Jan. 16, 1968 | J. J. JENSEN | 3,363,705

CORE BARREL INNER TUBE

Filed Aug. 19, 1965

2 Sheets-Sheet 1

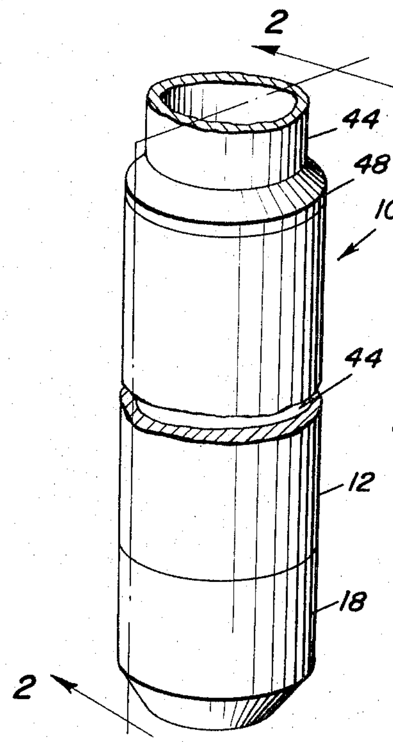
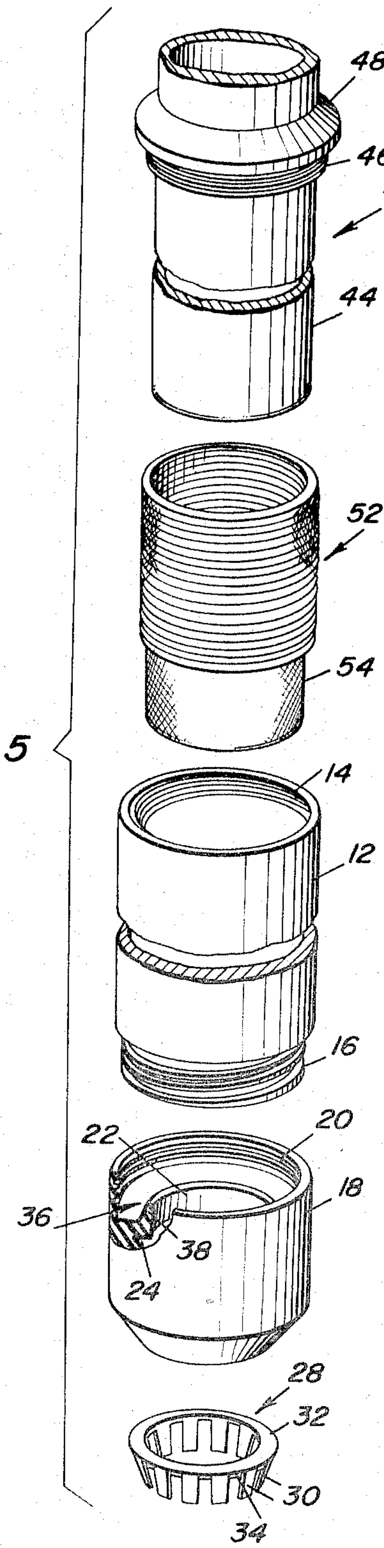


Fig. 1

Fig. 5



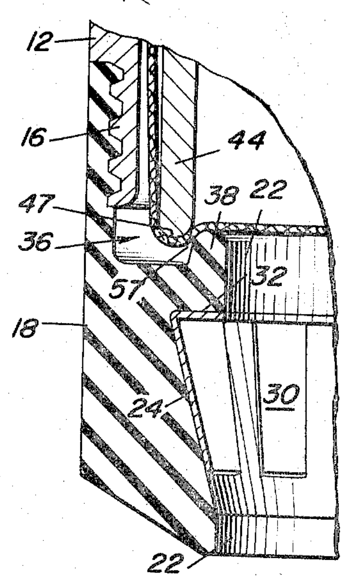


Fig. 4

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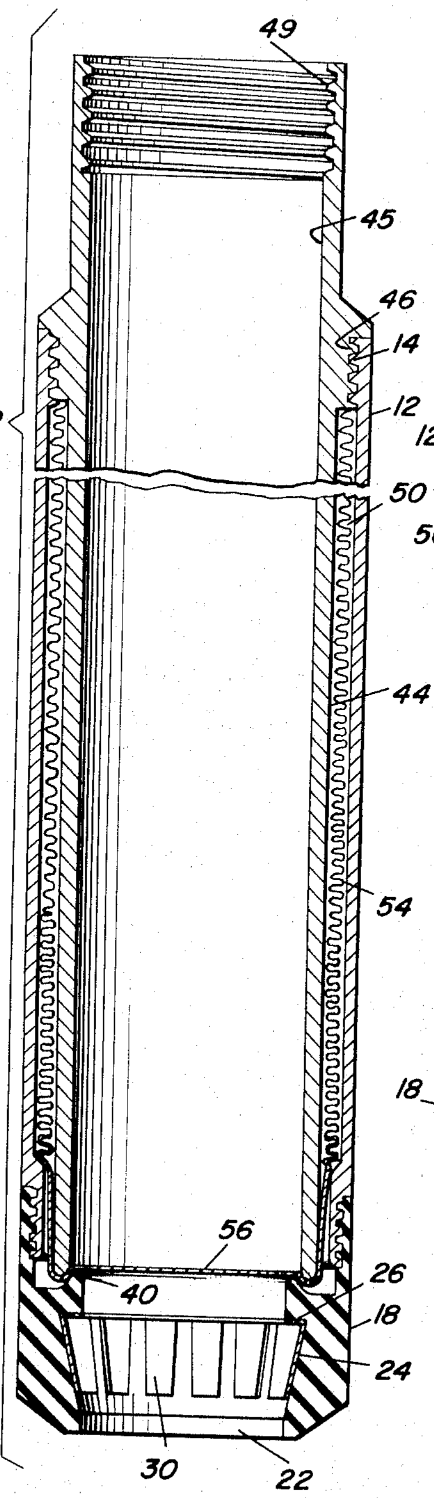
Fig. 2



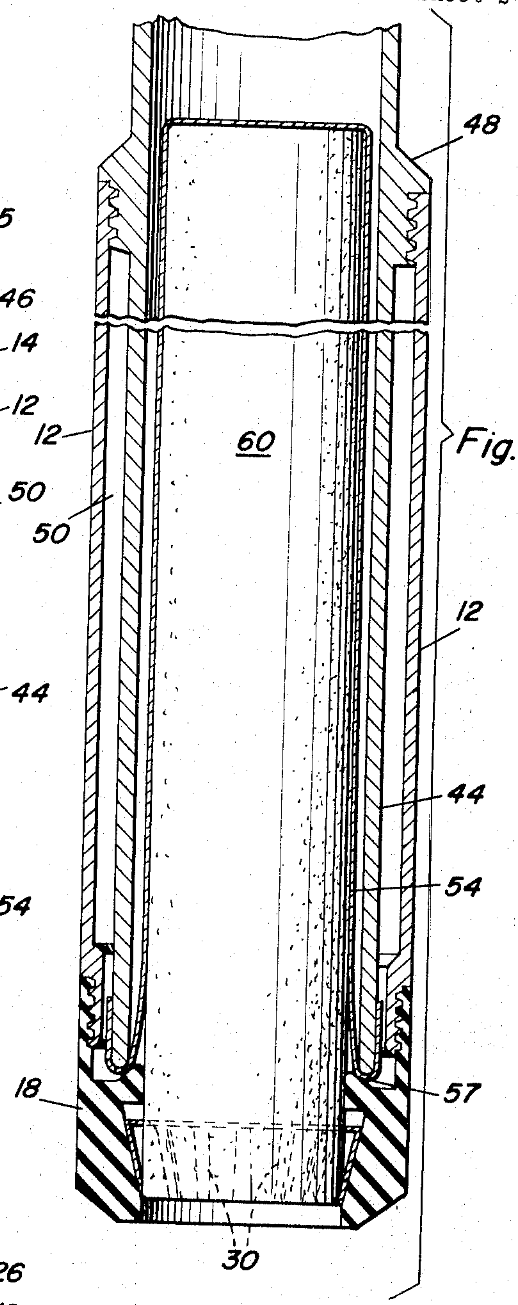


Fig. 3

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United States Patent Office 3,363,705
Patented Jan. 16, 1968

3,363,705
CORE BARREL INNER TUBE

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Filed Aug. 19, 1965, Ser. No. 480,874
10 Claims. (Cl. 175—226)

ABSTRACT OF THE DISCLOSURE

A core barrel inner tube adapted to be connected with a conventional core drilling apparatus and which comprises an elongated cylindrical core barrel inner tube body and an inner tube connector means removably and telescopically received within the core barrel inner tube body sized so as to provide a normally downwardly opening annulus therebetween whereby a core sample receiving sock may be readily placed within the downwardly opening annulus and wherein the lower end of the inner tube connector means is normally occluded by the core sample receiving sock. The core barrel inner tube body is provided with a removably engaged shoe provided with an annular portion which cooperates with the lower end of the core barrel inner tube body to define an annular guide throat therebetween which is adapted to guide the core sample receiving sock being withdrawn from the downwardly opening annulus by the relative upward movement of a core sample being received with the inner tube connector.

The present invention relates generally to an improved apparatus for the coring of subterranean strata, and more particularly to an improved core barrel inner tube which facilitates the recovery of a more representative core from a relatively unconsolidated formation traversed by the coring device by the provision of a core sample receiving sock which is withdrawn from an annular storage chamber by the relative upward movement of a core sample being received by the core barrel inner tube.

The location, spacing, drilling, etc. of oil and gas wells is generally done on a more scientific basis than was the case a number of years ago. This modern practice requires a more accurate and detailed knowledge of subsurface conditions in order to properly complete a well. In addition, data pertaining to the depth, thickness and character of formation to be, or being traversed in the course of drilling a well, is perhaps the most useful information shown by the well log, while other more detailed data such as fluid content, porosity, permeability, and formation dip or inclination are also valuable to the producer as well as to the drilling crew. Such data can most easily be obtained from coherent, uncontaminated core samples.

Heretofore, it has been difficult to secure a truly representative core in all types of formations traversed in the course of a drilling of a well. This is particularly true with respect to relatively unconsolidated formation being cored.

Generally coring apparatus comprises a core receiving barrel adapted to receive and retain a core sample after it has been cut by a coring bit of the type which drills an annular-type hole, which leaves a center core sample which is retained within the core receiving barrel for retrieval of the core sample at the well head.

Various constructions for core barrel inner tubes have been proposed heretofore in an attempt to facilitate the recovery of truly representative core samples by providing the core barrel inner tube with a protecting means which is adapted to prevent the physical breakdown or contamination of the core sample prior to recovery from the core barrel inner tube.

The core sample protecting means known heretofore were of such configuration that a relatively complex structure was required for the core barrel inner tube and core sample protecting means.

It is therefore a primary object of this invention to provide an improved core barrel inner tube which protects the core sample so that a truly representative "picture" of the formation being sampled may be obtained.

Another object of this invention is to provide an improved construction for a core barrel inner tube provided with a core sample protecting means which facilitates the recovery of core samples from relatively unconsolidated or soft formations while assuring that the relative position of the strata being sampled and the grains comprising the strata will remain in their normal orientation thereby assuring the recovery of a truly representative core sample of a formation being cored.

Still a further object of this invention is to provide a novel structure for a core barrel inner tube which may be readily adapted to be utilized in conjunction with a conventional core barrel and which may be readily assembled and disassembled thereby facilitating the re-use of the core barrel inner tube and core sample protecting means for a successive series of core samplings.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a fragmentary persepective view of the core barrel inner tube of the present invention;

FIGURE 2 is an enlarged vertical cross-sectional view of the core barrel inner tube of the present invention taken substantially along the plane of the line 2—2 of FIGURE 1 and further showing a means for threadably securing the core barrel inner tube to a conventional core barrel;

FIGURE 3 is a fragmentary cross-sectional view of the core barrel inner tube of FIGURE 2 as seen subsequent to the coring of a formation to be sampled;

FIGURE 4 is an enlarged fragmentary cross-sectional view of the lower portion of the core barrel inner tube in FIGURE 2; and

FIGURE 5 is an exploded view of the core barrel inner tube of FIGURE 1 with certain of the components having been illustrated as being foreshortened.

Briefly, the device of the present invention comprises a core barrel inner tube which is adapted to be rotatably secured within a conventional core barrel such as the type produced by Christensen Diamond Products, which core barrel inner tube is provided with a core sample protecting means comprising a core "sock" which encapsulates the core sample simultaneously with the cutting of the core sample from the formation being cored.

Referring now to the drawings and FIGURE 1 in particular an exemplary embodiment of the core barrel inner tube of the present invention is indicated generally at **10**. Referring to FIGURE 5 it may be seen that the core barrel inner tube **10** includes a core barrel inner tube body **12** of a generally cylindrical configuration of a suitable diameter to permit operatively positioning of the body member **12** within the core barrel head of a conventional core barrel not shown. The inner tube body member **12** is internally threaded adjacent the top portion thereof such as at **14** and as seen best in FIGURES 2 and 3 the inner bore of the body member **12** is recessed outwardly, i.e., has a greater diameter than the bore of the tube adjacent the internal threading **14**, for reasons which will become clear. The lower end of the core barrel inner tube body **12** is provided with an inwardly recessed externally threaded portion **16** which is adapted to threadably receive an inner tube shoe 18 of substantially the same diameter as the body member 12 which is provided with internal threading such as at 20, which threading is complementary to the threading 16 on the lower portion of the inner body 12.

As seen best in FIGURES 2, 3 and 4, the inner tube shoe 18 is provided with a longitudinal bore 22 which it will be understood is complementary in diameter to the diameter of the core sample being made by the annular bit blank of the conventional core barrel within which the core barrel inner tube 12 of the present invention is rotatably secured thereby assuring that the core barrel inner tube, in a conventional manner, remains stationary relative to the core sample as the core barrel bit blank rotates.

The bore 22 of the inner tube shoe 18 is provided with a diverging upwardly extending recess 24 which terminates in an axially disposed planar surface 26. As seen best in FIGURES 2, 3 and 4 the annular recess 24 of the inner tube shoe 18 is adapted to receive a core lifter spring 28 provided with a plurality of circumferentially spaced longitudinally disposed resilient fingers 30 which are adapted to frictionally engage and retain, the core sample passing upwardly therethrough.

As seen best in FIGURE 5 the annular ring 32 supporting the resilient fingers 30 is split such as at 34 thereby permitting the diameter of the core lifting spring 28 to be reduced in diameter so as facilitating its positioning within the annular recess 24 by insertion through the bore 22 of the inner tube shoe 18 into the operative position shown in FIGURES 2, 3 and 4. As seen best in FIGURE 4, the annular ring 32 of the core lifter spring 28 is provided with an inner diameter which is complementary to the bore 22 of the inner tube shoe 18. In addition, the inner tube shoe 18 is provided with a annular recess indicated generally at 36, which recess 36 is spaced outwardly of the bore 22 of the inner tube shoe 18 thereby defining an upstanding annular ring 38 which is preferably smoothly rounded such as at 40.

An inner tube connector indicated generally at 42 includes a generally cylindrical inner tube connector body member 44 which is adapted to be telescopically received within the inner tube body 12 and threadably secured therein by means of suitable external threads 46 provided on an annular boss 48 integral with the cylindrical body 44. As seen best in FIGURE 2 the external threads 46 on the annular boss 48 are complementary to the internal threading 14 adjacent the upper portion of the inner tube body 12.

In FIGURES 2 and 3 it may be seen that the body 44 of the inner tube connector 42 is of a somewhat smaller diameter than the inner diameter of the inner tube body 12 thereby defining an annular chamber 50 therebetween, which chamber 50 is adapted to telescopically receive a relatively flexible fluid impervious core sample receiving means 52. The core sample receiving means 52 comprises a somewhat resilient core receiving sock 54 of a generally tubular configuration having one end closed such as at 56. The core sample receiving sock 54 is preferably fabricated from nylon mesh, neoprene or other similar relatively inert resilient material.

As seen best in FIGURES 2, 3 and 4, the core sample receiving sock 54 is foreshortened by inserting it over the inner tube connector body 44 in an accordion pleated configuration with the closed end 56 of the sock 54 blocking the bore 45 of the inner tube connector body 44. The lower portion of the inner tube connector body 44 is sized so as to stop short of the upstanding annular ridge 38 so as to provide an annular throat 57 therebetween. As seen best in FIGURE 4 the lower portion of the inner tube connector body 44 is preferably smoothly curved such as at 47 in a manner similar to the rounding of the annular ring 38 such as at 40, thereby assuring that as the core sample receiving socket 54 envelopes the core sample being taken, in a manner to be described, the sock 54 will

be smoothly guided through the annular throat 57. It will be understood of source that the distance between the body 44 and the annular ring 38 in their operatively assembled relationship is primarily dependent upon the thickness of the wall of the core sample receiving sock 54.

In a similar fashion, the annular chamber, or core sample receiving means storage chamber 50 is sized so as to first permit storage of substantially the entire length of the tubular portion of the core receiving sock 54, and secondly is sized so as to not impair the withdrawal of the core receiving sock, in a manner to be described.

The upper portion of the inner tube connector body 44 is internally threaded such as at 49 in order to permit the core barrel inner tube of the present invention to be threadably connected onto a swivel type core barrel of conventional construction. It will be understood of course that should the conventional core barrel be provided with coupling means other than threads the device of the present invention may be provided with a complementary coupling means in lieu of the internal threading at 49.

In operation, the core barrel inner tube 10 comprising the present invention, which is generally approximately 5 to 10 feet in length, is operatively assembled preparatory to the taking of a core sample by assembling the device in the relationship shown in FIGURE 2 wherein the core lifter spring 28 is snapped into the inner tube shoe 18 through the top of the bore 22 into the conical annular recess 24. The inner tube shoe 18 is then threadedly secured to the lower portion of the inner tube body 12.

The core sample receiving sock 54 is then slipped over the outer diameter of the lower portion of the inner tube connector body 44 in an accordion pleat configuration with the closed end 56 with the core sock 54 resting across the open end, or bottom, of the member 44. The inner tube connector body 42 with the sock 54 mounted thereon is then telescopically inserted within the inner tube body 12 and threadably secured thereto by means of the complementary coupling threads 14 and 46.

The core barrel inner tube 10 is then ready to be secured to the inner tube connector, not shown, by means of threads 49, or the like, which connector is rotatably secured when in a conventional core barrel as mentioned supra.

As the boring proceeds the annular cutting bit of the core barrel will cut a core sample from the formation being traversed which core sample 60 will pass upwardly through the bore 22 of the inner tube shoe 18 by virtue of the relative downward movement of the core tube inner barrel 10 relative to the formation aforementioned being traversed.

In doing so, the core sample 60 will pass through the core lifter spring means 28 and then come to bear against the closed end 56 of the core sample receiving means 52. The relative upward movement of the core sample 60 within the bore 45 of the inner tube connector body 44 will carry the core receiving sock 54 upwardly therewith by withdrawing the sock 54 from the annular storage chamber 50 through the annular guide throat 57 thus encapsulating and protecting the core sample 60 from disintegrating.

Although not shown, it will be understood that if desired a suitable lubricant may be applied to the sock 54 within the annular storage chamber 50 to facilitate withdrawal of the sock therefrom as described above. Additionally, it will be understood that the annular throat 57 should preferably exert restraining action upon the core sample receiving sock 54 to insure that the sock 54 is drawn taut against the core sample 60, such as shown in FIGURE 3. The core sample sock 54 is of course of sufficient length to entirely encapsulate the core sample of a desired length to be received within the core barrel inner tube 10.

It may therefore be seen that there has been provided a core barrel inner tube of a novel construction which completely facilitates the recovery of truly representative core samples from hard fractured, unconsolidated or otherwise incompetent formations which improved core barrel inner tube is characterized by a relatively simple and efficient construction thereby providing a valuable adjunct to core sampling operations not only in oil fields but in mining and foundation work, building foundations, quarry site investigations, bridge formations, etc. In addition, the relatively simple but efficient construction of the core barrel inner tube **10** of the present invention permits utilization of the device for an excessive series of corings without substantial down time between the recovery of a core sample and the time when the core barrel tube is re-assembled with a fresh core sample receiving sock **54** and consequently ready to be re-used in the recovery of a subsequent core sample.

With further regard to FIGURE 3 it will be noted that when the coring is completed and the core barrel inner tube **10** is withdrawn from the well the core sample **60** will tend to move downwardly out of the core barrel inner tube connector **44**. However, the lower portion of the core sample **60** will carry the cover lifter spring **28** downwardly therewith into the position shown in FIGURE 3 thus causing the converging cam surface provided by the annular recess **24** of the inner tube shoe **18** to cam the fingers **30** of the spring **28** into frictional retaining engagement with the core sample **60** thereby preventing the core sample **60** from dropping out of the core barrel inner tube **60**.

To recover the core sample **60** from the core barrel inner tube **10** it is merely necessary to uncouple the inner tube connector **44** together with the swivel head assembly from the conventional core barrel and then uncouple the inner tube connector **44** from the inner tube body **12** thereby permitting the encapsulated core sample **60** to be withdrawn from within the inner tube connector **44**.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. In combination an improved core barrel inner tube adapted to be connected with a conventional coring apparatus which comprises a core barrel inner tube body, inner tube connector means removably and telescopically received within said core barrel inner tube body means so as to provide a normally downwardly opening annulus therebetween, core sample receiving means carried by said inner tube connector means and adapted to encapsulate and protect a core sample under the influence of a sample moving upwardly within said inner tube connector means, and inner tube shoe means removably secured to the lower portion of said core barrel inner tube body means, said inner tube shoe means including integral guide means cooperating with the lower end of said inner tube connector means to normally define an annular guide throat through which said core sample receiving means is released from said annulus, said shoe means being provided with a core lifter spring means adapted to retain a core sample within said core barrel inner tube body means.

2. The combination of claim **1** wherein said integral guide means comprises an upwardly and inwardly disposed annular ring having a generally rounded upper surface whereby said core sample receiving means will be smoothly guided through said annular guide throat.

3. In combination an improved core barrel inner tube adapted to be connected with a conventional coring apparatus which comprises a generally cylindrical tubular inner tube connector means removably secured within said coring apparatus, a generally cylindrical tubular inner tube body means removably secured in telescopic relation concentrically and outwardly of said inner tube connector means whereby an annular chamber is defined therebetween, said annular chamber having a closed upper end and an open lower end, said open lower end being adapted to communicate with the interior of said tubular inner tube connector means, a core sample encapsulating means adapted to be removably stored within said annular chamber and adapted to be withdrawn to encapsulate a core sample by the relative upward movement of the core sample being received within said tubular inner tube connector, a generally annular inner tube shoe removably secured to the lower portion of said inner tube body means, said inner tube shoe having a bore therethrough generally complementary to the diameter of the core samples being taken, said inner tube shoe being provided with an internal annular recess in said bore adapted to receive a core lifter spring means, said spring means being adapted to coact with said annular recess to prevent the downward movement of a core sample passing upwardly therethrough into said tubular inner tube connector means, said inner tube shoe including means communicating which said annular chamber and cooperating with the lower portion of said tubular inner tube connector means to define an annular guide throat therebetween adapted to guide said sample encapsulating means being withdrawn from said annular chamber by the relative upward movement of a core sample.

4. The combination of claim **3** wherein said core sample encapsulating means comprises a core sample sock formed of a relatively resilient material, said sock having a generally tubular configuration having a first and a second end, said first end being open and adapted to be slidingly received about the lower portion of said inner tube connector body means, said lower portion of said core sample sock being closed and adapted to occlude the end of said inner tube connector body means.

5. The combination of claim **3** wherein said annular guide throat is defined by the lower portion of said inner tube connector body means, and an upstanding annular ring carried by said inner tube shoe means, said upstanding annular ring being disposed concentrically inwardly of said lower portion of said inner tube connector body means.

6. In combination, an improved core barrel inner tube adapted to be connected with a conventional coring apparatus which comprises a core barrel inner tube body, inner tube connector means removably and telescopically received within said core barrel inner tube body means so as to provide a normally downwardly opening annulus therebetween, core sample receiving means carried by said inner tube connector means and adapted to encapsulate and protect a core sample under the influence of a sample moving upwardly within said inner tube connector means, and an inner tube shoe means removably secured to the lower portion of said core barrel inner tube body means, said inner tube shoe means including integral guide means cooperating with the lower end of said inner tube connector means to normally define an annular guide throat through which said core sample receiving means is released from said annulus.

7. The combination of claim **6** wherein said integral guide means comprises an upwardly and inwardly disposed annular ring having a generally rounded upper surface whereby said core sample receiving means will be smoothly guided through said annular guide throat.

8. In combination, an improved barrel inner tube adapted to be connected with a conventional coring apparatus which comprises a generally cylindrical tubular inner tube connector means removably secured within said coring apparatus, a generally cylindrical tubular inner tube body means removably secured in telescopic relation concentrically and outwardly of said inner tube connector means whereby an annular chamber is defined therebetween, said annular chamber having a closed upper end and an open lower end, said open lower end being adapted to communicate with the interior of said tubular inner tube connector means, a core sample encapsulating means adapted to be removably stored within said annular chamber and adapted to be withdrawn to encapsulate a core sample by the relative upward movement of the core sample being received within said tubular inner tube connector, a generally annular inner tube shoe removably secured to the lower portion of said inner tube body means, said inner tube shoe having a bore therethrough generally complementary to the diameter of the core samples being taken, said inner tube shoe including means communicating with said annular chamber and cooperating with the lower portion of said tubular inner tube connector means to define an annular guide throat therebetween adapted to guide said sample encapsulating means being withdrawn from said annular chamber by relative upward movement of a core sample.

9. The combination of claim **8** wherein said core sample encapsulating means comprises a core sample sock formed of a relatively resilient material, said sock having a generally tubular configuration having a first and a second end, said first end being open and adapted to be slidingly received about the lower portion of said inner tube connector body means, said lower portion of said core sample sock being closed and adapted to occlude the end of said inner tube connector body means.

10. The combination of claim **8** wherein said annular guide throat is defined by the lower portion of said inner tube connector body means, and an upstanding annular ring carried by said inner tube shoe means, said upstanding annular ring being disposed concentrically inwardly of said lower portion of said inner tube connector body means.

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