

Dec. 14, 1954

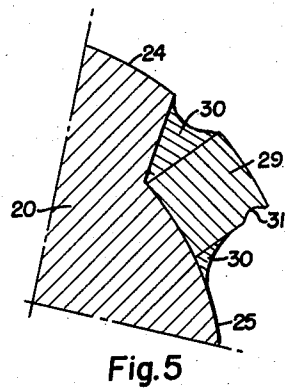
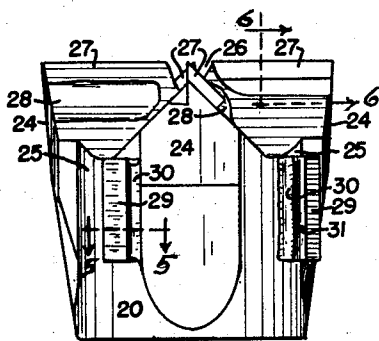
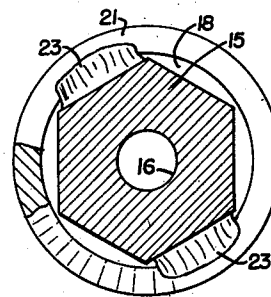
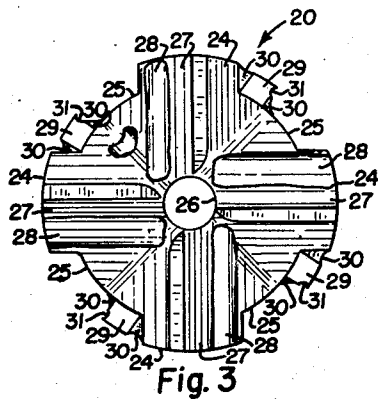
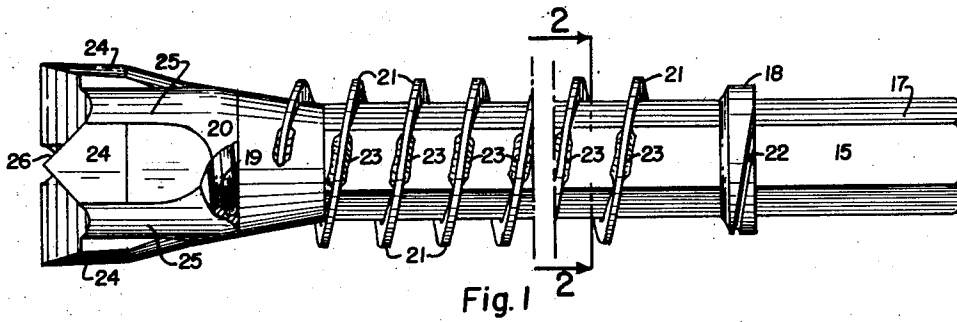
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2,696,973

NONSTICKING DRILL BIT

Filed Feb. 9, 1951

2 Sheets-Sheet 1



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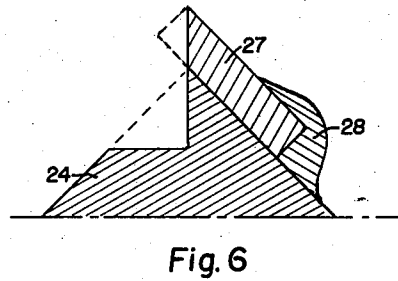
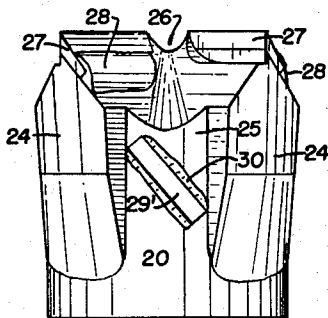
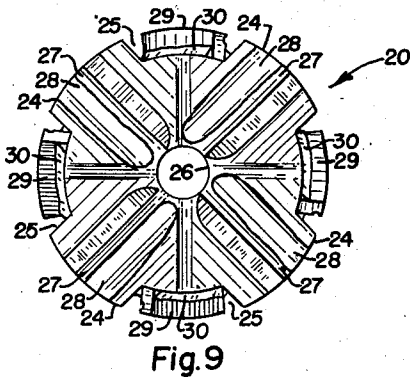
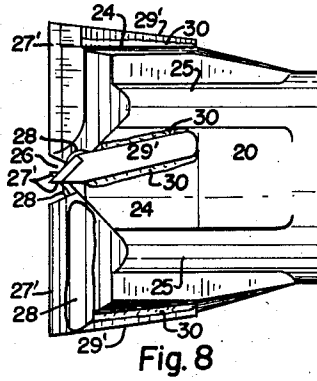
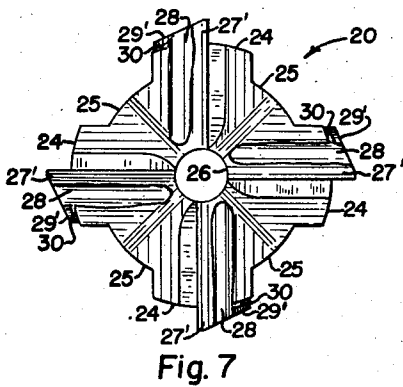
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NONSTICKING DRILL BIT

Filed Feb. 9, 1951

2 Sheets-Sheet 2



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1

2,696,973

NONSTICKING DRILL BIT

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Application February 9, 1951, Serial No. 210,264

9 Claims. (Cl. 255—64)

This invention relates to drills and drill bits of percussion types adapted to be driven and rotated in a conventional manner for the development of bores in and through earth strata, and has as an object to provide improved drill bit and drill stem constructions particularly adapted for use and of enhanced efficiency in so-called drifting operations wherein the desired bore is at a considerable angle to the vertical.

A further object of the invention is to provide improved, percussion-type drills and drill bits operable to minimize, if not wholly eliminate, sticking or hanging of the drill in the bore.

A further object of the invention is to provide improved means for guiding and supporting a percussive drill bit in non-vertical drilling operations.

A further object of the invention is to provide improved means operable as an incident of conventional percussive drill actuation to scavenge and clear the resulting bore.

A further object of the invention is to provide an improved, percussion-type drill bit of enhanced penetrative efficiency and extended operative life.

A further object of the invention is to provide an improved, percussion-type drill bit operable with cutting effect in reaction to both rotational and axially-applied phases of conventional drive.

A further object of the invention is to provide an improved, percussion-type drill bit that is simple and inexpensive of production in an extensive variety of particular sizes and forms, that is rugged, durable, and efficient in use, and susceptible of ready rehabilitation in the field.

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 claims, and illustrated by the accompanying drawing, in which—

Figure 1 is a side elevation of a typical drill unit comprised from a conventional bit and a stem modified in accordance with certain principles of the invention, an intermediate portion of the stem being broken away to conserve space. Figure 2 is a cross section, on an enlarged scale, taken on the indicated line 2—2 of Figure 1. Figure 3 is an elevation of the cutting face or working end of a typical percussion-type drill bit incorporating certain features and principles of the invention. Figure 4 is a side elevation of the construction according to Figure 3. Figure 5 is a fragmentary, detail section, on an enlarged scale, taken substantially on the indicated line 5—5 of Figure 4. Figure 6 is a fragmentary, detail section, on an enlarged scale, taken substantially on the indicated line 6—6 of Figure 4. Figure 7 is a view similar to Figure 3 of a relatively modified bit cutting face within the contemplation of the invention. Figure 8 is a side elevation of the construction according to Figure 7. Figure 9 is a view similar to Figure 3 showing a somewhat modified arrangement of the elements thereof. Figure 10 is a side elevation of the construction according to Figure 9.

Percussive drilling of non-vertical bores in earth strata by hitherto conventional means and agencies is commonly characterized by a gravity-induced deviation of the bore away from a straight line, by inadequate scavenging of cuttings from the bore with consequent reduction of drilling efficiency, and by a grievous tendency of the bit to catch, hang and stick relative to the bore walls during the entering and withdrawing operations essential to bit replacement, adjustment of stem length, and the

2

like, and it is hence to the elimination of such disadvantageous characteristics that the improvements of the instant invention are directed.

Representative of conventional practices, and as shown in Figures 1 and 2, a drill stem 15 in the form of a straight length of suitable metal, such as round or hexagonal bar stock, is formed with an axial bore 16 for the translation of cooling and scavenging fluid, with an angularly-surfaced end 17 receivable in the chuck of a jack-hammer whereby the stem is both axially driven and rotated, with a fixedly-related collar 18 limiting the length and determining the chuck-engageable extension of the end 17, and with its other end worked to the form of a coaxial, shouldered stud 19, usually threaded, for engagement with and to operatively mount a socketed drill bit 20 of conventional type; all of which is common and well known in the related art and practice.

Conditioning the conventional assembly illustrated and above described for improved scavenging effect incidental to the usual rotational and percussive power drive thereof, a feature of this invention is the provision of a spiral fin exteriorly about and along the stem 15, or at least that portion of said stem adjacent the bit 20, pitched to apply stem rotation to retraction of cuttings from the bit working face or inner bore end toward the open or entering end of said bore. While spiral fins exteriorly of drill stems for auger-like extraction of cuttings are not new, per se, the generally-available percussive drill stem sections are not commonly so equipped and the production of drill stem sections with integral spiral fins is reflected in an onerously high unit cost, hence the novelty and advantage of this feature of the invention reside in a fin construction and operative mounting thereof which are inexpensive and susceptible of convenient utilization. As shown in Figures 1 and 2, the spiral fin featuring this invention is developed from a length of suitable-width strip metal 21 by winding said strip, as upon and about a mandrel, to the form of a suitably-pitched, hollow, spiral coil having an internal diameter slightly exceeding the maximum diametric dimension of the drill stem section 15 whereupon the coil is to be mounted and an exterior diameter slightly less than the diameter of the bore susceptible of development by the associated bit 20. The coil constituted from the strip 21 having been formed, a slot or groove 22, pitched in conformity with the convolutions of said coil, is cut or ground circumferentially of the stem collar 18 in a depth and width accommodative of the coil strip and said coil is then rotated through said slot or groove and axially of the stem 15 until the said coil has passed beyond the collar and into loosely embracing, slidable relation with the stem, whereafter the coil is moved into end proximity with the stud 19 and is there positioned and fixed by means of welds or brazings 23 disposed to unite spaced points of the coil inner circumference with adjacent stem areas. As is manifest, the spiral fin coils are susceptible of convenient production in sizes appropriate for use on and with conventional drill stems, to which they may be applied by any user having access to usually-available equipment, and the presence of a spiral fin coil on the drill stem portion adjacent the bit applies rotation of the drill assembly to effect mechanical extraction of cuttings in a manner efficiently supplementing customary fluid scavenging.

Conventional percussion drill bits of the type within the contemplation of this invention, and as shown at 20 in Figure 1, are characterized by a plurality of angularly-spaced teeth 24 separated by flutes or channels 25 longitudinally of and interrupting the drill body exterior surface for accommodation of scavenging fluid flow and cuttings travel. The teeth 24 are alike in an angular convergence axially of the body definitive of a tooth cutting edge substantially radial of the bit working face and extending from the fluid flow bore 26 axially intersecting the bit body to an outer end or corner outwardly overhanging the bit body and, with its counterparts, determinative of the bore diameter. In the use of bits of the type and characteristics shown and described, the axially-advanced cutting edges of the teeth rapidly dull and blunt to a degree requiring frequent rehabilitation, said teeth effect little, if any, cutting action during the rotative phases of the assembly drive, and the outer corners of

said teeth are prone to catch and hang on the rough bore walls when the assembly is withdrawn from the bore for servicing or replacement of the bit, and it is to the practical correction of such deficiencies that the further features of the invention are directed.

In accordance with the principles of the invention, the cutting efficiency and the useful working life of the bit teeth 24 edges may be materially enhanced by armoring said teeth edges with blocks 27 of appropriate alloy material, such as tungsten-carbide, having the form of rectangular wafers. Blocks of wear-resistant alloy material appropriate for arming of the teeth 24 are commercially available in a variety of shapes, sizes, and proportions, hence it is practical and wholly feasible to obtain wafers suitable for the desired use in mounted relation with the wedge-shaped teeth 24 of variously-sized bits 20. The blocks 27 selected for mounting on a given bit 20 should have a length, or maximum dimension, at least equal to the length of the tooth 24 cutting edge with which it is to be associated, a width on the order of half, or less, of its length, and a thickness on the order of half, or less, of its width, and one such block 27 is placed flat against the slope of each tooth 24 trailing in the direction of bit rotation with the axially-outtermost long edge of the block registered in alignment and in the same axial plane of the bit body with the associated tooth cutting edge, in which position and relation the said block is fixed and secured by a welded fillet 28 filling the angle between the block 27 trailing edge and the adjacent tooth surface, adhered to said block edge and surface, and overlapping a trailing portion of the exposed block width, as is clearly shown in Figure 6; it being within the contemplation of the invention that the contacting block and tooth surfaces may be correspondingly united by welding or brazing through the application of known techniques. Mounted as shown and described, the inner long edge corner of the block 27 projects beyond the axial plane of the associated tooth cutting edge, as indicated by broken lines in Figure 6, and conditioning of the so-mounted block for actual use involves a grinding away of such projecting corner, and a portion of the tooth 24 surface underlying the same, to provide a chisel-edge, flat face leading in the direction of bit rotation and disposed as a plane axially and approximately radially of the bit body through the original tooth cutting edge and the outer long edge corner of the block. As so conditioned, the axially-directed chisel edge of the block 27 becomes the percussively-penetrative, cutting edge of the associated tooth, the narrow angle chisel edge and the character of the block material enhancing the cutting efficiency and prolonging the useful life of the tool, while the form and particular disposition of said chisel edge conditions it to perform a scraping action on the end face of the bore as an incident of tool rotation, with consequent gain in the penetrative efficiency of the tool. In the embodiment of the invention shown in Figures 3-6, inclusive, any projection of a block 27 radially of the bit body and beyond the outer end of an associated tooth 24 is ground away to bring the block exterior end into smooth conformity with the adjacent body and tooth exterior wall, in which relationship the radially-outward, wear-resistant end corners of the block 27 protectively overlie the associated tooth 24 outer corner to minimize abrasive wear of the latter and to maintain the initial bit diameter determinative of desired bore size.

The slightly-flared tooth corners of the conventional-type bit 20 have an aggravating and time-consuming tendency to catch and hang on the rough bore walls when the tool is shifted axially of the bore, particularly during retraction of the tool assembly from the bore, and this tendency, present even when the tooth edges are armored by means of the blocks 27, increases during operation of the block-armored bit due to abrasive wear of the tooth corners and consequent gradual exposure of the harder block 27 ends as projections beyond the adjacent abraded body and tooth end surfaces, hence a further feature of the invention is the provision of means reactive to normal bit operation to true and smooth the bore, to minimize wear of the bit body and tooth surfaces in contact with the bore walls, and thus to largely eliminate the objectionable tendency above mentioned. This further feature is developed through the provision of blocks 29 of suitable alloy material, similar to or the same as that characterizing the blocks 27, fixed to exterior surfaces of the bit 20 body, preferably in the flutes 25 thereof, to function as reaming agents during rotation of the bit. As represented

in Figures 3, 4 and 5, the blocks 29 may be rectangular units of appropriate length, width and thickness each seated in a flute 25 of the bit body with its length paralleling the bit body axis, its end adjacent the bit working face disposed inwardly along the bit body from and in clearing relation with the base of the notch between the adjacent bit teeth 24, and preferably with its side trailing in the direction of bit rotation closely adjacent the rotationally trailing side of the flute 25 wherein it is seated. Mounted upon the bit 20 body in the relation with a flute 25 thereof shown and described, each of the blocks 29 is fixed and secured to said body, as by means of welded fillets 30 engaging between leading and trailing sides of the block and the adjacent body surfaces, or the like, to present an outer edge corner of the block leading in the direction of bit rotation as a reaming cutter effective to smooth and true the bore wall in reaction to bit rotation incidental to power drive thereof. The blocks 29 are conditioned, either through initial selection or by means of grinding subsequent to their mounting on the bit body, to so outstand radially from the bit 20 body as to define an orbit of outer corner rotation slightly smaller than that of the bit tooth and block 27 outer end corners and slightly larger than that of the bit body exterior surfaces, whereby to concentrate the abrasive effects of bit operation on the exposed surfaces of the blocks 29, rather than upon the bit body surfaces, and to minimize any tendency of the blocks 29 to wedge or stick in the bore. Promotive of the reaming action of the block 29 outer corners leading in the direction of bit rotation, a shallow groove or channel 31 is formed in the block 29 radial face leading in the direction of bit rotation adjacent and to parallel said outer leading corner, whereby to constitute said corner as a chisel edge of enhanced cutting efficiency and susceptible of ready rehabilitation after wear.

In the modified arrangement according to Figures 9 and 10 the characteristic elements of the improved organization are functionally and structurally the same as those hereinabove described, the only variation presented by the modification being one of arrangement exemplified as a skewed mounting of the blocks 29 resulting from an inclined, rather than a parallel, relation between the block 29 lengths and the bit body axis which, in an appropriate like pitch of said blocks relative to the axis of rotation, imparts a slicing effect to the shear action of the block cutting corners and operates as an auger to retract cuttings away from the bore face.

In the modification according to Figures 7 and 8, the tooth arming blocks 27 are replaced by structurally similar and functionally identical blocks 27' fixedly associated with the teeth 24 of the bit as previously described, the said blocks 27' of a given bit assembly being alike in a uniformity of length greater than the radial length of the tooth edges on which they are mounted so as to each project outwardly and radially of the bit beyond the associated tooth in and as a cutting end determinative of the effective bit diameter. Cooperating and in backing support with the projecting ends of the blocks 27', and in substitution for the blocks 29 of the earlier embodiment, longitudinally-tapered blocks 29' of alloy material are fixed on and welded to outer end faces of the teeth 24 with the thicker ends of said blocks 29' conformably abutting under the block 27' end projections and their thinner ends directed away from the bit working face, the slope due to the taper of said blocks 29' providing the desirable slight flare of the bit tooth outer corners. While it is feasible to dispose the blocks 29' with their lengths paralleling the bit body axis, it is preferred that said blocks be similarly skewed relative to said axis, as illustrated, to thereby develop the cuttings retraction effect characteristic of the modification shown in Figures 9 and 10.

The improved bit, in use, is marked by enhanced cutting efficiency, extended useful life, ease of rehabilitation, effective removal of cuttings from the bore face, smooth, true bores, and freedom from tendency of the tool to stick, catch, or hang on the bore walls; it being also noteworthy that the blocks 29 and 29' also provide guided support for the bit and thereby conduce to straight bore development.

Since changes, variations, and modifications in the 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 claims, rather than by any details of the illustrative showing and foregoing description.

I claim as my invention:

1. In a drill bit of the character described having a frusto-conical body formed with integral, axially and outwardly converging, symmetrically-sloped teeth definitive of angularly-spaced cutting edges radially of a working face on the greater end of said body and flutes longitudinally relieving the body conical surface between outer ends of said teeth, blocks of hard, wear-resistant, alloy material overlying and affixed to the slopes of said teeth trailing in the direction of bit rotation, and chisel cutting edges on said blocks defined by a plane axially and radially of the bit body through the forwardly-directed edge of each block and the associated tooth apex in intersecting relation with the exposed block surface.

2. The organization according to claim 1, wherein said blocks are affixed to their respective tooth mountings by weld fillets filling the angle between the tooth surface and the block edge trailing in the direction of bit rotation and overlapping upon the otherwise-exposed, adjacent block surface.

3. In a drill bit of the character described having a frusto-conical body formed with integral, axially and outwardly converging, symmetrically-sloped teeth definitive of angularly-spaced cutting edges radially of a working face on the greater end of said body and flutes longitudinally relieving the body conical surface between outer ends of said teeth, blocks of hard, wear-resistant, alloy material overlying and affixed to the slopes of said teeth trailing in the direction of bit rotation, chisel cutting edges on said blocks defined by a plane axially and radially of the bit body through the forwardly-directed edge of each block and the associated tooth apex in intersecting relation with the exposed block surface, and other blocks of alloy material spaced angularly about and affixed to the body peripheral surface for bore-reaming action incident to bit rotation.

4. The organization according to claim 3, wherein said alloy material blocks on the body peripheral surface are seated and welded-affixed in the body flutes to dispose their outer edge corners leading in the direction of bit rotation as cutting edges definitive of an orbit slightly less in diameter than the effective area of the bit working face.

5. The organization according to claim 3, wherein said alloy material blocks on the body peripheral surface are seated and weld-affixed in the body flutes to dispose their outer edge corners leading in the direction of bit rotation as cutting edges definitive of an orbit slightly less in diameter than the effective area of the bit working face, and faces of said blocks leading in the direction of bit rotation are grooved adjacent their

outer corners to constitute said corners as chisel-type cutting edges.

6. The organization according to claim 3, wherein said alloy material blocks on the body peripheral surface are seated and weld-affixed in the body flutes in correspondingly-skewed relation with the bit axis of rotation for auger-like retraction of cuttings away from the bore face as the bit is rotated.

7. The organization according to claim 3, wherein the alloy material blocks affixed to the bit teeth similarly end-project radially and outwardly beyond their respective mounting teeth and the alloy material blocks on the body peripheral surface are seated and weld-affixed on the outer ends of said teeth in conforming engagement and buttressing relation with the projections of said first blocks.

8. The organization according to claim 3, wherein the alloy material blocks affixed to the bit teeth similarly end-project radially and outwardly beyond their respective mounting teeth and the alloy material blocks on the body peripheral surface are seated and weld-affixed on the outer ends of said teeth in conforming engagement and buttressing relation with the projections of said first blocks and in correspondingly-skewed relation with the bit axis of rotation for auger-like retraction of cuttings away from the bore face as the bit is rotated.

9. The organization according to claim 3, wherein the alloy material blocks affixed to the bit teeth similarly end-project radially and outwardly beyond their respective mounting teeth, the alloy material blocks on the body peripheral surface are longitudinally tapered from a thicker and to a thinner end, and said latter blocks are seated and weld-affixed on the outer ends of said teeth in conforming engagement and buttressing relation of their thicker ends with the projections of said first blocks.

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