

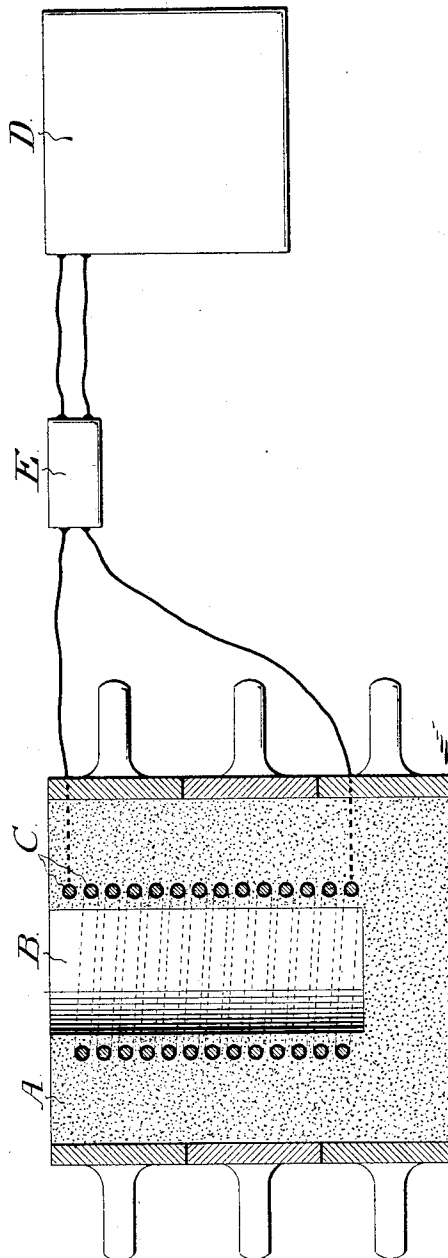
(No Model.)

J. C. FRALEY.

PROCESS OF RENDERING IRON, STEEL, AND OTHER SIMILAR METALS
HOMOGENEOUS.

No. 475,498.

Patented May 24, 1892.



WITNESSES:

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PROCESS OF RENDERING IRON, STEEL, AND OTHER SIMILAR METALS HOMOGENEOUS.

SPECIFICATION forming part of Letters Patent No. 475,498, dated May 24, 1892.

Application filed July 21, 1891. Serial No. 400,247. (No specimens.)

To all whom it may concern:

Be it known that I, JOSEPH C. FRALEY, of Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Process of Rendering Iron, Steel, and Similar Metals Homogeneous.

The following is a specification of my said process, reference being had to the accompanying drawing, which illustrates a form of apparatus adapted for the conduct thereof.

My invention, though primarily intended for use in connection with iron and compounds or alloys thereof, such as steel of all kinds and grades, embraces in principle other metals which are analogous to iron in the particular of substantial susceptibility to magnetic influence.

The most complete and characteristic application of the process is as an adjunct to the manufacture of "castings," by which term I include both ultimate products and initial products—such as ingots—intended for further treatment; but the beneficial effects of my invention are not restricted to casting processes, and, as will be specified hereinafter, it is capable of a more general application.

Broadly speaking, the process consists in exposing the metal in a heated state within a magnetic field and repeatedly varying or modifying the character of such magnetic field while permitting the metal to cool.

The main objects of this treatment are as follows: If applied to metal in a fluid condition, it facilitates during the period of fluidity the disengagement or definite localization of foreign substances, such as occluded gases, and both during the period of fluidity and thereafter (while the particles are more or less mobile) modifies the internal structure of the mass in the direction of hindering the formation of large crystals or other unequal aggregations of particles, which would otherwise detract from the homogeneity of the product and occasion local strains therein.

I believe that the mode of operation thus brought into play may be explained as follows: The phenomena of elongation and shortening which attend, respectively, upon the magnetization and demagnetization of an iron bar, for instance, indicate that these acts are accompanied by molecular movement

throughout the metal, possibly partial rotation of the individual molecules, or other definite change of position relatively to one another. Repeated recurrences of such molecular movements, if produced in metal, either in a fluid condition or whose particles are in the act of settling down into a definite structure, such as a mass of crystals, should produce effects analogous to those which would follow from the mechanical agitation or shaking of the particles while in an abnormally-mobile state, and thus tend toward the results above referred to as the objects of the process.

I will now proceed to describe the process as an adjunct to or in connection with the formation of a casting.

In the accompanying drawing an elementary form of apparatus is shown adapted to produce a cylindrical casting under the conditions mentioned. An ordinary sand mold A, having a cavity B, in which the casting is to be formed, is provided with a coil or helix C of wire, surrounding said cavity, said wire being insulated by a coating of refractory material and embedded in the sand at such a distance from the inner surface of the cavity as to prevent injurious overheating from the molten material. The coil is placed in circuit with a suitable source of electricity, which in the present instance is indicated as a storage-battery D. Interposed in the circuit is an alternator E, whereby the polarity of the field produced by the helix may be reversed, such alternator being worked mechanically or by means of the current itself in any of the well-known modes. The strength of the current and the number of convolutions of the helix should, of course, be proportioned to the mass which is to be acted upon within the field, and to produce the best results an excess of current should be used beyond what would be necessary to magnetically saturate a mass of cold iron of equal size. Immediately upon the pouring of the metal into the mold the current is applied and rapid reversals thereof are produced by means of the alternator. This treatment should be continued during the solidification of the metal, and may be advantageously protracted after that point and so long as the internal structure is susceptible of modification.

I am aware that it has heretofore been proposed to make castings in a permanent magnetic field or one which is substantially unvaried, and I do not claim such treatment. Persistence of uniform magnetic influence would have no substantial effect upon fluid or solidifying metal toward attaining either of the above-indicated objects of my process, since it would fail to produce the agitation upon which the process depends.

I am also aware of the general belief that magnetic influence practically ceases at a temperature below that of melted iron. The foundation of this view is doubtless the fact that one particular phenomenon attendant upon magnetic conditions—viz., attraction of a mass as a whole—sensibly diminishes in accordance with the elevation of temperature. It must therefore be understood that in using the expression “magnetic field” as a convenient term to describe the conduct of my process I do not intend to imply that the phenomenon of attraction is necessarily to be exhibited by the mass of metal within such field, since it is quite possible for other so-called “magnetic phenomena” to persist even though the conditions have interfered with this particular one. Furthermore, it is entirely in harmony with my theory of operation that the cooler parts of the mass should exhibit attractive force in a substantial degree, while the hotter parts do not indicate it, and disturbance of one part relatively to the other be thus produced. I therefore use the term “magnetic field” in a sense broad enough to include such a field of energy as is produced in the neighborhood of a conducting-wire through which a current of electricity is passing and without restriction to the ordinary signification of the word “magnetic” as necessarily implying the display of attractive force upon the total mass of material exposed within such field.

In the foregoing description I have described a storage-battery and an alternating device in connection with a helix which surrounds the casting as an apparatus adapted to carry out the process; but I wish it to be understood that such description is typical and not restricted, and that not only the magnetic field might be otherwise produced, but that

the necessary disturbances therein might be brought about in various ways—such, for instance, as by a series of interruptions or pulsations of the current as distinguished from a reversal of polarity, by diminishing the extent of the magnetic field, by moving the metal relatively to the field, and vice versa, or by exposing the metal in a plurality of fields and modifying one or more of them. So, also, instead of the storage-battery and alternator above indicated, an alternating-current dynamo might be employed to energize the field-producing helix.

I have given the above typical illustration of my invention because it is one which affords scope for all the useful effects thereof; but it must be understood that I do not limit my claim to a casting process. Thus, if the mass of heated metal within the field produced by the helix C, above described, had not been a casting made *in situ*, but were simply a cylinder of iron or steel, which, after being heated to a temperature even below its melting-point, as in ordinary annealing, were subjected to the treatment above described during the period of cooling, the useful results which depend upon modification of the general internal structure would be developed in a substantial degree, although of course those results which depend upon the disengagement of foreign substances from a fluid mass would be lacking. I therefore use in my claim the word “heated” in a sense broad enough to include not only a metal which is in a fluid condition as the result of casting or otherwise, but also metal whose temperature has been raised in any manner to a point which renders its particles abnormally mobile.

I claim—

The hereinbefore-described process of rendering iron, steel, and similar metals homogeneous, which consists in exposing the metal while in a heated condition within a magnetic field and repeatedly varying such magnetic field during the cooling of the exposed metal, substantially as set forth.

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Witnesses:

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