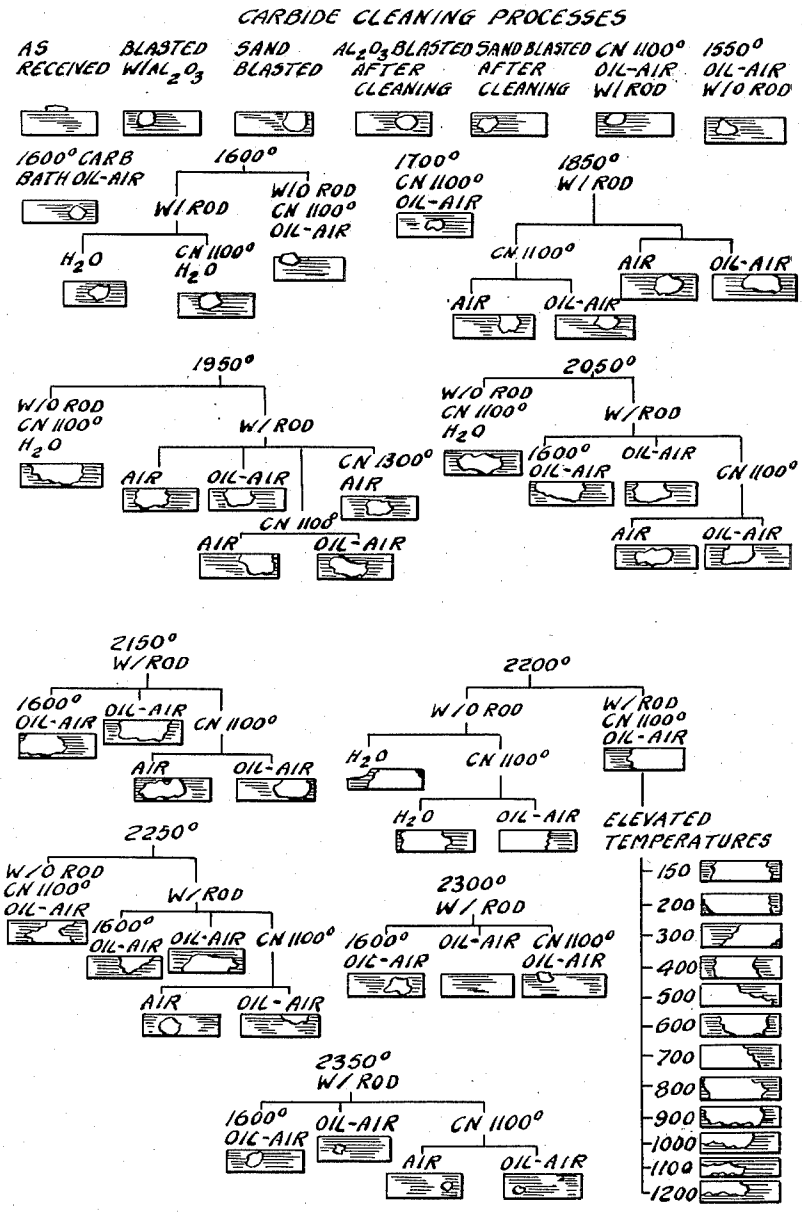
April 18, 1961 L. B. TONEY 2,979,811

CEMENTED CARBIDE BODY HAVING WETTABLE SURFACE AND METHOD OF PRODUCING SAME

Filed Oct. 24, 1958



INVENTOR.
LAWRENCE B. TONEY
BY
Whittemore, Hulbert & Belknap
ATTORNEYS

United States Patent Office 2,979,811
Patented Apr. 18, 1961

2,979,811

CEMENTED CARBIDE BODY HAVING WETTABLE SURFACE AND METHOD OF PRODUCING SAME

Lawrence B. Toney, Rochester, Mich., assignor to National Twist Drill & Tool Company, Rochester, Mich., a corporation of Michigan

Filed Oct. 24, 1958, Ser. No. 769,354

8 Claims. (Cl. 29—182.7)

The present invention relates to a cemented carbide body having a wettable surface and the method of producing the same.

It is an object of the present invention to provide a cemented carbide body, of the type commonly employed as cutting bits or blades, with a surface having increased affinity for conventional brazing materials such for example as a silver brazing alloy, and which is therefore wettable thereby.

More specifically, it is an object of the present invention to provide a cemented carbide body formed of metallic carbide particles bonded together with a cementing binder which is essentially cobalt in which some of the cobalt is caused to migrate to the surface portion of the body to form a continuous cobalt case to a depth of approximately 100 micro-inches.

It is a further object of the present invention to provide a method of treating cemented carbide bodies to improve the bond produced by brazing, which treatment consists of heating the body to a temperature of 1950–2250 degrees Fahrenheit, thereafter cooling the body to room temperature, and preventing air from coming in contact with the body during heating and cooling.

More specifically, it is an object of the present invention to provide a method of treating a cemented carbide body which comprises heating the body to a temperature of 1950–2250 degrees Fahrenheit by immersion in a salt bath, followed by quenching in a quenching salt bath at a temperature of approximately 1100 degrees Fahrenheit, and thereafter, further quenching in oil or water.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, illustrating a preferred embodiment of the invention, wherein:

The figure is a diagram illustrating the appearance of test specimens, the legends indicating the treatment.

Prior to the present invention cemented carbide bodies have been cleaned by blasting with sand or with aluminum oxide. The surface of the cemented carbide body cleaned by these methods is not easily wetted by brazing alloys, and accordingly imperfect brazed connections with support bodies have been obtained.

It has been found that a surface readily wettable by brazing alloys may be formed on the cemented carbide body by immersing the body in a salt bath at a temperature of between 1950 and 2250 degrees Fahrenheit and quenching in any medium that prevents oxidation. Best results were produced by immersion in a bath operated at about 2200 degrees, quenching in salt at about 1100 degrees, and then quenching in oil. However, it has been determined that the critical condition was the high heat temperature and any quenching sequence or medium could be used provided that the opportunity for oxidation was excluded. The duration of immersion in the heating bath need only be sufficient to insure bringing the surface portions of the body to the critical temperature.

It has been found by examination of the cleaned cemented carbide body that the treatment causes a migration of some of the cobalt or other bonding material to the surface to form a film, case or shell to a depth of about 100 micro-inches. This surface is a surface which exhibits the affinity for the brazing alloy and is efficiently wetted thereby.

Careful tests indicate that the process has no detrimental effects on the carbide.

Wettability of the treated carbide bodies subjected to different cleaning processes was determined by testing with silver brazing alloy (Easy Flo 3) cut and weighed to insure uniform amounts for each specimen of cemented carbide. This alloy has approximately the following composition by weight: silver 50%, copper 15½%, zinc 15½%, cadmium 16% and nickel 3%. The actual weight of the brazing alloy was .044 gm.±.002 gm. The cemented carbide after treatment was placed on top of the brazing alloy in a ceramic boat in which flux was preheated to a liquid state. The alloy sinks to the bottom and the carbide specimen sinks onto the brazing alloy. This process hinders spread of the alloy and thus provides a severe test of wettability of the surface of the carbide specimen. The boat was then placed in an induction heater (Thermonic) and heated for a period of ten seconds, to bring the brazing alloy well above its fusion temperature.

Referring now to the drawing, the rectangular blocks represent the specimen of cemented carbide and the area thereon enclosed by the irregular line indicates the spreading over the surface of the test sample of the brazing alloy. Test blocks were 1 x ¼ x 1/16 inch. Wettability of the surface by the alloy is of course indicated by an enlargement of the area enclosed within the irregular line.

The salt employed in the high temperature bath is essentially barium chloride which is sold by the A. F. Holden Company of Detroit, Michigan, as a high speed hardening salt under the designation HS–17–23–AA–15. This salt was selected only because it is a high temperature salt and any salt operable within the designated temperature range may be employed. In heat treatment it is sometimes considered desirable to provide a carbon rod in the bath and accordingly, in the tests disclosed herein tests were made both with and without the carbon rod in the bath. It was found that the rod had no direct effect on the cleaning, but is useful in keeping the bath clean. A contaminated bath of course would not produce a clean surface. In the figure there is designated whether a carbon rod was or was not used.

The intermediate quenching salt bath consists essentially of sodium cyanide, potassium chloride, and potassium cyanate and is designated on the drawing as "CN 1100°."

In some cases the bodies were quenched in oil, in other cases in water, and in some cases were allowed to cool in the air after having been quenched in the intermediate bath.

Under the group of specimens treated at 2200 degrees Fahrenheit, as seen in the figure, appears a heading "Elevated Temperatures." These specimens after completion of the treatment as heretofore disclosed, were subjected to the designated temperature prior to brazing. This was done to determine the effect of oxidation. As is apparent in the figure, oxidation begins to affect the wettability of the carbide at about 900 degrees Fahrenheit.

Life tests were made on the treated cemented carbide bodies. Tests to date indicate that up to six months (the time available so far for testing) no visible deterioration due to ageing is ascertainable.

Tests were made on different grades of carbide as follows, the proporations being by percent weight:

Source	Grade	Tungsten Carbide	Titanium Carbide	Tantalum Carbide	Cobalt
Kenna-metal	K6	94			6
Carboloy	44A	94			6
	78B	82	8		10
	350	70.7	12.6	12.2	4.5
	370	72	8	11.5	8.5
	883	94			6
Firth-Sterling	4	94			6
	4A	90.5		3	6.5
	TXL	81	12.5		6.5
	T-04	85	4	1	10
Allegheny-Ludlum	CA4	94			6

In the tabulation above it will be noted that a typical cemented carbide is 94% tungsten carbide and 6% cobalt. It will further be observed that Carboloy for example, produces two different grades having the same proportion of tugnsten carbide and cobalt. The differences in these two grades is in the coarseness of the carbide grains. Tests indicate that the variations in size of the grains of Carboloy do not affect results obtained by the practice of the method disclosed herein.

A comparison of the specimens illustrated in the figure make it apparent that significant improvement was obtained when the cemented carbide bodies were brought to a temperature of at least 1950 degrees Fahrenheit, and that best results were obtained when the bodies were immersed in a bath of about 2200 degrees Fahrenheit, quenched in the cyanide bath at about 1100 degrees Fahrenheit, and finally quenched in oil. It is further noted that heating above 2250 degrees Fahrenheit produced result definitely inferior to those obtained in the selected range.

The several specimens illustrated in the figure are slightly misleading because the spread of the brazing alloy is shown in only two dimensions. If the surface of the carbide body is not at all wettable by the brazing alloy, the alloy does not tend to spread but remains in a generally rounded relatively thick globule. Globules of this types are well indicated for example under the 2350° with rod test. In other cases where the brazing alloy did not wet the surface of the carbide body, the melted brazing alloy tended to run off to one side. Thus for example, in the upper left hand corner of the figure the specimen labelled "As Received" ran completely off the block and adhered to the side. It may be mentioned in passing that some of the blocks fractured when quenched in water, as for example the specimen indicated under 2200° without rod and quenched in water. Nevertheless, the remaining portion of the body was substantially covered by the spreading brazing alloy, indicating that the surface was wetted.

In order to determine if the cleaning process had a harmful effect on other properties of the cemented carbide body, a specimen was cycled five times through the cleaning process at temperatures of 1900, 2000, 2100, and twice at 2200 degrees Fahrenheit. The sample was then analyzed and it was found that there was no apparent change in hardness, structure or porosity, but there appeared to be a migration of some of the cobalt binder to the surface to form a shell or case to a depth of less than 1000 micro-inches, as for example, about 100 micro-inches, the outer surface of which is essentially cobalt.

A spectrographic analysis revealed that the surface was essentially cobalt, with traces of nickel and iron. The nickel and iron obviously came from the electrodes and salts. Micro-hardness tests showed that the cobalt is comparatively soft, having a hardness of about 200 Brinell.

A shear test was performed to determine whether the cobalt surface produced by the practice of the present method adversely affected the bond strength of a brazed joint. Joints were made of specimens that were prepared

by the salt bath method disclosed herein and by specimens that were cleaned by aluminum oxide shot blasting. Statistical analysis of the results showed no difference in the bond strength of the two cleaning methods.

It is desired to emphasize that the practice of the present method results in a surface readily wetted by brazing alloys so that uniform and highly efficient brazed bonds are obtained without the exercise of particular care to obtain a fully wiped joint. The practice of the present invention does not produce a bonded joint which is stronger than a carefully wiped joint in which the surface of the cemented carbide was satisfactorily cleaned by conventional methods such as sand blasting, steel shot blasting, or blasting with aluminum oxide. However, the wettability of the surface of the carbide blocks produced by fused brazing alloy resulting from the practice of the present invention permits the cemented carbide bodies, such as tool tips and blades and the like, to be brazed without particular care in wiping the joint and will result in uniform, highly efficient joints. In other words, the present invention permits the production of substantially 100% of satisfactorily brazed joints without the necessity of carefully wiping the joint, whereas similar procedures in the absence of the clean surface as taught by the present invention will produce a substantial percentage of imperfect and unsatisfactorily brazed joints.

The drawing and the foregoing specification constitute a description of the improved cemented carbide body having wettable surface and the method of producing the same in such full, clear, concise and exact terms as to enable any person skilled in the art to practice the invention, the scope of which is indicated by the appended claims.

What I claim as my invention is:

1. The method of treating a cobalt cemented carbide body composed essentially of one or more metallic carbides selected from the group consisting of tungsten carbide, titanium carbide and tantalum carbide, and a cobalt binder for said carbides, to improve wettability by brazing alloy which comprises: heating the body to a temperature of 1950–2250 degrees Fahrenheit, thereafter cooling the body to room temperature, and preventing air from coming in contact with the body during heating and cooling.

2. The method of treating a cobalt cemented carbide body composed essentially of one or more metallic carbides selected from the group consisting of tungsten carbide, titanium carbide and tantalum carbide, and a cobalt binder for said carbides, to improve wettability by brazing alloy which comprises: heating the body to a temperature of 1950–2250 degrees Fahrenheit by immersion in a salt bath for an interval sufficient to bring at least the surface portions of the body to the stated temperature, quenching in a salt bath at about 1000–1200 degrees Fahrenheit, and thereafter quenching to room temperature while protecting the body from air.

3. The method as defined in claim 2 which comprises rinsing the body in a dilute hydrochloric solution to remove residual salt.

4. The method of treating a cobalt cemented carbide body composed essentially of one or more metallic carbides selected from the group consisting of tungsten carbide, titanium carbide and tantalum carbide, and a cobalt binder for said carbides, to improve wettability by brazing alloy which comprises: heating the body to a temperature of 1950–2250 degrees Fahrenheit by immersion in a salt bath for an interval sufficient to bring at least the surface portions of the body to the stated temperature, quenching in a salt bath at about 1000–1200 degrees Fahrenheit, and thereafter quenching to room temperature in oil.

5. The method as defined in claim 4 which comprises rinsing the body in a dilute hydrochloric solution to remove residual salt.

6. A cobalt cemented carbide body composed essentially of one or more metallic carbides selected from the group consisting of tungsten carbide, titanium carbide and tantalum carbide, and a cobalt binder for said carbides, in which some of its binder material has migrated to the surface portion to provide a surface film or layer to a depth of not more than 1000 micro-inches.

7. A cobalt cemented carbide body composed essentially of one or more metallic carbides selected from the group consisting of tungsten carbide, titanium carbide and tantalum carbide, and a cobalt binder for said carbides, in which some of its binder material has migrated to the surface portion to provide a surface film or layer to a depth of approximately 100 micro-inches.

8. A cobalt cemented carbide body formed of metallic carbide particles selected from the group consisting of tungsten carbide, titanium carbide and tantalum carbide, and a cementing binder which is essentially cobalt, some of the cementing binder having migrated to the surface of the body to form a surface film or layer to a depth of approximately 100 micro-inches.

References Cited in the file of this patent

UNITED STATES PATENTS

2,176,802 Romp ---------- Oct. 17, 1939