September 1970

Brief 70-10391

NASA TECH BRIEF

Core Drill's Bit Is Replaceable Without Withdrawal of Drill Stem: A Concept

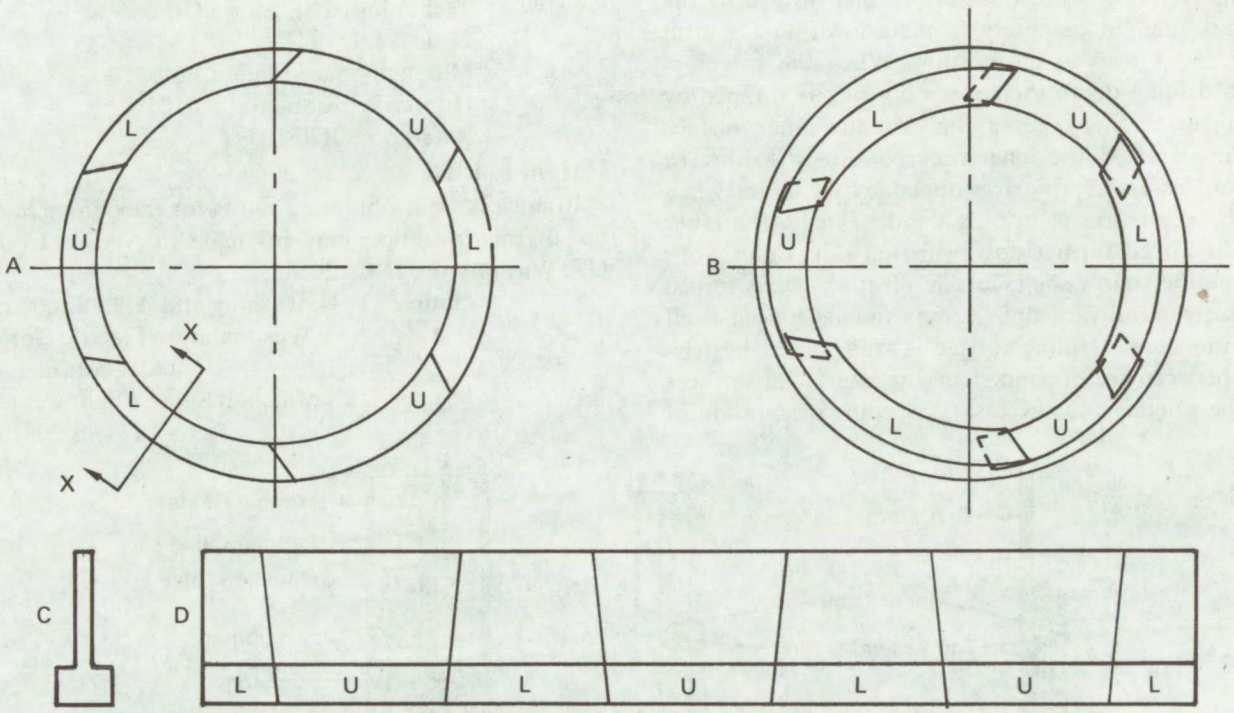

Figure 1. Sectors in Cutting Position (A), Collapsed within Drill Stem (U above L) (B), in Transverse Section (C), and Viewed from the Inside, as if Flattened from X–X (D).

The problem:

To drill a deep hole in the earth for recovery of a core without withdrawing the drill stem for replacement of dulled bits.

The solution:

A newly conceived bit divided into several sectors (Fig. 1). When the bit assembly is collapsed, its outside diameter is small enough for it to be forced down the drill stem; when it reaches bottom the sectors are forced outward and together to form a cutting bit (Fig. 2A). For drilling, all sectors are clamped between the drill stem and a longitudinally movable inner tube that is part of the insertion and withdrawal assembly; the clamped portion of each sector can be thinner than the cutting face. A dulled bit is retracted by reversal of this procedure.

(continued overleaf)

How it's done:

The possible number of bit sectors is infinite, with two or more assembly rings (in certain special circumstances one ring is enough). Here described is a six-sector bit, having two assembly rings, for drilling of a 1.875-in.-diam hole and recovery of a 1.375-in.-diam core.

Figure 1 shows that when the three "upper" (U) sectors slide upward relative to the three "lower" (L) sectors the outside diameter of the collapsed bit is smaller than the inner diameter of the drill stem. Around the inner tube are two sliding assembly rings; by leaf springs the U-sectors are attached to the top ring; the L-sectors, to the bottom ring. The springs tend to spring the sectors inward.

With the inner tube drawn upward relative to the assembly rings, and the sectors sprung inward by the springs, the bit assembly is placed within the drill stem and forced to the bottom. When the L-sectors reach drilling depth their assembly ring is stopped by its finger that engages a shelf on the inner surface of the stem. As the inner tube continues downward the top assembly ring is stopped by its finger when the U-sectors are at drilling depth. Finally the inner tube is forced further downward until its outer stops engage the stem's shelf; in this position it has forced the sectors outward and clamps them between itself and the stem. Drilling torque is transmitted by friction between sectors and stem; the interfacial surfaces can be roughened if necessary. Specific orientation of the bit is unnecessary, but all parts of the bit assembly are angularly keyed by vertical grooves in the inner tube's stop ring.

A dulled bit is withdrawn from the hole by reversal of this procedure: as the inner tube is pulled upward it unclamps the sectors, allowing them to spring inward, and its stops force upward the assembly rings with the sectors attached. For insertion or withdrawal of a bit a hammer mechanism is used; hammering may be upward or downward (Fig. 2C).

Notes:

1. This device is in the conceptual stage only; at the time of this publication no model or prototype exists.
2. No additional documentation is available. Specific questions, however, may be directed to:

   Technology Utilization Officer
   Code A&TS-TU
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B70-10391

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: F. C. Rushing and A. B. Simon of
Westinghouse Electric Corp.
under contract to
Marshall Space Flight Center
(MFS-20819)

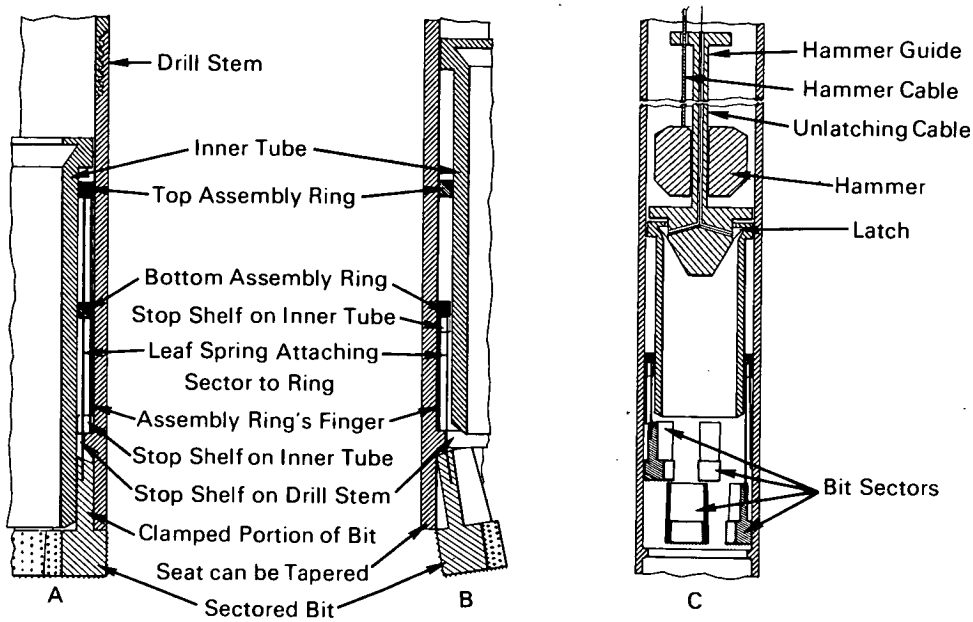

Figure 2. A, Bit Locked for Drilling; B, Beginning of Removal; Sector Sprung Inward. C, Hammer Mechanism and Bit Assembly Sliding through Drill Stem.