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J. V. EMMONS

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DRILL

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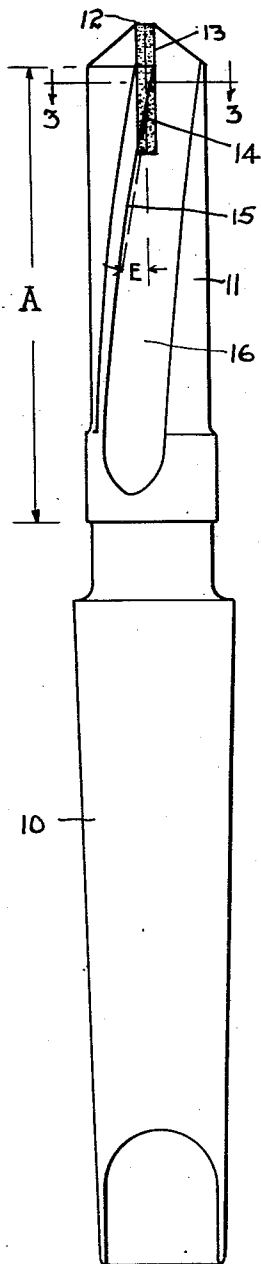


Fig. 1

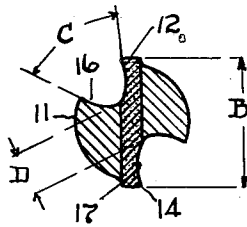
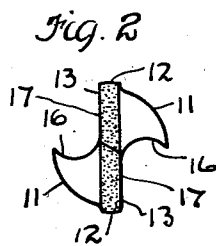


Fig. 3

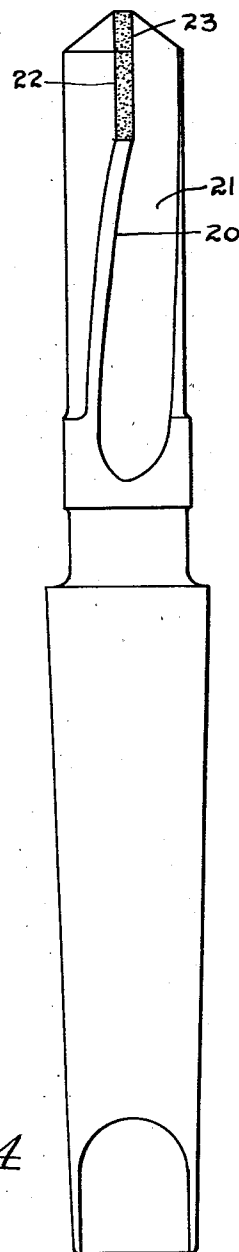


Fig. 4

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## UNITED STATES PATENT OFFICE

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## DRILL

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The present invention, relating, as indicated, to drills, has more particular reference to drills of the type which are provided with a cutter consisting of a hard metal alloy or the like, and its primary object, broadly stated, is to improve the construction of such drills to the end of better adapting them to the characteristics of the material of which their cutters are composed.

It is well recognized that the extreme hardness of the so-called "hard metal alloys" should well adapt them to being used as the cutting members of tools of the general class referred to, but it must also be recognized that in tools which have employed such materials for the indicated purpose, the expected advantages have not always been fully obtained. I have investigated this apparent failure of such tools to realize the expected improvements in cutting efficiency and have found that the present constructions are objectionable in two respects; in the first place, such constructions do not provide sufficient strength to enable a complete utilization of the potentially very large cutting abilities of the material of their working parts, and in the second place, in such constructions there is a tendency for the working parts to chip and crumble. These features of present tools which employ cutting members made of the hard metal alloys are, I believe, due on the one hand to the fact that the actual hardness and cutting ability of such materials has not been fully appreciated, and on the other hand to the fact that their sometimes inadequate toughness and strength have not been taken into account. In other words, it has been discovered that these attempted uses of the hard metal alloys have failed to afford the expected increased efficiency for the reason that they did not provide the means of completely utilizing their desirable and advantageous hardness, and for the further reason that they did not provide the means of compensating for their undesirable and disadvantageous brittleness and lack of toughness and strength.

My invention, with a view to correcting the above-mentioned and objectionable features of present drill constructions, con-

templates certain improvements whereby strength sufficient to enable a more complete utilization of the cutting abilities of the hard metal alloys will be afforded, and whereby the sometimes inadequate strength and lack of toughness or even brittleness of such materials will be effectively compensated for. In obtaining the first of these improvements, the usual practice is departed from in that a shorter operating portion with narrower flutes and a thicker web is provided, and in obtaining the second of such improvements, a reduction in the magnitude of the helix angles of the active surfaces of such flutes is contemplated. In the case of large drills with a diameter of about two inches, the length of the flutes will be, say, four or fewer times the diameter of the operating portion, and in the case of small drills when a diameter of about one-eighth of an inch, the length of such flutes will be, say, eight or fewer times the diameter of the operating portion. Similarly, the width of the flutes will be less than, say, eighty degrees of the circumference of the operating portion, and the thickness of the web between such flutes will be greater than, say, twenty per cent. of the diameter of the operating portion. Correspondingly, and for the purpose of compensating for the deficient properties of the hard metal alloy cutting members, it is intended that ordinarily the helix angles of the active surfaces of the flutes formed in the operating portion shall be between, say, minus ten degrees and plus twenty-two degrees and of substantially uniform magnitude at all points longitudinally, but in cases, it is contemplated that even in the same tool such angles shall vary if a variation is necessary to afford the desired compensation and to, at the same time, provide an adequate hole-clearing capacity for the sections of the flutes to the rear of those sections contiguous to the cutting end.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims. The annexed drawing and the following description set forth in detail certain structure embodying the invention, such disclosed

means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:—

5 Figs. 1, 2 and 3 are side, end elevational and transverse sectional views of a twist drill which embodies the present improvements; and Fig. 4 is a side elevational view of a modification of the drill shown in the preceding figures.

10 The drill illustrated in Figs. 1, 2 and 3, consists of a shank 10, an operating portion 11, and an inserted or attached cutter 12. The shank 10 and the operating portion 11 may be constituted of any suitable material, 15 of tool steel, for example; and the cutter 12 may be constituted of one or another of the so-called hard metal alloys, compounds or compositions, of one consisting of a cemented carbide of tungsten or molybdenum, 20 for example. Such cutter is secured (as by welding or brazing) within a slot formed in the end of the operating portion 11, and its edges 13 and 14 are preferably arranged for effecting most of the cutting, the edges 15 25 of such operating portion functioning either as guides or as supplementary cutters or scrapers.

In accordance with this invention: in large 30 sized drills having a diameter of, say, two inches, it is contemplated that the length of the flutes 16 in the operating portion 11, that is to say the distance A, shall be something like four or fewer times the magnitude of 35 the diameter B; and in drills of the smaller sizes, of say, one-eighth of an inch in diameter, it is contemplated that the distance A shall be, say, eight or fewer times the magnitude of the diameter B. Similarly, my in- 40 vention contemplates that the width of the flutes 16, when measured on the circumference, that is to say the magnitude C, shall be less than, say, eighty degrees, and with the same object in view, it is contemplated 45 that the magnitude D, that is to say the thickness of the web, shall be more than, say, twenty per cent. of the diameter B. If desired, however, such web thickness may be reduced in the usual manner at the end in order 50 to facilitate feeding when the tool is in use.

The above-discussed dimensional characteristics, or the thickness of the web, width of the flutes, and length of the flutes, are made desirable by the potentially large cutting 55 capabilities of the materials of which the insert 12 is composed, but in constructing a drill to fully utilize these capabilities, it must be recognized that some of such materials while advantageously hard are nevertheless 60 lacking in toughness and strength. Therefore, and with the object of compensating for these deficiencies, my invention intends that the helix angles of the active surfaces 17 of the flutes 16, which surfaces are continued on the 65 insert 12, shall be between minus ten degrees

and plus twenty-two degrees, these values having been found to effectively overcome a tendency for the material of the cutting insert to chip and crumble.

In the particular drill shown in Figs. 1, 2 70 and 3, the helix angle E is ten degrees, the dimension D is twenty-eight per cent. of the dimension B, the dimension A is three times the dimension B, and the dimension C is sixty-five degrees. 75

In some cases, the helix angle of those portions of the active surfaces of the flutes which are formed on the cutting insert may advantageously differ from the helix angle of those portions of such surfaces which are formed 80 on the operating portion. The drill illustrated in Fig. 4 has an operating portion 20 which is provided with the flutes 21 and the cutting insert 22. The helix angle of those portions of the active surfaces of such flutes 85 which are formed on such operating portion is about ten degrees, and in contrast, the helix angle of those portions of such surfaces which are formed on the cutting insert are 90 parallel with the axis of the tool. This arrangement provides for the flutes having a sufficient twist to carry the cuttings out of the hole being drilled and affords such a degree of angularity to the cutting lips 23 that the material of which such lips are constituted 95 will have little if any tendency to chip or crumble. The amount of this variation in the angularity of the different parts of the active or operating surfaces of the flutes will, of course, depend upon the size of the drill and 100 the conditions of its use, in some cases such variation will be greater and in others less than ten degrees.

The operating ends of the drills herein illustrated and described may be ground for 105 use in any desired manner, but the angle of lip clearance, the included angle of the point, and the other features of the ends so ground should preferably be such as not to materially offset the advantages obtained in the man- 110 ner above explained. It will be understood that my invention contemplates the use of other than tool steel for the main part of the operating portion, that different methods of attaching the hard metal cutter or cutters may 115 be employed, and that in cases the entire operating portion of the tool may be constituted of the material desired in the cutting end.

Other modes of applying the principle of 120 my invention may be employed instead of the one explained, change being made as regards the structure herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated 125 means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. As a new article of manufacture, a composite metal-working drill having in its oper- 130

ating end a cutter of a non-ferrous hard metal alloy, and presenting a helix angle of negative rake.

2. As a new article of manufacture, a composite metal-working drill having secured in its operating end a tungsten carbide cutter, and having flutes with active edges of helix angles of between  $-10^{\circ}$  and  $0^{\circ}$ .

3. As a new article of manufacture, a composite metal-working drill having in its operating end a cutter of tungsten carbide, and having a helix angle presenting a negative rake.

4. As a new article of manufacture, a composite metal-working drill having in its operating end a cutter of tungsten carbide, and flutes whose active edges adjacent the cutter end have helix angles of from  $-10^{\circ}$  to  $0^{\circ}$  and whose active edges more remote have helix angles of between  $0^{\circ}$  and  $+22^{\circ}$ .

5. As a new article of manufacture, a metal-working drill having an end cutting-blade of a frangible hard non-ferrous alloy, and means for supporting said cutting-blade against breakage, said means including steel shoulders backing the cutting-blade and thence extending generally axially as secondary cutting edges and providing flutes of arcuate width less than  $68^{\circ}$ .

6. As a new article of manufacture, a metal-working drill having an end cutting-blade of tungsten carbide, and means for supporting said cutting-blade against breakage, said means including steel shoulders backing the cutting-blade and thence extending generally axially as secondary cutting edges and providing flutes of arcuate width less than  $68^{\circ}$ .

7. As a new article of manufacture, a metal-working drill having an end cutting-blade of a frangible hard non-ferrous alloy, and means for supporting said cutting-blade against breakage, said means including steel shoulders backing the cutting-blade and thence extending generally axially as secondary cutting edges and having flutes with helix angles of between  $-10^{\circ}$  and  $+22^{\circ}$ .

8. As a new article of manufacture, a metal-working drill having an end cutting-blade of tungsten carbide, and means for supporting said cutting-blade against breakage, said means including steel shoulders backing the cutting-blade and thence extending generally axially as secondary cutting edges and having flutes with helix angles of between  $-10^{\circ}$  and  $+22^{\circ}$ .

9. A rotary metal cutting drill of great strength and rigidity having an operating portion formed with two helical flutes and intermediate lands, said flutes having a width of less than  $68$  degrees of the circumference and a depth so that the web thickness of the drill at a section one-half diameter from the point is more than 20 per cent of the diameter of the drill and said flutes and lands

having a helix angle of between minus 10 degrees and positive 22 degrees.

10. A rotary metal cutting drill of great strength and rigidity having an operating portion formed with two helical flutes and intermediate lands, said flutes having a width of less than  $68$  degrees of the circumference and a depth so that the web thickness of the drill at a section one-half diameter from the point is more than 20 per cent of the diameter of the drill, said flutes and lands having a helix angle of between minus 10 degrees and plus 22 degrees, and said operating portion having primary cutting edges of hard non-ferrous material.

Signed by me this 8th day of April, 1929.  
JOSEPH V. EMMONS.

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