

July 27, 1943.

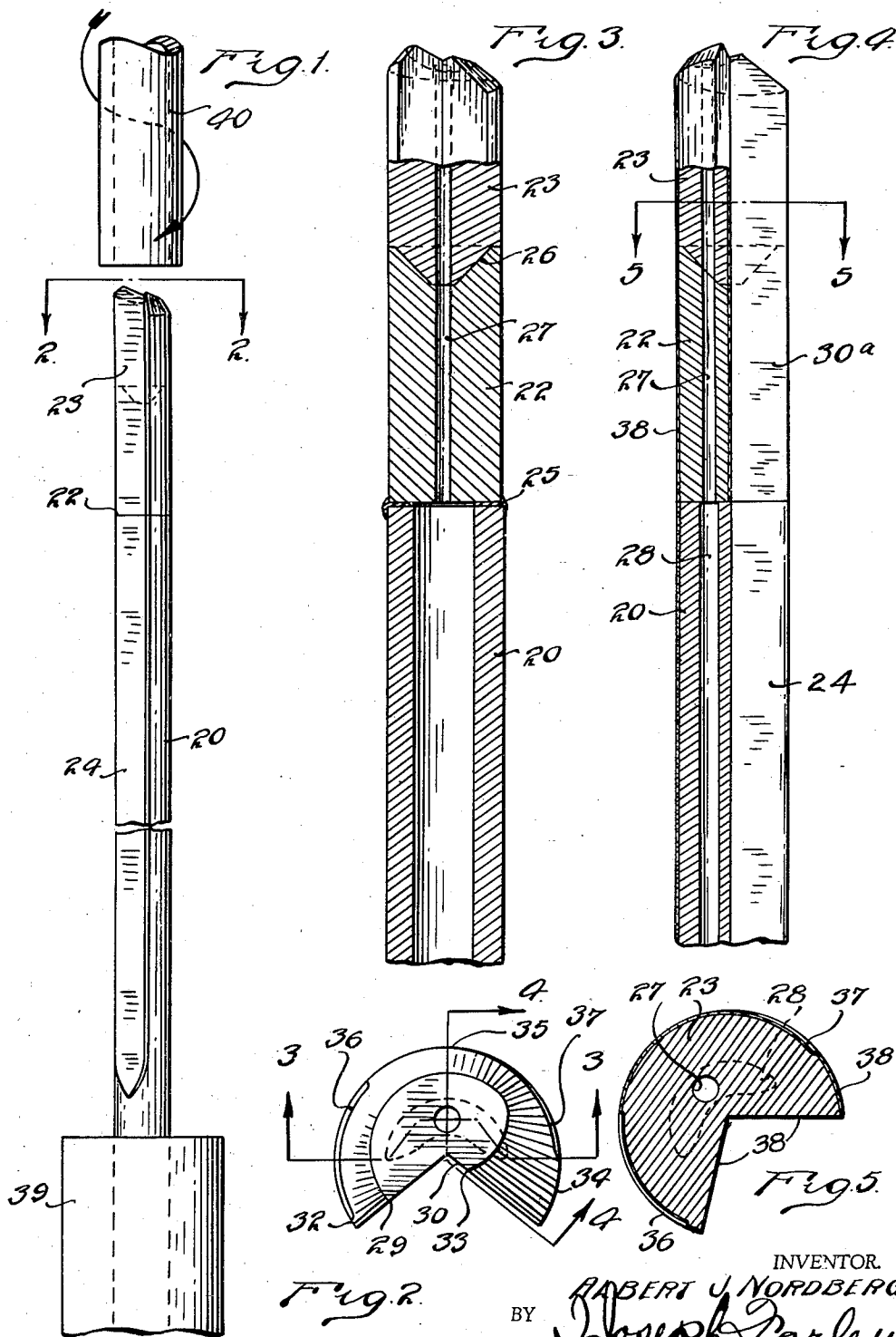
A. J. NORDBERG

2,325,535

DRILL

Filed Oct. 28, 1941

2 Sheets-Sheet 1



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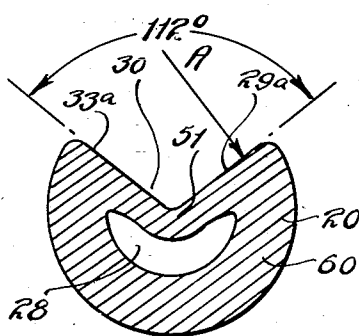
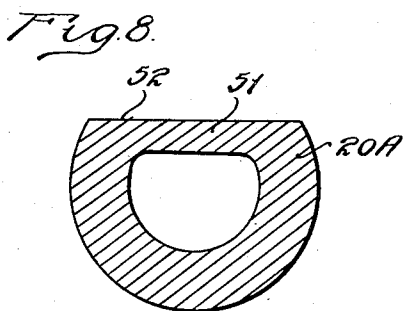
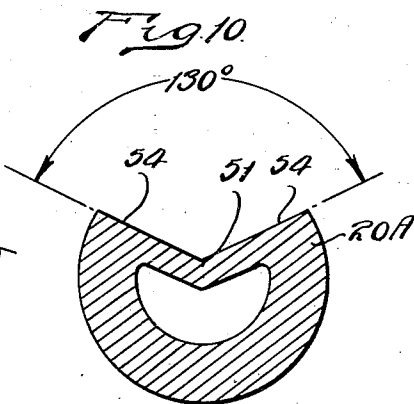
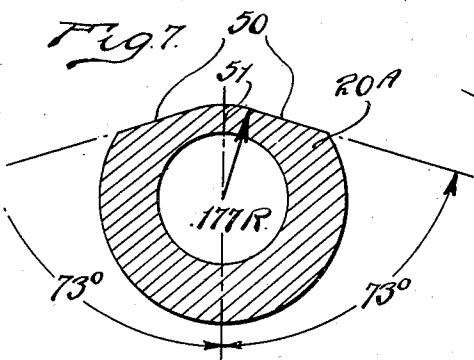
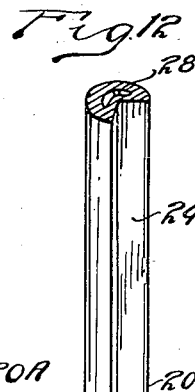
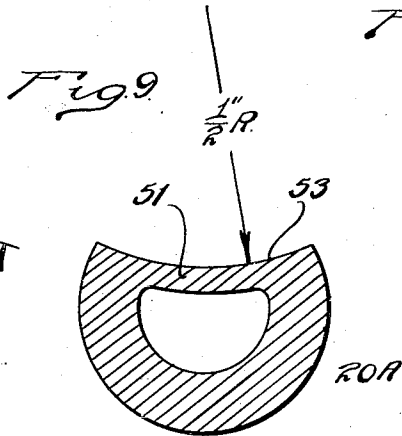
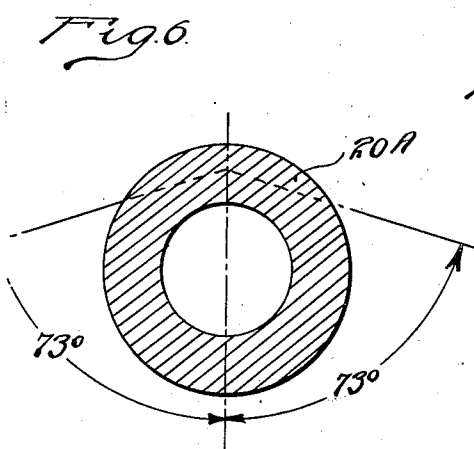
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DRILL

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2 Sheets-Sheet 2



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2,325,535

DRILL

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Application October 28, 1941, Serial No. 416,857

7 Claims. (Cl. 77—68)

This invention relates to the manufacture of rifle barrels and has for its principal objects to provide a new and improved construction of a drill especially adapted for such work by means of which the rate of production is greatly increased and the cost of manufacture decreased.

The drilling of a rifle barrel, and particularly barrels for military rifles, has, with the production methods heretofore employed, been a very difficult, time consuming operation that was capable of being performed only by the most highly skilled mechanic. The barrels of military rifles are quite long, usually from 45 to 90 inches in length, and have heretofore been finished by the use of a special drill which must of necessity be longer than the rifle barrel. As the bore of the barrel must be perfectly straight and smooth, great care must be employed to prevent the tool from scoring the gun barrel as the result of gouging or as a result of the accumulation of chips and consequent seizing of the drill in the barrel and likewise great care must be exercised to prevent the drill from drifting sidewise during the drilling operation which would result in the production of a bore that is not perfectly straight. Allowable tolerances being of the nature of fractions of one thousandths of an inch, the most meticulous accuracy is required.

It has been found that because of the great length of the barrel relative to the diameter thereof, barrels could not be drilled or bored by the use of an ordinary twist drill or by the use of a boring bar, and it has been the practice for many years to employ a special single fluted drill in which the flute provided for chip clearance extends parallel with the axis of the drill. Such drills as heretofore used have almost universally been mounted horizontally in special machines which have required the services of highly skilled mechanics for their operation and due to the great length of the drill and its comparatively small diameter, such drills as heretofore used have had but very slight resistance to torque. Consequently the operators of the gun barrel drilling machines have had to develop an almost uncanny ability to perceive almost instantaneously when, in drilling a gun barrel, the torque thrown upon the drill threatened to become great enough, either as a result of chip accumulation or from any other cause, to throw the cutting edge of the drill out of proper alignment or to place strain enough upon the drill as to cause it to break.

Drills, as heretofore employed for this purpose, have consisted of a main shank portion formed of

a piece of steel tubing, one side wall of which has been pressed or rolled to provide the chip clearance flute and to the end of which tubing a piece of tool steel has been brazed or welded to form the cutting end or bit of the tool. Due to the manner in which the shank portion of the cutting drill has been fabricated by pressing in one side wall of the tube to form a chip clearance flute and also to provide an oil passage extending longitudinally through the shank, a very definite limitation has of necessity been imposed upon the thickness of the wall of the tube employed.

Among the principal objects of the present invention are to provide a new and improved drill for the fabrication of rifle barrels in which the shank portion of the drill is constructed of a tube having a much thicker tube wall than heretofore employed so that the drill can withstand heavier torque strains and to obtain the desired shape of chip clearance flute while insuring an outer contour that will more accurately conform to the rifle barrel for supporting the drill during the drilling operation and allow for an oil passage of sufficient volume, all of the above described results being obtained as the result of a novel method of fabricating the drill shank as will presently be more fully described.

Another object is to provide a drill of this character with a cutting bit portion formed of the well known tungsten carbide type of material such as sold under various trade names as for example "Carboloy."

A further object is to provide a new and improved construction of the means for combining the improved type of drill shank with a high speed cutting bit to form a unitary structure and to unite the cutting bit portion with the tool shank in such a way that a smooth continuous outer surface will be formed on the drill and further to provide the cutting bit portion with lands and relieved portions adjacent thereto that will effectually cooperate with the drilled or bored portion of the hole to prevent any lateral drifting of the drill during the boring operation while at the same time insuring proper clearances for effective cutting.

The above and other objects of the invention will appear more fully from the following more detailed description and by reference to the accompanying drawings forming a part hereof, wherein:

Fig. 1 is a side elevation showing the improved manner in which the drill of the present invention is employed in machining the bore of a rifle barrel;

Fig. 2 is a plan view of the cutting end of the drill as seen from line 2—2 in Fig. 1;

Fig. 3 is a longitudinal section taken along the line 3—3 of Fig. 2 and showing the component parts of the drill united to form a unitary structure but in partially finished condition;

Fig. 4 is a view similar to Fig. 3 showing the unit in finished form;

Fig. 5 is a horizontal section on the line 5—5 of Fig. 4;

Figs. 6 to 11 inclusive illustrate the various steps performed in the fabrication of the shank portion of the drill, and

Fig. 12 is a perspective view of such shank portion when in finished condition.

As shown in the drawings the drill bit of the present invention comprises a main shank portion 20 constructed of steel tubing in a manner presently to be described more fully, an intermediate tool bit holder portion 22 and a cutting bit or tip 23. The shank portion 20 of the drill, as clearly shown in Fig. 12, is provided along substantially its entire length with a longitudinally extending flute 24 to provide for chip clearance. After the shank portion has been fabricated the tool bit holder 22 which may be constructed of high carbon steel, is secured to the end of the shank portion 20 by an ordinary brazing, as indicated by the reference character 25. The intermediate bit holder portion 22 is preferably made of a piece of solid bar stock which at its inner end is squared off for ready attachment to the tool shank 20 while the other end thereof is machined out to form a recess or socket 26 into which the similarly shaped inner end of the cutting bit portion 23 is adapted to be seated. The cutting bit 23 is preferably constructed of one of the high speed duty compositions such as tungsten carbide of the type known as "Barboly" or the like and is secured to the bit holder portion 22 by copper brazing; the recess 26 of the holder 22 and similarly shaped inner end of the bit 23 being provided for the purpose of providing a greater surface area of brazed joints to insure a more intimate uniting of the parts for withstanding the torque stresses placed upon the drill when in service.

The bit 23 and holder 22 are provided with a longitudinally extending hole 27 which forms a conduit for oil under pressure and which is in communication with a conduit 28 formed in the shank portion 20 of the drill. The bit portion 23 of the drill has its outer end ground to provide a special type of a cutting edge 29 such as usually employed for gun barrel drills and formed by one side of the flute 30 provided in the tip portion 23. The flute 30 is arranged in longitudinal alignment with a similar flute 30—*a* provided in the holder portion 22 and which is similarly aligned with the similar flute 24 formed in the shank portion 20 of the drill.

In order to insure efficient cutting action of the tool bit and to insure ample lateral support thereof to prevent sidewise drifting of the cutting end of the drill, the tool bit portion is provided on that side of the flute 30, the end of which forms the cutting edge 29, with a land 32 the width of which is of the order of about $\frac{1}{8}$ of an inch while the opposite side of the drill adjacent the side edge 33 of the flute 30 is provided with a wider land 34 and that portion of the tool bit diametrically opposite from the flute 30 is provided with a land 35. The three lands 32, 34 and 35 are the full diameter of the tool bit and of the hole to be drilled while those portions

of the tool bit between the land 32 and 35 and 34 and 35 respectively are relieved as indicated at 36 and 37 to reduce the frictional contact area between the drill and the hole drilled thereby. The bit holder portion 22 is also provided with lands and relieved portions similar to those provided in the cutting bit 23.

After the parts 20, 22 and 23 have been united together as indicated in Fig. 3, the flash formed by the brazing 25 is ground off and the parts are then preferably subjected to a plating or nitriding operation, but preferably chrome plating, which serves to form a continuous outer surface along the three assembled portions and to completely cover the joints between the respective parts formed by the brazing of the bit 23 to the holder 22 and of the latter to the shank 20, the plated coating being built up to a point a few thousandths above the desired finished outer diameter and then being ground down to the exact dimension, the outer plated coating of the parts as indicated by the reference character 38 being shown in a somewhat exaggerated form in Fig. 4.

In contradistinction to the methods heretofore employed for the boring of rifle barrels and in which the drill was held in horizontal position, I have found that much better results and a higher rate of production can be procured by holding the drill stationary in any suitable holder or chuck, as indicated by the reference character 39 in Fig. 1, while the rifle barrel 40 to be drilled or bored is rotated rapidly and fed downwardly over the drill as indicated by the arrow in Fig. 1.

In the drilling of the rifle barrels it has always been the practice to supply oil or other suitable cutting fluid under extremely high pressure through the central tubular part 28 of the drill shank and connecting conduit 27 under very high pressure and to rely upon the pressure of the cutting fluid to carry away the chips and wash them through the flute 30 to the back end of the drill. By mounting the drill in a vertical position and feeding the gun barrel 40 downwardly on to the drill as indicated in Fig. 1, the force of gravity carries the chips downwardly along with the fluid to be ejected at the back end of the drill and it is not, therefore, necessary with a drill as disclosed and used in accordance with the present invention, to resort to such extremely high pressures for the cutting fluid.

As hereinbefore explained the shank portion 20 of the cutting drills heretofore employed for the drilling of gun barrels have always been constructed of a piece of tube steel one side wall of which has been rolled or pressed inwardly to form the clearance flute 30, therefore, there was a very decided limitation in the thickness of the wall of the tube employed for these drill shanks. Moreover, as the flute portion was formed entirely by rolling and drawing, the flow of the metal produced a very appreciable curvature of the metal of the tube in those portions thereof immediately adjacent the chip clearance flute which resulted in a corresponding appreciable decrease in diameter of the shank below the desired finished dimension at the place where the full dimension of the drill was most needed for lateral support to prevent drifting and vibrating.

Moreover, the formation of the shank into the desired configuration to provide the chip clearance flute by bending and rolling the tube with the resultant necessary limitation in the thick-

ness of the wall tube that could be used for drill shanks fabricated in the manner heretofore employed, resulted in a final product which had very slight resistance to the torque which the drill was called upon to resist in performing its intended cutting function.

In order to avoid the above mentioned undesirable features and to provide a contour of the drill shank in which the shank would be of the desired full diameter closely adjacent to the chip clearance flute and so that the shank can be constructed of much heavier tubing better able to withstand the torque stresses, the drill shank of the present invention is constructed in the manner indicated by the series of views Figs. 6 to 11 of the drawings.

In fabricating the shank portion a relatively thick walled tube 20—a as shown in Fig. 6 is employed. This tube then has a portion of one side wall thereof cut away by any suitable means such, for example, as a form milling cutter to provide the converging side wall portions or flats 50 and to reduce the tube along its entire length to the form shown in Fig. 7 of the drawings. This operation, it will be seen, reduces the wall 51 of the tube adjacent the flats 50 particularly at the central point thereof to a thickness approximately one-half of the original thickness of the tube wall. The tube is next subjected to a rolling operation which presses the thin wall portion 51 of the tube inwardly towards the center thereof and causes the flats 50 to be merged into a single flat surface 52 which bears the relation of a chord to the original circular cross section of the tube.

The next step in the formation of the shank is to subject the flat wall 52 to a further rolling operation, thereby forcing the thin wall 51 further towards the center line of the tube and to transform the flat wall 52 into the re-entrant arcuate or convex wall 53 and to bring the tube to the form shown in Fig. 9 of the drawings. The tube is then subjected to another rolling operation which forces the thin wall 51 thereof slightly past the center of the tube and towards the opposite thicker wall and to form a pair of flats 54 forming a re-entrant angle and leaving the tube in the condition shown in Fig. 10 of the drawings.

The next step is to subject the tube to still a further rolling operation in which the wall 51 is pressed still farther towards the opposite side wall and to form the chip clearance flute 24 in the shank 20, this flute having side wall portions 29—a and 33—a which correspond with the similar side walls 29 and 30 of the tool bit portion 23. As the tube leaves the rollers which press the wall 51 downwardly to the position shown in Fig. 11, the tube then is subjected to the action of a group of finishing rolls which engage the outer arcuate surface of the tube adjacent the edges of the flute walls 29—a and 33—a, thereby to insure that substantially the entire outer curved surfaces of the tube will be of the required diameter and free from any protuberances; the tube in its final condition being as shown in Fig. 11 in which the original cylindrical bore has been converted from its circular cross sectional form into a somewhat crescent shape which forms the conduit 28 by means of which cutting fluid under pressure is supplied to the cutting edge of the tool bit 23.

After the shank 20 has been produced in its final finished form, as indicated in Fig. 12, the tool bit holder 22 to which the Carbide cutting

bit 23 has been fastened is then secured to the end of the shank by a simple butt welding or brazing operation as hereinbefore described.

As will be seen from an inspection of the cross sectional view of Fig. 11 the shank 20 in its final form has the major portion of its arcuate side wall portions 60 of a thickness substantially twice that of the thickness of the side wall portion 51 at the flute portion of the shank, the major portion of the torque reaction being transmitted to the shank in the direction of the arrow A in Fig. 11, is therefore, communicated directly to the thicker side wall 60 with the result that a drill provided with a shank of the type shown in the drawings offers very effective resistance to the torque stresses.

It will also be seen from an inspection of Fig. 11 that the opening formed by the crescent shaped conduit 28 forms but a minor portion of the cross sectional area of the shank—the major portion thereof being formed of the solid metal of the tube walls. Due to the greatly reduced area to the conduit 28 over devices of the type heretofore employed, the conduit at its greatest width is but approximately one-half the cross sectional diameter of the shank.

Another feature of great importance in a tool shank constructed in accordance with the present invention is that due to the method of fabricating the shank the outer curved surface thereof is maintained at substantially the full diameter up to a point very close to the side walls 29—a and 33—a of the flute portion 24 and consequently the shank is of the full dimension of the hole to be drilled for very much more than the semi-circumference of its circular cross section. This insures that the shank will be in lateral contacting engagement with the bore of the hole to be drilled closely adjacent to the flute portions thereof at which point the need for lateral support is greatest.

In using the drill of the present invention it is, as hereinbefore pointed out, preferably supported in a vertical position as indicated in Fig. 1 of the drawings. The bit portion of the drill having been formed as hereinbefore described and as illustrated in Figs. 2 and 3 of the drawings and the drill preferably being provided with a high speed duty type of cutting bit or tip, the rifle barrel 40 may be rotated at a speed of rotation many times greater than that employed with the drills as hereinbefore constructed, and consequently it is not necessary in order to get remarkable increased production, to use a heavy feed that would place heavy torque stresses upon the drill. As the chips are cut away by the cutting edges of the tool from the gun barrel, such chips will tend to drop by the force of gravity to the fluted portion thereof and prevent any undesirable accumulation of chips either adjacent the cutting edge of the drill or along the shank portions thereof. However, as an added precaution against chip accumulation, oil under pressure is supplied from a suitable source of fluid pressure through the crescent shaped conduit 28 of the shank 20 to pass therefrom to the hole or conduit 27 provided in the bit holder 22 and bit 23 to be delivered immediately adjacent the cutting edges of the tool and to wash the chips as they are cut from the stock backwardly through the fluted portion of the drill.

It will be noted that the thicker curved walls of the shank form a brace for substantially more than half the sides of the flute and which brace extends substantially along the line of the twist-

ing or torque forces, thus providing a stiffer, more torque resistant construction.

I claim:

1. A tool of the character described comprising a tubular shank portion provided with a crescent shaped conduit, a tool bit holder and a high speed cutting tool bit, each having a conduit in alignment with said crescent shaped conduit, said tool shank, tool bit holder and tool bit being provided with a continuous outer coating covering the joints between said shank, tool bit holder and tool bit.
2. In a tool of the character described a tool shank having a longitudinally extending chip clearance flute and a substantially central crescent shaped fluid pressure conduit, the thickness of the side wall of said shank along the arcuate portion thereof, and for substantially more than half the cross sectional circumference, being approximately twice the thickness of the side wall at the central part of said chip clearance flute.
3. A tool of the character described having a cutting bit portion and a tubular shank with a longitudinally extending chip clearance flute provided therein, the thickness of the side wall of said shank adjacent the central part of said flute being approximately one-half the thickness of the opposite side wall of said shank, said shank being formed with a cylindrical portion the circumferential length of which is substantially greater than its semi-circumference.
4. A tool of the character described having a cutting portion and a tubular shank with a longitudinally extending chip clearance flute and a substantially central crescent shaped fluid pressure conduit provided therein, said shank having a thickened portion side wall bounding the convex side of said crescent shaped conduit and extending substantially in the direction of the reaction to the torque forces to which the shank portion of said tool is subjected and bracing the major portion of the side of said flute that corresponds to the cutting edge of the bit against the torque forces.

5. A tool of the character described comprising a cutting bit portion, a bit holder portion and a shank portion secured together in abutting relationship to form an integral structure and having a thin outer coating extending along the outer periphery of each of said portions to fill the crevices at the points of union of said portions with each other and thereby to form a smooth, continuous and uninterrupted surface.
6. A drill of the character described comprising a tubular shank portion, a tool bit holder member and a tool bit member, each of said members and said tubular shank being provided with a continuous longitudinally extending chip clearance flute and each of said members being provided with a land extending along the outer periphery of said drill adjacent to each outer edge of said flute and a third land extending along said outer periphery intermediate the first mentioned two lands, said lands being substantially the full diameter of the hole to be drilled by said drill and the outer periphery of said members being relieved between said lands to provide clearance spaces.
7. A drill of the character described comprising a tubular shank portion, a tool bit holder member and a tool bit member, each of said members and said tubular shank being provided with a continuous longitudinally extending chip clearance flute, one side only of said flute at the extremity of said tool bit holder member forming the entire cutting edge of said drill and said tool bit member and tool bit holder member being provided along the periphery of the drill adjacent the cutting edge side of said flute with a narrow land and said periphery being provided with a wide land adjacent to the other edge of said flute and said drill being provided with a third land extending along the periphery of said members between said narrow land and said wide land and the remainder of the periphery of said members between said lands being relieved to form clearance spaces.

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