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W. GILMOUR & A. LINDSAY.

PROCESS OF TEMPERING OR HARDENING CAST IRON.

APPLICATION FILED NOV. 8, 1902.

NO MODEL.

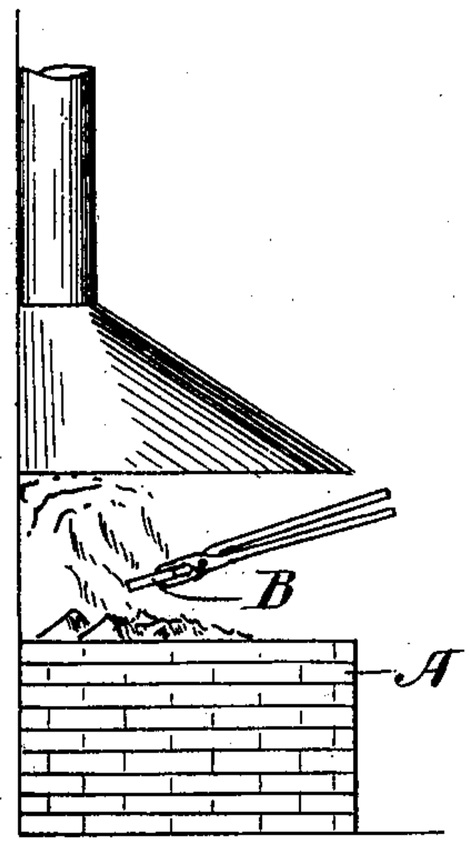

Fig. 1.

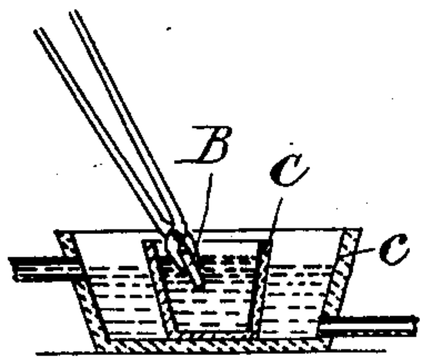

Fig. 2.

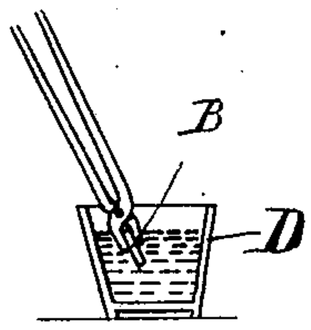

Fig. 3.

Witnesses.

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UNITED STATES PATENT OFFICE.

WILLIAM GILMOUR AND ALEXANDER LINDSAY, OF MONTREAL, CANADA, ASSIGNORS OF ONE-HALF TO CHARLES AUGUSTUS MYERS AND HERBERT HENRY BRADFIELD, OF MORRISBURG, CANADA.

PROCESS OF TEMPERING OR HARDENING CAST-IRON.

SPECIFICATION forming part of Letters Patent No. 755,763, dated March 29, 1904.

Application filed November 8, 1902. Serial No. 130,598. (No specimens.)

To all whom it may concern:

Be it known that we, WILLIAM GILMOUR and ALEXANDER LINDSAY, machinists, and residents of the city and district of Montreal, in the Province of Quebec, Dominion of Canada, have jointly invented certain new and useful Improvements in Processes of Tempering or Hardening Cast-Iron, of which the following is a specification.

Our invention relates to an improved process whereby cast-iron in the rough or in the finished state may be hardened or tempered, the hardness extending completely through articles of comparatively large dimensions; and one of the objects in view in inventing the process is to devise a cheap and simple method of rendering iron castings so hard as to be able for many purposes to take the place of steel, thus reducing the cost of manufacturing of a large number of articles, the various steps of the process and the manner of carrying it out being hereinafter more particularly described.

In the drawings we have illustrated simple apparatus which may be employed in using our process, in which—

Figure 1 represents a fire. Fig. 2 represents a vessel containing a substance to be hereinafter described, and Fig. 3 represents a vessel containing water.

The castings which are to be treated by our process may be completely finished as regards machine-work before they are hardened, and it will thus be seen that the wear on the machines is greatly reduced and the necessary labor is also less than where similar articles are made from hardened steel. The casting is first heated in any suitable or convenient heating device until it reaches the temperature sufficient to cause the casting to glow, or, in other words, to what is known as a "cherry-red" heat. It is then dipped in a bath which consists of a practically anhydrous acid of high heat-conducting power, preferably sulfuric acid of a specific gravity of from 1.8 to 1.9, to which is added a suitable quantity of one or more of the heavy metals or their compounds—such, for example, as arsenic or the like. The preferable ingredients of the bath are sulfuric acid of a specific gravity of approximately 1.84 and red arsenic in the proportions of three-quarters of a pound of red-arsenic crystals to one gallon of sulfuric acid. The castings may be either suddenly dipped in the aforementioned mixture and then taken out and cooled in water or they may be left in the bath until cool. We find, however, that by dipping the castings in the bath and holding them there for a time, which varies according to the size of the castings, and then completely cooling in water is quite as satisfactory and produces a material which is just as hard as if the castings were allowed to remain in the bath until cool, and the former method is preferable if a large number of castings are to be hardened, as the bath is thus prevented from becoming overheated. In preparing the bath when sulfuric acid and red arsenic are used we find that better results are obtained when the crystals are added to the sulfuric acid and the bath is allowed to stand for about a week before using, the reason probably being that the bath becomes more saturated with arsenical compound when the dissolved red arsenic has been long in the sulfuric acid.

The proportions above stated, although found to work very well, may of course be varied, if desirable, without departing from the spirit of our invention. We may also mention that it is not necessary that the castings should be completed before hardening, as rough unfinished castings may be hardened equally well.

It is found that in castings of comparatively large dimensions the hardening extends completely through the material, and thus the results obtained are far preferable to those obtained by what is known as "case-hardening." The change which takes place in the metal is in the nature of a molecular rearrangement or recrystallization coincident with an increase in the combined carbon at the expense of the graphitic carbon, and in this change lies the difference between the results obtained by our bath and ordinary case-hardening processes in which a certain portion of the carbon contained

in the materials of the bath is actually given up to the metal.

It is found that the more rapid the cooling of the metal the harder will it become. For this reason the bath must be of high heat-conducting power, and this requirement is obtained by the use of the ingredients above referred to. The bath must further be practically free from water, as it is found that when the acid contains water in any considerable quantities a steam-cushion is formed between the acid and the metal, which prevents their coming in contact, with the result that the cooling is less rapid, and the iron is consequently not so hard. By having one or more of the heavy metals or their compounds dissolved in the acid the heat-conducting and heat-absorbing powers of the bath are considerably increased.

It will now be seen that we have invented an extremely useful process for hardening or tempering cast-iron.

The uses to which the process might be put are numerous. Among others may be mentioned the hardening or tempering of such articles as worms, pinions, journals, bushings, and the like.

Referring now to the drawings, A represents a suitable furnace in which the casting B is heated to a suitable temperature, preferably to a cherry-red as above mentioned. When the desired temperature has been reached, the casting B is dipped in the vessel C, containing the solution. The vessel C may be inclosed in an outer vessel *c*, through which water is caused to continuously circulate, whereby the water is kept cool. The next step is to cool the casting by immersing it in the vessel D, containing water. It might be further pointed out that if it is desired to harden one portion of a casting while leaving the remaining portion soft this may be accomplished very readily by immersing only the portions to be hardened.

What we claim as our invention is—

1. The herein-described process of hardening or tempering cast-iron which consists in heating the metal; then dipping it in a bath consisting of a practically anhydrous acid of high heat conducting and absorbing quality in which is dissolved a heavy metal as and for the purpose specified.

2. The herein-described process of hardening or tempering cast-iron which consists in heating the metal; then dipping it in a bath consisting of a practically anhydrous acid of high heat conducting and absorbing quality in which is dissolved a heavy metal combined with a non-metallic substance as and for the purpose specified.

3. The herein-described process of hardening or tempering cast-iron which consists in heating the metal; then dipping it in a bath consisting of sulfuric acid of a specific gravity of between 1.8 and 1.9 or thereabout, and red arsenic as and for the purpose specified.

4. The herein-described process of hardening or tempering cast-iron which consists in heating of metal; then dipping it in a bath consisting of sulfuric acid of a specific gravity of between 1.8 and 1.9 or thereabout and red arsenic, the proportions being approximately one gallon of the former to three-quarters of a pound of the latter as and for the purpose specified.

Signed at Montreal, in the Province of Quebec, this 5th day of November, 1902.

WILLIAM GILMOUR.
ALEXANDER LINDSAY.

Witnesses:
ROBERT BENNETT HUTCHESON,
JESSIE AIRD STEPHEN.