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The 100th Anniversary of the Establishment of the Carbide: Carbide Bit

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Abstract

The goal of this paper is analysis of the history of the creation of the first carbide bits. In which conducted patent research on databases of leading in the research and development for the countries of the world, as well as on patent-associated literature. The result of this paper considers the history of tungsten carbide drill bits, and identified the first carbide rock-cutting as a tool for core drilling. We consider names of the inventors of the first patented bits in the world and the Soviet Union.

Keywords: Tungsten carbide; Rock-cutting; Drilling history

Introduction

Tungsten carbide is an alloy of elements including tungsten, nickel, tantalum, niobium, titanium and chromium. High quality tungsten carbide, like that used in our Tungsten Forever™ tungsten rings, is composed with a large percentage of tungsten, giving the alloy the inherent hardness and dark-grey color tungsten implies. By adding the other trace metals, the benefits of tungsten are maximized, and the resulting metal can be better worked into the many unique styles found on our site.

Establishment of the carbide

The Department of engineering exploration of the National Mining University pays great attention to the rock-cutting tool. These issues, in particular, was devoted to a series of dissertations [1]. Currently, scientists of the Department continue to work in this direction. So, only recently has the following works were published.

This paper analyzes the history of hard alloys and their application to drilling. Drilling began in the late Paleolithic and Neolithic (13-7 Millennium BC). Any process of creating holes can be seen as boring or drilling. In many languages for both these concepts, there is only one term (drilling, Bohren, etc.,). Holes made from stone tool types of wire, awl or drill.

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Among the findings of a late neolith plate found flint drill [2]. Later, in addition to the Flint drill began to apply diamond, corundum or as an abrasive made of quartz sand. With the advent of the steel industry for the manufacture of rock, cutting tool has become a widely-used copper [3].

Then replaced copper implements came bronze (early 2ND Millennium BC). Eventually the iron drove out them. The emergence of the actual drilling in rocks of the Earth's crust typically associated with Chinese civilization. On wells for water extraction and brine, built during the reign of the dynasty of Chou (early Rule 1122 BC) tells Confucius (sixth century BC). Some wells have had a depth of 900 m Wells drilled percussive way [4]. Drilling a projectile made of bamboo. To the lower end of the bit were (chisel), which destroyed the breed at bottom. There is information about drilling exploratory wells and in ancient Rome. Long time steel was the only material used for the manufacture of rock cutting tool. Diamond drilling was first suggested by master watchmaker George Augustus manufacture, in collaboration with his son Rodol'fom (Switzerland) [4].

In 1899, on the proposal of the engineer Davis (United States) as an alternative to Diamond begins to be used a drilling. Diamond drilling in some countries for some time, it has been completely superseded by the shot. Thus, by the early twentieth century, were not yet invented a material that can destroy rocks with any significant speed. The Aim of the present work we reviewed the history of hard alloys and their applications in fracture rocks, in particular to create tungsten carbide bits [5].

Presentation of the basic material. Hard metals are composite materials of a special class, which has high hardness, wear resistance and durability that are stored at high temperatures (600°C to 800°C). These properties are particularly useful in the drilling of wells. You can briefly define them as a composition consisting of refractory compounds, typically carbide, and a relatively low-melting binder material. Firstly, Henri Muassanom (Henri Moissan) synthesized tungsten carbide in 1893 when he fused tungsten with carbon in his electric furnace [6].

The next step towards the creation of carbide tools considered by a work of American engineer Frederick Winslow Taylor (Frederick Winslow Taylor). It belongs to the priority development of high-speed steel, which he shared with his compatriot White. On the basis of the known tool steel "Midvale, Taylor and Monsel' white (Maunsel White) applied high temperature quenching, provided her with high hardness and heat resistance, as well as improved the original [7].

Created by Taylor and white tool material based on tungsten, had a high resistance at high cutting temperatures and allowed to raise the cutting speed to 5 times, so it was named "high speed steel". Reached the speed of 40 m/min at the time was considered fantastic, and represented a real revolution in metalworking. In 1900 at the world exhibition in Paris created by Taylor and White steel won a gold medal. In 1907 d. Englishman Jelvudom Heyns (by Elwood Haynes) was patented "Stellite" (from Latin stella is a star)-cast solid cobalt based alloy, used not only for the manufacture of cutting tools, but also for welding machine parts and tools with a view to durability improvement (United States Patent 873745) [8]. Then there were the alloy carbides tungsten for welding on drilling as a wear-resistant coating. The first alloy carbides were part of more porous.

German inventor Hugo Lohman (Hugo Lohmann) in 1913-1914 Gg. tried to improve the properties of the alloy carbides due to grinding in a thin powder, pressing and heating the preforms formatted (dragged) to near the melting point [9]. The most famous of its development was hard alloy containing tungsten carbide and named "lomanit". This alloy was distinguished by exceptionally high hardness, approaching to the hardness of diamond, but like "Stellite" was extremely fragile, besides expensive, which has not received much spread. In the future, Lohman continued its development and made a number of inventions, on the various solid alloys, the most interesting of which singled out Meyer (J.R. Mejer) [10]. TABLE. 1 show information about these inventions.

TABLE 1. **The most important patents Lohmann.**

Raw material	Additives	Authors and Patent
WO_2 и C	-	Voigtländer A. and Lohmann H, patent DE286184 Germany, published 17.04.1914
Tungsten matrix, which is then exposed to carbon	-	Lohmann-Metall GMBH, patent DE335405 Germany, published 04.01.1921, declared 07 (08) .12.1918 Patent GB157774 UK, published 10.04.1922 No. SN96340 Switzerland, published 30.03.1921 Patent AT100441 Austria, published 07.10.1925 No. DK32119 in Denmark, published 20.08.1923
W and B or Si	Mo, Fe, Ti, Ni, Cr	Lohmann-Metal GMBH, patent GB157769 UK, published 07.10.1922, claims priority 12/07/1918 No. SN96341 Switzerland, published 30.03.1921
WO_2 or W	Th, U, Mo, Ta	Lohmann H, patent GB246487, published 17.02.1927, claims priority 01/24/1925
W	5% to 10% ThO_2 3% to 5% Mo	Lohmann (1926)

We note that this is not a complete list of patents for inventions of different modifications of hard alloys made by h. Broken. We point out some more, most early developments in this field:

-German patent DE289066 (o. Voigtländer and h. Lohmann, published by 03.01.1914)

-German patent DE289066 (o. Voigtländer and h. Lohmann, published by 30.01.1914)

-German patent DE295656 (o. Voigtländer and h. Lohmann, published by 12.04.1914)

-German patent DE295656 (o. Voigtländer and h. Lohmann, published by 17.05.1914)

-Uk patent GB27369 (o. Voigtländer and h. Lohmann, published 15.07.1915, pending 27.11.1913)

-United States Patent US1212426 (o. Voigtländer and h. Lohmann, published 16.01.1917, pending 02.12.1913)

-United States Patent US1610061 (h. Lohmann, published 07.12.1926, priority from 16.04.1914).

Based on patent activity Lomana and his firm Lohmann-Metall GMBH shows that the inventor is perfectly aware of the importance and the commercial value of its developments. Unfortunately, we could not in the databases of WIPO data, the EPO and Germany to find a mention of the issued in the name of Lohmann patents for carbide bits for drilling.

Although the literature exactly Lohman is associated with the creation of the first carbide bits.

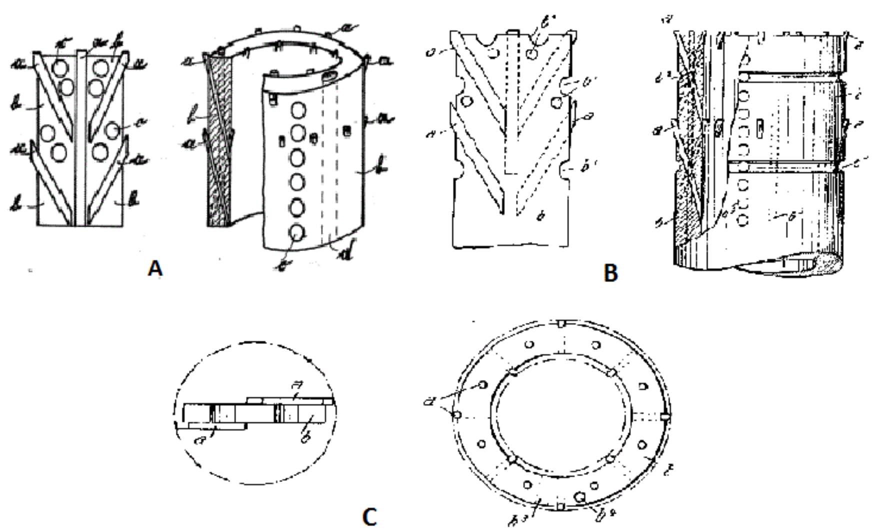
This can be due to several reasons:

- Author, whose main business interests lay in the field of metal cutting, not drilling, could not protect their interests in the area where he was not going to use his invention;
- Lohman could take it that he received patents for hard metals and without additional patentability will not allow anyone to use his invention in various related fields, without his consent;

- Perhaps the author believed that the crown he created is only way to use carbide, and, without a fundamentally new solutions to most of the crown design, lacks patentability;
- Finally, the option cannot be ruled out that we could not find an invention because it was patented in any other country that is not impossible, given that in those years Germany has participated in the first world war.

Thus, significantly called the creator of the first carbide bits is not possible. Our patent research on the database of the European Patent Office (Espacenet), which contains more than 90 million. patent documents from more than 90 countries of the world, revealed first issued patent to the crown, equipped with carbide cutters. With high probability, they can be considered as the crown, described in the German patent DE335805 issued in the name of Alfred Stapf and Hans Hundrieser. The patent was issued 14.04.1921 stated 26.03.1920. Almost at the same time, namely 16.03.1922 (filing date 22.12.1920) was granted a patent Switzerland CH93763. It does not indicate the inventor and the applicant was made by a German company Berlin-Anhaltische Maschinenbau-Actien-Gesellschaft. However, the design of the tooth described in this patent is almost similar to the previous one, so it is likely that the inventors are the same as in the German patent.

In FIG. 1 shows the bibliographic part of the description of the invention (FIG. 1a) and appearance of the crown of the German patent DE335805 (FIG. 1b), and the appearance of the crown, described in the patent Switzerland CH93763 (FIG. 1c).



a: Carbide inserts; b: The case of the softer metal; c: Radial Holes; d: Axial holes

FIG. 1. **Description of the invention on the first solid carbide bit. a) Bibliographic part of the description of the invention; b) The appearance of crowns, described in the German patent DE335805; C) Appearance of the crown, described in the patent Switzerland CH93763.**

Further development of hard alloys was facilitated by two progressive trends in technology: the emergence of new methods of manufacturing products made of refractory metals-powder metallurgy and development of methods for obtaining very strong "metal-like" substances carbides. The method of powder metallurgy remains the only possible, when you want to create alloys consisting of components of significantly different melting temperature. Patents Lehmann served as the basis for the development of various grades of alloy, Vidia (WIDIA=WIe DIAmant=like diamond) type G and H (the German standard for solid alloys). A breakthrough in the cutting of materials made of solid alloy based on tungsten carbide and cobalt, patented in 1922-1923 employees of Osram GmbH Carl Schröter (Karl

Schroter patents DE420689 and DE498349 declared in 1923) and Henry Baumhauer (Henrich Baumhauer-patent US1512191 declared in 1922). "Osram study society for electrical lighting" the electric lighting company Osram (OSmium+wolfRAM) in those days was the leader in the manufacture of electric lamps. Looking to replace diamond as the material for metal this firm received the first results in the sintering of alloys with the desired cutting properties.

But, not having the equipment to use this material on an industrial scale, Osram sells the license to German concern Fredrich Krupp at the end of 1925. In addition, Fredrich Krupp began commercial production of hard alloys and presents them on the market under the name Widia. At the Leipzig fair in 1927 demonstrated cutting tools from Widia N alloy of the composition 94% WC + 6% Co, designated subsequently in the German standard brand name G1. The tool revolutionized the Metalworking industry, allowing increasing speeds 10-20 times. Firm AC Wickman of Coventry acquired the exclusive rights to import Widia and sell it in the UK (under the brand name of vilit). Very interesting situation with hard alloys in the United States. "American industry is seriously ill," wrote Dr. E. Amman, one of Krupowki experts who reviewed the industrial potential of possible opponents in case of war [11]. The expert was based on the position in the United States with hard alloys of tungsten carbide. These alloys were already known for 10 years.

They are not threatened by the revolution in technology. Their role was much more important: they allowed several times to improve the performance of existing industrial equipment. Cutters with cutting plates made of hard alloy got to the beginning of the war in Germany is 20 times greater than in the US. Here only a few specialists knew them. Whereas in Germany pounds super hard alloy cost about $ 100 in the US the cost was 10 times higher. Gold, and cost half the price. As a result, the consumption of these alloys has been artificially retarded by nearly a quarter of a century. It was a major achievement kroposki patent. In addition, most interesting is that German patents for alloys solid any American court for many reasons could easily invalidate. The firm of Krupp was set up in relation to these patents very skeptical. The Germans knew that to slow down the development in such a technologically simple region is almost impossible. Therefore, they for a small amount sold the license to an American company "Karbala", a subsidiary of General electric. "Karbala" tried using the license to gain a monopoly in the U.S. and for this reason is not addressed to the court, but German patents were legally vulnerable. Instead, they inflated 10 times the price.

Only in 1940, after a special investigation the company was forced to reduce prices. However, by this time she is using German patents and causing enormous damage to the country's defense, finally crushed the competitors and concentrated in the hands of 80% of the production of hard alloys [11]. The emergence and formation of production of hard alloys in the USSR is closely associated with the previous development of technology for rare metals. In 1929, under the leadership of Meyerson and Malkov at the Moscow electrical plant was obtained the first samples of Soviet hard alloy, called wins, and then established and pilot production of products. An alloy containing 90% of monocarbide tungsten and 10% cobalt, intended for the manufacture of plates for equipment tools, dies for pulling the wire, inserts and drill bits. The term "win" and to this day is used by manufacturers, but quite forgotten the names of other compete with him domestic hard alloys: "Murom", "Svyatogor", "Dobrynya", "titanite", etc.,

In 1931, production of hard alloy relit (rare item cast). Note also the produced in the USSR hard alloys sormayt (plant "Red Sormovo", and then plant special steels), shift (Leningrad Institute of metals), Stalin and catch up (plant them. Schmidt), vokar (plant rare elements), drill powder, VZO (Elektrozavod), TAS-hard alloy for drilling blowtorch (plant rare elements) [9]. In 1933, in the laboratory of self-sharpening tools Ignatiev was the world's first self-sharpening carbide-insert bit. Zukhurov (Donbass) has proposed and used bits with a stepped arrangement under the end koromacno ring [12]. However, these developments were not patented.

Outstanding inventor Ignatiev went down in history as the inventor of the first self-sharpening cutting tool and received his patents in the USSR (No. 14451), Germany, USA, France, UK, Italy and Belgium. However, information on the receipt of a patent for a self-sharpening carbide tools, could not be found.

As a result of the patent research database of the Federal Institute of industrial property (Russia) we have found that the first patents for inventions relating to bits are the following two patents (issued in one day, although with a different filing date). Copyright certificate of the USSR 21086 a Method of producing cutters for drill bits. Author Karwacki published 31.07.1931 stated 06.01.1930. USSR patent 21895 Method welding of drill bits of solid carbide. The author is not specified, the applicant State all-Union electrotechnical Association "VEO". Published 31.07.1931 stated 22.03.1930. In these inventions was motivated by the opportunity and suggested a technology of drill bits hard alloy. First patented in the USSR design carbide boring tools should be recognized and described in with. USSR 33493 (Method of surfacing hard alloys of the type vokar or Stellite on the working part of the tool for rotary drilling, the authors Romanov and Roshchin, published 31.12.1933 stated 17.07.1932).

In FIG. 2 shows the working part of the tool with USSR 33493. In accordance with this invention, a solid alloy is fused to the working part of the tool parallel stripes at an angle to the axis of rotation. A strip so that the strip 1 solid alloy with one side of the blade correspond to the intervals between the 2 lanes on the other side of the blade chisels. Romanov was known specialist in the field of hard alloys, which has patented a number of inventions associated with them, including portarray tools.

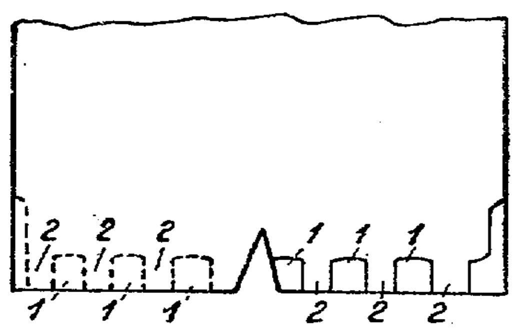
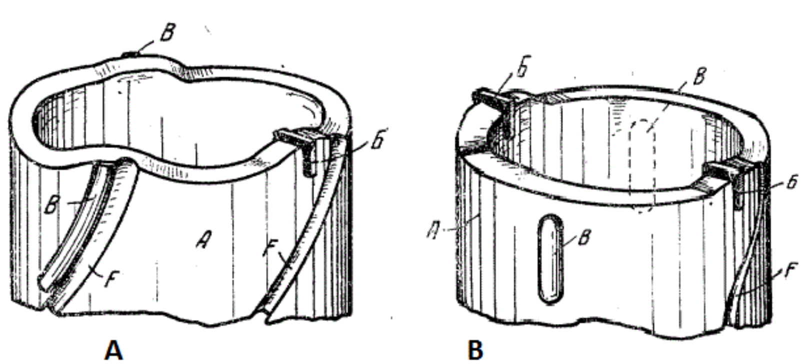


FIG. 2. **Bit Romanov and Roshchina.**



A-body; B-solid carbide cutters; C-Cemented carbide strips or islands; F-channels.

FIG. 3. **Carbide drill bits Romanova. a) crown with a cutter and two guide surfacing; b) crown with a symmetrical combination of two cutters and two claddings.**

He is also the author of the first patented designs in the Soviet Union Carbide bits. A.s. USSR 50195 drill bit, stated 07.02.1935, published 31.08.1935.

Conclusion

The paper considers the history of hard alloys. Conducted patent research, as a result of which revealed the world's first tungsten carbide drill bits. Its authors Alfred Stapf and Hans Hundrieser. Consider the appearance of hard metals in the USSR identified the first carbide rock cutting tool. Romanov were patented and chisel (co-authored with Roshhinym) and Crown.

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