Oct. 14, 1947. M. G. WRIGHT 2,428,823

METHOD OF PRODUCING DRILL BITS

Filed May 18, 1943 3 Sheets-Sheet 1

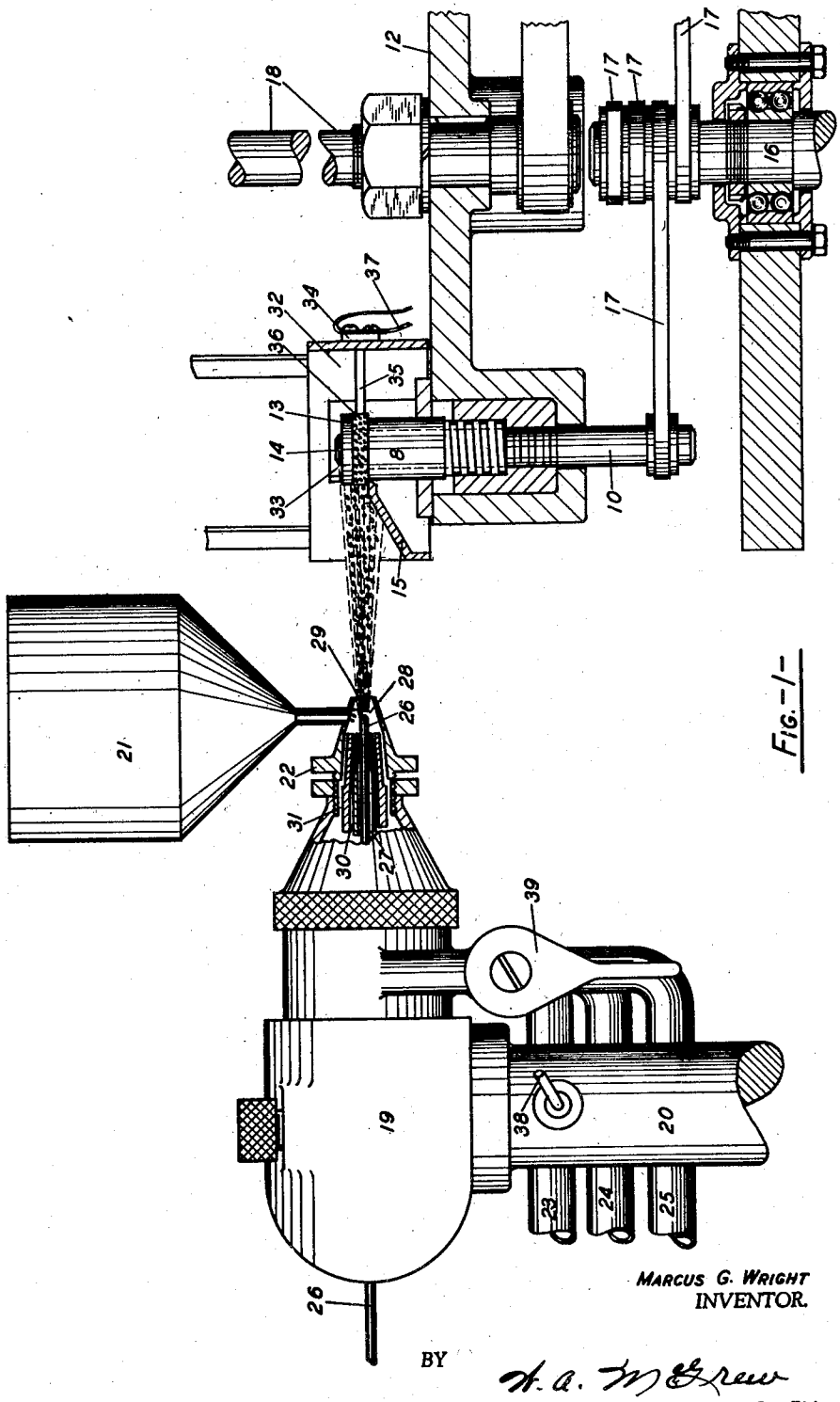

FIG. 1

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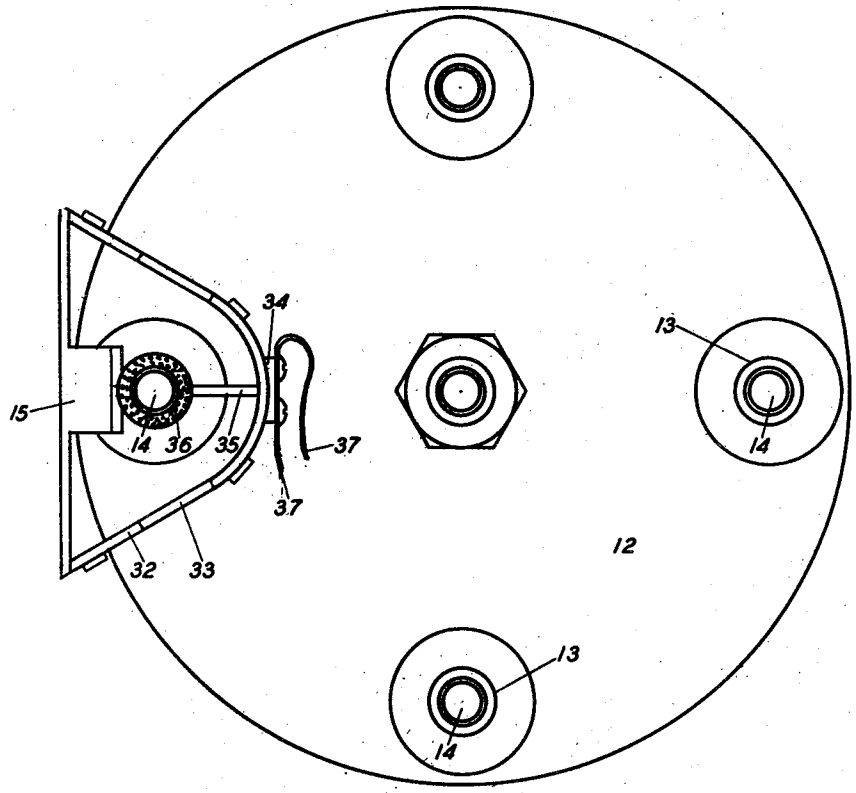

FIG.-2-

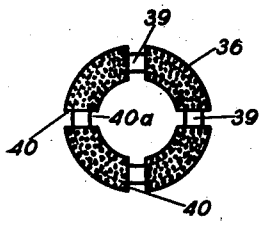

FIG.-4-

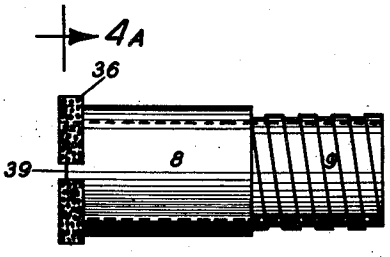

FIG.-3-

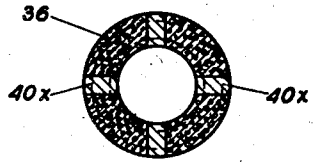

FIG.-4A-

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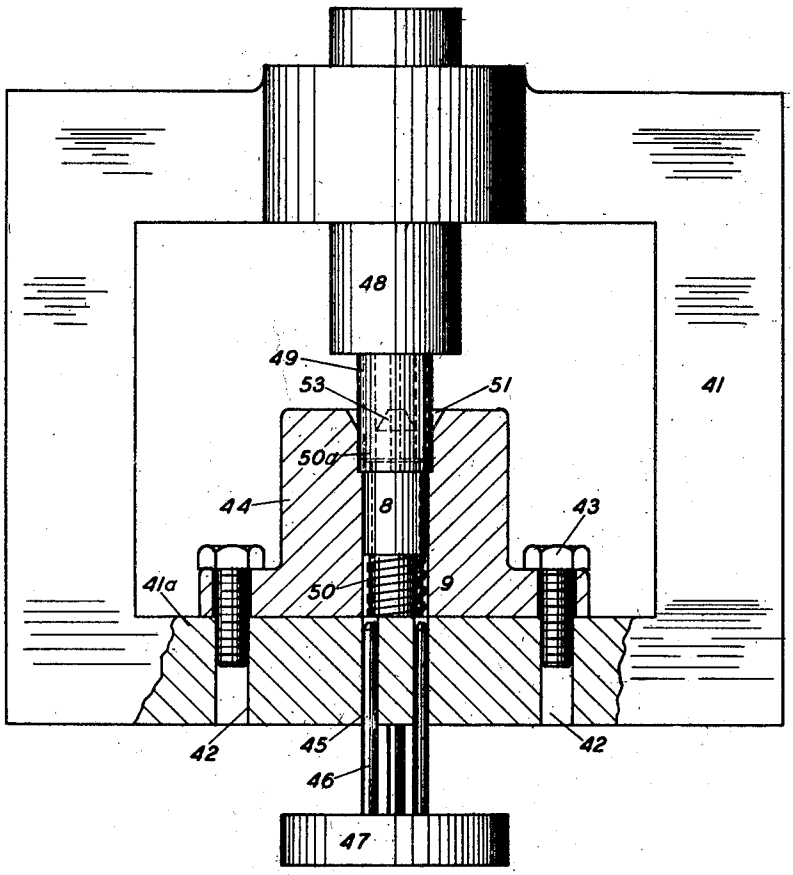

FIG.-5-

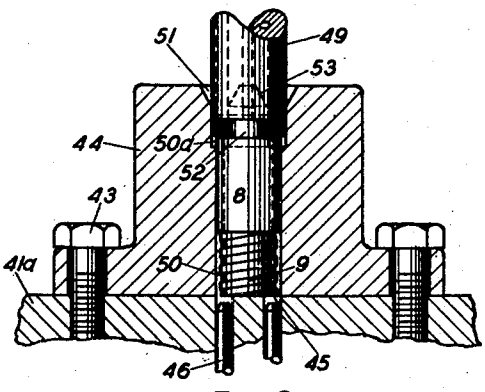

FIG.-6-

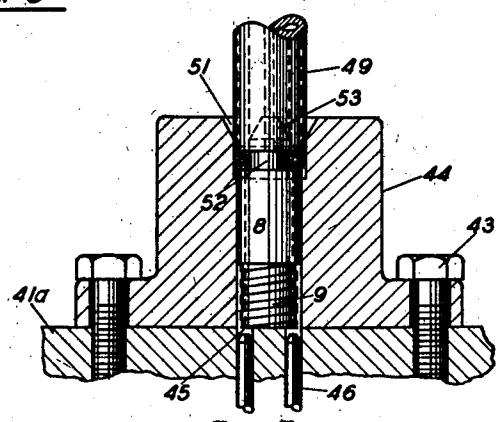

FIG.-7-

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Patented Oct. 14, 1947 2,428,823

UNITED STATES PATENT OFFICE

2,428,823

METHOD OF PRODUCING DRILL BITS

Marcus G. Wright, Denver, Colo., assignor of thirty-five one-hundredths to Thomas P. Campbell and thirty-five one-hundredths to W. Myron Owen, both of Denver, Colo.

Application May 18, 1943, Serial No. 487,437

8 Claims. (Cl. 76—108)

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This invention relates to drill bits for core drilling and the like, and specifically to a method of producing such bits. More particularly, the present invention relates to drill bits of the type shown and described in my co-pending application Serial No. 460,828 and certain features described but not claimed herein have been made the subject matter of claims in the aforesaid application.

Drilling apparatus of the aforesaid character is used in many different types of operations, and the structures drilled frequently possess a high degree of hardness and usually are quite abrasive. Consequently, such drilling is likely to be a power-consuming and tedious operation, causing rapid deterioration of the drill bits.

In an effort to reduce excessive wear on drill bits, the industry has utilized diamonds, carboloy and similar compositions possessing an extreme degree of hardness, as constituents of the drill bits. However, the problem of embedding such compositions in the drill bit structure has not been easily solved, and the methods heretofore in use either have involved too much production expense in providing a satisfactory product, or have been only partially satisfactory for their intended purpose.

It is an object of the present invention to provide a simple, efficient and economical method of producing durable drill bits possessing efficient drilling properties.

Another object of the invention is to provide simplified methods for producing drill bits that are suited for use with a variety of materials.

A further object of the invention is to provide a method for producing a simple, durable and efficient drill bit.

Other objects reside in novel steps and treatments and novel combinations and arrangements of steps, all of which will be explained in the course of the following description.

Briefly stated, the novel method of the present invention involves forcefuly depositing a mixture of molten metal and an abrasive, such as diamond chips, on the end of a piece of tubular metallic stock, and forming said metal-abrasive intermixture after deposit on the stock into an annular cutting surface, having a series of passages for removal of a core and circulation of a heat-exchange fluid about the bit.

The aforesaid method may be performed in a variety of ways, and utilizing different apparatus and in the accompanying drawings typical operations utilizing features of the invention have been illustrated. In the drawings in the several views of which like parts have been designated similarly,

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Figure 1 is a fragmentary side elevation, partially in section, of the arrangement of apparatus used in forming drill bits according to the present invention in a metal spraying action;

Figure 2 is a top plan view of the turntable utilized for the support of drill bits and stock in performing the operation illustrated in Figure 1;

Figure 3 is a side elevation of one of the drill bits produced by any of the several methods disclosed herein;

Figure 4 is an end view looking toward the crown of the drill bit illustrated in Figure 3;

Figure 4*a* is a section through a drill bit of the type shown in Figures 3 and 4 at an incomplete stage in its formation and corresponding to the location shown by the lines 4A—4A of Figure 3;

Figure 5 is a side elevation, partially in section, of a press assembly for forming drill bits according to the present invention;

Figure 6 is a fragmentary side elevation of the press assembly of Figure 5 showing another stage in the operation of forming drill bits according to the present invention; and

Figure 7 is another fragmentary side elevation of the press assembly of Figure 5 showing a stage in a different operation of forming drill bits.

Referring first to Figures 1 and 2, a metal spray operation for forming drill bits is illustrated. In this operation, a piece of tubular stock 8 is first threaded at one end as indicated at 9, and provided with soft lead, channeled inserts 40*x* (see Figure 4A) at its opposite end, and is then mounted on a spindle 10 journaled on a turntable 12. A cap element 13 supported on a stem 14 which fits into the hollow portion of stock 8 is held in spaced relation from the upper end of stock 8 by inserts 40*x* and determines the thickness of the crown portion that can be formed on the stock.

A shield 15 is mounted on the periphery of turntable 12 and extends to an elevation slightly below the upper end of stock 8 and in close proximity to the periphery of the stock as it spins on the spindle. This shield determines the inner limit of the crown formed on stock 8 by the spraying operation.

A plurality of spindles 10, here shown as four, but which may be any number permitted by the size of turntable 12, are mounted on the turntable and rotated by a drive shaft 16 through the intermediary of belts 17. The turntable is mounted for rotation on another shaft 18, the rotation of which is automatically controlled in a manner that will be described subsequently.

A metal spray gun, designated generally by the reference numeral 19 is mounted on a standard 20 or other suitable support and held in fixed relation to turntable 12. Various guns of this

type now on the market may be adapted for the purposes of the present invention, and a modification of the "Metco metallizing gun" has been illustrated in Figure 1.

The details of construction and operation of gun 19 are standard, except for the inclusion of an abrasive hopper 21 feeding into the nozzle member 22 of the gun. Thus in the gun 19, any metal produced in wire form is melted by a high temperature flames, and sprayed by a compressed air blast in fine molten particles against any surface toward and in proximity to which the nozzle 22 is pointed.

The high temperature flame is produced by a mixture of oxygen and some other gas such as acetylene, propane or the like. To this end, a battery of conduits, 23, 24 and 25, deliver the gases to the gun 19 from a suitable source of supply. The conduit 23 is connected with a suitable compressor (not shown) for supplying the compressed air for the discharge blast. The compressed air also is used to operate a turbine in the gun which provides the power for feeding the wire through the gun at constant speed.

Conduit 24 communicates with a suitable oxygen supply source, and conduit 25 communicates with a suitable acetylene supply source. These gases are held at predetermined pressures by regulators. As the details of such systems are well known in the art, the supply sources and regulators have not been illustrated in the drawings.

The wire 26 is fed into the rear end of gun 19 from a suitable supply source (not shown) and is then melted in the action hereinbefore described in the nozzle 22. This nozzle has a central passage 27 which narrows in width from the inner end to the outer end of the nozzle and the wire 26 is fed through this passage until melted in a combustion chamber 28 adjoining its discharge outlet 29.

An annular passage 30 in spaced but proximate relation to passage 27 delivers the oxyacetylene gas to combustion chamber 28, while an outer annular passage 31 delivers the compressed air blast to chamber 28. Abrasives, such as diamond chips, are fed at a controlled rate from hopper 21 to chamber 28, and the discharge through outlet 29 comprises an intermixture of molten metal and abrasive particles in an air stream traveling at high velocity.

This mixture deposits on the exposed surface of stock 8 between cap 13 and shield 15 and due to the uniform rate of discharge and the uniform rate of rotation of stock 8, the abrasive-metal intermixture builds up a deposit on stock 13 which is of substantially uniform thickness at all points about the periphery of stock 8.

A baffle or shield 32 is supported above and in close proximity to the top surface of turntable 12 and is substantially U-shaped to provide an enclosure for the spindle 10 and associated stock 8 which is positioned to receive the metal spray. This shield has a slot 33 along each side of the U in the path of the spindles 10 as they are rotated by shaft 18.

This rotation is periodic or intermittent and is determined by a switch 34 having a contact bar 35, the outer end of which is disposed at the elevation of the space between cap 13 and stock 8 and at a distance from the stock which is equal to the predetermined thickness of a crown 36 being formed thereon. When the crown is built up sufficiently to engage switch bar 35, the switch closes a circuit through conductors 37 which actuates the turntable mechanism to rotate shaft 18 a partial turn, to bring a new spindle into register with gun 19.

In this case the rotation is through an arc of 90°, at which point the movement is automatically stopped, the circuit is opened and the turntable rotation arrested until the switch again is actuated by the contact of crown 36 with bar 35. Between each actuation, or at least before the turntable has made a complete revolution, the machine operator withdraws the crowned bit stock and inserts new pieces of stock in place of each one so removed.

The metal spraying action, although employing temperatures high enough to melt the metal wire, does not transmit an appreciable amount of heat to the base metal of the stock and consequently warping, crystallization, heat strain and the like are avoided. Upon reaching the surface of the stock, the particles of sprayed metal chill almost instantly while the abrasive particles are embedded by the hardening action. In this way, a strong and tenacious bond is attained.

When it is necessary to stop the operation, the gun can be stopped by actuation of a control switch 38 and a gas regulator valve 39. Excess metal and abrasive depositing on the turntable 12 after striking shield 32 are collected periodically and may be utilized in the manufacture of drill bits by other methods hereinafter described, or may be used in forming other abrasive articles.

Following removal from the turntable the crowned stock is heated to melt inserts 40*x*, and removing them together with adhering matter forms a plurality of slots 39 on the cutting face of the crown portion 36. These slots 39, preferably four in number at 90° intervals as shown in Figure 4, form continuations of inner and outer passages 40 and 40*a* respectively, extending lengthwise of stock 8.

Following this forming operation, the drill bits are in condition for use and may be and preferably are used in association with apparatus of the type shown and described in my aforesaid pending application.

Another method of forming drill bits according to the present invention involves an initial mixture of metal and abrasive, which is subjected to a high compression in a suitable mold thereby bonding the crown on the metal and shaping it in a single operation. The abrasive-metal intermixture preferably employs metal shreddings and abrasive particles mixed in a ball mill or the like, although a mixture of metal foil and abrasive may be substituted, if desired. Preferably, at least a portion of the metal comprises the collected deposit from turntable 12 of Figure 1.

A press and mold arrangement suitable for performing the aforesaid operations has been illustrated in Figures 5, 6 and 7. The press for performing this operation may be of any conventional form and is designated generally by the reference numeral 41. The base 41*a* of the press 41 has a plurality of threaded bores 42 for the reception of nuts 43 clamping a mold member 44 on said base.

Another series of passages 45 extend through base 41*a* and receive guide rods 46 of an ejecting device 47, the function of which will be described subsequently. A plunger 48 is journaled in press 41 for movement toward and away from mold 44 and has a suitable socket (not shown) for attachment of die members 49 adapted to engage work in mold 44 when the plunger is moved to the limit of its downstroke position.

The mold 44 has a cylindrical bore 50 extending entirely through it from top to bottom and in the upper portion of the mold the bore widens as indicated at 50*a* and terminates in a tapered entrance 51. The bore 50 is designed to provide a close clearance for the tubular stock 8, and a piece of said stock is inserted into this bore with its threaded end 9 engaging base member 41*a*. When so positioned in the mold bore 50, the upper end of stock 8 extends into the widened bore portion 50*a* a distance slightly less than the predetermined width of the crown portion 36 to be formed on stock 8, as will be best understood by reference to Figures 6 and 7.

An insert member consisting of a cylindrical shank 52 and a conical head 53 is fitted in the hollow interior of stock 8 and extends above the upper end of the stock for a substantial distance to provide an annular compression zone within bore portion 50*a*. The diameter of the shank 52 and the wider end of conical head 53 provides a slight clearance with the inner wall of die member 49.

The die member 49 is of a length calculated to penetrate substantially the entire length of bore portion 50*a* when the plunger 48 is moved to its extreme downstroke position, and as a consequence exerts a compacting influence on material deposited in the compression zone encompassing the upper end of stock 8.

Thus, if metal foil and abrasive are premixed as by grinding in a ball mill or the like to form an intimate intermixture and a quantity of said intermixture is deposited in the compression zone as indicated in Figure 6, actuation of the press mechanism to force the die member 49 to its extreme downward position through conjoint movement with plunger 48, will serve to compact the intermixture into a metallic mass in which the abrasive is well distributed and firmly bonded.

As the insert member 52, 53 prevents escape of any of the intermixture into the hollow interiors of stock 8 or die 49, the compacting action serves to bond the metallic mass on the end of stock 8 and forms the crown 36 as an integral part thereof. The plunger is next raised away from the mold, withdrawing die member 49 from bore 50, whereupon mechanism can be actuated to elevate ejector 47 into abutting relation with base 41*a* thereby elevating stock 8 to a position in which it can be removed from mold 44.

Figure 7 illustrates another operation in which the arrangement of parts and functioning of the apparatus is duplicated, but in which the compressible intermixture is metal shreddings and abrasive. The compacting action serves to bond the abrasive to the resulting metallic mass and said mass likewise is firmly bonded on the stock 8. Other intermixtures such as the collected deposit from turntable 12 of Figure 1 may be treated silmilarly with equivalent results.

In such actions, the die member 49 preferably is shaped to form the slots 39 and grooves 40 and 40*a* in the same action in which the crown 36 is formed. From the foregoing it will be apparent that drill bits of uniform dimension and quality within reasonable tolerance limits are formed by employing any of the aforesaid methods.

It will be apparent that the operations just described may include a battery of molds and dies associated with a single actuating mechanism, and if desired, the feeding and discharge actions may be completely automatic, or may be a combination of manual and mechanical actions. With all such arrangements, the time required in the crown forming operation is reduced considerably from that required in the heating and shaping operation heretofore in use in bonding abrasives to the metallic surfaces of drill bits.

For some purposes it will be advisable to vary the spray method operation depicted in Figures 1 and 2. One variation involves the omission of the inserts 40*x* from the stock and the substitution of an indexed drive of spindles 10 for the constant speed rotation illustrated. With such an arrangement the spindles 10 are rotated at relatively slow speed throughout substantially 90° of a revolution, for example at the rate of about 6 revolutions per minute.

Then for the few degrees of a revolution representing the width of slots 39 the rotation is increased to a rate of about 200 revolutions per minute, after which the 6 revolution rate is resumed. This action is repeated through each 90° of revolution or whatever other spacing interval between slots 39 is desired. Due to the high rate of travel at the 90° divisions, an inconsequential deposit of spray metal is obtained and this is readily removed at the completion of the operation to complete the formation of slots 39, if desired.

In either of the metal spray operations hereinbefore described, it may be desirable to direct the spray at the end of stock 8 rather than at the side of same. This can be done by setting the gun 19 to discharge downwardly onto the turntable 12, in which event forced feeding of abrasive would have to be substituted for the gravity feed from hopper 21.

Another and perhaps more convenient arrangement can be effected by mounting turntable 12 on a horizontal rather than a vertical shaft as depicted in Figure 1. In all such modified operations the cap element 13 will be reduced in diameter to correspond to the inner diameter of stock 8 and the height of the crown 36 will be determined solely by the spraying interval employed.

The various metal spray operations hereinbefore described are particularly effective in producing crowns on drill bits of a novel character. Heretofore, the metal in which the abrasive is embedded has been relatively soft as compared with the abrasive. Consequently, when the bits are operated the abrasive-gripping surfaces of the metal deform and loosen their hold on the abrasive, which drops out and is lost long before the wear on its surfaces has rendered it unfit for further useful work.

Due to the relatively hard binding surfaces provided by the metal spray operation, the abrasive in the bits of the present invention does not become loosened as above described and is retained in the crown throughout substantially its entire useful life.

The several methods hereinbefore described are not intended to be limited to the operations of the apparatus shown and described, but may be performed in a variety of apparatus capable of performing the functions hereinbefore described. For this reason, the representations of apparatus shown in the drawings are intended to be more or less diagrammatic and are incomplete in the sense that only such parts as are necessary in performing the necessary steps and treatments have been illustrated.

Again referring to the metal spraying operations of the present invention, a variety of metals may be used in the metal spray which have not been used in abrasive bits in the past. For ex-

ample, high carbon steel, nickel alloy steel and other hard, high tensile metals may be used. Similarly, when the inserts 40x are used, various metals having a low melting point may be utilized in forming the inserts. As an example, lead, tin, or alloys having similar properties will be found satisfactory for this purpose.

In all the spraying operations hereinbefore described, it will be desirable to initially roughen the surface of the stock at the end on which the crown is formed to get a better bonding action. Likewise in the press methods described herein, the crown end of the stock may be slotted or otherwise partially deformed to provide irregularly shaped areas in which the compressed matter may flow to provide a stronger bond.

In the various compressing methods, the mixture of metallic composition and abrasive may be introduced into the mold in stratified arrangement, and by proper proportioning of ingredients, the abrasive will be substantially uniformly distributed throughout the crown so formed. Such a method may be used when the metallic composition is metallic shreddings, metal gauze or metal foil. Likewise, when desired the intermixture may be subjected to heating in conjunction with the compression to more firmly bond the crown on the tubular stock.

Persons skilled in the art of manufacturing drill bits will be able to adapt operable arrangements for the metal spraying operation or the compressing treatments by following the procedure described herein and illustrated in the drawings. Changes and modifications may be availed of within the spirit and scope of the invention as defined in the hereunto appended claims.

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

1. The method of producing drill bits, which comprises threading one end of a piece of tubular metallic stock, rotating said stock, spraying the rotating stock with a mixture comprising molten metal and abrasive particles, cooling the mass during deposit on the stock, and continuing the spraying operation until a measured amount of the cooled mass has been deposited on the stock.

2. The method of producing drill bits, which comprises threading one end of a piece of tubular metallic stock, rotating said stock, spraying the rotating stock with a mixture comprising molten metal and abrasive particles, shielding the bore of the stock from deposit of matter therein during said spraying action, cooling the mass during deposit on the stock, and continuing the spraying operation until a measured amount of the cooled mass has been deposited on the stock.

3. The method of producing drill bits, which comprises threading one end of a piece of tubular metallic stock, mounting low melting-point metal inserts at the periphery of the stock, rotating said stock, spraying the rotating stock adjacent said inserts with a mixture comprising molten metal and abrasive particles, cooling the mass during deposit on the stock, continuing the spraying operation until a measured amount of the cooled mass has been deposited on the stock, and forming a plurality of slots in the face of the deposited matter at the completion of the spraying treatment by melting the inserts.

4. The method of producing drill bits, which comprises threading one end of a piece of tubular metallic stock, rotating said stock, spraying

the rotating stock with a mixture comprising molten metal and abrasive particles, cooling the mass during deposit on the stock, continuing the spraying operation until a measured amount of the cooled mass has been deposited on the stock, and spacing the deposit of matter on the stock to form a plurality of slots at uniform intervals in the face of the deposited matter.

5. The method of producing drill bits, which comprises mixing a molten metallic composition in divided condition with abrasive particles in fine sizes in a spraying action, forcefully depositing said intermixture on a piece of tubular stock in the spraying action to form a crown thereon, forming a plurality of slots at uniform intervals in the face of the crown, and forming means on the stock adapted for attaching the bit so formed to a drill.

6. The method of producing drill bits, which comprises threading one end of a piece of tubular metallic stock, roughing the surface of the stock at its end remote from the threaded portion, rotating said stock, spraying the roughened surface of said rotating stock with a mixture comprising molten metal and abrasive particles, cooling the mass during deposit on the stock, and continuing the spraying operation until a measured amount of the cooled mass has been deposited on the stock.

7. The method of producing drill bits, which comprises threading one end of a piece of tubular metallic stock, roughing the surface of the stock at its end remote from the threaded portion, rotating said stock, spraying the roughened surface of said rotating stock at spaced intervals with a mixture comprising molten metal and abrasive particles, cooling the mass during deposit on the stock, and continuing the spraying operation until a measured amount of the cooled mass has been deposited on the stock.

8. The method of producing drill bits, which comprises mixing a molten metallic composition in divided condition with abrasive particles in fine sizes in a spraying action; rotating a piece of stock adapted to form at least a portion of a drill bit; forcefully depositing said intermixture on said rotating stock in the spraying action to form a crown thereon; and shielding said stock to limit the deposition of said intermixture to a predetermined portion of said tubular stock.

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