May 12, 1953 T. C. BANNON 2,638,323

MEANS AND METHOD OF REMOVING CORES

Filed Dec. 3, 1948

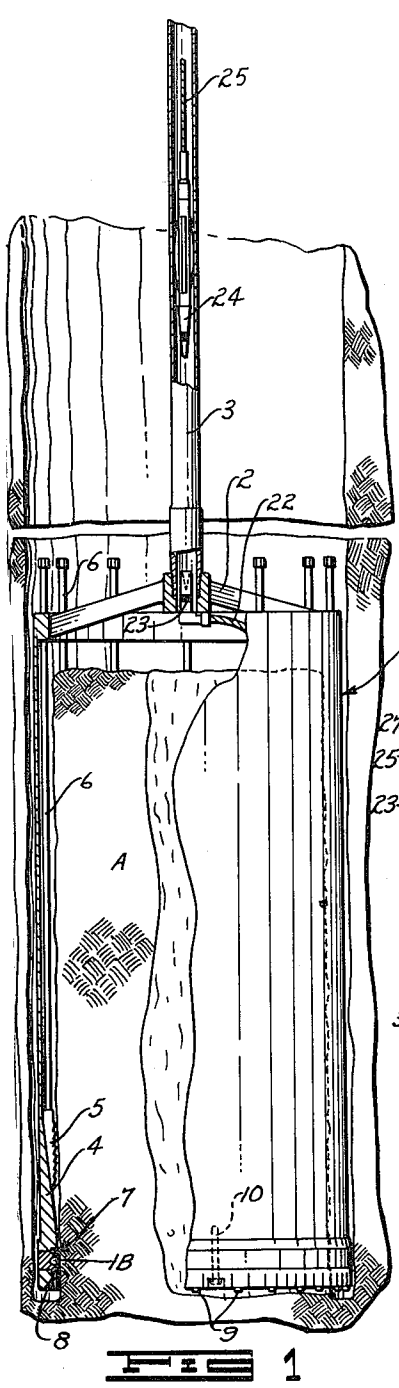

FIG 1

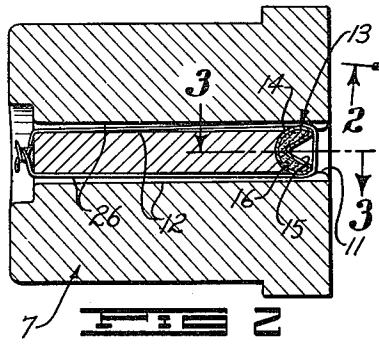

FIG 2

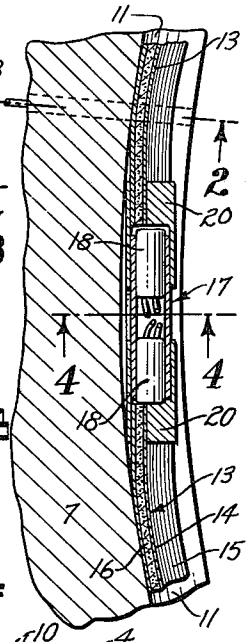

FIG 3

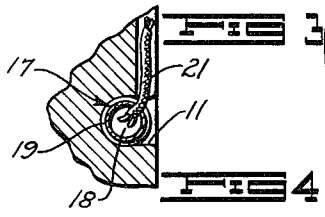

FIG 4

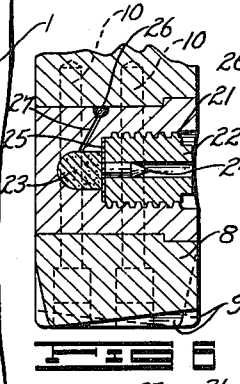

FIG 5

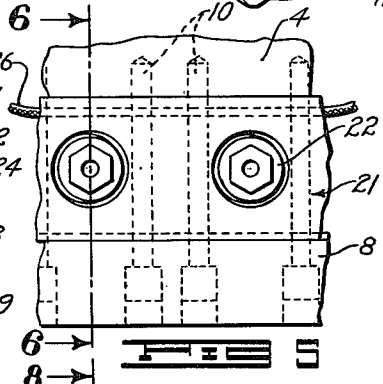

FIG 6

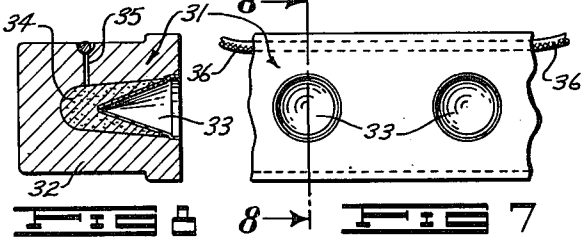

FIG 7

INVENTOR.

THOMAS C. BANNON

BY Lloyd Spencer

ATTORNEY

Patented May 12, 1953

2,638,323

UNITED STATES PATENT OFFICE

2,638,323

MEANS AND METHOD OF REMOVING CORES

Thomas C. Bannon, Altadena, Calif., assignor of fifty per cent to Lloyd Spencer, Los Angeles, Calif.

Application December 3, 1948, Serial No. 63,245

14 Claims. (Cl. 255—1.8)

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In core drilling, particularly the drilling of shafts several feet in diameter, it is the practice to employ an annular drill or core drill. The annular cutting end may contain diamond or other hard cutting material, or more frequently in the drilling of large bores, chilled shot is fed to the cutting surface.

The core drill or cutter is several feet in height to accommodate the central core formed as drilling proceeds. The core drill is driven by a central shaft from a drive unit immediately above the core drill, or more commonly by means of drill pipe which extends to the surface of the shaft and which is rotated by a surface rig similar to the drilling rigs employed in oil well drilling.

Water is introduced through the string of drill pipe to cool the drill and to carry away cuttings, usually a collector is mounted on the core drill for this purpose.

After drilling has proceeded a distance determined by the length of the core drill, the core drill is removed and a core extractor barrel is lowered over the core. Conventional core barrels are provided with slips or wedging devices to engage the core near its base. The core barrel or extractor is preferably suspended from drill pipe so that upon engaging the core a substantial upward strain, calculated to part the core by tension, may be applied. In firm rock of high tensile strength twenty tons or more is required to break a core of thirty inches in diameter weighing approximately four to eight tons. In attempts to core drill larger bores, lateral wedging of the core is resorted to in attempt to break it loose; still further, a dynamite charge may be placed on one side to force the core laterally. These methods of breaking the core are haphazard and often result in spauling or breaking the core into fragments which cannot be removed by the core extractor barrel but must be removed piecemeal by dangerous and costly methods. In some cases workmen are lowered into the borehole to wedge the cores loose and/or retrieve core fragments.

I seek by means of my invention to avoid and eliminate the difficulties which have been previously encountered in the removing of cores, particularly cores of large diameter. Accordingly then, included in the objects of my invention are:

First, to provide a means and method of removing cores whereby the core is severed from the formation by a clean transverse break with a minimum of spauling and without application of excessive tensional loads, and which minimize the need for workmen to descend into the shaft.

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Second, to provide a means and method of removing cores which utilizes a controlled explosive force concentrated in a predetermined plane but distributed evenly about the periphery of the core.

Third, to provide a means and method of this class which in one form employs a specially arranged shaped explosive charge of annular form, in another form a circumferential series of shaped charges, and in still another form a series of bullets all directed radially inwardly.

Fourth, to provide a means and method of this class wherein the explosive means for severing the core is incorporated in an explosive resisting body carried by a core engaging structure or core extractor barrel whereby the core may be engaged and placed under moderate tension while simultaneously subjecting the core to a directed explosive force.

With the foregoing and other objects in view as may appear hereinafter, reference is directed to the accompanying drawings, in which:

Figure 1 is a partial elevational partial sectional view of a core extractor barrel incorporating my invention and shown suspended from a drill-pipe string within a shaft in which remains an upstanding core.

Figure 2 is a typical transverse sectional view of the body structure and showing an explosive charge in the form of an annular ring carried thereby, the view being taken along the line 2—2 of Fig. 3.

Figure 3 is a fragmentary sectional view thereof taken in the plane 3—3 of Fig. 2, showing the explosive charge and a detonating means therefore.

Figure 4 is a fragmentary sectional view through 4—4 of Fig. 3 showing the detonating means and the lead wires thereto.

Figure 5 is a fragmentary internal view of a modified form of explosive device, wherein projectiles are employed to effect cleavage of the core.

Figure 6 is a fragmentary sectional view thereof taken through 6—6 of Fig. 5.

Figure 7 is a fragmentary internal view, similar to Fig. 5 showing a further modified form of explosive device in which individual shaped charges are employed.

Figure 8 is a transverse sectional view thereof taken through 8—8 of Fig. 7.

Reference is first directed to the construction shown in Figs. 1 through 4. A core extractor barrel 1 in the form of a steel sleeve adapted to encompass a core A, is suitably supported as by a spider frame 2 from the lower end of a drill-pipe string 3. The lower portion of the core extractor

barrel is provided with internal downwardly converging wedging faces 4 on which ride wedges or slips 5. The slips are arranged to engage the sides of the core adjacent its lower or attached end. The slips may be attached to rods 6 extending above the core barrel and accessible in case it is desired to remove the core extractor barrel without engaging the core.

The lower end of the core extractor barrel is adapted to receive a ring body 7, below the ring body is an annular guard head 8, which may be provided with cutting teeth 9 to aid in bottoming the core extractor barrel. The core barrel extractor, ring body and guard head are preferably provided with stepped interlocking axial ends so disposed that the guard head and core extractor barrel tend to support the ring body against radially outward forces. Axially directed bolts 10 join the guard head and ring body to the core extractor.

The ring body 7 is provided with an internal channel 11 intersected at intervals by pairs of small radially outwardly extending bores 12. The channel 11 is adapted to receive an explosive cartride 13. The cartridge 13 includes a bendable tube or shell 14 having an essentially crescent shaped cross section, the convex side being semicircular and the concave side being V-shaped to form a longitudinal V-groove 15. The shell may be extruded or otherwise formed of copper, lead or other soft metal and is filled with a detonatable explosive material 16 such as TNT, PETN, Balistite, or other material capable of high velocity detonation.

The cartridge may be in the form of an elongated tube either straight or curved in coil form. A length is provided which forms a loop within the channel 11 the ends of which confront. Between the confronting ends of the cartridge there is placed a detonating unit 17, comprising one or more electrical detonators 18 within a circular tube 19. Adapter fittings 20 having tubular ends to fit the tube 19 and crescent apertured to conform to the cartridge shell 14 join the ends of the shell 14 to the ends of the tube 19 to form a closed circle. Lead wires 21 extend radially from the tube 19 and are adapted to fit in a groove extending upwardly across the radially inner face of the ring body.

The lead wires enter a conduit 22 provided within the core extractor barrel and terminate in a suitable connector unit 23 mounted in the spider frame 2 and exposed to the interior of the drill-pipe string 3. The circuit to the detonators 18 may be completed through a contactor 24 lowered on a suitable conductor cable 25.

The cartridge 13 is held in place with its V-groove 15 directed radially inwardly by means of tie wires 26 threaded through the radial bores 12.

Operation of the structure shown in Figs. 1 through 4 is as follows:

The core extractor barrel 1 is lowered over the core A. If necessary it is rotated by the drill-pipe string 3 to insure seating of the core extractor barrel. The slips arranged to wedge when the core extractor barrel is raised so that a firm grip is obtained on the core. The cartridge 13 is then fired.

By reason of the V-groove 15 as much as forty to fifty percent of the explosive force is directed radially inwardly in the plane passing through the center of the cartridge. As a consequence, a relatively small charge, insufficient to damage the ring body 7 is sufficient to sever the core in this plane.

While it is not necessary to do so, the effect of the explosive charge is improved by placing the core under tension prior and during firing; however, such tension is much lower than the tensional strength of the core.

Reference is now directed to Figs. 5 and 6. The construction here shown involves the use of special gun units for exerting a transverse splitting force on the core. A body ring 21 corresponding to the body ring 7 is provided. The body ring 21 is provided with radially outwardly directed cavities equally spaced about its inner side. These cavities are threaded to receive gun radially inwardly directed barrels 22 and, at the breach ends of said barrels, cartridge chambers 23. The gun barrels 22 receive bullets 24 whereas explosive cartridges are provided in the chambers 23. A rupturable seal disk 25 is provided at the breach end of each gun barrel to exclude moisture.

The axially upper side of the ring body 21 is provided with a circular groove which receives a detonating element 26, connected with an appropriate electrical detonator, not shown. A detonator passage 27 leads from the circular groove to each cartridge chamber 23. A suitable sealing gasket, not shown, is interposed between the axially upper end of the ring body and the core extractor barrel to exclude moisture.

Operation of the construction shown in Figs. 5 and 6 is essentially the same as in the previously described structure. The bullets penetrate several inches radially inwardly into the core A and exert a splitting force out-of-proportion to actual penetration. In addition the explosive cartridges preferably have excess energy which backs the bullets as they penetrate with high pressure gas tending to part the core.

Reference is now directed to Figs. 7 and 8. In the construction here shown a body 31 is provided which is similar to the body 21. The body 31 is provided with radially inwardly directed cavities 32 which are capped by cone members 33 and filled with detonating charges 34. Flame or detonating passages 35 communicate with an annular groove in the axially upper face of the body 31 which groove contains a detonator cord 36 such as a PETN cord.

Operation of this arrangement involves employment of the radially inwardly directed jets produced by detonation of the several charges 34 concentrated by the form of the cones 33.

It should be observed that the ring bodies 7, 21 and 31, particularly the latter two, may be made in arcuate sections rather than one piece.

My method of removing cores consists essentially in directing radially inwardly from an explosive resistant body an explosive force calculated to sever a core embraced by the resistant body; and further to direct such force while subjecting the core to tensional strain.

Having thus described certain embodiments of my invention, I do not desire to be limited thereto, but intend to claim all novelty inherent in the appended claims.

I claim:

1. In the art of bore drilling wherein an annular core bit is employed to drill a section of hole in which remains a central core, the method of removing such core, characterized by: directing explosive charges radially inwardly at the base of a core while protecting the surrounding wall from the effect thereof; and simultaneously placing tensile strain on said core, thereby to sever said core across its base to permit removal.

2. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: a core extractor barrel adapted to fit over said core; core catchers within said extractor barrel for engaging said core; an annular explosive resisting structure below said core catchers, said structure defining at least one explosive receiving recess directed radially inwardly; an explosive charge in said recess; and means for igniting said explosive charge to produce a radially inwardly directed explosive impact against said core to split the same transversely.

3. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: an annular explosive resisting structure adapted to fit around said core and be disposed adjacent the base thereof, said structure defining at least one explosive receiving recess directed radially inwardly; an explosive charge in said recess; and means for igniting said explosive charge to produce a radially inwardly directed explosive impact against said core to split the same transversely.

4. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: an annular explosive resisting structure adapted to fit around said core and be disposed adjacent the base thereof, said structure defining a radially inwardly directed circumferentially extending channel; an explosive charge in said channel; and means for igniting said explosive charge to produce a radially inwardly directed explosive impact against said core to split said core transversely in substantially the plane of said channel.

5. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: an annular explosive resisting structure adapted to fit around said core and be disposed adjacent the base thereof, said structure defining a radially inwardly directed circumferentially extending channel; an explosive charge in said channel, the radially inner side of said charge having a circumferentially extending V-groove thereby to produce a concentrated radially inwardly directed explosive force calculated to split said core in the plane of said explosive charge; and means for detonating said charge.

6. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: an annular explosive resisting structure adapted to fit around said core adjacent the base thereof, said structure defining a plurality of radially inwardly directed explosive charge cavities disposed substantially in a common plane; explosive charges in said cavities; and means for igniting said explosive charges to produce radially inwardly directed impacts against said core in said common plane to split said core transversely.

7. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: an annular explosive resisting structure adapted to fit around said core adjacent the base thereof, said structure defining a plurality of radially inwardly directed explosive charge cavities disposed substantially in a common plane; explosive charge units in said cavities, said explosive charges having conical recesses in their radially inward sides to produce a radially inwardly concentrated explosive impact against said core thereby to split said core in said common plane; and means for igniting said explosive charge units.

8. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: an annular explosive resisting structure adapted to fit around said core adjacent the base thereof, said structure defining a plurality of radially inwardly directed explosive charge cavities disposed substantially in a common plane; explosive charge units in said cavities, each explosive charge unit including a cartridge chamber and a radially inwardly directed barrel, an explosive cartridge in said chamber and a bullet in said barrel; and means for igniting said cartridges to drive said bullets radially inwardly into said core thereby to split said core in said common plane.

9. An apparatus for removing cores formed in bores by previous operation of an annular core drill, comprising: an annular explosive resisting structure adapted to fit around a core and having an internal, circumferential channel; an explosive charge extending along said channel and having a circumferentially extending radially inwardly directed V-groove in its inner side; and means for detonating said charge to produce an explosive impact concentrated in the plane of said charge.

10. An apparatus for removing cores formed in bores by previous operation of an annular core drill, comprising: an annular, explosive resisting structure adapted to fit around said core; explosive means carried by said structure and directed radially inwardly; said means adapted to concentrate and direct an impact force radially inwardly in a plane traversing said core, and at plurality of points about the periphery thereof; and an instrumentality for actuating said means.

11. An apparatus as set forth in claim 10 wherein: said explosive means comprises a plurality of gun units each including a cartridge chamber, a radially inwardly directed barrel, an explosive cartridge in said chamber, and a bullet in said barrel.

12. An apparatus as set forth in claim 10 wherein: said explosive means comprises a plurality of gun units each including a radially inwardly directed barrel and an explosive charge having a conically formed recess at its radially inward end.

13. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: a core extractor barrel adapted to fit over said core; core catchers within said extractor barrel for engaging said core; an annular explosive resisting structure below said core catchers, said structure defining a radially inwardly directed circumferentially extending channel; an explosive charge in said channel; and means for igniting said explosive charge to produce a radially inwardly directed explosive impact against said core to split said core transversely in substantially the plane of said channel.

14. In the art of bore drilling wherein an annular drill is employed to form a section of hole in which remains a central core, an apparatus for severing said core, comprising: a core extractor

barrel adapted to fit over said core; core catchers within said extractor barrel for engaging said core; an annular explosive resisting structure below said core catchers, said structure defining a radially inwardly directed circumferentially extending channel; an explosive charge in said channel, the radially inner side of said charge having a circumferentially extending V-groove thereby to produce a concentrated radially inwardly directed explosive force calculated to split said core in the plane of said explosive charge; and means for detonating said charge.

THOMAS C. BANNON.

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