L. G. NILSON.

PROCESS AND APPARATUS FOR TREATING METALLIC ARTICLES.

APPLICATION FILED JULY 25, 1918.

1,335,453. **Patented Mar. 30, 1920.**

Fig. 1.

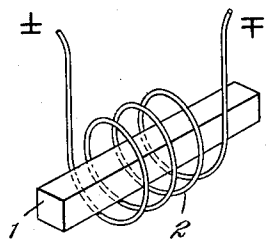


Fig. 2.

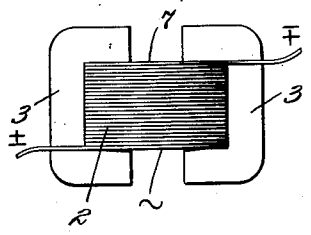


Fig. 3.

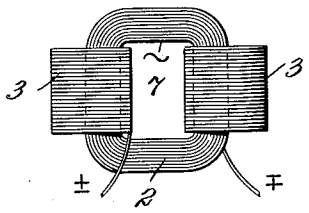


Fig. 4.

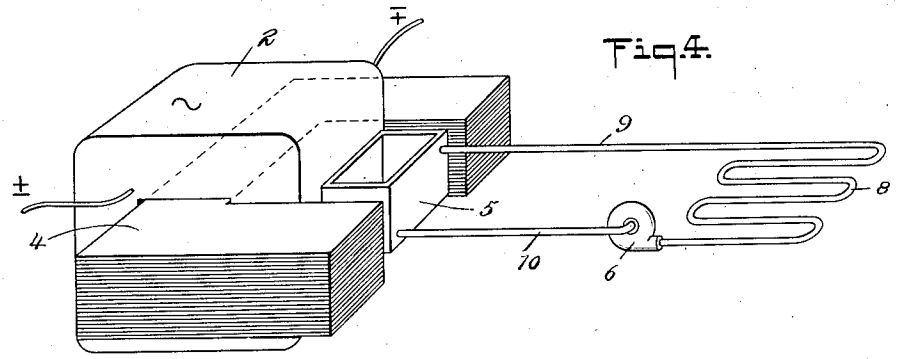
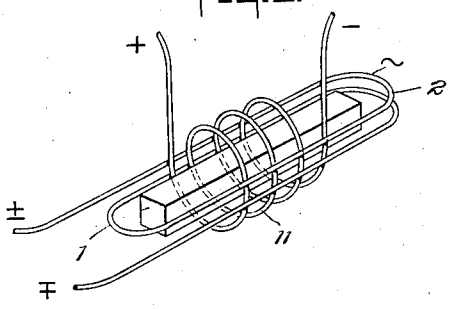


Fig. 5.



WITNESSES:

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PROCESS AND APPARATUS FOR TREATING METALLIC ARTICLES.

1,335,453. Specification of Letters Patent. Patented Mar. 30, 1920.

Application filed July 25, 1918. Serial No. 246,682.

To all whom it may concern:

Be it known that I, LARS G. NILSON, a citizen of the United States, and a resident of Hoboken, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Processes and Apparatus for Treating Metallic Articles, of which the following is a specification.

This invention relates to process and apparatus for treating metallic articles, and has for its object to enable forgings, castings, stampings, and other articles which have to withstand strains, including tools, shafts, gears, cylinders, casings, wheels, etc., to be quickly and cheaply relieved of internal strains, or seasoned, by subjecting them to repeated reversed magnetism, whereby the internal molecular strains caused in hammering, cooling, casting, drawing, setting, hardening, etc., are eliminated.

It is a well known fact that metal articles, especially those of steel, usually have internal strains. In castings these strains are caused by unequal shrinkage due to the cooling taking place at different rates, the thin sections cooling and setting while the heavier sections still remain liquid. Such strains are also produced by unequal rates of cooling in different portions of the article, the portions nearest the pouring gate being usually the hottest. In articles of high carbon steel, strains are set up in the hardening process, some portions of the articles being cooled faster than others in quenching. The presence of these strains is indicated by the article coming out more or less distorted. In forgings the strains are usually caused by the metal being compressed to varying density under the hammer blows during the forging process. Similar considerations apply to drawn articles, and also to stampings whether or not partially machined after being initially formed.

Metal articles containing internal strains naturally tend to slowly eliminate these strains at ordinary temperatures, which process is commonly applied in castings and is known as seasoning, the castings sometimes being rough machined first and sometimes not. Annealing is employed to accelerate the seasoning process, but this is not always practical in the case of hardened tools such as gages, milling cutters, twist drills, etc., which are left glass hard for the purpose of better wear. Tumbling is also employed, but this shocks and batters up the surface and is not practical in the case of large or finished articles. The time required by natural seasoning is somewhat problematic, but research seems to indicate that it goes on for many years, and for present industrial conditions it is not effective at best and is impractical.

My invention consists in subjecting the article to be treated to a powerful interrupted magnetic field, preferably an alternating electro-magnetic field under such conditions of flux density, time, and temperature as to quickly remove internal strains without affecting the desired hardness, tensile strength, or other desired characteristics of the article being treated.

In the accompanying drawings,

Figure 1 is a diagram illustrating the broad idea of the invention,

Fig. 2 is an elevation of an apparatus better embodying the idea,

Fig. 3 is a plan view,

Fig. 4 is a diagram of an apparatus whereby the temperature of the article being treated is controlled, and

Fig. 5 shows a special application of the invention for treating an article such as a permanent magnet.

In Fig. 1, 1 represents an article such as an iron or steel bar, inserted in a coil 2, through which is passed an alternating current of such strength and frequency as to produce good saturation and rapid reversals of magnetizing force in the bar. I have obtained good results with the ordinary commercial frequency of 60 cycles. Where desirable, the article can be placed in the magnetic field with proper reference to the strains it will take in actual use.

In Fig. 2 the coil 2 is provided with laminations of iron 3, 3 forming pole pieces, between which pole pieces and within space T in the coil 2 is placed the bar to be treated. This forms a more nearly closed magnetic circuit with better efficiency.

In Fig. 4 the coil 2 is wound over a horse-shoe shaped core 4, and the article to be treated is introduced between what would ordinarily be the poles of the core 4. A tank 5 is placed between the poles of the core 4, and the article to be treated is immersed in the tank 5. The tank can be

filled with water, oil, fused metal or salt, or other liquid having the temperature desired for the combined drawing and magnetizing treatment, or combined cooling and magnetizing treatment. Circulation is provided by a pump 6 and cooling or heating where necessary by a coil 8 connected to the tank by pipes 9 and 10. By means of this arrangement hardened articles of steel like milling cutters and edge tools can be put in the tank and subjected to the alternating magnetic field without objectionable rise in temperature, since the temperature can be controlled by the circulation of the liquid to give the desired draw, or to keep the eddy currents from heating it up. The use of fused salts or alloys in the tank is of advantage because thereby articles which require heat treatment such as alloy steels, can be heat treated at the same time. The coils and core can also be cooled where desired, as in the case of transformers.

In Fig. 5, an application of the invention is shown for making permanent magnets for instruments where great constancy is desired rather than maximum strength. It has been customary to age magnets by subjecting them to steam, slight blows, etc., in order to reduce internal strains. By this invention, the article can be magnetized in the usual manner by a coil 11 wound thereon carrying a direct current, and at the same time a coil 2 wound thereon at substantially right angles to coil 11 carrying the interrupted or rapidly reversed current. The greatest possible magnetization is produced in the bar if the alternating current in coil 2 is cut off first, but if the alternating current in coil 2 is continued after the magnetizing current is cut off, a slight amount of magnetization is lost, but the remainder will be of maximum constancy. This process of using two currents is not only applicable to magnets, but can be applied to other articles where seasoning is desired, whether or not they are to remain permanently magnetized, or where it is immaterial whether or not the article retains the magnetism.

The invention is also applicable to articles requiring heat treatment. This usually consists of heating the article to say 1,500 or 1,600 degrees F., then cooling in air, which is practically annealing, then reheating to say 1,500 degrees F., quenching in oil or water, and finally drawing or reheating to anything desired from say 300 degrees F. to 1,000 degrees F., depending upon the kind of steel and the purpose for which it is to be used. If high tensile strength is wanted draw only slightly, while for an article subject to shocks and requiring toughness rather than tensile strength draw more. As applied to articles made of high carbon steel, heat treatment usually is referred to as hardening and tempering. In making a milling cutter for example, the sequence of operations should be forming the blank, whether by forging, casting or rough machining, then annealing, then hardening (heating and quenching) then drawing back (annealing) and finally finish by grinding. Many articles made of high carbon steel go to pieces during the quenching, caused by internal strains, and sometimes they will crack or warp a long time after being finished, even while being carried in stock. By treating such an article according to my process, preferably just before the final grinding, or simultaneously with drawing, it is insured that the finished article will be completely free of internal strains and will permanently retain its finished form.

This process is of great commercial value inasmuch as it saves much time and labor now required on manufactured articles such as high grade machine tools for accurate work. Gages for measurements can be made so that they are and will remain correct. Experience has shown that gages may be passed as correct at a certain time, but they have been found defective three or six months afterward because of having warped on account of internal strains. Gages for work of high accuracy, are often made of soft steel case-hardened for wear, and then ground to size. Internal strains frequently cause the gage to warp after some time, and become inaccurate without being discovered. By subjecting a gage to this process, whether case-hardened, or made from tool steel, just before the final finishing to size, the cause of warping is removed. Cutting tools, such as finished milling cutters, drills, reamers, will be more efficient if treated by this invention, since they can be left harder than is customary at the present time. It will be seen that by quenching in a tank such as 5 in Fig. 4, where the cooling liquid is kept at the proper cooling temperature, everything can be done in one operation so that no drawing is afterward necessary, the cooling medium being some low melting alloy or fused salt kept fluid by the eddy currents or by additional heating means. In some instances, the heat developed by the article itself will melt the alloy, which may be circulated as shown, if desired, although the alloys commonly used for this purpose usually have a sufficiently constant melting temperature for the purpose. The alloy will be chosen according to its melting temperature to produce the desired drawing temperature in the finished article.

Instead of alternating current, an interrupted direct current can be used, although alternating current is preferable because more efficient.

The apparatus herein shown can be varied in various particulars without departing from the scope of the appended claims.

What is claimed, is:

1. The method which consists in forming an article, hardening it, subjecting it to a periodic magnetic field while drawing, and finishing to size.

2. The method which consists in drawing an article while immersed in a heated bath in a magnetic field.

3. The method which consists in drawing an article while immersed in a heated bath in a rapidly changing magnetic field.

4. The method which consists in maintaining a bath at a predetermined temperature, immersing an article therein, and subjecting the article while immersed to an alternating magnetizing force.

5. The method which consists in circulating a drawing bath to maintain a predetermined temperature, immersing an article therein to be drawn, and subjecting the article while being drawn to a periodic magnetizing force.

6. The method which consists in subjecting an article to a periodic magnetizing force while carrying off the heat due to eddy currents by a cooling medium.

7. In combination, a coil, a source of periodic current, a core forming separated poles, and a receptacle between said poles adapted to contain a drawing bath for the article to be treated.

8. In combination, a coil, a source of periodic current, a core forming separated poles, a receptacle between said poles adapted to contain a bath used in the heat treating of the article and means for maintaining the bath at the proper temperature.

9. In combination, a coil, a source of periodic current, a core forming separated poles, a receptacle between said poles adapted to contain a drawing bath for the article to be treated and a circulating pump and cooling pipe coils for said bath.

Signed at New York city, in the county of New York and State of New York, this 24th day of July, A. D. 1918.

LARS G. NILSON.