

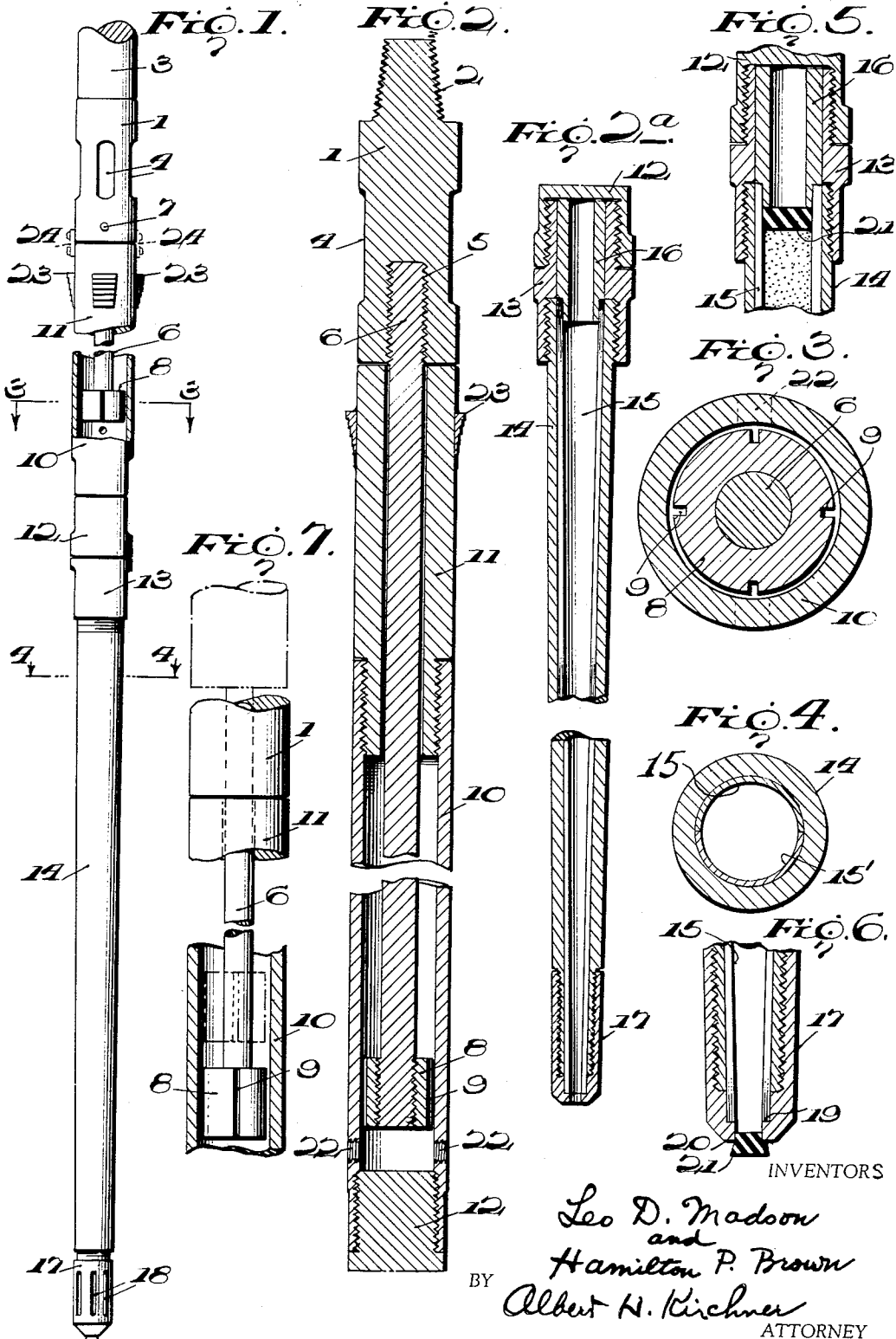
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CORE DRILL

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CORE DRILL

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The present invention relates to core drills, i. e., to devices for boring into subterranean formations and bringing up samples of the strata penetrated, and more particularly to such devices as are specially adapted for use in sampling deep lying iron ore.

In the prospecting of iron ore formations, in order to determine accurately the feasibility of commercially mining a particular stratum, it is important that the withdrawn sample faithfully reproduce exactly the material in situ, in respect not only of composition, including particularly water or moisture content, but also in respect of density. That is to say, no extraneous water, as from levels overlying the sampled stratum, can be allowed to seep into the core barrel, and the sample must be kept undistorted and undisturbed in the barrel so that its component parts and portions all occupy therein exactly the same relative positions that they did prior to the material becoming encased in the barrel for removal from its place in the formation. The only change that is permissible is compaction by compression of voids, i. e., small air pockets. To this end the ideal core drill for such purposes as iron ore prospecting must be capable of penetrating water, mud, and various strata of high moisture content without introducing any material therefrom into the core barrel, and it must present at the stratum to be sampled a minimum of frictional resistance to entry of material from that stratum so as to avoid disturbing material in the barrel with corresponding deviation from accuracy. Moreover, the device must be capable of being withdrawn to the surface of the ground with the sample intact, and it must be possible to remove the sample from the barrel without distorting it.

The purpose of the invention is to provide a core drill that will accomplish all the foregoing objects and that will be simple in construction, economical to make, easy to use, durable in operation, and entirely safe and certain in performance.

With the foregoing and other objects and advantages contemplated, a preferred form of embodiment of the invention is shown in the accompanying drawing, in which:

Figure 1 is a side elevational view, partly broken away to show a portion of the interior, of a complete core drill assembly coupled to the lower end of a drill stem, with certain of the parts shown loosely connected but otherwise ready for use;

Fig. 2 is a longitudinal cross sectional view, on a larger scale, taken through a diametrical plane, of the upper portion of the drill;

Fig. 2a is a similar view of the lower portion of the drill, being a continuation of Fig. 2;

Fig. 3 is a transverse cross sectional view, on a still larger scale, taken on the line 3—3 of Fig. 1;

Fig. 4 is a similar transverse cross sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is a detail longitudinal cross sectional view of the upper part of the core barrel showing its connection to the piston tube and showing a core in the barrel;

Fig. 6 is a detail longitudinal cross sectional view of the drill shoe; and

Fig. 7 is a detail view, partly in longitudinal section and partly in side elevation, with a portion broken away, illustrating the manner in which the drill is driven.

Broadly speaking, the invention comprises a tapered core barrel containing a complementally tapered liner which is longitudinally split into two separable half sections which are assembled so as to be strongly supported by the barrel as the drill is driven into the formation to be sampled. Means are provided for admitting a generally cylindrical sample, which rises in the liner with a minimum of friction and hence substantially no alteration of any kind except increased compactness of material originally containing substantial voids, and means are also provided for sealing the core from ingress of moisture, soil and all other foreign matter, i. e., material from strata other than that which is being cored to produce the sample. The device also contains parts functioning as a hammer and a tube head acting as an anvil for receiving the thrust of the hammer and for carrying the core barrel as the latter is driven into the stratum to be sampled. Various other preferred and desirable features and parts are included in the illustrative embodiment which has been selected for use in connection with the present explanation of the invention.

The new core drill comprises a driving member 1, taper threaded at its upper or pin end 2 to engage the bottom end of a drill stem 3. Flats 4 may be formed on the member 1 to receive a wrench or like tool, and the lower end of the member is axially bored and threaded at 5 onto the upper end of a piston rod 6. Permanent tight engagement of the piston rod and driving member may be effected by standing a setscrew 7 in through the threads of these two parts.

The rod 6 is elongated, having a length equal to or exceeding that of the regular drill stroke, and has threaded onto its lower end a piston 8 in the form of a solid steel cylinder having longitudinal grooves 9 in its surface and working slidably in a tube 10 which is internally threaded at its upper and lower ends. Threaded into the upper end of the tube 10 is a bushing 11 having a bore passing the rod 6 and serving as a guide therefor, and threaded into the lower end of the tube is a heavy solid plug 12 which makes a fluidtight seal with the tube.

The plug 12 is internally threaded at its lower end to receive a tubular connector 13 for a core barrel 14. The connector 13 has a reduced upper end which is externally threaded and screwed into the bottom of the plug 12, and its lower end is internally threaded and screwed onto the top of the barrel 14.

The barrel 14 is slightly tapered, both externally and internally, toward its lower end, and contains a similarly tapered liner which is longitudinally split into two equal and similar half-sections 15, 15'. These sections are locked in the barrel 14 by a collar 16 which is reduced around its lower end to provide a shoulder seating on the top of the liner sections and which fits up into the bore of the connector 13 and seats up against the base of the solid portion of the plug 12.

At its lower end the barrel 14 is reduced and externally threaded and has screwed onto it the upper end of an internally threaded drill shoe 17. This drill shoe may be ribbed, as shown at 18 to be engaged by a wrench, and has an inside shoulder 19 forming a seat for the bottom ends of the two sections 15, 15' of the liner. The lower end of the shoe is tapered to a relatively blunt cutting edge 20, and its bore may be closed by a rubber plug 21.

Like the setscrew 7, other setscrews may be used to hold securely together the several threaded connections and prevent their becoming disconnected during normal use of the drill. Thus, the tube 10 and bushing 11 may be so

connected, and the plug 12 may be similarly secured in the tube 10. The connector 13 is also desirably setscrewed to the barrel 14.

The tube 10 is preferably drilled to provide a pair of small diametrical openings 22 just above the top of the plug 12 and these openings are tapped to receive flush plugs (not shown). The flush plugs are installed to close the openings 22 when the drill is being operated in a dry hole, but when the device is used in taking core samples under water they are removed to allow the water to be vented from the tube.

Lugs 23 may be formed on the bushing 11 to provide a grip for a fishing tool in the event that the device becomes disconnected from the drill stem and falls into a drill hole.

To keep the rod 6 fully telescoped in the bushing 11 and the driving member 1 seated down on the bushing when the device is not in use, so that the parts will be held together at minimum length, it is convenient to attach a pair of straps 24 by screws removably set in the members 1 and 11 at diametrically opposite sides thereof. The screws and straps are removed when the device is to be used.

The operation of the device, constructed and arranged as hereinabove explained, is as follows:

The pin end 2 of the driving member is threaded into a standard drill stem 3, and the several parts of the assembly are connected together as shown in Fig. 1 with the threads turned up tight as shown more in detail in Figs. 2 and 2a. The drill is then lowered into a drill hole until the shoe 17 strikes the top of the formation which is to be sampled. The drill stem is then reciprocated by any conventional or other rig provided for that purpose which causes the driving member 1 to apply a succession of hammer blows to the top or anvil surface of the heavy bushing 11. In this driving movement any fluid, such as air or water, which may gain entry into the tube 10 freely passes the piston 8 through the grooves 9 and is discharged through the openings 22. The driving thrust is transmitted to the barrel 14 and its shoe 17, and the latter cuts down into the formation which is to be sampled, the core of sample rising in the barrel liner. Because of the slight taper, this rise of the core is practically frictionless. This feature of the operation will be understood when it is considered that the core is cylindrical, having a diameter equal to that of the shoe orifice, which is the same as the smallest or extreme bottom end diameter of the liner, and that the core of this fixed diameter rises past gradually but constantly increasing diameters of the liner. The core is thus subjected to no force tending to compress it either laterally or longitudinally, i. e., either radially or axially, except the negligible load of its own weight. Thus the stratum structure, including particularly its density, remains unchanged in the sample core.

Ingress of foreign matter, including especially water and moisture, is prevented from the top of the liner by the tight fit of the plug 12 in the bottom of the tube 10 and by the vent provided by the openings 22. Entry of all material from below, except that of the formation which is being sampled and which becomes the core, is prevented by use of the plug 21 of rubber or equivalent yieldable expansible material. This plug is initially inserted in the shoe orifice, as shown in Fig. 6. It rises with the incoming core, being soft enough to offer only negligible resistance and yet make fluidtight contact with the liner wall so that no material can rise above it.

When a core of the desired length, which in accordance with standard practice is generally approximately five feet, has risen in the barrel liner, as can be determined by the operator observing descent of the drill through the required distance to produce such a core, the expansible plug 21 will have risen to a point below the collar 16. Fig. 5 shows the plug contacting the bottom of the collar, which of course is the upward limit of its movement, but in actual practice this maximum elevation of the plug is seldom

reached. The length of the barrel and liner is best made great enough to accommodate a five foot core with the risen plug spaced somewhat below the collar. This spacing accommodates the air which is entrapped above the plug and provides a chamber larger than the hollow collar for containing the compressed air. However, the collar is purposely made hollow so that a core of substantially the full liner length can be produced without requiring special openings for venting air from above the core. The hollow of the collar has been found sufficient in actual practice because of the high compressibility of air.

Of course the drilling descent may be halted with any length of core formed in the liner. In any case, regardless of core length, the plug holds down in the core all the material which entered the shoe orifice and permits no other or foreign matter to pass up through the core.

The drilling being complete for the purpose of taking the desired sample, the rig is then lifted. This causes the piston 8 to bear up against the bottom of the bushing 11, and the whole drill assembly is thus raised from the drill hole. The barrel 14 and shoe 17 are then unscrewed from the connector 13. This leaves a short length of liner protruding from the lower, smaller end of the barrel 14, as will be evident from Fig. 6, where it will be seen that the end of the liner seats against the internal shoulder 19 of the shoe. A few light hammer taps on this protruding portion free the entire liner from the barrel 14, and the two sections 15, 15' of the liner are then withdrawn axially as a unit, laid down on a horizontal surface, and the liner is then opened by removing one of the two sections, thus exposing the core.

We claim:

1. A core drill for sampling underground deposits of iron ore and similar relatively dense earth formations comprising a core barrel having a downwardly tapered bore terminating at its upper and lower ends in unrestricted axial openings and a hollow drill shoe open at its bottom and top removably connected to the lower end of the barrel, in combination with a liner longitudinally divided into separable sections and having its outer surface tapered similarly to the bore of the barrel and snugly fitting said bore and having its bore similarly downwardly tapered, said liner being removable through the unrestricted opening at the upper end of the barrel by relative axial movement of the liner and barrel, and said drill shoe having a bore of the same diameter as the internal diameter of the lower end of the liner for admitting to the liner a cylindrical core having a diameter no greater than the smallest diameter of the bore of the liner.

2. A core drill for sampling underground deposits of iron ore and similar relatively dense earth formations comprising a core barrel having a downwardly tapered bore terminating at its upper and lower ends in unrestricted axial openings and being externally threaded at its lower end, a hollow drill shoe open at its bottom and top threaded onto said lower end and having an internal shoulder spaced above its lower end, and a longitudinally split liner having its outer surface tapered similarly to the bore of the barrel and snugly fitting said bore, the bore of the liner being similarly tapered and the liner having its lower end seated on said internal shoulder of the drill shoe and being removable through the unrestricted opening at the upper end of the barrel by relative axial movement of the liner and barrel, and said drill shoe having a bore of the same diameter as the internal diameter of the lower end of the liner for admitting to the liner a cylindrical core having a diameter no greater than the smallest diameter of the bore of the liner.

3. A core drill for sampling underground deposits of iron ore and similar relatively dense earth formations comprising an internally downwardly tapered core barrel externally threaded at its lower end and terminating at its upper and lower ends in unrestricted axial openings, a hollow drill shoe open at its bottom and top threaded

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onto said lower end and having an internal shoulder spaced above its lower end, a longitudinally split liner having its outer surface tapered similarly to the internal taper of the barrel positioned in snugly fitting relation inside the barrel with its lower end projecting into the drill shoe and seated on said shoulder, the liner having its bore similarly tapered, and a removable shouldered element bearing on the upper end of the liner and constituting the sole means holding the liner in said position, whereby the liner is removable axially through the unrestricted opening at the upper end of the barrel on removal of the shouldered element, and said drill shoe having a bore of the same diameter as the internal diameter

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of the lower end of the liner for admitting to the liner a cylindrical core having a diameter no greater than the smallest diameter of the bore of the liner.

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