

- [54] **DIAMOND-IMPREGNATED MASONRY BIT WITH RADially-STEPPED CUTTING FACES**
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- [51] Int. Cl. **E21b 9/36**
- [58] Field of Search **175/330, 329, 387, 175/403**

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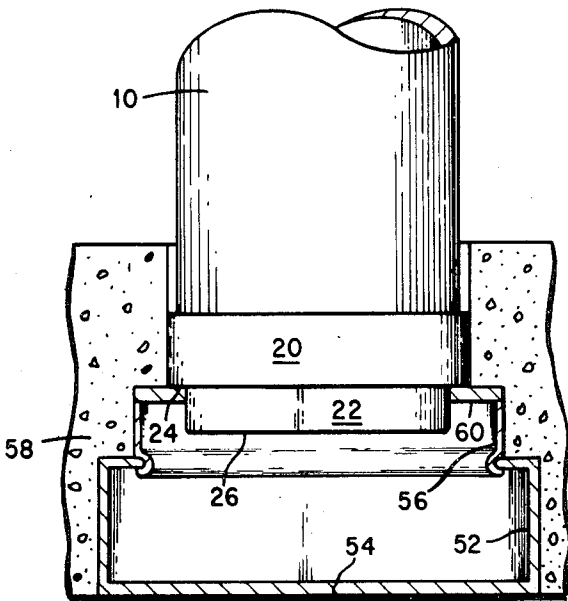
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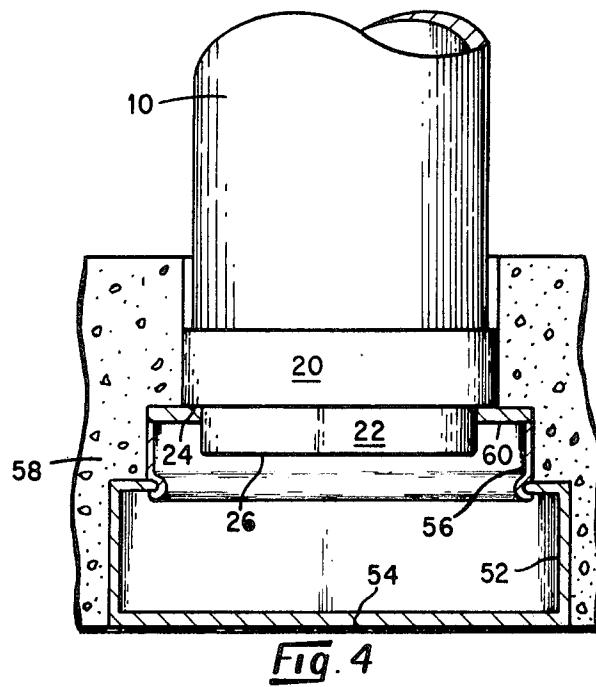
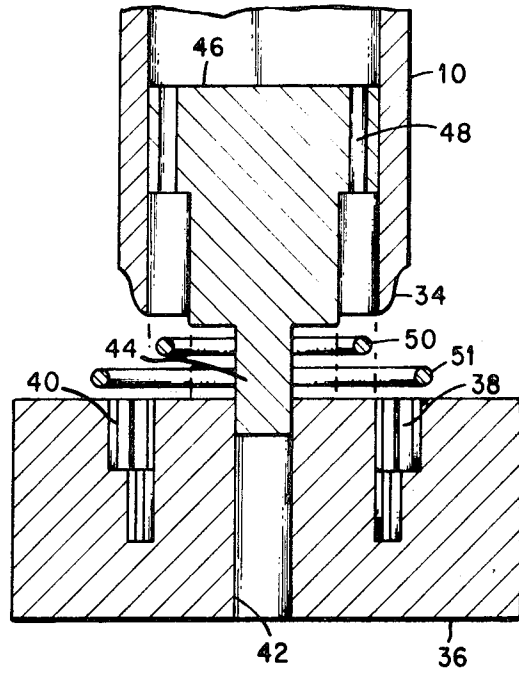
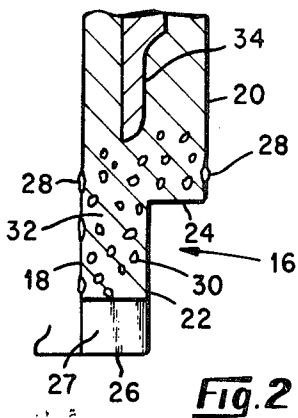
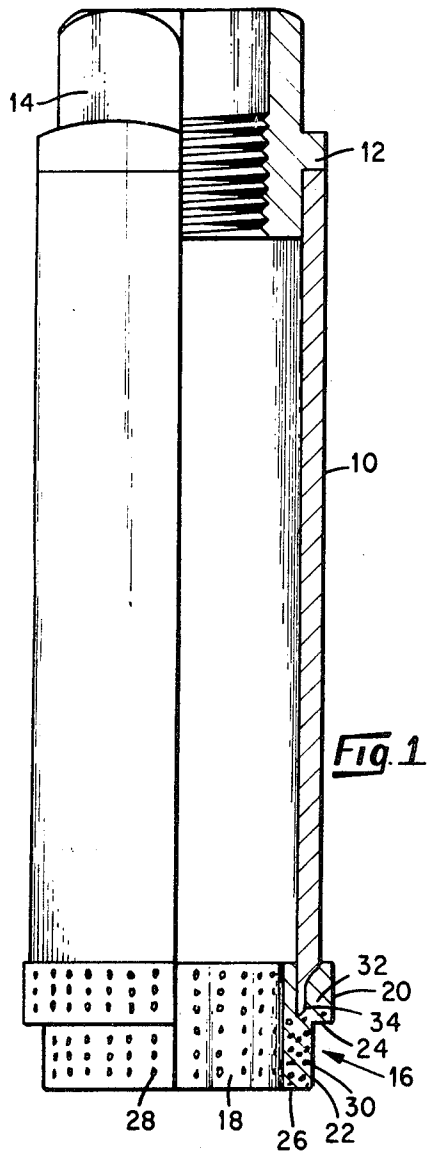
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[57] **ABSTRACT**

A masonry core drilling bit for cutting through cast concrete into preplaced utility conduit cells beneath the surface. The bit has two concentric, axially offset, end cutting faces on a unitary cutter head arranged at the end of a hollow shank for simultaneously cutting through concrete and through the metal cover of the embedded cell while, at the same time, providing an enlarged hole in the concrete to accept an insert for a utility outlet. The cutter head of the bit contains 5 to 60 volume per cent uniformly dispersed diamonds in a matrix of substantially pure iron powder, or an iron powder containing 20–80 vol. percent WC, infiltrated during fabrication with a relatively low-melting alloy. Spaced diamonds are provided along the internal and exterior cylindrical surfaces of the cutter head of the bit.

8 Claims, 4 Drawing Figures





DIAMOND-IMPREGNATED MASONRY BIT WITH RADIALLY-STEPPED CUTTING FACES

BACKGROUND OF THE INVENTION

The subject development relates generally to core drilling bits containing diamonds and more specifically to a masonry drill bit with dispersed diamonds to bore into utility conduit cells beneath the surface of cast concrete and to simultaneously prepare an opening for a utility outlet insert leading to the conduit cell.

It is current conventional practice in the construction of large office and factory buildings, particularly high-rise buildings which may contain 40-50 stories, to provide essentially all utilities in the floors. This includes feeder lines and outlets for power, telephones, computers, etc. In order to provide these services, conduit is preplaced in the floor before the concrete is poured. This is accomplished by fastening utility conduits to cellular steel flooring or the like. The conduits, or ducts, include junction boxes or cells at points where outlets for the utilities may be desired. Concrete is then poured over the entire floor. Thereafter, holes are cut down through the poured concrete, one-half to three inches thick, into the conduit cells for attaching outlets to the utilities. Typical of the utility ductwork used for these installations is the Walker Headerduct System manufactured by Walker/Parkersburg, Parkersburg, West Virginia. The method of reaching the cells, as described in an instruction manual of Walker/Parkersburg, is to carefully cut down to the top of each cell with a masonry core drill. A metal hole saw of a smaller diameter is then used to cut through the top of the cell. Thereafter an insert is placed in the larger hole through which utility lines are brought out of the ductwork. The dual cutting operation for installing utilities in the construction of a large building is expensive because of the high labor costs. Typically, one worker cuts only 25-30 holes per day in this manner.

Another method of cutting into the conduit cells has involved utilizing two concentric diamond-impregnated hole saw type bits. The inner bit cuts down through the concrete and into the cell cover while the outer bit only penetrates to the cell cover. Thereafter, as before, the appropriate utility outlet insert is positioned in the hole. While this bit substantially reduces the cutting time for an individual hole, concrete dust and metal pieces often plug the annular space between the bits requiring frequent disassembly for cleaning out debris. Instead of a desired 70-80 holes per day, only 30-40 holes per day can be drilled because of this jamming problem, again creating high costs.

Accordingly, it is a principal object of the subject invention to provide a masonry bit to accomplish simultaneous concrete cutting and penetration of the cell cover without the disadvantages inherent in the prior art.

It is another object to provide a durable masonry bit of relatively low unit cost which may be utilized for preparing a large number of holes prior to discard because of the self-renewing characteristic of the cutting portion.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical elevation of my improved diamond-impregnated masonry bit, partly in section;

FIG. 2 is an enlarged cross sectional drawing of the cutter head portion of the bit of FIG. 1;

FIG. 3 is a cross sectional view of components utilized in the typical manufacture of my bit; and

FIG. 4 is a cross sectional view of my improved bit in relationship to utility conduit cells in concrete structures to illustrate its use.

SUMMARY OF THE INVENTION

My invention is an improved diamond-impregnated core drilling bit or hole-cutter to be used for cutting through cast concrete into embedded duct work and simultaneously providing an enlarged opening down to the outer surface of the duct work. It is a one piece diamond-containing bit with two concentric flat cutting faces, an inner axially-extending face to cut down through the concrete and the duct work, and an outer face to cut a larger diameter hole in only the concrete. Diamonds are also set into the outer and inner longitudinal surfaces of the bit to speed the cutting and establish proper clearance diameters. The matrix for the diamonds is primarily fine spheroidal carbonyl iron powder which is consolidated by pressure and by infiltration with a low-melting alloy while simultaneously joining the cutting portion to a hollow bit shaft. The matrix may also include tungsten carbide particles or other hard substances to reduce wear.

DETAILED DESCRIPTION

My invention is best understood by reference to FIG. 1. A tubular body 10 is provided at one end with an internally threaded adapter 12 for attachment to any rotary bit driving means (not shown). The adapter 12 is fastened to the body 10, as by welding, and the exterior thereof is provided with flat surfaces 14 to receive a wrench (not shown) for aid in attaching the bit to any driving means. These components are generally conventional.

A cutting element 16 is located at the opposite end of tubular body 10. This cutting element is a single body having a cylindrical inner cutting surface 18 (bore) with a diameter less than the inner diameter of a body 10. The exterior of cutting element 16 is provided with two concentric cylindrical cutting surfaces 20, 22; cutting surface 22 being the farther axially extending surface and having a diameter less than surface 20. The transition face between surfaces 20 and 22, as well as the terminal face of cutter element 16, form flat grinding or cutting faces 24, 26, respectively, which are each in planes perpendicular to the axis of the drill. These cutting faces preferably have surface areas chosen to give substantially equal wear during usage. The cutting surfaces 18, 20, and 22 contain surface-mounted diamonds 28 of about size 125/150. The term "size 125/150," as used herein, designates a diamond chip size such that 125 to 150 of such chips are equivalent to one carat. This is a standard designation in the industrial diamond industry.

The structure of the cutter element or head 16 is shown more clearly in the enlargement in FIG. 2. Internally it contains from 5 to 60 vol. percent (typically 20 vol. percent) diamonds 30 of size 125/150 uniformly dispersed throughout a matrix of, for example, substantially pure carbonyl iron powder 32. As described below, other materials may be provided in this matrix. An infiltrant, such as a brazing or soldering alloy, bonds the mixture of iron powder and diamonds as well as

joins the cutting element 16 to a thinned and sand-blasted end 34 of body 10. In this FIG. 2 is illustrated a notch 27 that may be provided in cutting face 26 to enhance coolant flow. A typical value for the radial dimension of the cutting faces 24, 26 is $\frac{1}{8}$ to $\frac{3}{16}$ inch. The dimension of surfaces 20, 22 in an axial direction is typically $\frac{3}{8}$ to $\frac{1}{2}$ inch, and the notch 27 typically is $\frac{3}{16}$ inch deep and $\frac{3}{16}$ inch wide.

A typical method of fabricating my improved bit can be explained by reference to FIG. 3 which is a partially exploded view of the required elements and fabrication tooling in cross section. A graphite mold 36 is provided with a stepped cylindrical annular recess 38 conforming to the finished dimensions of the cutter element 16 to be fabricated. All cylindrical surfaces of recess 38 are provided with axially-extending grooves 40 to receive surface diamonds. A central bore 42, coaxial with recess 38, is provided in mold 36 to receive a pin 44 of a graphite alignment jig 46 which has as its largest diameter a sliding surface that fits within the inner surface of body 10. Jig 46 has a plurality of axially extending holes 48 for venting of gases, etc., during fabrication.

Surface or "kicker" diamonds 28 (FIG. 1) are placed in grooves 40 of recess 38. These diamonds may be held in place by any suitable volatile adhesive, such as a lithium stearate grease of suitable consistency. A blended mixture of diamonds and iron powder is then prepared as described below and added to the recess 38 filling it approximately two-thirds of the depth. The remaining portion of recess 38 is then filled with only iron powder (to conserve diamonds). For some drilling applications it may be desirable to replace a portion of the iron powder with a -200 mesh tungsten carbide powder or other similar granular material to give a harder (more wear resistant) matrix to the composite. The non-iron constituent may be present in a range of 20 to 80 vol. percent. The preferred form of iron powder is a very fine spherical grade having an average particle size between 5 and 10 μ and a purity of greater than 99.5 percent iron. Such a powder is grade HP carbonyl iron powder as produced by the General Aniline and Film Corp. of Linden, N. J. Where tungsten carbide powder is used, an angularly-shaped monocarbide form (WC) with a carbon content between 6.10 and 6.15 wt percent has proven suitable.

The above-referenced mixing of diamonds with the matrix powder is enhanced, with respect to the ultimate uniformity of dispersion of the diamonds, if the diamonds are first precoated with a heavy grade of pure mineral oil. These coated diamonds are then stirred into the bed of matrix powder. The powder then agglomerates around the individual diamonds and prevents segregation of the diamonds from the matrix during loading of the mold.

The components for my bit are assembled as shown in FIG. 3 with one or more rings 50, 51 of an infiltrant metal or alloy encompassing the outer and inner surfaces of body 10, respectively. A conventional liquid or paste flux (as recommended for the infiltrant material) is also applied over the infiltrant material. This infiltrant material may be, for example, a nickel-silver brazing alloy such as Airco-21 manufactured by Air Reduction Corporation which melts at about 1675°F and flows at about 1725°F. The composition of this alloy is 48 Cu - 42 Zn - 10 Ni (wt percent). Certain other copper- and iron-based alloys may be utilized as infiltrants as long

as the temperature does not exceed about 2300°F for any length of time. Higher temperatures cause graphitization of, or other harm to, the diamonds. Thereafter, the entire composite structure is heated to a temperature in excess of the melting point of the infiltrant for a brief time, e.g., 6 min. and the end 34 of body 10 is hydraulically pressed into the powdered mixture to secure a proper bond thereto by the infiltrant during the consolidation process. Gases and excess infiltrant vent through holes 48 into the bore of body 10. The unit is then cooled and the graphite components are removed. The infiltrant material may be alternatively added as a powder to the iron-diamond mixture thereby permitting consolidation using hot-pressing techniques. The final step in fabricating my drill is the removal of any excess infiltrant material by machining and cleaning the surfaces 18, 20 and 22 with a dressing stone.

My bit is shown being used for its intended purpose in FIG. 4. A utility duct 52 is tack-welded upon a steel decking 54. This duct 52 has periodically positioned upstanding risers or cells 56. Prior to the pouring of a cement floor 58, the cell is closed with a cover plate 60. This cover plate may be from about one-half to three or more inches below the surface of the concrete 58. The location of cell 56 is obtained from architectural plans in a conventional manner and my bit is then used to cut holes into the concrete. A drilling fluid is applied through the bore of body 10 and therefore flows out across the cutting faces 26 (and through notch 27, if provided) and 24 to the exterior of the bit thereby cooling the cutting faces and flushing out debris. When cutting face 26 engages plate 60, a change of sound is heard and metal particles appear in the drilling fluid exterior to the bit. Cutting then is continued until face 24 contacts or nearly contacts cover plate 60, as shown. This point is determined either by sound or by distance of travel of the bit.

The bit is then removed from the hole and a conventional "afterset" unit is inserted, which provides for the attachment of the desired utility outlet (not shown). The exterior diametral dimensions of these inserts are typically $2\frac{1}{8}$ to $2\frac{1}{4}$ in. Accordingly, my drill bits are sized for these inserts, with the opening into the cell being $2\frac{1}{8}$ to $2\frac{1}{2}$ in. It will be apparent, however, that these sizes do not constitute a limitation to my improved bit. Furthermore, the core of concrete that is produced is of no value. Thus, the diameter of inner surface 18 of the cutter head and of the inner surface of shank 10 are not critical. The larger the diameter of the bore, the smaller is the quantity of materials required for the cutter head and the less quantity of concrete that is removed during drilling. The bore of the bit shank and cutter head, however, provides for a flow of coolant to the cutting surfaces when coolant is desired.

Drill bits of my design have routinely been used to drill from 80 to 100 holes per day in contrast to the rate cited above for the prior art. Accordingly, a substantial saving in costs is made when thousands of holes must be drilled in a particular building. Cutting is not limited to floor concrete as there are applications where cutting into walls is similarly required.

Although I have described a core drilling bit for effectively and simultaneously cutting a hole having two diameters, the cutting unit may be formed with additional stepped surfaces for preparing a hole having multiple-diameter recesses in the bottom thereof.

I claim:

1. A drill bit for simultaneously cutting through masonry into a capped utility junction conduit therein and providing an enlarged hole to the surface of the conduit to receive a utility outlet insert, which comprises an elongated cylindrical drill bit shank, an adapter at one end of the shank for releasible attachment to a bit-driving means, and a unitary cutter head element attached at the second end of the shank, comprising:

a composite integral body;

first and second cylindrical external cutting surfaces on the body, each coaxial with the shank and having a transition therebetween, the second external cutting surface having a smaller outer diameter than the first external cutting surface and extending axially a greater distance from the shank;

a first flat cutting face perpendicular to the axis of the shank at the transition between the first and second external cutting surfaces;

a second flat cutting face perpendicular to the axis of the shank at the extremity of the second external cutting surface;

diamonds mounted in the cylindrical external cutting surfaces; and

diamonds dispersed throughout the body of the cutter head body.

2. The drill bit of claim 1 wherein the bit shank and the cutter element body are provided with coextensive axial bores, and further comprising diamonds mounted in the surface of the axial bore in the cutter element body to form a cylindrical internal cutting surface.

3. The drill bit of claim 2 wherein the diamonds in the

cylindrical external and internal cutting surfaces are placed in axially aligned rows equally spaced about the surfaces, and the dispersed diamonds are held in a matrix of consolidated and infiltrated powder.

4. The drill bit of claim 2 wherein the first and second flat cutting faces have substantially equal cutting areas, and wherein the second cutting face is provided with at least one radially-oriented notch across the entire width of the cutting face.

5. The drill bit of claim 3 wherein the matrix of consolidated and infiltrated powder comprises fine spherical iron powder having an average particle size between 5 and 10 μ infiltrated with an alloy which melts below 1800°C and wherein the dispersed diamonds therein occupy 5-60 volume per cent of the cutter head body.

6. The drill bit of claim 3 wherein the surface mounted diamonds and the dispersed diamonds are each about 125 to 150th of a carat, and wherein the dispersed diamonds are uniformly distributed throughout about two-thirds of the cutter head body farthest from the bit shank.

7. The drill bit of claim 3 wherein the infiltrant alloy consists essentially of, by weight, 48 percent Cu - 42 percent Zn and 10 percent Ni, and wherein the alloy bonds cutter head body to the bit shank.

8. The drill bit of claim 3 wherein the matrix of consolidated and infiltrated powder further comprises up to 80 volume per cent angularly-shaped tungsten monocarbide powder having a particle size of -200 mesh.

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