ring mounted in said recess and a core lifter mounted in said case for limited slidable relative movement between a position abutting against said stop ring and a position axially spaced therefrom, said case mounting said stop ring axially intermediate said tube and the core lifter.

2. The core lifter apparatus of claim 1 further characterized in that said core lifter case has a transverse inner tapered surface and that said core lifter has a transverse outer tapered surface of about a matching taper with the core lifter case, said surfaces being tapered toward said central axis in the direction that said case extends away from said tube, said core lifter case tapered surface intersecting said recess.

3. In core barrel apparatus having a drill stem with a core bit at its inner end and a core barrel inner tube assembly adapted to be moved through the drill stem to a latched position adjacent the bit, said core barrel inner tube assembly including a core receiving tube and a core lifter having an outer tapered surface, the improvement comprising a stop ring and a core lifter case connected to the one end of the core receiving tube to extend axially away from said core receiving tube and to mount said core lifter for limited axial movement therein, said core lifter case having means for receivingly seating said stop ring adjacent the connection of said case to the core receiving tube and a transverse inner tapered surface of increasing transverse dimensions toward said seating means and axially opposite said seating means from said core receiving tube, said tapered surfaces being oppositely tapered and said stop ring having an inner transverse dimension less than the corresponding dimension of the tapered surface of the core lifter case that is most closely adjacent thereto and less than the corresponding maximum transverse outer dimension of the core lifter whereby said core lifter is axially slidable relative to the case to a position abutting against said stop ring.

4. The apparatus of claim 3 further characterized in that said means comprises a lifter case portion having an internal annular recess and that said stop ring is a hardened spring steel split ring seatable in said recess.

5. The apparatus of claim 4 further characterized in that said core lifter case tapered surface intersects said recess.

6. The apparatus of claim 5 further characterized in that said connection of the core lifter case to the core receiving tube is a threaded connection having one end portion of the core receiving tube extending into the core lifter case, said one end portion having a transverse annular edge axially adjacent said stop ring in the recess.

7. In a core barrel assembly having an axially elongated core receiving tube that is threaded at one end, a core lifter case having a threaded end portion threadedly connected to said tube one end to extend axially away therefrom, said case having a transverse internal groove adjacent said tube and extending in axial spaced relation thereto, a core lifter mounted in said case, said core lifter and core lifter case having abutting surfaces permitting limited axial movement of the core lifter relative the case between a first axial position and a second axial position more remote from said tube, and means removably mounted in said groove for limiting the movement of the core lifter toward said tube to said first axial position, said means having an opening of a minimum transverse dimension approximately the same as the inside diameter of the core receiving tube.

8. For an axially elongated core receiving tube, core lifter apparatus comprising an axially elongated core lifter case having an end portion threadedly connectable to one end of said tube, said end portion having an annular internal recess adjacent to and extending axially away from the core receiving tube when said case is threadedly connected thereto, said case having a transverse inner conical surface of a gradual taper of progressively decreasing transverse dimensions in an axial direction toward said end portion, a resilient, hardened stop ring removably mounted in said recess, and a core lifter mounted in said core lifter case for limited axial movement, said core lifter having a transverse outer conical surface of a taper opposite the taper of the core lifter case in abutting engagement with said core lifter case conical surface, the last mentioned conical surface having a transverse dimension axially adjacent said recess substantially larger than the corresponding transverse inner dimension of the stop ring seated in said recess whereby the stop ring will limit the axial movement of the core lifter in a direction toward a core receiving tube when said case is connected to such a tube.

9. The apparatus of claim 8 further characterized in that said recess has axially opposite generally transverse planar annular edges and that said stop ring has opposite, substantially planar, transverse annular edges.

References Cited

UNITED STATES PATENTS

2,829,868	4/1958	Pickard	175—246
3,126,064	4/1964	Miller	175—246
3,127,943	4/1964	Mori	175—246
3,225,845	12/1965	Koontz	175—246 X
3,305,033	2/1967	Pickard	175—246

CHARLES E. O'CONNELL, *Primary Examiner.*

NILE C. BYERS, JR., *Examiner.*

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,340,939 September 12, 1967

Leonard A. Lindelof

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, lines 24 and 25, strike out "the edge is often worn such as that of a core receiving tube,".

Signed and sealed this 24th day of September 1968.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents