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PELLET IMPACT CORE DRILL

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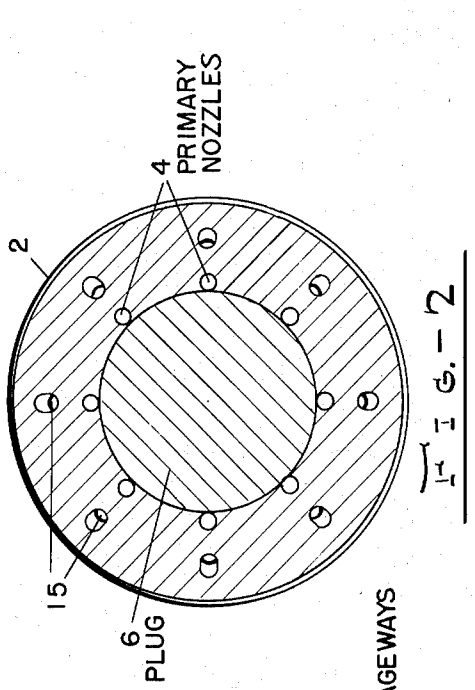

Fig. - 2

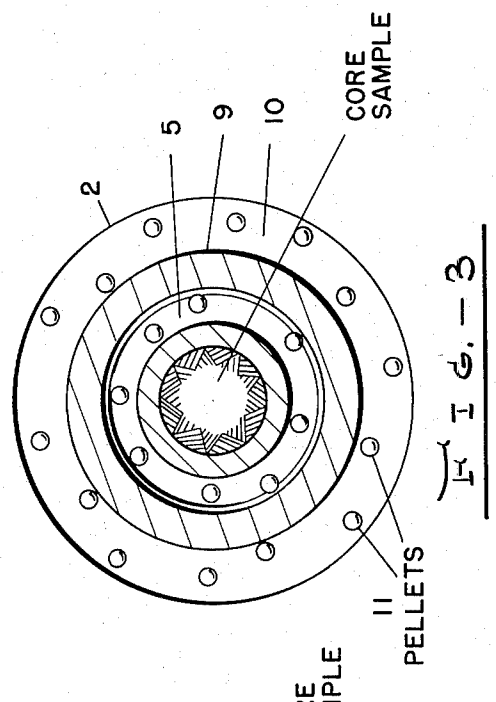

Fig. - 3

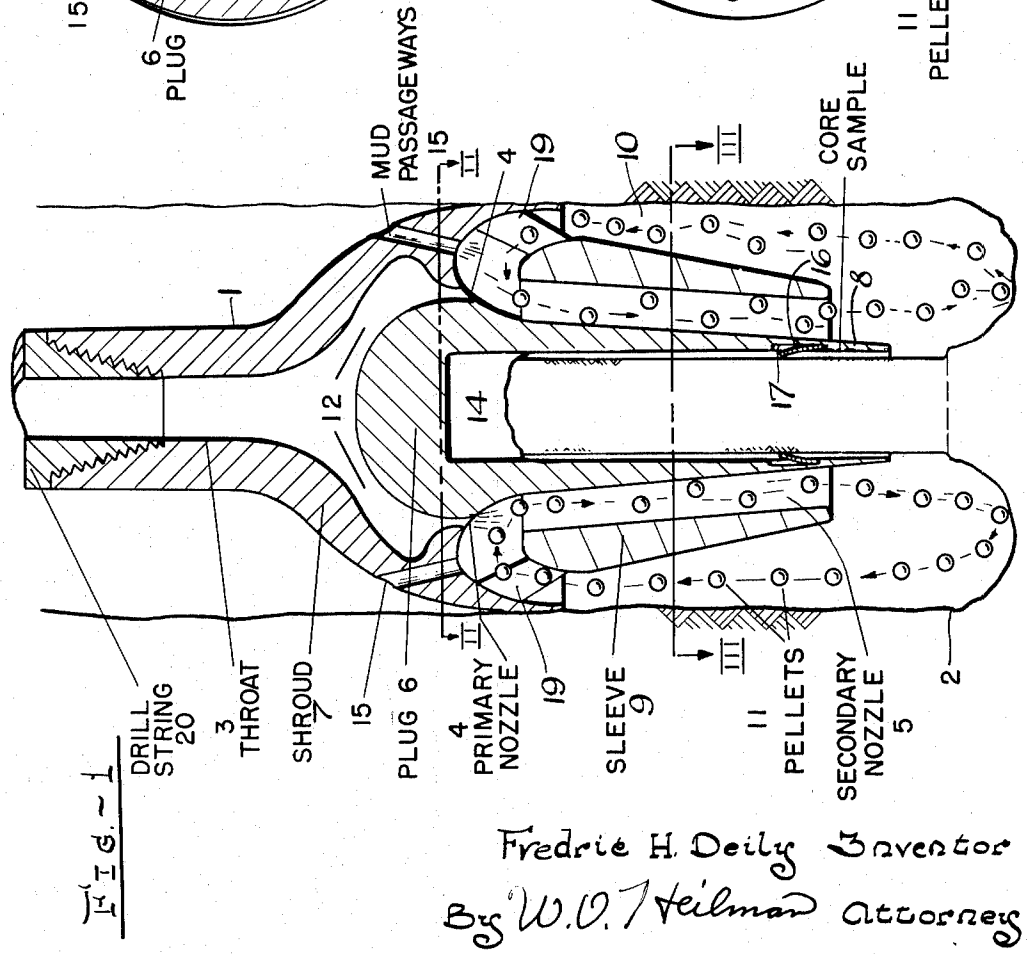

Fig. - 1

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PELLET IMPACT CORE DRILL

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1 Claim. (Cl. 255—72)

The present invention is concerned with an improved method for securing core samples during the drilling of a well bore hole. The invention is more particularly concerned with a core bit wherein the desired core is cut by utilizing circulating pellets which are jetted against the well bore hole bottom. In accordance with the present invention, a core is secured by using a core drill wherein pellets are positively directed into a series of primary fluid jets so as to cut an annular hole, leaving a core which is removed to the surface with the bit.

In prospecting and drilling for oil it is a conventional procedure during the drilling of the bore hole to determine the character and nature of the substrata through which the bore hole is being drilled. One method is to periodically remove cores at particular depths, to bring these cores to the surface and to analyze them for the purposes stated. Many procedures and apparatuses have been developed for the effective removal of representative cores from an earth substrata. In general, these coring devices or core bits remove an annular hole, leaving a center core which is broken off and taken to the surface by various means. The present invention is directed toward an improved core bit wherein the annular hole about the core is drilled, utilizing small pellets which are recirculated in the bottom of the bore hole in the vicinity of the area where the core is being removed.

The basic principles of pellet impact drilling are that hardened, dense pellets are impinged on the bottom of a bore hole, propelled by a high velocity fluid jet. The action of these pellets, carried by the high velocity fluid jet is somewhat similar to that of sandblasting. The drilling action is considered to be primarily that of surface pulverization caused by the forceful and multitudinous impingement of the solid pellets against the earth formation encountered. The pellets are substantially spherical in nature and have a smooth surface so as to limit wear of the nozzle assembly through which the pellets are to be ejected. The pellets are made of metal of the desired resistance, hardness and toughness. Iron, steel and other various alloys may be employed to prepare the pellets. In general, the bit assembly comprises a primary nozzle or nozzles and a secondary nozzle of a somewhat greater cross-sectional area than the primary nozzle. A critical relationship exists between the diameters of the primary jet and the secondary jet, as well as with respect to the diameter of the pellets.

The process and apparatus of the present invention may be more fully understood by reference to the attached drawings illustrating embodiments of the same.

Figure 1 is a diagrammatical cross-sectional elevation of the pellet impact core drill; while

Figures 2 and 3 are sectional views taken along the lines II—II and III—III respectively.

Referring specifically to Figure 1, a pellet impact core drill assembly is shown positioned at the bottom of a

well bore 2. The core bit assembly includes a tubular support member 1 which is attached by suitable means, as for example by the threads shown, to the lower end of a drill string 20 which may be suitably raised or lowered or rotated by equipment on the surface of the ground. Support member 1 terminates at its lower end in, or has attached thereto, a shroud member 7 whose external diameter at least at its lower end is essentially that of the bore hole. A throat passage or conduit 3 at the upper end of the core drill assembly communicates between the drill string and a plurality of passageways 12. These passageways 12 taper off into primary nozzle elements 4 which communicate with a secondary elongated annular nozzle 5. The passageways 12 and the primary nozzle passages 4 are formed between shroud element 7 and a plug element 6. Plug element 6 is supported by the shroud member or element and is characterized by being a hollow cylindrical plug open at its lower end, the cross-sectional area of its sides tapering inwardly toward its lower ends 8 as illustrated. Supported below primary nozzles 4 and surrounding plug 6 is a cylindrical sleeve element 9 which is spaced from the outer wall of plug 6 so as to define an annular passageway which constitutes the annular secondary nozzle 5. Sleeve 9 has an external diameter less than that of the largest diameter of the shroud member, so that the sleeve will define with the bore hole an annular passageway 10 adjacent the wall of the bore hole. Sleeve 9 is suitably supported by means of web members 19 attached to the underside of shroud member 7. The top of sleeve 9 is spaced a sufficient distance below the underside of shroud member 7 so as to permit pellets to enter the passageway 5 from the annular passageway 10. The impact pellets are designated by numeral 11.

In operation, the drilling fluid is pumped down the drill stem 20 through throat conduit 3 and into the plurality of passageways 12. This fluid passes through restricted primary nozzles 4 and aspirates the pellets into the high velocity stream which passes downwardly through the secondary annular nozzle 5. The pellets impinge on the bottom of the drilled hole and drill an annular hole, as shown, and a core sample of the formation gradually enters the central bore 14 of plug element 6. Latches or springs 16 positioned within recesses 17 prevent the core from dropping back out of the plug element 6. The pellets, due to the velocity of the mud, pass upwardly along the wall of the bore hole through annulus 10 and are directed by the shroud into the downflowing drilling fluid being ejected through nozzles 4. Upflowing mud passes through mud passageways 15 into the annulus between the wall of the well bore and the drill string and is removed to the surface. These passageways are of a diameter insufficient to permit the pellets to pass therethrough.

The present invention is broadly concerned with an improved method and apparatus for securing a core of substrata through which a well bore is being drilled. It is more particularly concerned with an improved core drill bit wherein pellets are impacted against the bottom of the well bore so as to annularly drill about the core. In accordance with the present invention, pellets are positively urged into a series of primary fluid jets and so accelerated so as to cut an annular hole matching a core of the desired structure. One advantage of this core drill over previous designs is that it does not necessarily require that the drill pipe be rotated in order to cut the core.

What is claimed is:

An apparatus for cutting a core from an earth formation encountered by a bore hole, which comprises

in combination: a tubular support member of smaller external diameter than said bore hole, a shroud member supported by and positioned below said tubular member, said shroud member having an external diameter, at least at its lower end, essentially that of the bore hole, a centrally disposed elongated cylindrical plug element supported by and extending below said shroud member, the external diameter of the major portion of said plug member being substantially less than that of said shroud member, said plug member having a central bore open at its lower end to receive the core cut by the apparatus, a cylindrical sleeve of larger internal diameter than said plug member and of less external diameter than the lower external diameter of said shroud member, means supporting said sleeve in concentric relation about said plug member in a manner defining therewith an annular passage, sufficient clearance being maintained between the top of said sleeve and the underside of said shroud member to permit pellets to enter the top of said annular passage from the annulus between said sleeve and the bore hole, a plurality of primary nozzles circumferentially arranged about the plug member in a manner directing the outlets of said nozzles into said annular passage, means

establishing fluid communication between said primary nozzles and the interior of said tubular support member, and at least one return fluid passageway extending through said shroud member from the underside thereof to the bore hole annulus above the shroud member, whereby fluid may be circulated from within said tubular member through said primary nozzles into said annular passage to impart kinetic energy to a plurality of pellets directed into said annular passage, said pellets will impinge on the formation to drill an annular hole, fluid and pellets will flow upwardly in the bore hole annulus exteriorly of said sleeve, upflowing pellets will be directed into said annular passage by said shroud member and upflowing fluid will pass through said return fluid passageway into the annulus above the shroud member.

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