

Dec. 5, 1950

O. PHIPPS

2,532,783

SELF PILOTED ROTARY DRILL BIT

Filed Sept. 30, 1946

2 Sheets-Sheet 1

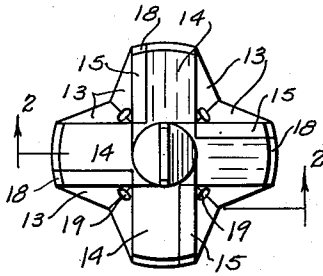


FIG. 1

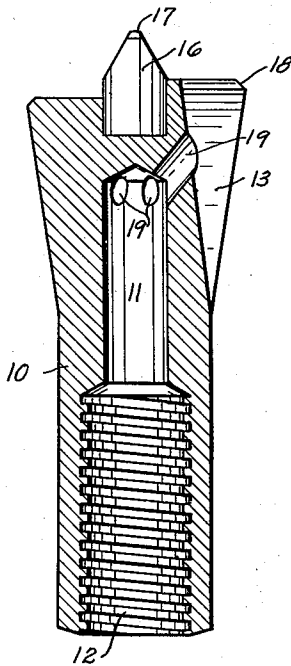


FIG. 2

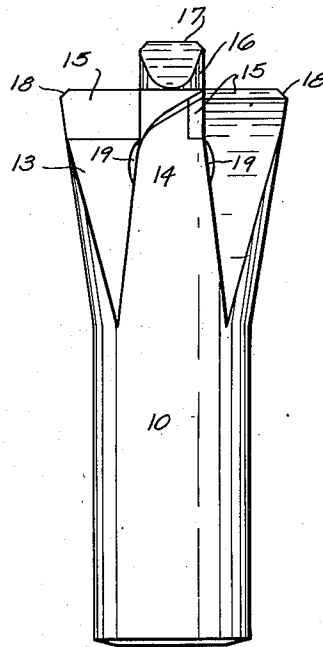


FIG. 3

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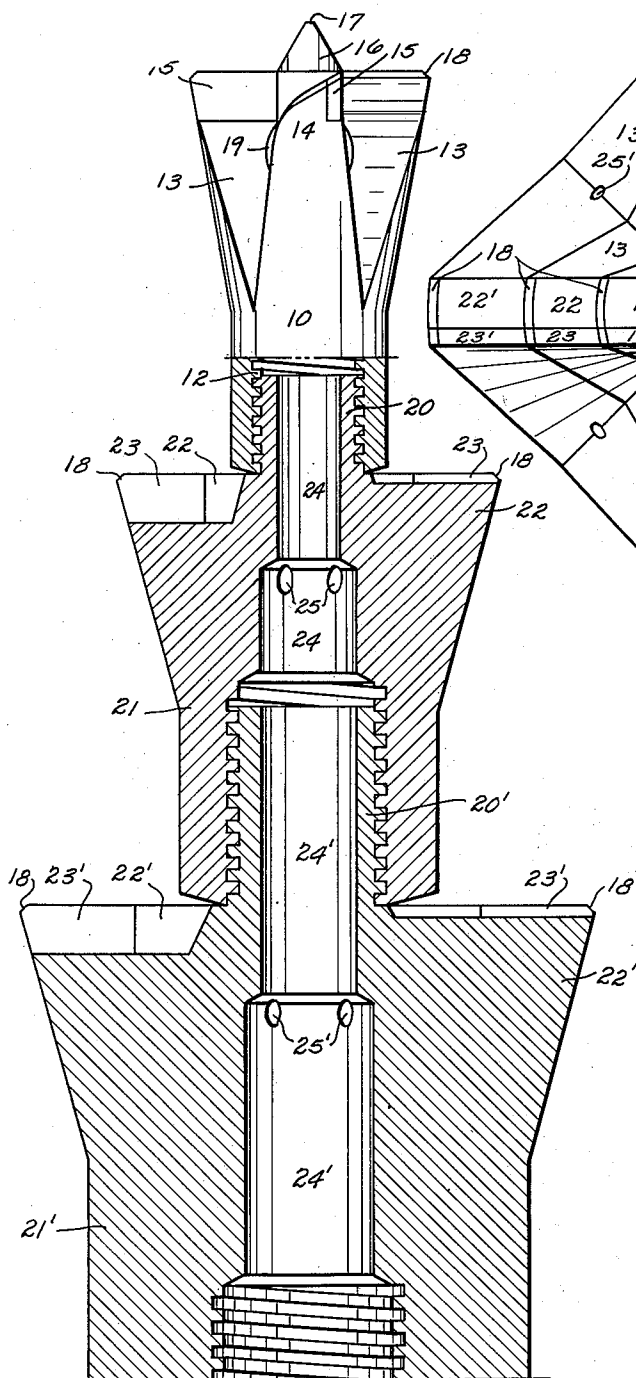


FIG. 4

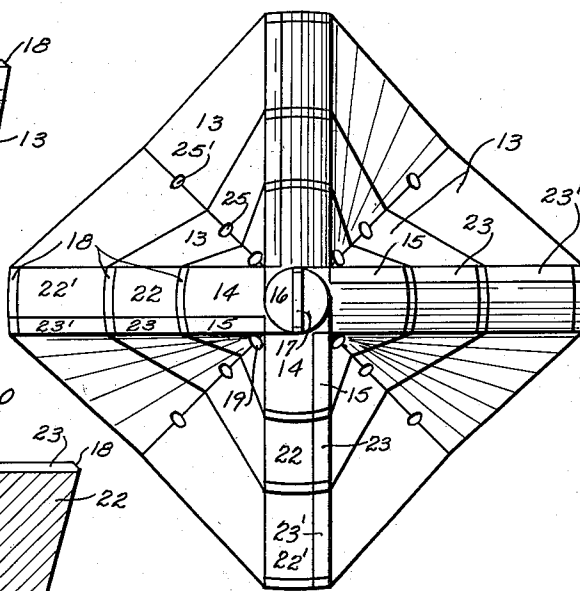


FIG. 5

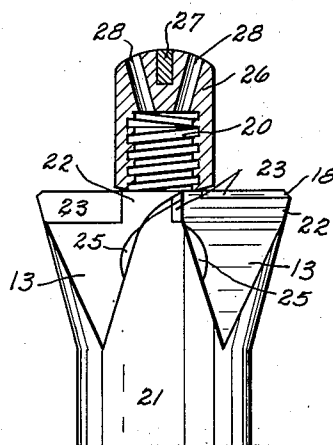


FIG. 6

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SELF-PILOTED ROTARY DRILL BIT

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Application September 30, 1946, Serial No. 700,314

1 Claim. (Cl. 255—61)

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This invention relates to drill bits of a type power-rotatable about an axis for the development of bores in penetrating relation through natural strata underlying the earth surface, and has as an object to provide an improved construction and relation of elements constituting such a bit.

A further object of the invention is to provide an improved power-rotatable drill bit particularly adapted for the development of straight, true bores through earthy strata of varying character bedded obliquely to the bore axis.

A further object of the invention is to provide an improved drill bit power rotatable for efficient and rapid penetration of highly-refractory material.

A further object of the invention is to provide an improved construction and arrangement of elements constituting a self-guiding, power-rotatable drill bit.

A further object of the invention is to provide an improved power-rotatable drill bit construction susceptible of selective multi-unit assembly in the field to vary the diameter of the bore produced thereby.

A further object of the invention is to provide an improved power-rotatable, multi-unit drill bit conveniently and efficiently operable for the enlargement of previously-drilled bores.

A further object of the invention is to provide an improved power-rotatable drill bit that is durable and long-lived in use, susceptible of convenient and repetitious rehabilitation in the field, operatively economical of time, power and labor, field-adjustable with a minimum supply of coactable elements to the development of a variety of bore sizes, and adapted for ready manufacture at low cost.

With the foregoing and other objects in view, my invention consists in the construction, arrangement, and combination of elements hereinafter set forth, pointed out in my claim, and illustrated by the accompanying drawings, in which—

Figure 1 is an end elevation of a typical drill bit, or drill bit tip element, embodying the principles of the invention and employable alone or in combination with complementary elements for the development of drilled bores. Figure 2 is a generally axial section taken through, and substantially on the indicated line 2—2 of, the arrangement according to Figure 1. Figure 3 is a side elevation of the construction shown in Figure 1. Figure 4 is a generally axial section, partly in elevation, through a multi-unit drill

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bit assembly typically incorporating the features of the invention. Figure 5 is an end view of the construction and arrangement shown in Figure 4. Figure 6 is a fragmentary, detail elevation, partly in axial section, of a modification within the contemplation of the invention.

The improvements of the instant invention are primarily designed for use in operative association with conventional rigs, facilities, and equipment for the effective drilling of deep earth bores, such as oil and artesian wells, and the like, and are of a type adapted for removable and replaceable association with and to operate as the working end of a power-rotatable drill line or string wherethrough liquid is circulated to and through the working face to cool the latter and to scavenge the bore during its development, an important attribute of the improved bit being its adaptability to use with existing drilling rigs as a substitute for hitherto employed analogous devices.

In the embodiment of the invention according to Figures 1, 2, and 3, a somewhat elongate, generally cylindrical body 10 is formed from any suitable, tractable metal, such as steel, in any convenient or desired manner, as by means of forging, pressing, rolling, or the like, to provide a right-cylindrical inner end or stem portion merging into and with an outwardly and conically expanded, coaxial outer or working end portion terminating in a working face plane perpendicular to the axis of the body. A bore 11 is formed axially within the body 10 to open through the end thereof remote from the working face and to terminate interiorly of the body in spaced relation with said face, the portion of said bore adjacent the body inner end being formed with threads 12, or equivalent mounting means adapted to interengage with complementary means normally terminating a conventional drill line or string and thereby removably and replaceably associate the body 10 with and in operatively-mounted relation on the end of such string or line. Uniformly spaced circumferentially about and individually intersecting the body 10 conical portion exterior surface, a plurality, in this instance four, of V-shaped notches 13 is formed to merge at their inner ends with the body cylindrical portion and to open at their outer ends through the unit working face, thereby dividing said working face into a corresponding number of like, radial fingers 14 which intersect centrally of the working face. Outer ends of the fingers 14 are relatively wide and are arcuately worked to provide an edge or margin

leading in the direction of unit rotation which lies in the working face plane, is tangent to a circle smaller than the outline of and concentric with said working face, and a rearwardly and inwardly inclined margin trailing in the direction of unit rotation offset inwardly from the working face plane and smoothly contoured to merge into the adjacent wall of its associated notch 13.

The margins of the fingers 14 leading in the direction of bit rotation constitute the cutting edges of the device, which edges, when formed from the tractable material of the body 10, rapidly abrade and wear away within a very short operating period, particularly when in contact with hard and refractory material, regardless of any known hardening or tempering techniques, hence an important feature of the instant invention is the arming of said edges with tough, hard, abrasive-resistant, block inserts having a wear characteristic such as imparts long operative life to and develops high operative efficiency in the bit. It is known that certain non-ferrous alloys, particularly one compounded from tungsten, titanium, tantalum, nickel, and cobalt, have the properties and characteristics necessary to long withstand abrasive engagement with refractory material without excessive chipping, faulting, or wear affecting the alloy margin or surface so engaged, and that such alloys, while difficult to machine and mechanically work, are amenable to grinding and conveniently susceptible of being welded, brazed, or similarly attached to other metals. Adapting the properties of such known alloys to function as the cutting edges of the improved bit, suitably-sized blocks 15 of the alloy material are formed to generally rectangular outline and section and are recess-mounted on and securely fixed to the fingers 14 to constitute the forward faces and outward leading margins of said fingers. The blocks 15 incorporated in a given tool are identical in size, shape, and mounted dispositions, each of said blocks having a length equal to the finger margin projection tangential to and outwardly beyond the projected circumference of the circle defining the location of and spacing between the finger margins, a thickness in the direction of bit rotation sufficient to withstand the stresses to which the tool may be subjected, and a dimension disposable axially of the tool several times that of the block thickness, and each of said blocks is correspondingly fitted within an angular recess or notch interrupting each finger 14 outer leading corner in such manner as to position the exposed forward face of the block parallel to the unit axis, the block inner end closing against a line tangent to the finger-defining circle and perpendicular to the exposed block face, the block outer end smoothly conforming with the adjacent body 10 exterior surface, and the forward, outer margin of the block coplanar with and constituting an element of the bit working face on a line tangent to the finger-defining circle. As so positioned, each of said blocks is welded, brazed, or otherwise permanently secured to the body 10 margins and surfaces wherewith it is in engagement, and the axially-directed edge margin of each block is beveled or relieved into conformity with the rearwardly and inwardly arcuate surface of the finger end to provide a chisel-like block cutting edge whereof the effective angle points in the direction of unit rotation.

Mounting of the blocks 15 in the spaced relation of their inner ends shown and described de-

fines a square area centrally of the bit working face having a side length corresponding with the diameter of the finger-defining circle and devoid of effective cutting agents save as hereinafter specified. The area between the block 15 inner ends mounts a pilot bit or cutter which contributes much to the novelty and efficiency of the improved tool, for which purpose a cylindrical recess or socket is formed to axially intersect and open outwardly through the tool working face in a diameter corresponding with that of the finger-defining circle, and a cylindrical plug 16 of special alloy material is seated and securely mounted, as by means of welding or brazing, in said socket to project axially from and outwardly beyond the tool working face, the free outer end of said plug being ground or worked to a diametric cutting edge or margin 17 which may, if desired, be obtusely pointed, in conformity with usual practice. Also, outer corners of the blocks 15, fingers 14, and edge 17 may be slightly beveled or relieved, as indicated at 18, in conformity with usual practice.

Completing the tool ready for operation, passages 19 are formed through the tool body adjacent its working face in communication between the inner end of the bore 11 and angles of the notches 13 for outflow distribution of liquid fed to and through the bore 11, the passages 19 preferably diverging outwardly and toward the tool working face from their inner end communication with said bore.

As is clearly evidenced by the showing of Figure 1, the construction and arrangement of elements comprised in the improved bit provides a working face for rotational engagement against the material to be penetrated which presents a cutting or working end of special highly-resistant alloy disposed to operatively engage with and sweep over every point and portion of the area engaged by said face, there being no zone or area on the tool working face which is not operatively so equipped. In the actual use of the improved tool, the axially-disposed pilot bit or plug 16 functions in an obvious manner to develop a small guide bore centrally and in advance of the tool working face. The small guide bore so developed is of operative advantage in that engagement of the plug 16 therein serves to guide and position the tool working face for preservation of main bore alinement even when the tool is working in strata bedded at a relatively steep inclination to the bore axis, and in that said guide bore, being an interruption of the material area against which the tool is working, facilitates detachment or disintegration of the material to be detached by working margins of the blocks 15.

The multi-unit construction typified by Figures 4 and 5 is designed to apply the operative principles of the tool hereinabove described to the development of bores having various diameters greater than that of the single unit bit in a manner which permits selective assembly in the field of an operative unit productive of the desired bore diameter. The multi-unit bit is a selective assembly with one of the bit units as hereinabove described of one or more coaxially-engaged, relatively greater diameter, cutter-equipped units interposed between and for rotation with the terminal bit unit and the drill string or line. As shown in Figures 4 and 5, the terminal bit unit consisting of the body 10 and associated elements as previously set forth threadedly engages with and is thereby operatively secured to a boss 20 outstanding axially from and beyond the working

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face of a body member 21, of tractable metal, similar to and somewhat larger than the body 10. The body 21 is formed with exteriorly-opening relief notches comparable to and conveniently disposed to register at times with the notches 13 of the body 10, and the working face of said body 21 is thereby divided into fingers 22 alineable with and to project radially of the assembly as axially-offset extensions beyond the fingers 14, and each of said fingers 22 is equipped or armed with a block 23 of alloy material closely similar to and operatively identical with the blocks 15 of the terminal unit; said blocks 23 extending inwardly along an associated finger 22 face from conformity with the outer margin of the body 21 to inner ends within the operative orbit of the block 15 outer ends. A bore 24 axially traverses and opens at both ends through the body 21 and boss 20, said bore 24 preferably being stepped in diameter to provide a more restricted portion traversing the boss 20 and communicating therethrough with the bore 11 of the terminal unit, a relatively larger intermediate portion interiorly of the body 21 and communicating through passages 25 with the body 21 exterior relief notches, and a relatively larger portion opening through the body 21 end remote from the blocks 23 and equipped with internal threads or equivalent fastening devices engageable with complementary agencies on the end of a drill string or line, or on the axially-protruding boss of a succeeding analogous bit element, to operatively mount the bit assembly. As is immediately apparent, additional bit units comparable to that represented by the body 21 and differing from the latter only in relative size, may be successively connected in axially-offset relation of their working faces to build up a bit assembly productive of any desired bore diameter, the elements constituting such an assembly being readily separable for replacement, rehabilitation, and recombination as may prove to be expedient or desirable; Figure 4 showing a three unit assembly including, in coaxial engagement with the body 21, a second body 21' constructed and equipped save for size as a replica of its coaxing unit.

Figure 6 shows a convenient arrangement whereby units such as are typified by the blocks 21 and 21' may be adapted for use in direct individual association with a drill line or string for the reaming and consequent enlargement of existing bores or for the initial penetration of relatively soft material. To adapt the relatively larger units of the multi-unit assembly for individual use, a cap 26, of tractable metal, is formed as a cylinder bored and worked to threadedly cooperate with the boss 20 of its associated unit and of a size to exteriorly overhang the inner ends of the adjacent unit insert blocks 23, said cap 26 being armed with a slot-seated diametric alloy

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insert block 27 traversing and marginally conforming with the cap 26 domed outer end, and with passages 28 opening through said cap outer end for outflow of liquid from the drilled unit bore. Obviously, a unit 21 or 21' equipped with a cap 26 is an effective agent for the enlargement of bores sized to accommodate said cap and for the development of new bores through material susceptible of efficient penetration by a pilot bit of the type provided by the cap 26.

Since many changes, variations, and modifications, in the specific form, construction, and arrangement of the elements shown and described may be had without departing from the spirit of my invention, I wish to be understood as being limited solely by the scope of the appended claim, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

In a self-piloted, rotary drill bit having a generally-cylindrical body of tractable metal detachably mountable as a coaxial terminal extension on the working end of a power-rotatable drill string and like, integral, angularly-spaced fingers similarly radiating from a common end central area of said body to constitute a working face perpendicular to the body axis, a bit pilot member comprising a cylindrical plug of hard, tough, abrasive-resistant alloy material fixedly socket-seated in said common end central area coaxially of said body and to project axially outwardly beyond the body working face, a cutting edge diametrically of the plug free end, and insert blocks of alloy material fixedly recess-seated in the rotationally-leading faces of said fingers to conformably intersect outer side and working face end margins of the fingers with the rotationally-leading corners of said blocks tangent to the cylindrical surface of said plug and spaced at their inner ends therefrom, whereby to effectively arm the bit working elements with wear-resistant material arranged for repetitious rehabilitation in the field through simple grinding applied to the bit assembly.

ORVILLE PHIPPS.

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