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METHOD OF TREATING METALS, SUCH AS STEEL OR STEEL ALLOYS.

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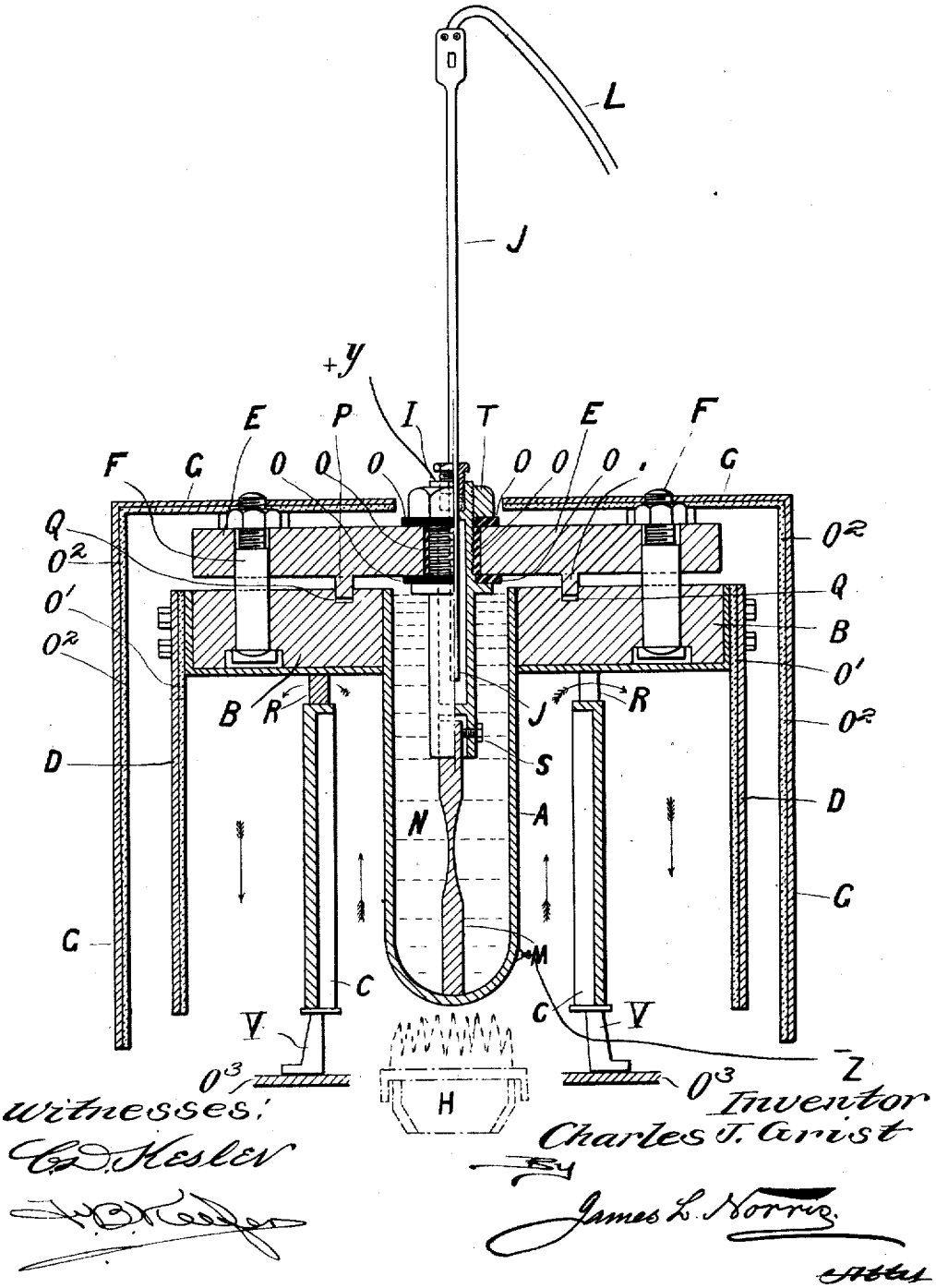
916,302. Patented Mar. 23, 1909.



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UNITED STATES PATENT OFFICE.

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METHOD OF TREATING METALS, SUCH AS STEEL OR STEEL ALLOYS.

No. 916,302. Specification of Letters Patent. Patented March 23, 1909.

Application filed December 2, 1907. Serial No. 404,788.

To all whom it may concern:

Be it known that I, CHARLES JAMES GRIST, a subject of the King of Great Britain, residing at 24 Rood Lane Chambers, in the city of London, England, metallurgist, have invented certain new and useful Improvements in Methods of Treating Metals, such as Steel or Steel Alloys, of which the following is a specification.

This invention relates to a process for improving the quality of steel which consists in heating it in a bath of mercury and passing an electric current through the material while at a recalescent period during the heating or cooling.

The invention is based on the discovery that peculiar advantages are to be attained by passing the current at certain selected portions of the time temperature curve during the heating or cooling, or both which are hereinafter referred to as recalescent periods.

It is well known to metallurgists that if a piece of steel be subjected to a uniform and constant supply of heat the curve which represents the time rate rise of temperature is not uniform. There are certain points on the temperature curve (known as the recalescent or critical points or periods) when the rise in temperature is suddenly arrested, or retarded with or without fluctuations; after this has occurred the uniform rise in temperature is resumed. While the metal is cooling similar recalescent points or periods occur at which the fall in temperature is arrested or retarded although the recalescent points during a falling temperature do not usually exactly coincide on the temperature curve with those of a rising temperature. The temperature curves about the recalescent periods will present irregularities, although the outside source of heat is uniform. Marked recalescent periods have been observed between 500° C. and 1,000° C., but it is possible that there are other recalescent periods which present the same phenomena and are similarly suitable to the purpose of this invention. Chill hardened steels as well as very low grade steels present recalescent periods as low as 200° to 400° C., which periods may be utilized. In each case a recalescent period must be ascertained. Different steels present different recalescent periods and no one formula will serve for all.

The invention consists in passing the electric current through the material during these recalescent periods only, as explained, the recalescent periods of the ascending and descending time temperature curves being first selected, and the current being passed preferably during the whole of either or both of such periods in the present specification. By the term "recalescent", a certain period in the ascending, and a certain period in the descending time temperature curves is included. Recalescent points are ascertained by any well known method, such for example as that followed by Mons. Le Chatelier who used a thermo-electric pyrometer. Results will be found to vary according to the particular recalescent period selected during which to pass the electric current. Results also vary according as the recalescent periods are selected on the rising or falling temperature curve. According to the variety of metal treated, it is generally found most advantageous to select that recalescent period for steel which is most marked. When the process is carried out upon any steel which has been "tempered" after hardening, such steel should not be heated up to the temperature at which it was "tempered." When the steel has been only hardened and not tempered the temperature of the steel when reheated must not be allowed to rise to the temperature at which it was hardened unless it be decided to continue the process over the next recalescent period. Having satisfied oneself as to a suitable recalescent period, a suitable voltage of current to produce the best results is next ascertained. As a general rule a "good" *i. e.* a well manufactured, close or homogeneous steel will require a higher voltage than a "bad" *i. e.* an ill-manufactured, loose or irregular steel. At the same time it must be borne in mind that the richer a steel is in carbon, or alloyed metals, the higher must be the voltage and it is found that a "good" steel with a high percentage of carbon will require (say) a current of 200 to 500 volts; whereas a "bad" steel with a high percentage of carbon could be effectively treated, at from 50 to 200 volts; and lastly a "bad" steel with a low percentage of carbon would be best dealt with, at (say) 100 volts or even less; the requisite amperage should be determined and this will be found to vary

with the material to be treated, the apparatus and the mercury or mercury vapor therein. In the apparatus described hereinafter (for treatment of small tools and test pieces) a current of from 15 to 25 amperes is used. The quantity of mercury surrounding the steel has to be considered and for the work instanced the tank is so arranged as to surround the steel with from $\frac{1}{8}$ to $\frac{1}{4}$ inch of mercury. By reason of the large capital expenditure, which operations on large pieces for experimental work would necessitate only small tools and pieces of steel have up to the present been dealt with, but this invention is also applicable to the treatment of large pieces.

Referring to the accompanying drawings which approximately indicate the disposition of the parts of an apparatus designed to carry out this invention, A is a circular wrought iron tank provided with an iron flange B. It is important in all cases that this tank should be of as small capacity as possible consistent with the size of the pieces of metal to be treated. The cover E is provided with an annular flange P to fit into a corresponding slot Q in the flange B, the slot being packed with asbestos to form a tight joint; F, F are the bolts which hold down the lid E to make the joint; a hollow piece of steel I passes through a hole in the lid and is electrically insulated therefrom by asbestos or other suitable packing O, O, O. This hollow piece of steel I is provided with a clamping screw S, and serves as a holder for the pieces of steel M, which is being treated and the other end of which is in contact with the bottom of the tank. The nut T is used for screwing up and making a joint with asbestos O, O between the hollow piece I and the lid E. The pyrometer couple J is inserted in the top of the hollow piece I. The tank A is surrounded by an inner muffle C lined with firebrick standing on legs V..V, these parts being insulated thermally with asbestos sheet O^3, O^3, which support the whole apparatus and an outer muffle D lined with asbestos O′ to minimize the loss of heat. The whole apparatus is surrounded by a casing G lined with asbestos or other heat insulating material O^2.

The tank A contains the requisite quantity of mercury or mercury vapor N, N. The temperature is raised by means of gas jets H and the heated products of combustion pass away in the direction of the arrows over the inner muffle at R, R. The pyrometer connected to the couple J by the wires L is watched. When the recalescent point is reached electric contact is established (in the arrangement illustrated) through the holder I as the negative pole and a current of electricity is passed as for instance through the connections Y, Z. It is assumed that a suitable electric resistance will be inserted in the circuit between the apparatus and the source of electric energy.

This invention results in toughening and thereby increasing the life and efficiency of tools and other articles submitted to this treatment.

What I claim is:—

1. A method of treating metals which consists in heating the metal to a recalescent period in the presence of mercury and at a recalescent period passing an electric current through the metal.

2. A method of treating metals which consists in heating the metal beyond a recalescent period and allowing it to cool in the presence of mercury, and passing an electric current through the metal during the recalescent periods on the ascending and descending time temperature curves.

3. The herein described improvement in the treatment of metals which consists in passing an electric current through the metal while the same is heated to a recalescent point in the presence of mercury.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

CHARLES JAMES GRIST.

Witnesses:

HAROLD HENRY YARICOTT,

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