Jan. 5, 1937. W. C. REA 2,066,853

HEAT TREATMENT OF CAST DRILL BITS

Filed July 18, 1933

Fig. 1.

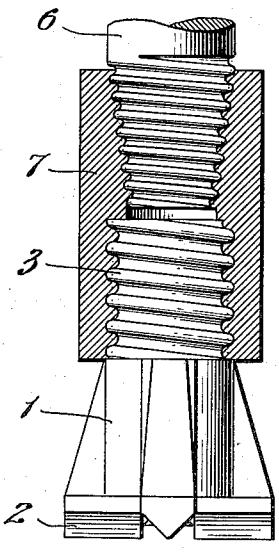


Fig. 2.

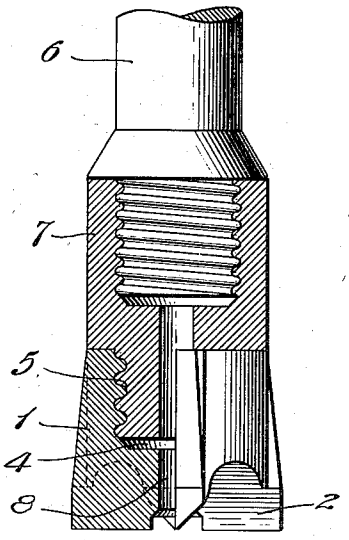
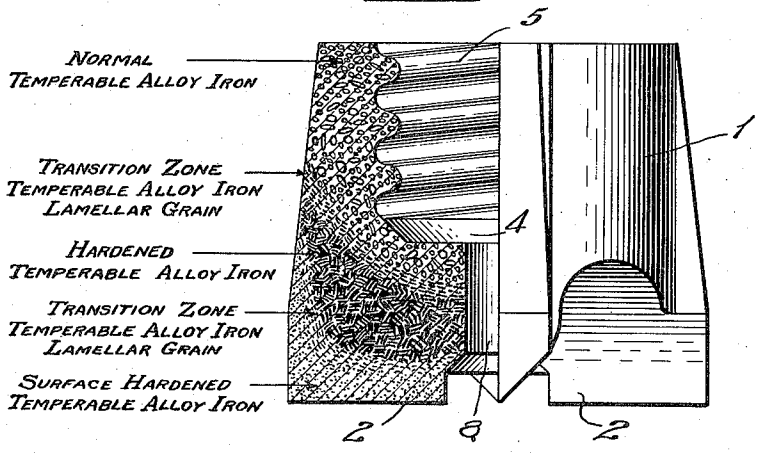


Fig. 3.



Inventor

Walter C. Rea

By Lowe & Lowe

Attorneys.

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HEAT TREATMENT OF CAST DRILL BITS

Walter C. Rea, New York, N. Y., assignor to The Detachable Bit Corporation of America, Bridgeville, Pa.

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2 Claims. (Cl. 148—21.7)

The invention relates to bit members for rotative percussive drills and bears particular relation to bits of a detachable nature, and has for its objects to provide new and useful improvements in devices of this character.

In rotative drills of the percussive type, the rotative bit and adjacent parts are subjected to great strains and shocks during usage, both as a result of the percussive action of the impact mechanism and rotative torque as well as due to relatively hard and flint-like materials encountered during the drilling operation.

An important object of the invention is to provide a detachable bit constructed of a temperable alloy iron which is capable of withstanding severe and continued strains and shocks of operation and usage without danger of breakage, notwithstanding the relative hardness of the rock or other material encountered by the bit.

A further object of the invention is to provide a drill bit which is cast entirely of alloy iron, including the teeth and internal or external threads usually provided. This is made possible and practicable by the material which I use in constructing the bit, as well as by special heat treatments to which the casting is subsequently subjected. Preferably the cast alloy iron bit includes the usual longitudinal channel for water, air or a combination of both.

The bit may be cast with integral teeth and an upper threaded socket for direct attachment to the lower end of the drill steel or for attachment to a coupling member having a threaded stem engaging the socket of the bit, said coupling member having threaded means at its upper end for threaded attachment to the lower end of the drill steel or rod.

If desired the drill bit may be cast with integral teeth thereon and an integrally cast upper threaded stem for engagement with a threaded socket in the coupling member, or for direct engagement with a threaded socket in the drill steel when desirable.

The invention also contemplates casting the drill bit including the teeth, with an upwardly projecting stem or hub designed to be securely shrunk into position within a sleeve or coupling member of metal having the same or different characteristics, said member being adapted at its upper end to be threaded or otherwise secured to the lower end of the drill steel.

Material economies are obtained by my invention due to the fact that the temperable iron alloy of which the bits are cast is of relatively low price and is readily obtainable on the market. Should the bit become worn it may be readily replaced by a new bit constructed in like manner.

After the bit is cast as an integral unit from the temperable alloy iron, the teeth may be heat treated and drawn or tempered as hereinafter described in order to obtain the desired degree of hardness in the teeth.

As a result of the invention it is possible to construct the entire drill bit as an integrally cast member or unit as distinguished from the usual forged and machined steel drill bit now employed for the purpose. The nature of the temperable alloy metal is such as to permit the threads of the drill bit to be cast in place coincidently with casting the entire bit, thereby obviating subsequent boring, reaming, facing and thread cutting, now necessary under present practice with attendant expense.

The drill bit member is preferably constructed as a casting as above emphasized. It will, however, be obvious that certain advantages of my invention will be obtained should the bit be constructed by other means, such as by forging and subsequent machining, it being understood that in every instance the drill bit is composed of a temperable alloy iron.

In the commercially obtainable types of bits such as the "crucible", "Timken", "Ingersoll-Rand" or "DeWitt", the socket or threaded portion must be annealed or softened after the hardening or tempering operation in order to relieve the hardness of the thin wall of the socket so as to obtain the same shock absorbing effect as is obtained when a separate coupling member is employed.

This invention contemplates the use of a bit of temperable iron alloy hardened throughout its entirety and connected to the drill rod by means of a shock absorbing coupling member. By constructing the bit of temperable iron alloy, the expensive operation of drawing back or softening by tempering mentioned above is avoided. In the bits mentioned above the drawn back or softened socket member performs the shock absorbing function whereas in my construction the bit is tempered throughout and the coupling member performs the shock absorbing function.

With such objects in view, as well as other advantages which may be incident to the use of the improvements, the invention consists in the use of the parts and combinations thereof hereinafter set forth and claimed, with the understanding that the several necessary elements constituting the same may be varied in propor-

tions and arrangement without departing from the nature and scope of the invention.

In order to make the invention more clearly understood there are shown in the accompanying drawing means for carrying the same into practical effect, without limiting the improvements, in their useful applications, to the particular constructions which, for the purpose of explanation, have been made the subject of illustration.

In said drawing:

Fig. 1 is a view in side elevation, partially in vertical section of a drill bit casting constructed in accordance with the invention and shown secured to the lower end of a drill rod by means of a coupling member.

Fig. 2 is a similar view of a modified form of the invention in which the drill bit casting is internally threaded, and the coupling member is omitted.

Fig. 3 is an exaggerated reproduction of a microphotograph of the cast metal of which the drill bit is composed, showing the different degrees of hardness in various locations of the metal after the several heat treatments incident to constructing the bit have been completed.

Referring to the drawing, 1 indicates generally the bit casting having the desired cutting teeth 2 formed integrally with the casting. In Fig. 1 the bit is cast with an integrally and externally threaded stem 3 thereon. In Fig. 2 the casting 1 is formed with internal socket 4, having screw threads 5 integrally formed thereon. In both embodiments of the bit the usual water channel 8 is provided in the casting. In use the improved bit is designed to be removably secured to the lower end of a drill steel or rod 6 by means of an interposed coupling member 7 and the construction and arrangement of the threads is preferably such that when it is desired to remove the bit the loosening will occur between the bit and the coupling rather than between the coupling and the drill rod. During the drilling operations the connections are made so that it is preferable that the coupling become a more or less integral part of the drill rod since it is seldom necessary to remove the same therefrom and any removability is concerned with the bit proper from the coupling member. By providing a greater number of threads between the drill rod and the coupling member, as distinguished from between the bit casting and said coupling member, or an increased pitch of thread in the latter instance, the desired removability of the bit from the coupling is effected, as will be apparent from an inspection of the drawing.

In use of the parts in percussive or impact drilling the lower end of the drill rod constitutes in effect an antifatigue member, the coupling is a shock absorbing member and the bit is a wear resisting member, all of these attributes of the respective elements being obtained by the nature and degree of heat treatments to which the various metals are subjected.

After the bit member 1 including the teeth and threads are cast from a temperable alloy iron, such as commercially known Z-metal, it is subjected to a number of heat treatments as hereinafter described to impart to the metal at various locations therein the desired temper, hardness, malleability and resistance to withstand the severe strains incident to usage.

"Z-metal" consists of a specially heat treated malleable white cast iron and its composition and properties are fully described in United States Patents Nos. 1,574,374, 1,574,375, 1,574,376 and 1,574,377, issued Feb. 23, 1926 to William J. Diederichs and Anson Hayes.

The first operation after casting of temperable alloy iron or Z-metal is to grind the cutting face of the bit teeth to remove decarburized material. The cutting portion only of the bit is then subjected to a heat treatment of from 1700 to 1800° Fahr. for as short a time as possible to secure an even heat, after which the bit is immediately quenched in oil.

The cutting portions or teeth only of the bit are then subjected to a reheat of from 1650 to 1750° Fahr. for a relatively short time after which the heated portion of the bit is quenched in water.

The final operation is to subject the entire cast and heat treated bit element to a drawing heat in a suitable annealing furnace, at a temperature of substantially 450° Fahr. for a period of approximately four hours. The bit is then withdrawn, slowly cooled and is ready for use.

With my improved cast bit the wear on the reaming portion of the cutting teeth is less with the use of temperable alloy iron than with a steel of lower carbon content which has been hardened sufficiently to cut rock. When steel from .75 to 1.00 percent carbon content is hardened to 58 to 62 Rockwell C scale, it will cut rock but has a tendency of being brittle and spalling under the impact blows. When the hardness is lowered by a tempering process to a 50 to 54 Rockwell C scale, the steel becomes tough but will not stand up under the duty of cutting rock as it has a tendency of peining over from contact. The hardness of a temperable iron alloy secured by the above described successive heat treatments gives a 56 to 60 Rockwell C scale. The cast bits of this material cut rock and resist wear better than the steel bits of greater hardness.

The temperable iron alloy of which my bit is constructed, when properly hardened with two quenches, and thereafter drawn in the manner above described, gives a Rockwell C scale of 54 to 60 and experiments demonstrate it will cut fine, withstands impact, peining and far outwears steel on gauge wear.

After the described heat treatments have been effected the cutting portion of the bit has a degree of hardness substantially that of from 54 to 56 Rockwell C. The intermediate portion of the alloy between the bit proper and the threaded portion possesses a hardness degree of substantially 40 Rockwell C. The upper portion of the bit where the same is attached to the drill rod of coupling has a hardness of substantially 30 Rockwell C. The heat treatments impart the described degrees of hardness temper and malleability at different and various portions to obtain the desired results. For example, the cutting portion of the bit is extremely hard and wear-resisting, while the upper or threaded portion of the bit is more ductile and resistant to crystallization or fracture in the torque strains imposed at this point of attachment to the coupling. The metal intermediate these zones is tempered to an intermediate degree to gradually blend with the characters of metal at the opposite ends of the cast bit.

As best seen in Fig. 3 the upper or body portion of the bit member 1 is relatively unaffected by the heat treatments and consists of the normal temperable alloy iron, such as Z-metal of which the bit is originally cast. As above stated, this

upper portion of the bit possesses a hardness of substantially 30 Rockwell C. The intermediate portion of the bit, indicated in darker lines, shows the result of the heat treatments to which the bit is subjected and is considerably harder than the upper portion, having a degree substantially that of 40 Rockwell C. The lower or cutting portion of the bit shows the much denser relation of the metal constituents as a result of the several described heat treatments and surface hardening. This portion of the bit possesses the hardness of substantially 54 to 60 Rockwell C scale. Between each described zone of hardness of the bit, as illustrated in Fig. 3, there is present a transition zone or zone of lamellar grain, which represents the merging or blending of the described upper, intermediate and cutting zones of substantially different degrees of hardness and consistency. As the hardness increases downwardly toward the cutting portion of the bit, the metal becomes denser and more closely knitted together but this transition is much more gradual and even than would appear from Fig. 3 of the drawing, in which the various zones appear to terminate rather abruptly. This, however, is merely to emphasize the respective zones and for the purpose of clearness. The extremely hard cutting portion of the bit results largely from the oil quenching, constituting an important part of the described heat treating process.

What is claimed is:

1. A method of forming a drill bit for rotative percussive drilling, which consists in casting the entire drill bit as a unit of a temperable alloy iron, subjecting the cutting portion only of the bit to a heat treatment of from 1700 to 1800° F. to secure an even heat, quenching the bit, subjecting the cutting portion only of the bit to a reheat of from 1650 to 1700° F., quenching the bit, subjecting the entire cast and heat treated bit in an annealing furnace to a drawing heat at a temperature of substantially 450° F., and then slowly cooling the bit.

2. A method of forming a drill bit for rotative percussive drilling, which consists in casting the entire drill bit including the attaching threads as a unit of a temperable alloy iron, grinding the cutting end of the bit to remove decarburized material from the bit teeth, briefly subjecting the cutting portion only of the bit to a heat treatment of from 1700 to 1800° F. to secure an even heat, quenching the bit in oil, briefly subjecting the cutting portion only of the bit to a reheat of from 1650 to 1700° F., quenching the bit in water, subjecting the entire cast and heat treated bit in an annealing furnace to a drawing heat at a temperature of substantially 450° F. for a period of approximately four hours, and then slowly cooling the bit.

WALTER C. REA.