April 7, 1964 J. L. STOCKARD, JR 3,127,794

METHOD OF MAKING DRILLING BITS

Original Filed March 31, 1959 2 Sheets-Sheet 1

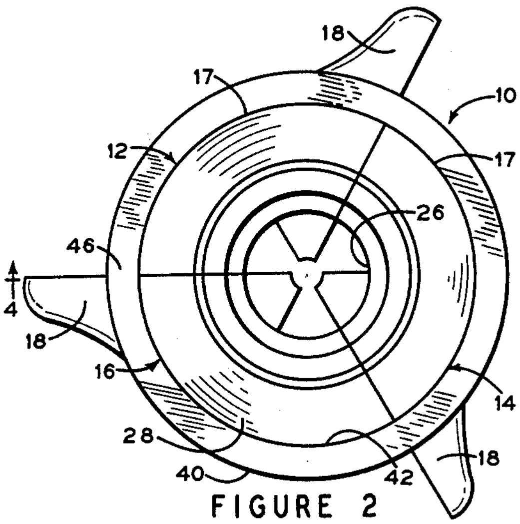

FIGURE 2

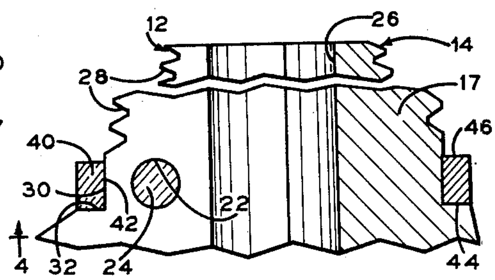

FIGURE 4

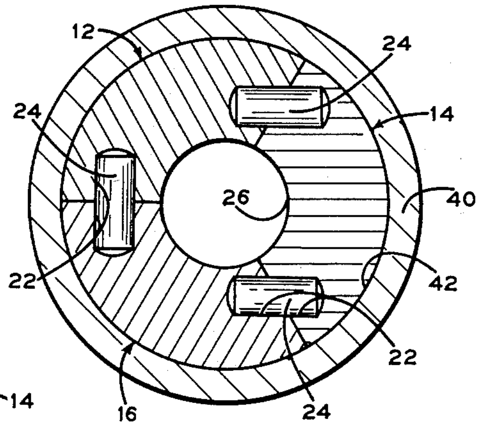

FIGURE 3

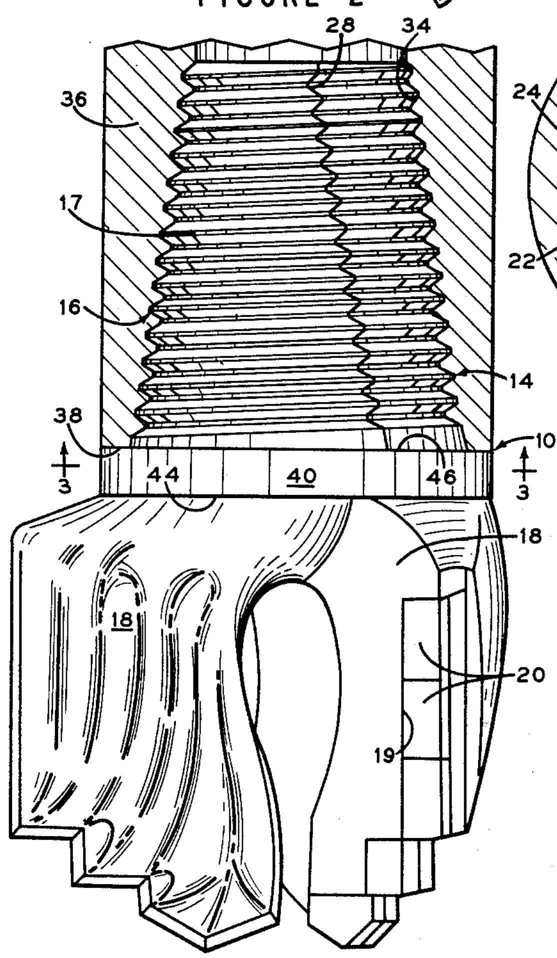

FIGURE 1

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METHOD OF MAKING DRILLING BITS

Original Filed March 31, 1959 2 Sheets-Sheet 2

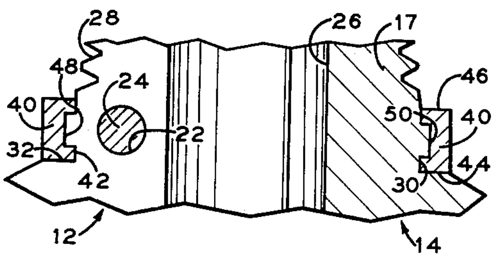

FIGURE 5

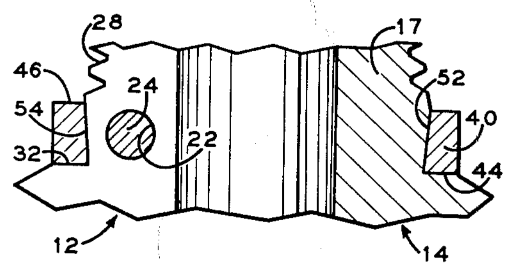

FIGURE 6

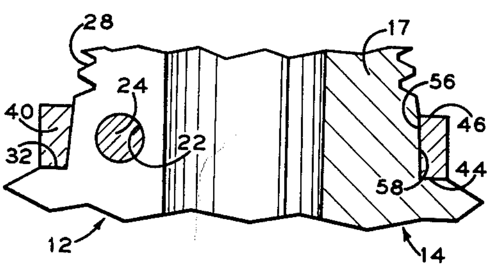

FIGURE 7

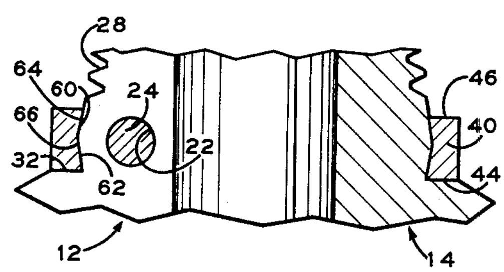

FIGURE 8

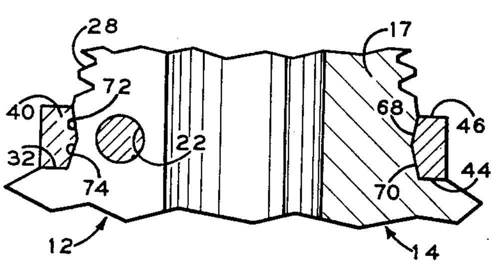

FIGURE 9

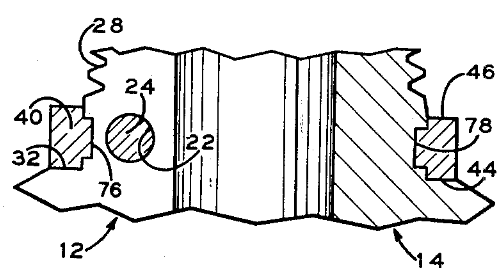

FIGURE 10

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3,127,794
METHOD OF MAKING DRILLING BITS

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Original application Mar. 31, 1959, Ser. No. 803,110, now Patent No. 3,061,025, dated Oct. 30, 1962. Divided and this application Aug. 16, 1962, Ser. No. 217,391
3 Claims. (Cl. 76—108)

This invention relates to drilling bits and more particularly to an improved drilling bit of the unitized type especially adapted for drilling holes in the ground such as shot holes, blast holes, grout holes, test holes, exploratory holes and small water holes. The present application is a division of application 803,110, filed March 31, 1959, now U.S. Patent 3,061,025.

Drilling bits of the unitized type are conventionally constructed of a plurality of cooperating bit segments, each segment having its cutting portion finished while the segments are in their individual condition and then the cooperating segments are secured together, usually by electrical welding. The primary reason for finishing the cutting portion of the bit as individual parts or separate segments is because of ease in manufacture. Particularly when dealing with bit blades of the insert type, it is an awkward procedure to try to fix the inserts on each of the blades of the bit when the individual segments are rigidly secured together. Moreover, the grinding of the cutting edge is made considerably more difficult due to space requirements and the like. It is, therefore, highly advantageous in the manufacture of a drilling bit to be able to finish each blade as a separate unit and then subsequently secure the units together to form a unitized bit.

The term "unitized" as used in connection with this type of blade refers to the fact that the individual blade segments are rigidly secured together as a unit, as opposed to removable type blades such as those disclosed in Hawthorne Patents 2,666,622 and 2,783,973. These patents disclose drilling bits which are made up of separate segments. The segments are mounted in a holding or clamping device and then mounted directly on the drilling collar rather than being rigidly secured together by the manufacturer prior to shipment. Stated differently, with a removable type blade bit, the segments are mounted together in fixed rigid relation by the user and shipped by the manufacturer as separate segments. A unitized type of drilling bit is initially made by the manufacturer in separate individual segments and these segments are rigidly fixed together by the manufacturer and shipped in that condition.

One significant problem encountered in the manufacture of unitized drilling bits of the type having insert type cutting blades results from the fact that when the separate segments are secured together by electrical welding, heat affected zones are created in the shanks of the bit segments, causing the formation of extremely hard spots in the metal. The creation of these hard spots makes subsequent machining of the welded unit, such as threadcutting and the like, difficult and inaccurate. Also, the heat generated in prior art welding procedures may develop heat-affected zones in the material which are weak and would result in failure of the bit in operation. Such weak zones can be strengthened by heat treatment of the welded unit but such heat treatment is rendered difficult, if not impossible, due to the melting point of the silver bond holding the inserts on the blades. The silver or silver bronze alloys melt at approximately 1100° F. to 1500° F., whereas the heat necessary for heat treatment is 1600° F. to 1800° F. Also, the difference in the thermal expansion and contraction of the steel of the bit and tungsten carbide

would shear the silver alloy bond, should the parts be brought to this temperature.

An object of the present invention is the provision of a method of manufacturing unitized drilling bits which eliminates the necessity of securing the bit segments together by an electrical welding procedure, thus eliminating the problems noted above.

In its broadest aspect the method of the present invention contemplates the finishing of a plurality of bit segments individually and then subsequently positioning the segments together in a shop fixture. The segments are then machined while they are held together in the jig or fixture and a retaining ring that is expanded by heat is placed onto the unit to positively retain the segments together.

It will be readily understood that in the manufacture of drilling blades it is highly desirable to use high speed automatic equipment to perform the machining operations for purposes of economy, maximum production and the like. However, due to the accumulation of inaccuracies resulting from tool wear, material variation and operator's inaccuracies and the like, the bits produced on high speed automatic equipment are not always machined within the desired tolerances required in operation. For example, most drilling bits are secured in the drilling string by a threaded connection, the lower end of which has an interior tapered thread box for receiving a cooperating threaded pin on the bit. In turning an exterior tapered thread on a one piece drilling bit by the use of high speed automatic equipment, the taper of the thread as well as the thread form can usually be made within the required tolerances. However, the axial position of the threads on the bit can not always be accurately determined within required tolerances. With the use of a tapered thread type connection between the drilling collar and the drilling bit it is important to provide on the drilling bit an abutment means, usually in the form of an annular shoulder, for engaging the lower end of the drilling collar to thereby limit relative axial movement between the drilling collar and the drilling bit. It will be understood that the axial position of the annular shoulder or abutment means must come within rather close tolerances in order for the connection to be proper and sufficiently rigid.

Accordingly, it is another object of the present invention to provide a method of manufacturing unitized drilling bits of the type described which enables the bit to be machined by the use of high speed automatic equipment, the possible inaccuracy of such equipment being compensated for by an improved procedure.

In this regard, the method of the present invention contemplates the utilization of a shrink or sweat ring, both to retain the segments together and as the abutment means for engaging the lower end of the collar, in operation, to limit axial movement. More specifically, in the general procedure mentioned above, prior to the step of shrinking the retaining ring on the bit segments, a ring receiving portion is machined in the bit segments while they are held together, and subsequently the axial position of the tapered threads are gauged with respect to the ring receiving position. By employing a sweat ring of appropriate thickness the annular shoulder of the finished drilling bit, provided by the upper surface of the sweat ring, is accurately positioned axially with respect to the tapered threads. In this way, any possible inaccuracies that may result from the use of high speed automatic equipment in the turning of the tapered threads is compensated for.

The present invention also has for an object the provision of a drilling bit of the unitized type embodying a retaining ring for securing together individual blade bit segments in fixed, rigid condition, under stress, such ring also serving to provide an abutment surface for engaging the lower end of a drilling collar when the drilling bit is connected in a drilling string.

Still another object of the present invention is the provision of a drilling bit of the type described which is simple and economical in manufacture and which can be easily serviced and maintained.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appendant claims.

The invention may best be understood with reference to the accompanying drawings wherein an illustrative embodiment is shown.

In the drawings:

FIGURE 1 is an elevational view of a drilling bit, embodying the principles of the present invention, showing the same operatively connected with a drilling collar, the latter being illustrated in vertical section;

FIGURE 2 is a top plan view of the drilling bit with the drilling collar removed;

FIGURE 3 is a cross-sectional view taken along the line **3—3** of FIGURE 1;

FIGURE 4 is a fragmentary cross-sectional view taken along the line **4—4** of FIGURE 2; and

FIGURES 5–10 are views similar to FIGURE 4 illustrating various modifications of the sweat ring which may be utilized in the drilling bit.

Referring now more particularly to the drawings, there is shown in FIGURES 1–4 a drilling bit of the utitized type, generally indicated at **10**, which embodies the principles of the present invention. In general, the bit is made up of a plurality of blade bit segments **12**, **14** and **16**. It will be understood that any desired number of segments may be employed although the utilization of three segments, as shown, is preferred. The segments are made of any suitable material as, for example, tool steel or the like, each segment being preferably produced by a forging operation. Each blade segment, as forged, includes an upper shank portion **17** and a lower blade portion **18**.

The exact configuration and method of forming the blade portion **18** of the blade bit segments form no part of the present invention. Preferably, they are constructed in accordance with the teachings of Weaver et al. Patent No. 2,894,726. In brief, the blade portion of each segment is forged so as to provide recesses **19** along the cutting edge thereof. In accordance with the teachings of the above mentioned patent, inserts **20** are subsequently positioned in the recesses and secured therein by the application of a suitable bonding agent of the type described in the aforementioned patent.

The upper shank portion of each bit segment is forged in 120° sector conformation as clearly illustrated in FIGURE 3. If necessary, the radial faces of the shank portion of each forging is initially ground to a desired accuracy. Next, the radial faces of the shank portion of each segment forging are drilled to form an aperture **22**. As shown in FIGURE 3, one of the apertures **22** in the segment **12** has its axis perpendicular to the associated radial face while the axis of the other aperture **22** in the segment **12** has its axis extending perpendicular to the axis of the first mentioned aperture. The apertures formed in the segment **16** are positioned in a like manner. Finally, the apertures **22** in the segment **14** have their axes parallel to each other and extending at an angle of approximately 60° with respect to the associated radial faces.

The apertures **22** formed in the bit segments **12**, **14** and **16** are accurately located so that three dowel pins **24** may be positioned within cooperating apertures as shown in FIGURE 3, to retain the three segments in cooperating relation so that their shank portions define an annular member having a central opening **26** extending therethrough. It will be understood that in assembling the segments with the dowel pins **24**, the segments **12** and **16** are initially secured together by inserting a dowel pin **24** within the apertures **22** formed therein which extend perpendicular to the associated radial faces. Finally, the segment **14** can be moved into position over the dowel pins **24** in the associated apertures **22** of the segments **12** and **16** by a substantial linear movement in the direction of extent of the associated pins **24**.

The dowel pins **24** serve to retain the shank portions of the segments in their proper relation with respect to each other, but they do not effect a sufficient securment of the segments together to permit subsequent machining without the utilization of additional securing means. For this purpose, the segments may be secured in position for purposes of machining the same together by tack welding, away from the threaded section, a suitable jig (not shown) or any other means. With the segments thus secured together, the exterior of the annular member formed by the shank portions of the segment is formed at its upper end with a tapered thread **28**. As indicated above, the formation or turning of the tapered thread **28** is preferably accomplished by mounting the segments, fixed together, on a high speed automatic machine. In addition to the tapered thread **28**, a ring receiving portion is machined in the shank portions of the segments, while held together, in a position below the thread **28**. This ring receiving portion preferably takes the form of an exterior cylindrical surface **30** of a predetermined diameter having an upwardly facing perpendicular transverse surface **32** extending from the lower end thereof.

As previously noted, with the use of high speed automatic equipment for turning the threads **28** accuracy of taper and thread form can readily be obtained. However, the axial position of the threads on the annular member formed by the shank portions of the segments can not always be accurately located. In a like manner, accuracy in the diameter of the cylindrical surface **30** can be readily achieved, but the axial position of the perpendicular transverse surface **32** does not always fall within the required tolerances of, for example, 1/16 inch.

The threads **28** provided on the annular member formed by the shank portions of the bit segments, in operation, are arranged to cooperate with interior tapered threads **34** formed in the lower end portion of a drilling collar **36**. To provide a proper threaded connection between the drilling collar and the drilling bit **10**, the relative axial movement between the two members should be positively limited when the threads **28** and **34** are in an optimum cooperative position with respect to each other. To this end, the drilling collar **36** includes a lower end surface **38** which forms one abutment means for effecting this limitation of axial movement.

As noted above, because the perpendicular transverse upwardly facing surface **32** formed in the bit segments can not always be accurately located in an axial direction with respect to the threads **28**, the cooperating abutment means on the drilling bit **10** is provided by a sweat ring **40**, which also serves to rigidly fix the bit segments **12**, **14** and **16** together after the same have been machined on the high speed automatic equipment.

As best shown in FIGURE 4, the ring **40** includes an interior cylindrical surface **42** having a diameter which, under temperature conditions, is somewhat smaller than the diameter of the cylindrical surface **30**. In addition, the ring includes a lower perpendicular transverse surface **44** which is arranged to engage the transverse surface **32** and an upper perpendicular transverse surface **46**, which, in operation, is arranged to engage the lower end surface **38** of the drilling collar so as to provide a cooperating abutment means therewith to limit relative axial movement between the drilling collar **36** and the drilling bit **10**.

Prior to the fitting of the sweat ring **40** into engagement with the ring receiving portion of the annular member provided by the shank portions of the bit segments, the relative axial position of the perpendicular transverse surface **32** is determined with respect to the diameter of the tapered threads **28**. This determination can be obtained by any standard A.P.I. gauging procedure with the use of Standard A.P.I. gauging equipment. Once the axial distance between the surface **32** and an axial position on the tapered threads **28** of a given diameter has been determined, it is a simple matter to determine the proper axial location of the surface **46** of the sweat ring **40**.

Preferably, this surface is located by choosing from a stock of sweat rings of various thicknesses and constant interior diameter, a ring having a thickness which will dispose the upper surface **46** in the proper axial location when the lower surface **44** is in engagement with the surface **32**. In normal manufacturing procedure, the operator performing the gauging operation will stamp on the bit a ring code number indicating the thickness of the ring which must be utilized with the particular drilling bit.

The sweat ring **40** is mounted in engagement with the ring receiving portion of the drilling bit **10** by heating the same to an elevated temperature to thereby expand the same and increase the interior dimension of the surface **42** so that it can be moved into engagement with the surface **30**. Such heating may be effected by direct flame application or by placing the ring in a furnace. In practice it has been found that the ring should be heated to a temperature of the order of at least 900° F. up to a maximum temperature of the order of between 1600° F. and 1800° F., a specific example of a preferred temperature being 1050° F. Of course, the ring is fitted onto the ring engaging portion of the drilling bit while the segments are held together and while the ring is in a heated condition. The segments should be at room temperature. When the sweat ring is properly fitted on the drilling bit with the lower surface **44** thereof in engagement with the surface **32**, and allowed to cool to room temperature, the upper abutment surface **46** will be disposed in proper axial position. This surface provides an abutment means in the form of an annular shoulder for engaging the lower end **38** of the drilling collar to insure a proper threaded connection between the drilling collar and the drilling bit.

Moreover, the sweat ring **40**, when it has cooled, is under stress and serves to rigidly fix the individual segments of the drilling bit together without the necessity of subsequent electric welding. The position of the ring on the drilling bit is such that it provides an optimum securement of the segments together and in addition cooperates with the drilling collar to provide an optimum threaded securement between the latter and the drilling bit. Moreover, the sweat ring can be removed for purposes of repairing the blade portions of the segments when they become worn or damaged.

While the procedure described above is greatly preferred, it is also possible to utilize the sweat ring **40** as a means for securing the segments together prior to the formation of the tapered threads **28**. When so employed, only one thickness size of the ring need be employed but, of course, it would become necessary to turn down the surface **46** in some instances to properly locate the abutment surface in an axial direction.

It will also be understood that the present invention is applicable to unitized bits of the blade type which are not provided with inserts as well as bits embodying rotary cutters and the like.

In FIGURES 5–10 there are shown various modifications of the cross-sectional configuration of the sweat ring that may be utilized in the drilling bit **10**. In general, the various embodiments of the sweat ring shown in these figures provide upper and lower perpendicular transverse surfaces **46** and **44** similar to the surfaces **46** and **44** previously described. However, the interior surface of the ring has been modified. In FIGURE 5, the interior of the ring includes a cylindrical surface **42** having an annular groove **48** formed therein. The cylindrical surface **30** of the ring receiving portion of the drilling bit

is provided with an annular ridge **50** arranged to cooperate with the annular groove **48**.

In FIGURE 6, the interior surface of the ring is frusto-conical and diverges upwardly, as indicated at **52**. The corresponding surface of the ring receiving portion of the drilling bit is frusto-conical, as indicated at **54**, and tapers in the cooperating direction.

FIGURE 7 discloses a construction similar to FIGURE 6 wherein the cooperating interior surfaces of the ring and exterior surface of the drilling bit are frusto-conical. However, the surface of the ring converges upwardly, as indicated at **56**, as does the surface of the drilling bit, as indicated at **58**.

FIGURE 8 discloses a configuration which is a combination of that disclosed in FIGURE 6 and FIGURE 7. More specifically, the interior surface of the ring **40** includes upper and lower portions which are frusto-conical and taper in opposite directions, the upper portions converging upwardly and the lower portions converging downwardly, as indicated at **60** and **62**. The cooperating exterior surface of the drilling bit is similarly tapered, as indicated at **64** and **66**.

FIGURE 9 illustrates a configuration which is a substantial reversal of the configuration illustrated in FIGURE 8. That is, a double frusto-conical configuration is employed, but the upper part of the interior ring surface diverges upwardly, as indicated at **68**, while the lower portion diverges downwardly, as indicated at **70**. The cooperating surface of the ring receiving portion of the drilling bit tapers in a corresponding manner, as indicated at **72** and **74**.

FIGURE 10 illustrates a configuration which is substantially the reversal of that illustrated in FIGURE 5. As shown, the interior surface of the ring **40** is provided with an annular ridge **76**. The corresponding surface of the ring receiving portion of the drilling bit is provided with a cooperating annular groove **78**.

It will be understood that, in all modifications described above and illustrated in FIGURES 5–10, the dimensions are such as to permit the ring to be expanded by heat and fitted over the cooperating surfaces on the drilling bit in the manner indicated above in connection with the embodiment illustrated in FIGURES 1–4.

It thus will be seen that the objects of this invention have been fully and effectively accomplished. It will be realized, however, that the foregoing specific embodiment has been shown and described only for the purpose of illustrating the principles of this invention and is subject to extensive change without departure from such principles. Therefore, this invention includes all modifications encompassed within the spirit and scope of the following claims.

I claim:

1. A method of producing a drilling bit of the type including a plurality of bit segments having cooperatively engaging upper shank portions rigidly secured together and provided with exterior tapered threads and an annular shoulder for engagement with the end of a cooperating interiorly threaded drilling collar which comprises the steps of forming the bit segments individually, positioning the shank portions of the segments in cooperating engagement, forming exterior tapered threads and an exterior ring receiving portion adjacent the lower end of the threads on said cooperating shank portions while together, measuring the axial position of the tapered threads on said bit segments to determine the proper axial location of said shoulder, heating separate from said bit segments a ring of interior dimensions less than the exterior dimensions of said ring receiving portion, fitting said ring, while heated, on said ring receiving portion in a position such that the upper surface of said ring will be disposed in the determined axial location of said shoulder, and allowing said ring to cool whereby the same serves to rigidly secure the bit segments together under pe-

ripheral stress and to provide said collar end engaging shoulder.

2. A method as defined in claim 1 wherein each of said bit segments includes lower rigid cutting blade portions formed with recesses along the cutting edges thereof, and wherein inserts of a hard material are secured within said recesses during the individual forming operation of each segment.

3. A method as defined in claim 1 wherein said ring is heated to a temperature of the order of between 900° F. to 1800° F.

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