# UNITED STATES PATENT OFFICE.

FREDERICK W. TAYLOR, OF SOUTH BETHLEHEM, AND MAUNSEL WHITE, OF BETHLEHEM, PENNSYLVANIA, ASSIGNORS TO THE BETHLEHEM STEEL COMPANY, OF SOUTH BETHLEHEM, PENNSYLVANIA.

## METAL-CUTTING TOOL AND METHOD OF MAKING SAME.

SPECIFICATION forming part of Letters Patent No. 668,270, dated February 19, 1901.

Application filed August 10, 1900. Serial No. 26,526. (No model.)

*To all whom it may concern:*

Be it known that we, FREDERICK W. TAYLOR, residing in South Bethlehem, and MAUNSEL WHITE, residing in Bethlehem, in the county of Northampton, in the State of Pennsylvania, citizens of the United States of America, have invented a certain new and useful Improvement in Metal-Cutting Tools and Method of Making the Same, of which the following is a true and exact description.

Our invention relates to the manufacture of metal-cutting tools, and has for its object to provide a tool specially adapted for cutting very hard metal and capable of running efficiently when cutting such metals at higher speeds and greater temperatures than has heretofore been practicable.

In our application for Letters Patent filed October 20, 1899, Serial No. 734,263, we have described and claimed our invention as consisting in the manufacture of metal-cutting tools from air-hardening steels containing not less than one-half of one per cent. of chromium and not less than one per cent. of one or more of the other commercially available members of the chromium group—to wit, tungsten or molybdenum or a mixture of these substances in proportion equal to not less than one per cent. of tungsten, tungsten being replaceable by molybdenum in the proportion of one-half portion of molybdenum to one of tungsten, our tools prepared from such steels being further treated by subjecting them or their cutting portions to a temperature of over 1,725° Fahrenheit. We have also pointed out in our former application that tools prepared and treated in this way have not only the capacity to work at much higher temperatures than has heretofore been practicable, but are distinguishable from tools not treated in accordance with our method by having a coarser and more crystalline grain in the steel and by a considerable reduction in the proportion of carbid of chromium present in the treated steel as compared with that present in the untreated steel.

In our said former application we have also pointed out that highly-beneficial results are secured by heating the tool at temperatures in excess of 1,725° Fahrenheit and up to the point where the heated steel softens or crumbles when touched with a rod, approximately 1,900° to 2,000° Fahrenheit. Also we have pointed out that it is preferable in the manufacture of the tools to use steels containing not less than one per cent. of chromium and not less than four per cent. of tungsten, or its equivalent—two per cent. of molybdenum.

In our former application we have also noted the advisability of cooling the tool (preferably rapidly) after heating to the high point indicated to a temperature below 1,550 Fahrenheit and have further noted the beneficial results secured by, after the tool has cooled down from the high heat, reheating it to a temperature above 700° and below 1,250° Fahrenheit.

While noting that the beneficial effect of our treatment is secured at and above 1,725° Fahrenheit, we also pointed out in our former application that it is advisable that the high heat at which the tool is treated should not be less than 1,850° Fahrenheit.

Our present invention is based on our discovery that for cutting very hard steel decidedly better results are obtained by forming the tool of air-hardening steel containing not less than three per cent. of chromium and not less than six per cent. of tungsten, or in place of tungsten not less than three per cent. of molybdenum, or in the alternative containing a mixture of tungsten and molybdenum in effective proportion equivalent to not less than six per cent. of tungsten. We have not found in our experiments that materially different results are obtained by increasing the percentage of tungsten or molybdenum above the proportions indicated.

As an example of a steel composition which we have found to give excellent results in cutting very hard metal when treated by our method we may cite one in which the iron is associated with the following percentages of other elements, to wit: carbon, 1.85; chromium, 3.80; tungsten, 8.00; manganese, .30; silicon, .15; phosphorus, .025; sulfur, .030.

The treatment of our tools containing the components above indicated does not differ from that described in our former application and briefly indicated above, and the advan-

tage of our new tool is, as far as we are aware, peculiar to its use for cutting very hard metal.

Having now described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. A metal-cutting tool formed of air-hardening tool-steel containing not less than three per cent. of chromium and in addition one or more of the other specified members of the chromium group in the proportion of not less than six per cent. of tungsten or its specified equivalent, said tool or its cutting portion being characterized, as described, by a considerable reduction of its contained carbid of chromium as compared with the steel from which it is made and by its capacity to maintain its cutting edge in cutting the softer steels at temperatures at or verging on incandescence.

2. The method of producing a metal-cutting tool adapted to retain its efficiency at high temperatures and in cutting very hard metal which consists in forming the tool of air-hardening tool-steel containing not less than three per cent. of chromium and one or more of the other specified members of the chromium group in amount equal to not less than six per cent. of tungsten, and heating said tool or its cutting portion to a temperature of not less than 1,725° Fahrenheit.

3. The method of producing a metal-cutting tool adapted to retain its efficiency at high temperatures and in cutting very hard metal which consists in forming the tool of air-hardening tool-steel containing not less than three per cent. of chromium and one or more of the other specified members of the chromium group in amount equal to not less than six per cent. of tungsten, and heating said tool or its cutting portion to a temperature of not less than 1,850° Fahrenheit.

4. The method of producing a metal-cutting tool adapted to retain its efficiency at high temperatures and in cutting very hard metal which consists in forming the tool of air-hardening tool-steel containing not less than three per cent. of chromium and one or more of the other specified members of the chromium group in amount equal to not less than six per cent. of tungsten, heating said tool or its cutting portion to a temperature of not less than 1,725° Fahrenheit and then cooling the tool rapidly to a temperature below 1,550° Fahrenheit.

5. The method of producing a metal-cutting tool adapted to retain its efficiency at high temperatures and in cutting very hard metal which consists in forming the tool of air-hardening tool-steel containing not less than three per cent. of chromium and one or more of the other specified members of the chromium group in amount equal to not less than six per cent. of tungsten, heating said tool or its cutting portion to a temperature of not less than 1,725° Fahrenheit, then cooling the tool to a temperature below 1,550° Fahrenheit and then reheating it to a temperature above 700° and below 1,260° Fahrenheit.

FREDERICK W. TAYLOR.
MAUNSEL WHITE.

Witnesses:
DAVID C. FENNER,
JAMES HENNESY.