

Aug. 1, 1939.

P. H. NAST

2,168,102

DRILL BIT

Filed Nov. 30, 1938

2 Sheets-Sheet 1

Fig. 1.

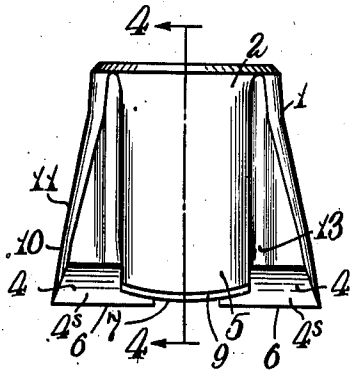


Fig. 2.

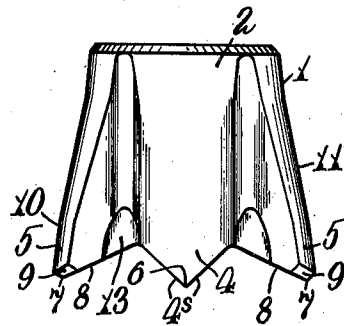
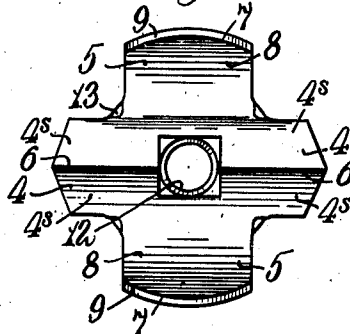


Fig. 3.



Aug. 1, 1939.

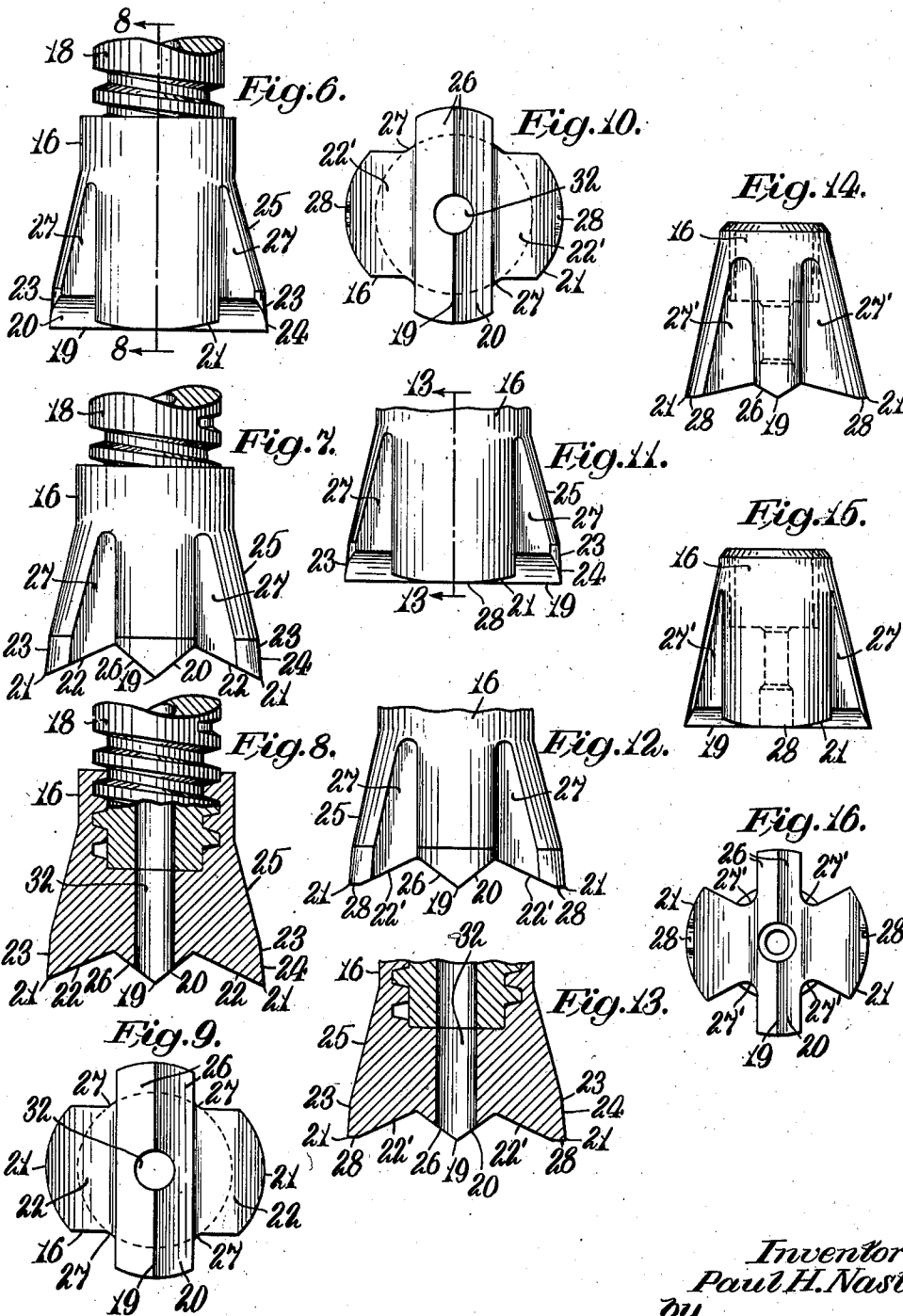
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DRILL BIT

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,168,102

DRILL BIT

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Application November 30, 1938, Serial No. 243,215

20 Claims. (Cl. 255—64)

This invention relates to drill bits, and more particularly to improvements in rock drill bits of the detachable, impact type.

Detachable rock drill bits of the impact type are rapidly coming into wider and wider use because of certain advantages over ordinary drill bits of the integral-shank type. They are much more readily portable. Less money is tied up in drill steel. They are relatively inexpensive, making it possible for them to be discarded after becoming worn, or, more often, after they have been resharpened a few times by grinding. When suitably designed, they require no very expensive resharpening equipment and can be resharpened by grinding, without reforing operations.

In such bits, it is therefore highly desirable to shape the cutting surfaces so that the bit can be resharpened by grinding on a conventional grinding wheel, thereby minimizing the expense of resharpening equipment.

It is also desirable to provide cutting edges of such shape and so arranged that the bit may not only have relatively great strength and inherent wearing qualities, but also operate very efficiently, whereby a hole may be drilled with relatively great speed and to a relatively great depth, before the bit becomes dull.

One difficulty in drill bits of the shapes more commonly used is that with them there is a rapid loss of gauge, and a consequent need, particularly when the gauge is lost very rapidly, of starting a hole much larger than the desired diameter of the bottomed hole. Furthermore, in many drill bits the working end of the bit is so formed that certain points or projections are either not sufficiently protected from carrying an excessive part of the work of drilling, and so dull rapidly, or portions may be so formed that fracture occurs.

An object of the invention is to provide an improved rock drill bit of the impact type having an improved working face formed with edges so shaped and arranged as to overcome the difficulties encountered by ordinary drill bits. It is another object of my invention to provide an improved drill bit, and particularly to provide an improved drill bit which by reason of ease of resharpening and unusual durability will be especially adapted to detachable drill bit constructions. Yet another object is to provide an improved drill bit having improved edges of such shape and so arranged as to increase the cutting efficiency thereof to a marked degree. Still another object is to provide, in a drill bit of the above character, improved working surfaces and edges so that rapid wear and breakage of the bit

due to fracture of sharp points or projections either at the extremities of the edges or at the bit periphery, are substantially reduced. Another object is to provide a drill bit whose resharpening may be wholly and readily performed by grinding operations and which will require a minimum number of different types of grinding operations and a minimum amount of handling during the grinding operations. It is another object of my invention to provide a drill bit which can be sharpened with great ease with the use of a single grinding wheel and, in certain embodiments wholly, and in others mainly, though not wholly, by relative movement between said bit and the grinding wheel in a direction only tangential to the circle of rotation of the periphery of the grinding wheel. A still further object is to provide an improved drill bit having chopping edges of rugged construction and of arcuate extent adapted to the work they are called upon to perform, and providing adequate clearance space for the discharge of cuttings produced, and having cutting edges also proportioned to the amount of work they are called upon to perform, in a very advantageous manner. Another object of the invention is to provide an improved drill bit having cutting and chopping edges so related to each other with respect to planes perpendicular to the bit axis as to insure most effective cooperation and maximum durability and rapidity of drilling. Still another object is to provide an improved drill bit which, while cutting away the material to be drilled very effectually across the inner portion of the hole, may at the same time chop away the material at or near the outer edge or periphery of the hole and prevent thereby rapid loss of gauge of the bit and decrease in cross sectional area of the hole, and, due to less rapid rounding off of the end of each cutting edge or portion of the bit, postpone for a relatively long time the tendency towards sticking of the bit in the drill hole. These and other objects and advantages of the invention will, however, hereinafter more fully appear in the course of the following description and as more particularly pointed out in the appended claims.

In the accompanying drawings there are shown, for purposes of illustration a preferred embodiment and several modifications which the invention may assume in practice.

In these drawings,

Fig. 1 is a view, in side elevation, of a detachable drill bit incorporating, in a preferred embodiment, my invention.

Fig. 2 is a view of the same bit in side elevation, looking at right angles to the view of Fig. 1.

Fig. 3 is a front end view of the bit shown in Figs. 1 and 2.

Fig. 4 is a longitudinal section taken substantially on line 4—4 of Fig. 1.

Fig. 5 is an enlarged perspective view of the improved drill bit.

Fig. 6 is a side view of a drill bit showing another embodiment of the invention.

Fig. 7 is a similar view taken at right angles to Fig. 6.

Fig. 8 is a section on the line 8—8 of Fig. 6.

Fig. 9 is an end view of the bit shown in Fig. 6.

Fig. 10 is an end view of a slightly different embodiment.

Fig. 11 is a side view of the end of the bit shown in Fig. 10.

Fig. 12 is a view similar to Fig. 11, but taken at right angles.

Fig. 13 is an axial section taken on the plane corresponding to the line 13—13 of Fig. 11.

Fig. 14 is a side elevational view of a further illustrative embodiment.

Fig. 15 is a second side elevational view of the modification of Fig. 14 with the bit in a different position—turned 90° on its axis.

Fig. 16 is a front end view of the bit of Figs. 14 and 15.

It will be observed, as the description of the several modifications of the invention proceeds, that the invention includes a number of features in combination; and that variations of a substantial nature are possible within the scope of the invention from its various aspects as hereinafter defined in the appended claims.

In Figs. 1 to 5 of the drawings, which illustrate the preferred embodiment, a detachable drill bit 1 of the impact type is shown, having incorporated therein improved cutting and chopping edges arranged in an improved manner. The drill bit 1 has a socketed body 2 internally threaded at 3 and adapted for attachment to the threaded end of a conventional drill rod or steel body. The drill bit, in this embodiment of the invention, is provided with pairs of relatively narrow wings 4, 4 and relatively wider wings 5, 5 arranged in right-angular relation with respect to each other, the pair of narrow wings 4, 4 having wedge-shaped forward ends bounded by relatively inclined cutting surfaces 4s, 4s converging at the forward face of the bit and intersecting in aligned cutting edges 6, 6 lying in a diametric line. The pair of wider wings 5, 5 are formed with a pair of diametrically oppositely disposed arcuate chopping edges 7, 7 lying at the intersection of outwardly and forwardly inclined surfaces 8, 8 and an outer narrow curved receding surface 9 terminating at the bit periphery. The surfaces 8, 8 may desirably be plane and parallel to the cutting edges. Further, the surfaces 4s are desirably disposed in the sides of a dihedral angle whose edge coincides with the line of the aligned cutting edges. Thus, the surfaces 8 terminate at their inner ends in lines parallel with the cutting edges 6, 6, and these same lines demark the rearward edges of the relatively inclined surfaces which terminate and intersect in the cutting edges 6, 6.

The outer surfaces of the wings are desirably formed as portions of surfaces of revolution whose axis coincides with the bit axis. A double taper may advantageously be used to provide strength for the working end of the bit and yet allow abundant clearance rearwardly. In the

drawings, the peripheries of the wings are shown as bounded by a forward, nearly-but-not-quite-cylindrical surface 10 (it is really frusto-conical) and a more sharply frusto-conical surface 11. The outer narrow surfaces 9, 9, outside the chopping edges 7, are preferably formed by grinding or turning off a portion of the chopping edges adjacent the bit periphery, and the chopping edges, as shown in Fig. 3, lie adjacent to, but slightly inside of, the bit periphery. The angle may be varied substantially, but good results are obtained when the angles at 14 are not far from right angles. The chopping edges are generally arcuate both in end and in side elevation, and preferably positioned to work in substantially the same transverse zone with the aligned cutting edges 6, 6. The chopping edges may be thought of, without substantial inaccuracy, as in a surface of revolution of slightly smaller diameter than that which contains the bit periphery. There is, in this embodiment of the invention, a very slight forward projection of the cutting edges with respect to the arcuate chopping edges, as clearly shown in Fig. 1. It will also be observed that the chopping edges are set in from the outer periphery of the wings which carry them but relatively slightly. The forward projection of the cutting edges is much less than the normal penetration of these edges, so that even originally the outer ends of the cutting edges operate in an annular clearance cut by the chopping edges; and as the edges tend to dull the chopping edges will continue to carry a substantial share of the actual bottom cutting work. It will be noted that the projection of the cutting edges in advance of the chopping edges is relatively slight in this embodiment, and is not present at all in others which will be hereinafter described. An important advantage of the outer narrow wedging surfaces 9, 9 resides in the fact that in certain types of rock it will be found to be possible, because of this structure, to drill very deep holes without changing the gauge of the bits used. This is obviously a great advantage, due to the fact that it will be possible, say, to drill a sixteen-foot hole with ordinary bits and with eight-inch bit gauge changes for each two feet, only if the hole is started with a three-inch bit; while if it is possible to start and finish with a two-inch bit, and use only two-inch bits in the interval, a much smaller amount of stone must be cut away. The reason why the starting of the hole greatly oversize is not necessary in all rocks with the present improved bit is that the bit tends to cut an oversize hole. The wedge-shaped chopping edges break the stone outwardly, as well as inwardly, and so there is formed a hole of slightly larger diameter than the bit; and, starting with a two-inch bit, a hole will be formed say 2-inches-plus in diameter, and at the end of two feet, say, (it should be understood that a change at 2 feet is not to be presumed to be necessary, as loss of gauge is retarded with the present bits) of hole, a new two-inch bit may be started at the bottom of the hole without binding. The bit is formed with an axial opening 12 located midway between the cutting edges for conducting cleansing fluid to the cutting face of the bit to wash away the cuttings from the cutting edges at the bottom of the hole; and the spaces between the pairs of wide and narrow wings are cut away at 13, as by grinding, so that there is added clearance for the discharge of cuttings rearwardly along the bit body.

The grinding away of the chopping portions of

the bit so that the arcuate chopping edges lie slightly inside of the bit periphery, makes it possible to avoid all danger of fracturing off of the chopping edges or of portions thereof, and yet these edges lie near enough to the annular zone of the extreme ends of the cutting edges to protect the latter from excessive work. The outwardly and forwardly inclined surfaces 8 of the chopping edges are shown in the present embodiment of the invention as plane surfaces.

It will be observed that there is shown in Figs. 1 to 5 inclusive, an embodiment of the invention which provides a cutting action of unusual effectiveness and which is enabled to perform its function better and to stand up longer, due to the chopping edges preventing wearing away of the ends of the cutting edges, and in which the angles are determined to avoid loss of energy in useless impact of the bit at the bottom of the hole. The surfaces in which the various edges lie can be originally shaped, and resharpened, with great ease with a suitably shaped grinding wheel and with a minimum of handling during the grinding operation and with a minimum of loss of gauge in resharpening. By arranging the relatively inclined wedge-shaped surfaces terminating in the cutting edges 6, 6 and the inclined surfaces 8, 8 terminating in the arcuate chopping edges, in the manner disclosed, it is possible to sharpen the cutting edges by two grinding operations simply by passing the bit straight across the wheel face at each side of the bit in a direction substantially parallel to the aligned cutting edges 6, 6, and the chopping edges may be formed again by simply grinding back the extremities of the wings 5, 5. The chopping edges 7, 7 aid in maintaining the full diameter of the hole by chopping away the material to be drilled annularly adjacent the periphery of the hole. Accordingly, greater penetration by the edges 6, 6 will be possible, and the ends of these edges will be protected; and the chopping edges not only will perform their function of maintaining the diameter of the hole, but also will tend to break away the material in a substantial annular zone extending inwardly from the periphery of the hole, thereby protecting the ends of the cutting edges as above indicated, and also provide the external fracturing effect hereinabove mentioned so effective in maintaining gauge in deep holes. The substantial surfaces at the periphery of the bit and at the cutting face thereof will very effectually prevent any tendency to rife and will maintain the bit at all times central of the hole being drilled.

From the foregoing description, it will be obvious that there is provided, by this embodiment of the invention, a highly efficient, rugged, rapidly cutting and readily resharpened drill bit, possessing relatively great advantages over drill bits of the ordinary type, and also possessing the advantages of maintenance of full diameter of the drill hole, and maximum delivered energy per unit of cutting-edge length. It will further be noted that by forming the arcuate chopping edges slightly inside the bit periphery, fracture and rapid dulling of the bit due to breakage of sharp points or projections at the extremities of the chopping edges at the bit periphery are substantially eliminated. Bits constructed in accordance with the invention have been shown by actual test under severe drilling conditions, to be very effective and under many conditions to far outperform ordinary bits, such as conventional cross bits, which have heretofore been recognized as among the most efficient drilling forms; to be

more durable than ordinary bits; and to have much greater capacity for drilling before resharpening than ordinary bits, when drilling in granite, for example. It will be obvious that bits of this character may be made inexpensively, and be resharpened easily and inexpensively.

As variations in the form and relative location of the reaming or chopping edges, and in their length relative to the lengths of the cutting edges, are among (though these are not to be understood to be the only) variations within the broad scope of my invention, I shall now describe certain other illustrative embodiments.

Referring next to the species of the invention shown in Figs. 6 to 9, it will be noted that I have illustrated there an embodiment of my invention as incorporated in a detachable drill bit 16 suitably secured, as by threads, to the lower end of a drill steel shank 18. The drill bit is provided with a diametric cutting edge 19 at the edge of a transversely-extending wedge-shaped cutting portion 20. At opposite sides of the cutting edge 19 are chopping edges 21, 21, these extending at their foremost portions, in this embodiment of the invention, into the same plane at right angles to the axis of the drill bit as includes the cutting edge 19. In this form of the invention, moreover, the chopping edges 21 are provided along the intersections of inclined surfaces 22, 22 with the periphery 23, 23 of the slightly tapered, relatively conical, forward portion 24 of the drill bit. As is common, the drill bit is shown as provided with a rearward portion 25 having a more pronounced taper. It is obviously unnecessary to employ the double taper to obtain many of the advantages of my invention. The inclined planes or surfaces 22 are shown somewhat flatter, that is to say, they make a somewhat more acute dihedral angle with a plane at right angles to the axis of the bit, than the surfaces 26 of the wedge-shaped portion supporting the cutting edge 19, this being desirable for the purpose of providing adequate support for the chopping edges, though not essential. The periphery of the bit is relieved at four points as, at 27, by grooves formed between adjacent wings, to permit the easy passage of cuttings and cleansing fluid from the bottom of the hole. The forward end of this bit will be noted, to summarize, to include one diametric cutting edge broken by the cleansing fluid discharge opening 32, and a pair of chopping edges at opposite sides of the cutting edge, the chopping edges each being in the form of a portion of a conic section and each being tangent to a line parallel to the cutting edge and lying in the same plane perpendicular to the bit axis, with the cutting edge. Obviously the chopping edges are, in this embodiment, curved both as viewed from the side and from the front of the bit. The forward face of the bit includes the forwardly projecting portion supporting the cutting edge in the form of a dihedral angle whose edge coincides with the cutting edge and a pair of preferably but not necessarily somewhat flatter plane surfaces extending from the rearmost portions of the sides of the cutting edge supporting portion out to the chopping edges.

The form of construction shown in the slightly modified bit of Figs. 10, 11, 12 and 13 differs from that of the species of Figs. 6 to 9 only in that the plane surfaces 22' 22', which corresponds generally to the plane surfaces 22, 22 of Figs. 7 to 9, would intersect at their outer edges the cone with whose surface the forward end of the drill coin-

cides, along lines whose farthest forward point would lie in advance of the transverse plane at right angles to the axis of the bit which includes the cutting edge 19. Therefore, since it is not desired to have the chopping edge extend in advance of the cutting edge, a small segment 28 in the same transverse plane with the cutting edge 19 is provided at the forward end or edge of the chopping portions. This merely amounts in effect to providing an initial small blunting which because it is done in advance results in the chopping edges lying further forwardly than they would lie were the blunting to occur through wear to a corresponding degree of dullness of the chopping edges in the species of Figs. 6 to 9.

Each of the forms of my invention may be provided with cleansing fluid passages if desired, and I have shown such at 32 in each of the last two species described. The two forms of the invention shown in Figs. 6 to 9 and in Figs. 10 to 13 inclusive, respectively, can be originally sharpened and re-sharpened with great ease with a suitably shaped grinding wheel, and with a minimum loss of gauge in resharpening. Of course, these forms are also very readily formable and resharpenable by purely forging operations. Hot milling or other machining processes are also applicable.

With reference to the embodiment of the invention shown in Figs. 14, 15 and 16, it will be observed that the essential difference between this construction and that shown in Figs. 10 to 13 resides in the fact that the cutting-edge supporting wings are relatively still narrower and that the angular recesses 27' are made of greater cross-sectional area by reason of the fact that the chopping edge supporting wings do not have parallel sides, but instead are ground back from their outer ends nearly radially instead of lying along parallel chords spaced substantially at opposite sides of the axis of the drill bit.

It will be noted that the cutting edges (the radial or diametrically extending edges) in each of the illustrative embodiments of my invention are shown as spaced by the provision made for cleansing fluid delivery. Obviously, these edges may be regarded, depending upon the point of view adopted, as either aligned spaced radial edges, or as a single diametric edge having, in the constructions shown, its center removed.

Since the advantages of my invention have been clearly pointed out in connection with the description of the several species disclosed for purposes of illustration, it is unnecessary to repeat them here.

This application is being filed to take the place of and so that it may be copending with my earlier filed applications Serial No. 117,175, filed Dec. 22, 1936, for Drill bits; Serial No. 25,246, filed June 6, 1935, for Drill bits; and Serial No. 744,298, filed Sept. 17, 1934, for Drill bit.

While I have in this application specifically described several forms which my invention may assume in practice, it will be understood that these forms of the same are shown for purposes of illustration, and that the invention may be further modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body formed with integral pairs of wings arranged in right-

angular relation to each other at the forward cutting end of the bit, one of said pairs of wings supporting a pair of aligned cutting edges extending along a diametric line and the other pair of said wings each supporting a curved chopping edge lying slightly inside the bit periphery and having an outer curved supporting surface receding rearwardly outwardly and terminating at the bit periphery, said chopping edges generally arcuate both in end and in side elevation, the forward end of the bit, between said aligned cutting edges and each of said arcuate chopping edges, bounded mainly by a pair of plane surfaces disposed in the sides of a dihedral angle whose edge is parallel to the aligned cutting edges.

2. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body formed with integral pairs of wings arranged in right-angular relation to each other at the forward cutting end of the bit, one of said pairs of wings supporting a pair of aligned cutting edges extending along a diametric line and the other pair of said wings each supporting a curved chopping edge lying slightly inside the bit periphery and having an outer curved supporting surface receding rearwardly outwardly and terminating at the bit periphery, said chopping edges generally arcuate both in end and in side elevation, the forward end of the bit, between said aligned cutting edges and each of said arcuate chopping edges, bounded mainly by a pair of plane surfaces disposed in the sides of a dihedral angle whose edge is parallel to the aligned cutting edges, and said aligned cutting edges projecting at the forward face of the bit in advance of said chopping edges a distance materially less than the normal penetration of said cutting edges.

3. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body having at its cutting end pairs of wings arranged in right-angular relation to each other, the wings of one of said pairs being materially wider than the wings of the other of said pairs, the narrower pair of wings supporting aligned cutting edges extending along a diametric line and the wider pair of wings each supporting adjacent the periphery of the bit a chopping edge curved both when viewed from the front and from the side of the bit, said chopping edges lying slightly inside of the bit periphery and having an outer curved supporting surface receding rearwardly outwardly and terminating at the bit periphery, the forward ends of said narrower wings essentially wedge-shaped, and the forward surfaces of each of said wider wings inside said chopping edges disposed substantially wholly in planes lying in single sides of a dihedral angle whose edge is parallel to and to the rear of said cutting-edge portions.

4. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body having integral wings and a front cutting face whose forward-end peripheral portions lie in a surface of revolution whose axis coincides with the axis of the bit, said bit having aligned cutting edges extending along a diametric line, said bit further having chopping edges at opposite sides of said aligned cutting edges spaced inwardly from the intersection with such surface of revolution of planes making with each other an obtuse dihedral angle whose edge is parallel to said aligned cutting edges, said aligned cutting edges wholly

supported by certain of the wings of said bit, and said chopping edges wholly supported by the remaining wings and at the outermost edges of planes disposed as aforesaid, but lying substantially in the wall of a surface of revolution of smaller diameter than the one bounding the wings.

5. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body having at its forward end a pair of mutually opposite relatively wide wings and a second pair of mutually opposite relatively narrow wings, the latter at right angles to the former, said narrow wings wedge-shaped at their forward ends to provide aligned cutting edges extending diametrically of the bit and said wider wings having forward plane surfaces sloping forwardly and outwardly from the junction of said wide wings with the body of the bit, said wide wings at their outer extremities terminating in chopping portions having curved cutting edges each of a length arcuately substantially equal to one-half the effective cutting-edge length, said arcuate chopping edges lying slightly inside the bit periphery and having supporting them curved outer outwardly receding surfaces terminating at the bit periphery.

6. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body having at its forward cutting end integral pairs of wings arranged in right-angular relation to each other, one of said pairs of wings supporting aligned cutting edges extending along a diametric line and the other pair of said wings each supporting adjacent the periphery of the bit a chopping edge generally arcuate both in end and in side elevation and positioned to work substantially in the same transverse zone with said aligned cutting edges, the forward end of the bit, between said aligned cutting edges and each of said chopping edges, bounded mainly by a pair of planes disposed in the sides of a dihedral angle whose edge is parallel to the aligned cutting edges and spaced from a plane which includes said cutting edges and the axis of the bit a distance equal approximately to one-half the thickness of the wings supporting said cutting edges, said arcuate chopping edges lying slightly inside the bit periphery and having outer supporting curved receding surfaces terminating at the bit periphery.

7. In a drill bit of the type which is percussively actuated and intermittently rotated during its percussive actuation, a bit body having at its forward cutting end integral pairs of wings arranged in right-angular relation to each other with the wings of each pair diametrically arranged, the wings of one of said pairs each supporting a straight radially extending cutting edge, said edges lying in a common straight line perpendicular to the bit axis and in a plane which bisects the bit, and the wings of the other pair each supporting a single chopping edge whose projection on a plane perpendicular to the bit axis conforms substantially to the arc of a circle lying slightly inside the bit periphery, said bit having provision for the delivery of cleansing fluid therethrough between said aligned cutting edges, and the forward end of said bit, between said chopping edges, being bounded, save for the portion thereof formed for cleansing fluid delivery, by two pairs of planes, the planes of each pair intersecting in a line parallel to the cutting edges, said lines of intersection parallel to each other in a plane perpendicular to the bit axis and

substantially in the sides of the wings which carry the cutting edges, and one plane of one pair intersecting with one plane of the other pair in a line including said cutting edges, and said chopping edges having outer curved receding surfaces terminating at the bit periphery.

8. A drill bit of the type which is percussively actuated and intermittently rotated during drilling, having at its forward end rectangularly-related pairs of aligned wings whose extremities lie in a common surface of revolution, the wings of one of said pairs supporting aligned cutting edges whose outer extremities extend to said surface of revolution, and the wings of the other, adjacent their outer ends, supporting chopping edges which lie substantially in a surface of revolution lying inside said first mentioned surface of revolution.

9. A drill bit of the type which is percussively actuated and intermittently rotated during drilling, having a pair of oppositely radially extending wings supporting at the forward ends of V-shaped edge-supporting portions cutting edges which lie in a plane bisecting the bit, said wings of a width only sufficient to support said cutting edges, and said cutting edges extending to the outermost ends of said wings, said bit having another pair of oppositely extending wings arranged at right angles to the wings of said first pair and supporting at their most forward portions but slightly inside their radially outermost portions chopping edges extending circumferentially of the bit, said latter wings materially wider than said cutting edge supporting wings whereby increased arcuate extent of said chopping edges is provided, the forward surface of said chopping edge supporting wings sloping inwardly and rearwardly toward the sides of the first mentioned wings, said chopping edges arranged and adapted to cut away the material in an annulus at the periphery of the hole and said cutting edges projecting forwardly, throughout their length, beyond the foremost portions of said chopping edges and also projecting, radially of the bit, beyond the circle struck from a point in the bit axis and including the foremost points in said chopping edges.

10. A drill bit of the type which is percussively actuated and intermittently rotated during drilling, having a pair of oppositely radially extending wings supporting at the forward ends of V-shaped edge-supporting portions cutting edges which lie in a plane bisecting the bit, said wings of a width only sufficient to support said cutting edges, and said cutting edges extending to the outermost ends of said wings but separated at their adjacent ends by a substantial space, said bit having a cleansing fluid discharge passage formed within and opening through said space, said bit having another pair of oppositely extending wings arranged at right angles to the wings of said first pair and supporting at their most forward portions but slightly inside their radially outermost portions chopping edges extending circumferentially of the bit, said latter wings materially wider than said cutting edge supporting wings and than said space separating the cutting edges and having to the inside of said chopping edges forward surfaces which slope inwardly and rearwardly towards the sides of the first mentioned wings whereby respectively increased arcuate extent of said chopping edges is provided and radially inward pressures directed toward the center of said hole are provided, said chopping edges adapted to cut away the material in an annulus at the periphery of the hole.

and said cutting edges projecting forwardly, throughout their full lengths, at least as far as the foremost points in said chopping edges, and extending radially of the bit at their outer ends, further than the distance from the bit axis to the radially outermost points in either of said chopping edges.

11. A drill bit of the type which is percussively actuated and intermittently rotated during drilling having a plurality of radially extending cutting edges formed at the intersections of forwardly converging splitting surfaces, and having adjacent its periphery, in the arcs between the outer extremities of said cutting edges, curved chopping edges which lie both at the outer ends of plane surfaces extending forwardly and outwardly towards the periphery of the bit and in the planes of such surfaces, and which also lie at the foremost edges of and constitute the foremost boundary of beveled surfaces extending from the bit periphery inwardly and forwardly to said chopping edges.

12. A rock drill bit having at its cutting end integral pairs of wings arranged in right-angular relation to each other, one of said pairs of wings supporting a single diametrically extending cutting edge and the other pair of said wings each supporting adjacent the periphery of the bit a chopping edge generally arcuate both in end and in side elevation, the forward end of said bit, between said diametric edge and each of said chopping edges, bounded mainly by a pair of planes disposed in the sides of a dihedral angle whose edge is parallel to the cutting edge.

13. A rock drill bit having at its cutting end pairs of wings arranged in right-angular relation to each other, the wings of one of said pairs being materially wider than the wings of the other of said pairs, the narrower pair of wings each supporting a diametrically extending cutting edge portion extending to the periphery of the bit, and the wider pair of wings each supporting adjacent the periphery of the bit a chopping edge generally arcuate both in end and in side elevation, the forward end of said narrower wings essentially wedge-shaped and the forward surfaces of said wider wings inside said chopping edges substantially wholly in planes lying in single sides of a dihedral angle whose edge is parallel to and to the rear of said cutting-edge portions.

14. A rock drill bit having at its cutting end integral pairs of wings arranged in right angular relation to each other with the wings of each pair diametrically arranged, the wings of one of said pairs each supporting a straight, radially extending cutting edge, said edges lying in a common straight line perpendicular to the bit axis, and the wings of the other pair each supporting a single chopping edge whose projection on a plane perpendicular to the bit axis conforms substantially to the arc of a circle struck from a center in said bit axis, said chopping edges each curved in side elevation and having their extremities substantially further towards the rear of the bit than their central points, said bit having provision for the delivery of cleansing fluid therethrough between said aligned cutting edges, and the forward end of said bit, between said chopping edges, being bounded save for the portion thereof formed for cleansing fluid delivery, by two pairs of planes, the planes of each pair intersecting in a line parallel to the cutting edges, said lines of intersection parallel to each other, in a plane perpendicular to the bit axis, and substantially in the sides of the wings which carry the cutting edges, and one

plane of one pair intersecting with one plane of the other pair in a line including said cutting edges.

15. A rock drill bit having at its forward end a body having thereon a pair of mutually opposite, relatively wide wings and a second pair of mutually opposite, relatively narrow wings, the latter at right angles to the former, said narrow wings wedge-shaped at their forward ends to provide a cutting edge extending diametrically of said bit and said wider wings having forward plane surfaces sloping forwardly and outwardly from the junction of said wide wings with the body of the bit, said wide wings at their outer extremities terminating in chopping portions each of a length arcuately equal to at least one-half the effective cutting-edge length.

16. A rock drill bit having at its cutting and integral pairs of wings arranged in right-angular relation to each other, one of said pairs of wings supporting a single diametrically extending cutting edge and the other pair of said wings each supporting adjacent the periphery of the bit a chopping edge generally arcuate both in end and in side elevation and positioned to work substantially in the same transverse zone with said cutting edge, the forward end of said bit, between said diametric edge and each of said chopping edges, bounded mainly by a pair of planes disposed in the sides of a dihedral angle whose edge is parallel to the cutting edge and spaced from a plane which includes said cutting edge and the axis of the bit a distance equal approximately to one-half the thickness of the wings supporting said cutting edge.

17. A rock drill bit having at its cutting end integral pairs of wings arranged in right-angular relation to each other with the wings of each pair diametrically arranged, the wings of one of said pairs each supporting a straight, radially extending cutting edge, said edges lying in a common straight line perpendicular to the bit axis and in a plane which bisects the bit, and the wings of the other pair each supporting a single chopping edge whose projection on a plane perpendicular to the bit axis conforms substantially to the arc of a circle struck from a center in said bit axis, said bit having provision for the delivery of cleansing fluid therethrough between said aligned cutting edges, and the forward end of said bit, between said chopping edges, being bounded save for the portion thereof formed for cleansing fluid delivery, by two pairs of planes, the planes of each pair intersecting in a line parallel to the cutting edges, said lines of intersection parallel to each other, in a plane perpendicular to the bit axis, and substantially in the sides of the wings which carry the cutting edges, and one plane of one pair intersecting with one plane of the other pair in a line including said cutting edges.

18. In a drill bit, a body rotatable upon its axis during percussive actuation and having a substantially circular rearward portion and a forward portion of cruciform shape whereby four wings arranged in pairs at right angles to each other are provided, the wings of one of said pairs being relatively wide and the wings of the other of said pairs being relatively narrow, said wider wings having at their outermost extremities chopping edges each arcuate in end elevation and having in side elevation its median portion in advance of its end portions, and said narrow wings providing support for and having thereon at least one cutting edge extending in the same general direction as said chopping edges, the median

portion of each of said chopping edges and said cutting edges in their entirety being substantially co-planar perpendicular to the bit axis, whereby said chopping edges protect from excessive abrasion the cutting edge extremities by maintaining the full gauge of the hole at a transverse zone forwardly of the rearmost limit of penetration at said cutting edge, said body having pairs of planes at its forward end forming dihedral angles and terminating respectively at their foremost portions in cutting and chopping edges.

19. A rock drill bit comprising: a shank rotatable upon its axis during percussive actuation and terminating in a plurality of edges, said edges including radial cutting edges and substantially peripheral arcuate chopping edges in alternation, each in a different quadrant from each of the others, said cutting edges in their entirety and the most forward portions of said chopping edges being substantially co-planar perpendicular to the bit axis, and the lateral extremities of said chopping edges being disposed axially of said bit nearer to the shank of the latter than the most forward portions of said chopping edges.

20. A rock drill bit comprising: a shank rotatable upon its axis during percussive actuation and terminating in four edges, said edges including in alternation radial cutting edges perpendicular to the bit axis and substantially peripheral arcuate chopping edges straight from end to end neither as viewed from the end nor as viewed from the side of the bit, each of said edges in a different quadrant from each of the others, said cutting edges in their entirety and the most forward portions of said chopping edges being substantially co-planar perpendicular to the bit axis, and the lateral extremities of said chopping edges being disposed rearwardly of the most forward portion thereof, the rock-engaging face of said bit primarily bounded by planes forming three dihedral angles of which the edge of the central one includes said cutting edges and of which the edges of the others are parallel to said cutting edges, said bit further having a cleansing fluid discharge separating said cutting edges, and the extremities of each chopping edge being separated by a distance greater than the length of said cutting edges.

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