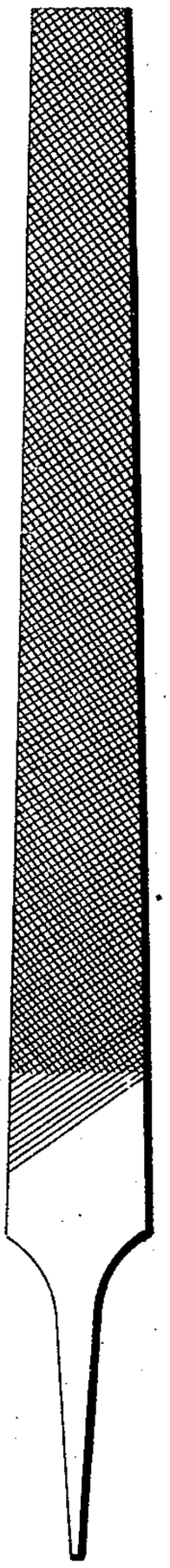
(No Model.)

M. A. HOWELL, Jr.

FILE.

No. 273,537. Patented Mar. 6, 1883.



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FILE.

SPECIFICATION forming part of Letters Patent No. 273,537, dated March 6, 1883.

Application filed November 10, 1882. (No model.)

To all whom it may concern:

Be it known that I, MARTIN A. HOWELL, Jr., a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Files, of which the following is a specification.

The object of my invention is to produce a file composed of metal having the essential characteristics of a true carburet of iron, all forging or hammering of said metal being avoided, whereby its crystalline structure remains unaltered.

To this end my invention consists in a cast-iron (decarburized and cut and subsequently recarburized and hardened) file having the essential characteristics mentioned above.

Referring to the drawing, the figure shows a file of one of the usual forms and embodying my invention.

In the manufacture of these files I employ the process set forth and claimed in an application filed by me the 25th day of January, 1883. This process is essentially as follows: It is well known to those skilled in the art that no edge-tool can be cast with a cutting-edge, and owing to the peculiar hardness of the metal no cutting-edge or cutting-teeth can be formed upon the cast blank without such expenditure of time and labor as to practically exclude the product from the market. Moreover, by all the processes in use prior to my invention for softening the metal and afterward restoring its hardness there has been no substance as yet known wherein the final product possessed the essential characteristics of a true carburet of iron. In this connection I will call attention to the fact that iron fused in contact with carbon combines with nearly six per cent. of that element. When this compound is cooled in such manner that the whole of the carbon remains in combination with the metal the product is known as "white cast-iron," which is extremely hard and of higher specific gravity, but brittle.

In order to convert cast-iron into bar-iron, it is necessary to remove the carbon and silicon associated with it. This is done by heating it in contact with oxide of iron, whereby the carbon is evolved in the form of carbonic oxide, while the silicon, also combining with a portion of the oxide, is converted into silicic acid, which unites with another portion, forming a fusible slag, which separates from the metal. In white cast-iron, however, the proportion of silicon is only about one per cent. This bar-iron may be again converted into cast-iron by restoring the proper percentage of carbon by cementation. In all the processes heretofore known, however, the metal has been heated in the presence of both carbon and oxygen, the latter being derived from the presence of atmospheric air. The consequence is that instead of the pure carbon with which the metal was formerly combined the known processes of cementation restore to the metal an oxide of carbon, and the presence of oxygen causes an oxidation of the surface of the metal, which in the process of converting a tool having a cutting edge or edges or cutting-teeth from bar-iron back to white cast-iron would entirely defeat the object of my invention by reason of the brittleness of the oxide. To avoid these objections and to produce files in finished condition and having all the characterics of a true carburet of iron, I construct said articles in the manner following: The files being first cast in molds in the form of blanks, it becomes necessary to remove the free carbon, and thereby restore the cohesion of the metal, by heating said blanks to a high degree in presence of oxygen or in contact with an oxide. After this operation is completed the blanks are in condition to be surfaced and cut, both which operations are performed by any of the well-known methods. The files thus formed being now in respect of their shape, teeth, &c., practically complete, it is necessary to restore the deficiency of carbon and to combine it with the metal without a trace of oxide, whereby it is again converted into a true carburet of iron. In order to accomplish this conversion, and at the same time avoid the oxidation of the surface by which the files would be practically ruined, I employ the following process: The files, after being decarburized and surfaced and cut in the manner already described, are placed in a flask or charger, together with substances rich in hydrocarbon, such as resins, animal and vegetable carbon, petroleum and its products, &c. The flasks or chargers are connected by a pipe with a gas-receptacle of any suitable form, and the former—viz., the flask—is adapted to be hermetically sealed, while the

gas-receptacle is exhausted of the air it contains, a cock or shut-off being placed in the pipe connecting the two, whereby the communication between them may be shut off. The exhausted gas-receptacle is placed in any suitable receptacle containing water, and weighted to keep it submerged. The flask or charger containing the files to be converted, together with the carbonaceous material, is placed in a muffle or other suitable furnace, and heat applied. As the heat of the furnace advances the vapors of hydrocarbon are generated, as already mentioned, being in advance of the temperature which is necessary to saturate the metal. The flasks containing the files also necessarily contain atmospheric air, and this air being mingled with the first vapors generated, the mixture is allowed to flow off through any suitable escape until the current is free from traces of oxygen. The outlet is then closed, and the cock in the escape-pipe is opened and the vapors allowed to flow into the exhausted vessel or gas-holder, where they are stored up for use at such a time as the advancing heat shall have raised the files to the point of saturation when the presence of said vapors will be required under heavy pressure to the end of the operation. By this means the vapors which under the former methods of carburization were dissipated and lost are stored up and retained for use, and all danger of an imperfect or partial saturation is avoided, as well as the further danger of injuring the metal by the oxidation of its surface through the presence of air. When the process is complete and the files become saturated the cock in the escape-pipe is closed, and the flask is taken from the muffle or furnace and placed in a pit, where it is covered with dry sand, lime, clay, or any suitable material which will preserve the heated flask from oxidation. Here it is allowed to cool down gradually, after which the contents are removed. The files being now charged with pure carbon, and no oxide being present, they will withstand a much higher heat in hardening than ordinary steel or any partially-oxidized metal. Therefore they are hardened in the usual manner without risk of oxidation, the result being the production of a tooth having all the characteristics of true carbon. These files resist the abrasion of all ordinary metals to a degree unsurpassed by any known product of steel.

It will be noticed that some of the steps of my process are old. For example, the decarburization of iron and its subsequent recarburization has long been known; and to this I lay no claim.

The special process of manufacture described above I have already disclaimed in this application as being presented in an application recently filed by me.

The files produced in this manner hold their teeth and resist abrasion far longer than files produced in any other manner. They present all the characteristics of true carburet of iron, the proper percentage of carbon having been restored by the process of cementation described.

In the process of annealing cast-iron in the presence of oxides or other matter having an affinity for carbon more or less of the free carbon remains in an oxidated condition. Now, by the final process of conversion in an atmosphere of hydrocarbon by the exclusion of all traces of oxygen the oxidated carbon is entirely deoxidated, leaving the metal a true carbide of iron—a standard impossible to be reached by any known process in manufacturing steel. Steel, therefore, is not a true carbide, as supposed by scientists, but an oxidated carbide of iron. In order, therefore, to determine a true carbide from an oxidated carbide, I will explain. In an oxidated carbide part of the carbon is combined with the metal, and part is crystallized between the particles of fibers. An annealing-heat will oxidize the latter by the admission of air at the point of expansion of the carbon, when the expansion of the carbon disintegrates the particles of metal or expands the metal, by which it becomes porous and admits air under the pressure of the surrounding atmosphere. This instantly oxidizes it and reduces it to graphite or free carbon, which, on breaking, after cooling gradually, is plainly seen in all annealed steel. When the carbon is wholly combined, as in pure white iron, or a true carburet, no process of annealing will show any carbon crystallized between the particles of iron; nor can it be oxidated at a point below fusion, and in many cases until the heat is raised beyond the point of fusion. This is why pure white iron remains pasty at or just above the melting-point. It requires an intense heat and a continuous blast to maintain fluidity, which renders the use of white iron impractical for the foundry, and suitable only for the forge or puddling.

Having thus described my invention, what I claim is—

A carbureted cast-iron file, substantially as described.

MARTIN A. HOWELL, JR.

Witnesses:
CARL FOORMAN,
H. SPIELER.