United States Patent [19]

Murrell

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[54] **DRILLING APPARATUS**

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[52] **U.S. Cl.** **175/195,** 175/60, 175/212, 175/215

[51] **Int. Cl.** **E21b 3/02,** E21b 21/02

[58] **Field of Search** 175/207, 213, 209–212, 175/215, 58, 60, 195

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[57] **ABSTRACT**

A sample drilling apparatus comprising an above ground unit and a drilling tube assembly which in operation is rotated about its longitudinal axis and advanced axially into the ground to be sampled by said above ground unit, said drilling tube assembly comprising a stem and a cutting head connected thereto at its lowermost end, said drilling tube assembly having a delivery passage therethrough for up-flow of sample dislodged by the cutting head and an air supply passage communicating with said delivery passage through an air transfer assembly located adjacent the lowermost end of said drilling tube assembly, and a mud supply passage communicating with the wall of the drilled hole, for supplying mud to the wall of the drilled hole, said delivery passage having an above ground sample outlet and said air supply passage and said mud supply passage respectively communicating with an above ground air inlet assembly, through which air may be forced into said air supply passage, through said air transfer assembly to pass up said delivery passage with said sample, and an above ground mud inlet assembly communicating with said mud supply passage.

16 Claims, 6 Drawing Figures

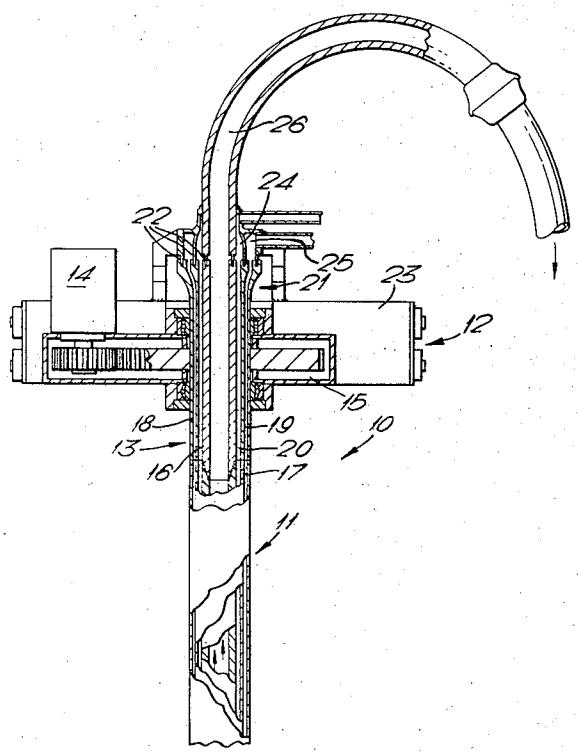


Fig. 1.

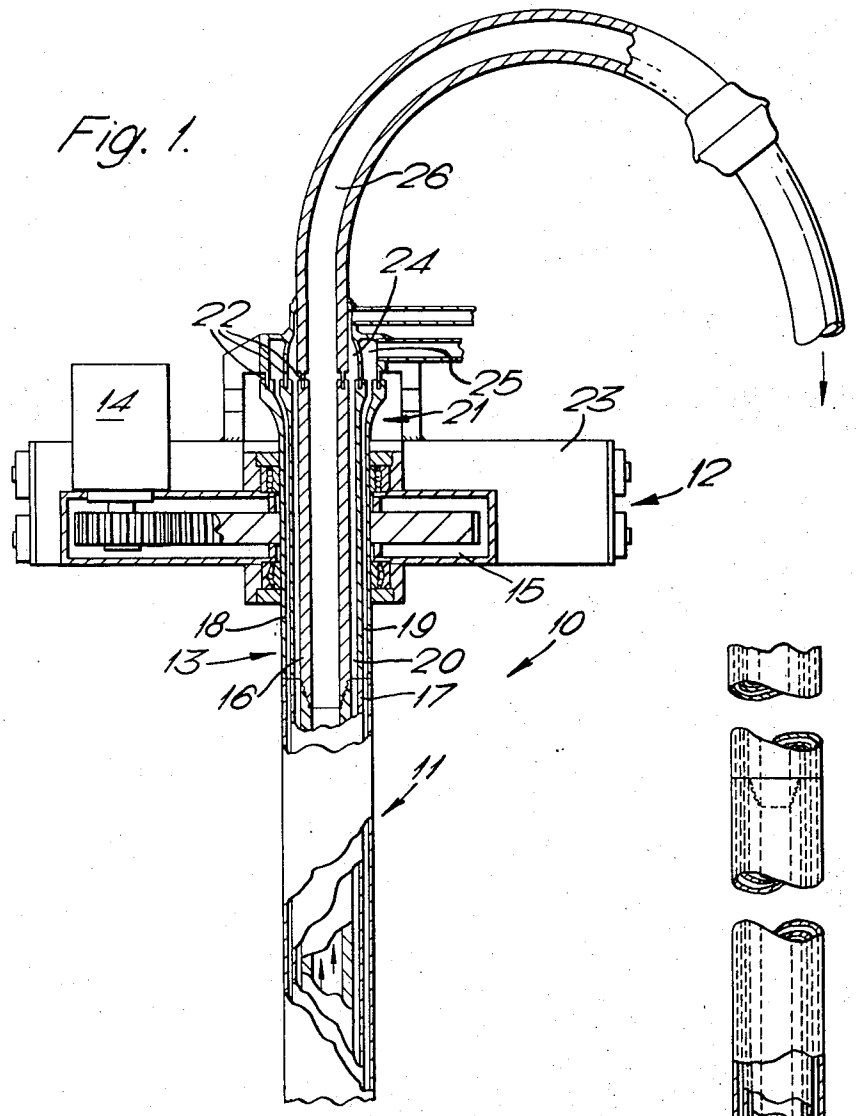


Fig. 2.

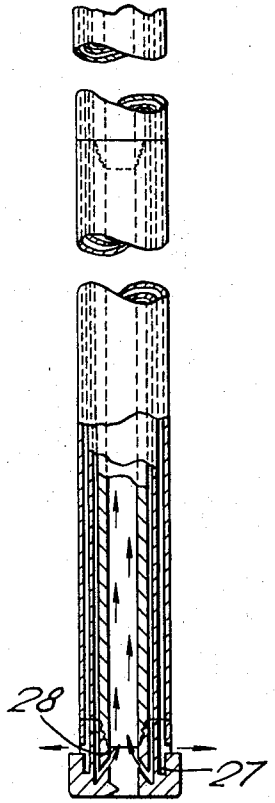


Fig. 3.

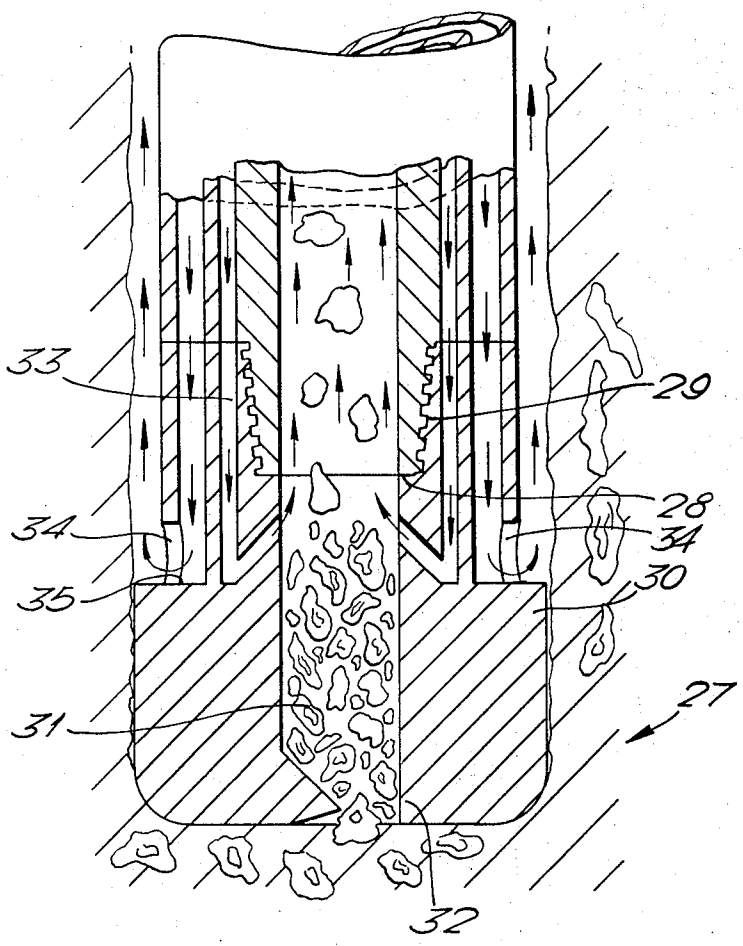


Fig. 4.

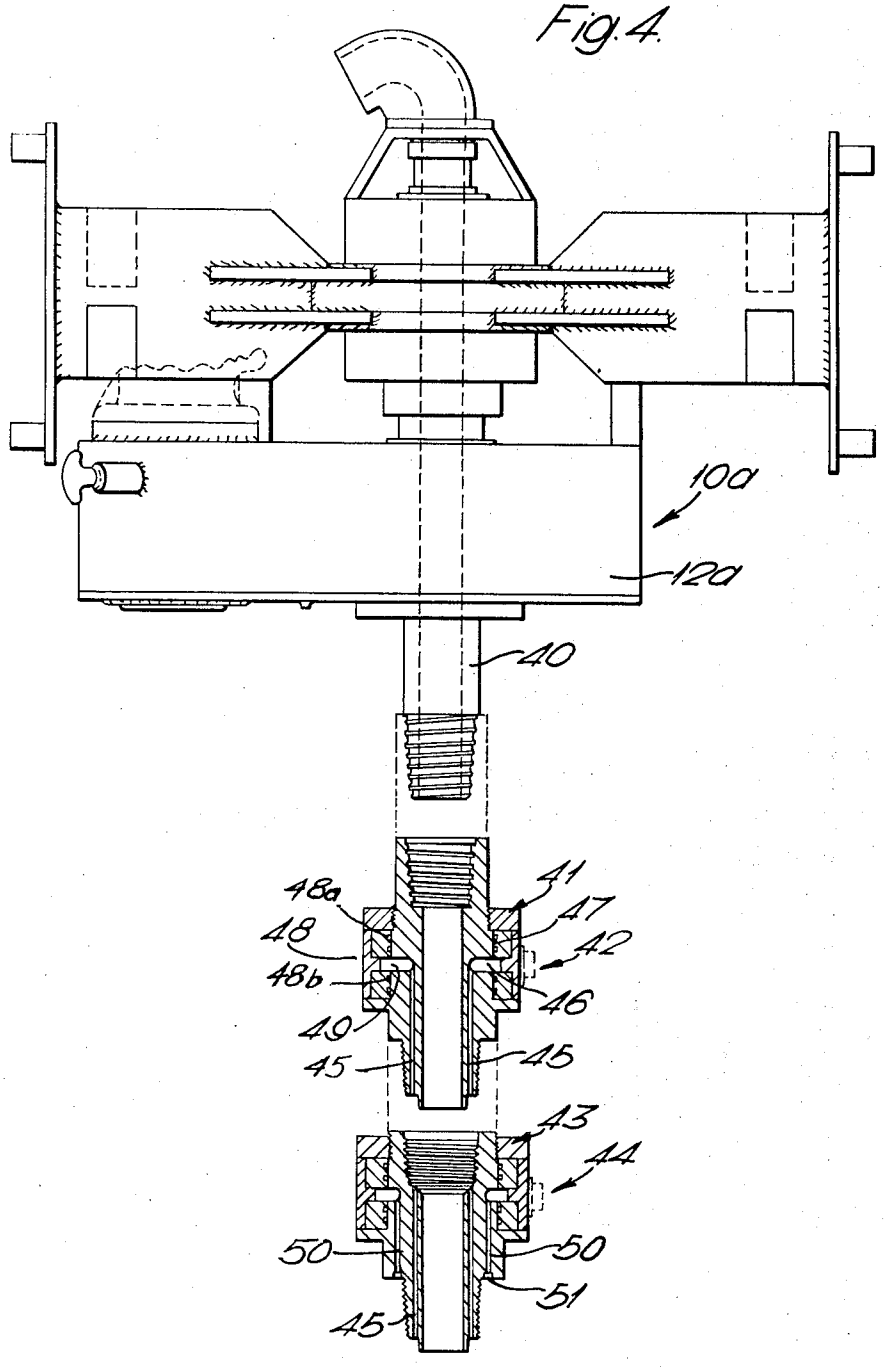


Fig. 5.

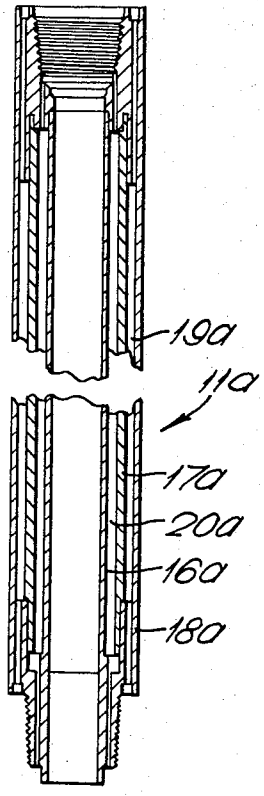
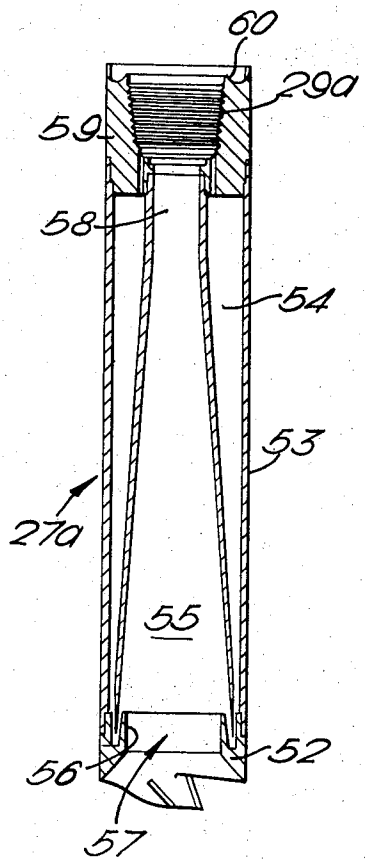


Fig. 6.



DRILLING APPARATUS

This invention relates to improvements in and relating to drilling apparatus and it has more particular reference to sample drilling apparatus for use in sampling sand or other soft formations.

The invention has been devised to provide a sample drilling apparatus for use in sandy areas and other soft formation areas, which will provide contamination-free samples. Other objects and advantages of the invention will hereinafter become apparent.

With the foregoing and other objects in view this invention resides broadly in sample drilling apparatus comprising an above ground unit and a drilling tube assembly which in operation is rotated about its longitudinal axis and advanced axially into the ground to be sampled by said above ground unit, said drilling tube assembly comprising a stem and a cutting head connected thereto at its lowermost end, said drilling tube assembly having a delivery passage therethrough for up-flow of sample dislodged by the cutting head and an air supply passage communicating with said delivery passage through an air transfer assembly located adjacent the lowermost end of said drilling tube assembly, and a mud supply passage communicating with the wall of the drilled hole, for supplying mud to the wall of the drilled hole, said delivery passage having an above ground sample outlet and said air supply passage and said mud supply passage respectively communicating with an above ground air inlet assembly, through which air may be forced into said air supply passage through said air transfer assembly to pass up said delivery passage with said sample, and an above ground mud inlet assembly communicating with said mud supply passage.

According to one feature of the invention the mud is supplied by forcing it down through the drilling tube assembly, suitably in a passage between concentric tubes, delivery means being provided, above the cutting head, from said passage to communicate with the wall of the drilled hole. The said mud passage within the drilling assembly is suitably sealed from the air supply passage, the latter being located concentrically inwardly of the mud passage.

According to another feature of the invention the above ground unit for rotating the drilling assembly includes drive means to rotate the drilling assembly and inlet assemblies for mud and air to supply the said mud to the mud passage within the rotating drilling assembly and air to the air passage within the rotating drilling assembly and an outlet passage from the delivery passage within the drilling assembly to enable the drilled and cut sample to be collected.

In order that the invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention wherein:

FIG. 1 is a partly schematic and sectional view of the above ground unit and the upper portion of the drilling tube assembly, according to one embodiment of the invention;

FIG. 2 is a partly schematic part sectional view of the drilling tube assembly and the cutting head according to one embodiment of the invention;

FIG. 3 is an enlarged sectional view of cutting head illustrated in FIG. 2;

FIG. 4 is a part sectional view of an alternate above ground unit and inlet assemblies for air and mud inlets into the drilling tube assembly;

FIG. 5 illustrates an alternate drilling tube assembly for use with the drilling head and inlet assemblies illustrated in FIG. 4; and

FIG. 6 illustrates in cross-section a suitable sand bit for use with the drilling tube assembly illustrated in FIG. 4 and FIG. 5.

Referring now to the drawings and in particular to FIGS. 1 to 3, there is shown sample drilling apparatus 10 comprising a drilling tube assembly 11 adapted to be rotated and advanced into the ground to be sampled by an above ground unit 12. In this embodiment, the above ground unit 12 has an output shaft 13 which is, in operation, rotated by a hydraulic motor 14 driving through a two speed gear box 15, contained within a main frame assembly 23. The normally vertical output shaft assembly 13 comprises an inner torque transmitting tube 16 which is disposed concentrically within and secured to an intermediate tube 17 and an outer tube 18. The outer passage 19 between the outer tube 18 and the intermediate tube 17, forms the mud passage 19 through which mud is supplied to the drilled hole, and the passage 20 between the intermediate tube 17 and the torque tube 16 forms the air passage 20 into which air is supplied under pressure. The top ends 21 of the concentric tubes of the drive spindle assembly 13 engage sealably and rotatably, by a glandular type connection as illustrated, with downwardly projecting concentrically disposed dividing walls 22 fixed rigidly to the main frame 23. These dividing walls 22 form therebetween an air inlet chamber 24, which remains stationary when the output shaft 13 rotates and which communicates with the air passage 20, and a mud inlet chamber 25 which communicates with the mud passage 19. The innermost concentric wall 22 continues upwards to form an outlet passage 26 onto which a length of flexible tube can be fixed to direct the cuttings to the sampling station.

The output shaft 13 connects to the drilling tube assembly 11 by means of a quick-action threaded connection which interconnects the inner torque tubes 16 of the drive spindle assembly 13 and the drilling tube assembly. As the tubes and passages in the drilling tube assembly 11 are similar to those of the output shaft 13 they will be referred to in the following description with names and numerals denoted above for the output shaft. As is normal practice, the drilling tube assembly 11 is made up of the required number of individual drilling tube lengths, connected end to end by quick-action screw threads to form a drilling tube assembly of the required length.

A cutting heat 27 is connected to the drilling tube at the lowermost end 28 of the drilling tube assembly 11 by means of a quick-action screw thread connection 29, shown clearly in FIG. 3. As illustrated, the cutting head 27 comprises a body portion 30 having a sample flow throat 31 which extends from cutting tips 32 at the lowermost end thereof, to the drilling tube assembly 13. This sample flow throat 31 communicates with the interior of the torque tube 16 which forms the delivery passage for upflow of sample dislodged by the cutting head 27. Air supplied to the air passage 20 of the drilling tube assembly 11 is fed into air transfer passages 33 in the cutting head and is directed therefrom, upwards and inwards towards the interior of the inner

tube 16 to force cuttings dislodged by the cutting head 27 up through the inner tube 16 to the surface whereupon it is directed to a sampling station, through the outlet passage 26.

In order to ensure that the mud forced down the mud passage 19 does not contaminate the sample, the cutting head 27 is provided with mud outlets 34 located towards the top of, and above a shoulder 35 in the cutting head 27. The viscosity of the mud and the volume pumped into the hold is regulated to an amount which will fill up the gap between the drilling tube 13 and the side wall. Mud as herein referred to is chemical mud used as a sealant in drilling operations.

Thus, in operation, as the cutting head 27 is forced down through the strata to be sampled, air is fed into the air passage 20 to force the cuttings up through the inner tube 16, and mud is pumped down through the mud passage 19 into the gap between the drilling tube assembly 11 and the side walls of the hole cut by the cutting head 27. It will thus be seen from the drawings and the description that the mud does not find its way into the underside of the cutting head and thus into the sample cuttings.

In the embodiment illustrated in FIG. 4, FIG. 5 and FIG. 6 there is shown an alternate form of sample drilling apparatus 10a comprising a two-speed above ground unit 12*a* having a quick-action threaded output shaft 40 which is adapted to engage with an air inlet assembly 41. The air inlet assembly 41 is provided with a fixed air inlet 42 which is fixed rigidly to the above ground unit, and the drill stem rotates relative to said air inlet assembly. A mud inlet assembly 43 engages threadedly with and below the first connector means 41 and it is provided with a fixed mud inlet 44 connected to the above ground unit. The lower tapered portion of the second connector means 43 is threaded to enable standard lengths of drill stem 11a to be connected thereto.

As can be seen from the drawings, the air inlet assembly 41 is provided with an internal annular arrangement air inlet passages 45 which communicate with a circumferential groove 46 provided in the outer cylindrical face 47 of the central connector means of assembly 41. A fixed air inlet housing 48 is located sealably around the face 47 to form an air inlet chamber 49 so that air supplied to the fixed housing 48 will be directed into the air passages 45. This assembly provides for a glandular type seal (not shown) in each of the internal recesses 48a and 48b in the structure fixed housing 48. An extension of the air passages 45 is formed in the mud inlet assembly 43 and is adapted, when the inlet assemblies 41 and 43 and the drilling stem assembly are operatively connected, to transfer air from the first inlet means to the annular passage 20*a* formed between the inner torque tube 16*a* and the intermediate tube 17*a* of the drilling tube assembly.

Similarly, the mud inlet assembly 43 is provided with a fixed mud inlet 44 which communicates with an mud passages 50 disposed annularly around the outside of the air passage 45. The mud passages 50 have outlets at their lower ends which communicates with the mud inlet passage 19*a* formed between the intermediate tube 17*a* and the outer tube 18*a*.

The cutting heat 27*a* is connected to the lowermost end of the drilling tube assembly by means of a quick-action screw connection assembly 29*a* which is fixed to the cutting bit 52 by outer housing 53 which incorporates therein an air chamber 54 which communicates with the air passage in the drilling stem assembly 11*a*. The inner surface of the housing 53 is conical, as illustrated. The air is adapted to be discharged from the chamber 54 into the interior 55 of the housing 53 past an upstanding flange 56, formed in the upper portion of the bit 52. This flange directs the air upwards and inwards into the interior 55 of the cutting head. As is clear from FIG. 6, the arrangement provides a relatively large mouth 57 for the introduction of mined sample and a reduced throat 58 for efficient air blast elevation of the sample up the inner or torque tube 16*a* of the drill stem assembly. The sample outlet is ejected at a station above the drilling head assembly 10*a*.

In this embodiment the sealing and stabilizing mud is ejected into the strata above the cutting head 27*a*. To this end, the upper end 59 of the cutting head is provided with a recess 60 which terminates the mud passage 19*a*. An outlet is provided from this recess 60 to the drilled strata.

Drilling apparatus as described and illustrated will therefore be found very effective in achieving the objects for which the invention has been devised, and the invention is to be understood to embrace all variations and modifications within its scope and ambit, as defined by the appended claims.

What is claimed is:

1. Sample drilling apparatus comprising an above ground unit and a drilling tube assembly which in operation is rotated about its longitudinal axis and advanced axially into the ground to be sampled by said above ground unit, said drilling tube assembly comprising a stem and a cutting head connected thereto at its lowermost end, said drilling tube assembly having a delivery passage therethrough for up-flow of sample dislodged by the cutting head and an air supply passage communicating with said delivery passage through an air transfer assembly located adjacent the lowermost end of said drilling tube assembly, and a mud supply passage communicating with the wall of the drilled hole, for supplying mud to the wall of the drilled hole, said delivery passage having an above ground sample outlet and said air supply passage and said mud supply passage respectively communicating with an above ground air inlet assembly, through which air may be forced into said air supply passage, through said air transfer assembly to pass up said delivery passage with said sample, and an above ground mud inlet assembly communicating with said mud supply passage.

2. Sample drilling apparatus according to claim 1, wherein said mud passage communicates with the side wall of the drilled hole adjacent the connection between said stem and said cutting head.

3. Sample drilling apparatus according to claim 1, wherein said stem is adapted to be lengthened by adding extra stem lengths and each stem length is connectable to the adjacent stem length in such manner that the said passages are formed continuously through said stem.

4. Sample drilling apparatus according to claim 3, wherein each said stem length comprises three spaced apart concentric tubes, an outer tube, an intermediate tube and an inner tube, said tubes being adapted to engage with corresponding tubes in adjacent stem lengths to form three concentric continuous passages, an innermost passage enclosed by the inner tube, an intermediate passage between the inner tube and the intermedi-

ate tube, and an outer passage between the outer tube and the intermediate tube, said three passages comprising said delivery passage, said air supply passage and said mud supply passage.

5. Sample drilling apparatus according to claim **4**, wherein said innermost passage forms said delivery passage, said intermediate passage forms said air supply passage and said outer passage forms said mud supply passage.

6. Sample drilling apparatus according to claim **5**, wherein said above ground unit has a rotary output shaft which connects to said drilling tube assembly for selectively rotating said drilling tube assembly, and said above ground unit is reciprocable in a direction along the axis of its output shaft for selectively advancing or withdrawing said drilling tube assembly into and/or from the ground.

7. Sample drilling apparatus according to claim **6**, wherein said rotary output shaft is tubular and connects to said inner tube to form an upper extension thereof, and said above ground sample outlet has a connector assembly fixed to said above ground unit and connected sealably with the upper end of said rotary output shaft by means of a glandular type fitting.

8. Sample drilling apparatus according to claim **7**, wherein said output shaft comprises three spaced apart concentric tubes which form upper extensions of said inner tube, said intermediate tube, and said outer tube respectively, and wherein there is provided a glandular type air connector assembly on said above ground unit, which connects sealably to the upper end of the air supply passage in said rotary output shaft and wherein there is provided a glandular type mud connector assembly on said above ground unit which connects sealably to said mud supply passage in said rotary output shaft.

9. Sample drilling apparatus according to claim **7**, wherein said above ground air inlet assembly is adapted to be connected between said output shaft and said drilling tube assembly and comprises a housing having a central through-passage which forms a continuous extension of said delivery passage and an outer annular passage which communicates with said air inlet passage, there being provided a glandular-type air connection between a fixed air inlet and said outer passage in said rotary output shaft.

10. Sample drilling apparatus according to claim **9** wherein said above ground mud inlet assembly is adapted to be connected between said air inlet assembly and said drilling tube assembly and comprises a housing having a central through passage which forms a continuous extension of said delivery passage and an intermediate annular passage which forms a continuous extension of said air inlet passage, and an upper mud supply passage which communicates with said mud supply passage, there being provided a glandular-type mud connection between a fixed mud inlet and said upper mud supply passage in said rotary output shaft.

11. Sample drilling apparatus according to claim **5**, wherein said cutting head is substantially tubular and has a central sample flow throat therethrough which communicates with said delivery passage.

12. Sample drilling apparatus according to claim **11**, wherein said cutting head has an air transfer passage which communicates with said air supply passage in said stem and said sample flow throat, said air transfer passage providing said air transfer assembly.

13. Sample drilling apparatus according to claim **12**, wherein said air transfer passage, in operation, directs air upwards and inwards from said air supply passage into said sample flow throat.

14. Sample drilling apparatus according to claim **13**, wherein there are provided a plurality of said air transfer passages spaced around said sample supply throat.

15. Sample drilling apparatus according to claim **13**, wherein said air transfer passage has a continuous annular opening around said sample flow throat.

16. Sample drilling apparatus according to claim **15** wherein said sample flow throat is frustro-conical shaped and opens out towards the base of the cutting head.

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