Jan. 31, 1933. H. C. KNERR 1,895,998

METHOD OF AND APPARATUS FOR HEAT TREATING MAGNETIC MATERIALS

Original Filed April 21, 1921

Fig. 1.

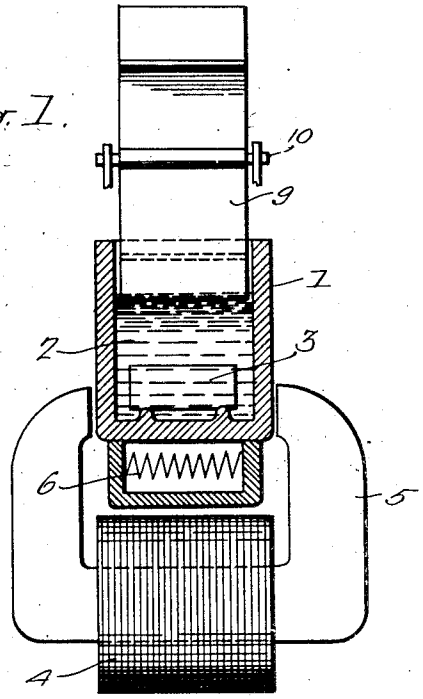
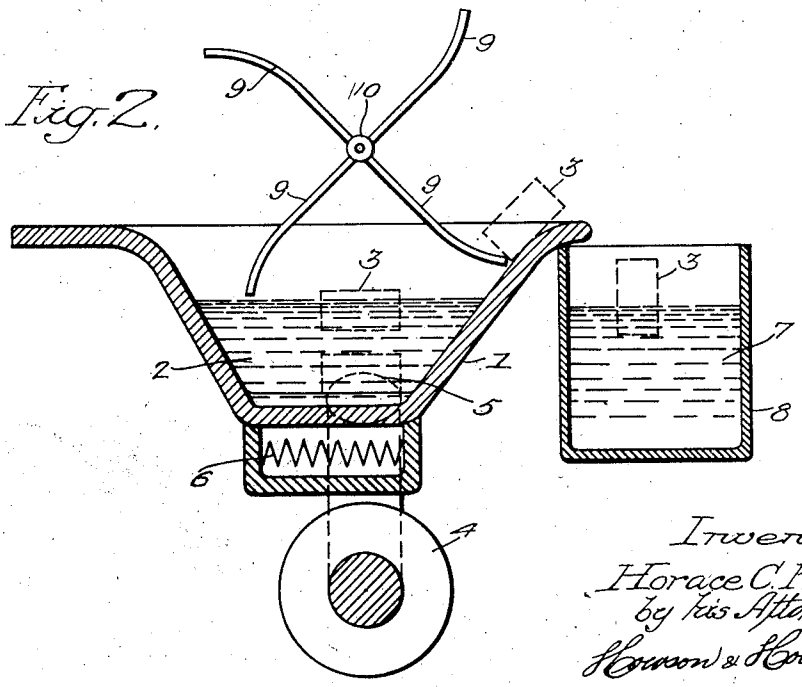


Fig. 2.



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UNITED STATES PATENT OFFICE

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METHOD OF AND APPARATUS FOR HEAT-TREATING MAGNETIC MATERIALS

Original application filed April 21, 1921, Serial No. 463,181. Divided and this application filed October 27, 1930. Serial No. 491,601.

My invention relates to a method of and apparatus for heat treating magnetizable metals, such, for example, as iron, steel, or their magnetic or magnetizable alloys, and all herein referred to for brevity as steel. The present invention is a division of my co-pending application, Serial No. 463,181, filed April 21, 1921.

The steel, in a single piece or in a plurality of pieces, according to circumstances or requirements, is raised in temperature to or beyond a critical point at which the steel with more or less abruptness loses its magnetic properties, such critical point corresponding with the critical point usually determined by pyrometers and temperature measuring devices, and to or beyond which the steel is commonly heated for hardening or other treatment; thereafter the steel is quickly or gradually cooled, as by quenching or otherwise, to ordinary temperature or suitable higher temperature, for purposes of hardening, annealing, refining the grain, normalizing, etc.

In accordance with my invention, the steel, while undergoing elevation in temperature as above referred to, is acted upon by a magneto-motive force, produced by an electromagnet, solenoid or equivalent, whereby it is held substantially stationary in the heating zone, and upon its loss of magnetic properties as aforesaid, starts from rest and leaves the heating zone and enters the cooling zone, as by entering a quenching liquid, or in general, into such surroundings as reduce its temperature to suitable degree and at suitable rate.

Further in accordance with my invention, as exemplified in the present application, the steel is placed in a heating vessel containing liquid of greater specific gravity than that of the steel, whereby the latter is subjected to buoyant force which overcomes the force of gravity acting thereon, and the steel tends to rise to the surface of the liquid. A magnetic field is created which is sufficiently strong to overcome the resultant force tending to carry the steel upward. Upon loss of its magnetic properties, the steel is released and rises to the surface of the liquid from whence it may be removed to a cooling chamber in any desired manner.

My invention resides in the method of and apparatus for effecting heat treatment as above referred to and as more fully hereinafter described, and in further features of method and apparatus hereinafter described.

For an understanding of the present specific embodiment of my invention, reference may be had to the accompanying drawing, in which

Fig. 1 is an end view, partly in section, of apparatus suitable for practicing my invention in accordance with a specific embodiment thereof; and

Fig. 2 is a side view, principally in section, of the apparatus of Fig. 1.

Referring to the drawing, there is provided a vessel 1, preferably of magnetic material. A mass 2 of molten metal or alloy of higher specific gravity than that of the steel 3, and of a melting point substantially lower than the critical temperature to which the steel is to be raised, is contained in vessel 1. Accordingly, the steel tends to float upon the molten metal 2. It is held submerged therein, as indicated clearly in Fig. 1, by a magnetic field produced by a coil or solenoid 4, traversed by current of suitable magnitude from any suitable source. The magnetic field is directed and intensified by employment of a suitable core structure having the poles 5 brought suitably adjacent, external to the vessel 1, to the submerged steel 3. Heat is imparted to the steel 3 from the molten metal 2, to which heat is imparted by any suitable means, as by heat applied to the vessel 1. In the example illustrated, the heat is electrically applied by means of the heating resistance 6 traversed by current of suitable magnitude from any suitable source.

It will be apparent that the steel may be passed into the heating vessel in any desired manner. It may, if desired, be simply dropped into the vessel. The magnetic field created will draw the steel to the bottom of the vessel against the action of the buoyant force tending to maintain it upon the surface of the liquid. When the steel reaches the aforesaid critical point, it is no longer held

submerged by the magnetic field, and it rises to the surface of the bath 2, which may be of lead, as indicated in dotted lines in Fig. 2. It may then be removed and cooled at a suitable rate to a suitable degree. In the present instance, the steel is delivered to the liquid 7 in the quenching tank 8. This delivery from the vessel 1 may be effected manually or automatically. In the present instance, a plurality of rotating arms 9 adapted to rotate about an axis 10 are provided. Such arms may be driven by any suitable source of power, not shown. It will be apparent, of course, that any other suitable means for removing the steel from the surface of the liquid in vessel 1 to that of vessel 8 may be utilized.

From the above description and disclosure, it will be apparent that the specific embodiment of my invention contained herein affords simple and efficient means for carrying out the contemplated purpose. While a single embodiment of the invention has been disclosed and illustrated in the present application, it is to be understood that such changes in the details of construction and in the method contemplated by the invention as come within the scope of the appended claims may be made.

I claim:

1. The method of heat-treating a steel piece, which comprises heating the piece while so disposed that it tends to move under the influence of a force greater than the weight of the piece to a position from whence it may be readily removed to a cooling zone, and opposing movement of the piece by magnetism acting directly thereon until its temperature has been raised to a point where its magnetism is substantially zero, whereby said loss of magnetism automatically releases the piece.

2. Apparatus for heat-treating a steel piece, comprising a heating chamber, means tending to move the piece in said chamber under the influence of a force greater than the weight of the piece to a position from whence it may be readily removed to a cooling zone, and magnetic field producing means for opposing movement of the piece until its temperature has been raised to a point where its magnetism is substantially zero, whereby said loss of magnetism automatically releases the piece.

3. The method of heat-treating steel, which comprises holding it submerged in a heavier liquid by a magnetic field, raising its temperature until its becomes non-magnetic and rises, and thereafter cooling it.

4. Apparatus for heat-treating steel comprising a vessel containing liquid of greater specific gravity than the steel, means producing a magnetic field for holding the steel submerged in the liquid, and means for heating the steel to a temperature at which it becomes non-magnetic, whereby it thereafter floats upon said liquid.

5. Apparatus for heat-treating steel, comprising a vessel containing liquid of greater specific gravity than the steel, means producing a magnetic field for holding the steel submerged in the liquid, means for heating the steel to a temperature at which it becomes non-magnetic, whereby it thereafter floats upon said liquid, a cooling device, and means removing the steel from the surface of the liquid and delivering it to said cooling device.

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