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PROCESS OF TREATING MALLEABLEIZED CAST IRON

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Our invention relates to a process for hardening malleableized cast iron and has for one purpose to increase the combined carbon content of the metal. Another object is to increase the abrasive wear resistance of such iron. A further object is to increase the combined carbon content of the outer layer of the metal to a proportion above that of the interior of the metal. Other objects will appear from time to time in the course of the specification and claims.

The process has two phases or main components which may or may not be associated, depending upon the product desired. The primary process is for hardening malleableized cast iron by increasing its combined carbon content, namely by combining the free carbon present in the iron by the application of heat. The extent of this combination may be controlled by controlling the temperature to which the mass is raised, and by controlling the time during which the metal is subjected to the temperature in question. It will be realized of course, that the malleableized cast iron has a proportion of free carbon which may be as high as three per cent. The amount of this free carbon which we combine by our process is very substantially less than the total of the free carbon being, for example .40 per cent in the interior of the casting, and the proportion of the carbon may be increased or diminished by controlling the temperature and the duration of heat treatment. A further important factor is the cooling rate. If the mass is cooled too rapidly the product is hard and brittle. If the mass is cooled too slowly a certain proportion of the carbon will escape from combination and will remain as free carbon in the mass. We therefore find it important to control the cooling rate.

Where it is necessary to increase the strength of a malleableized iron casting, but where the surface of the casting does not have to wear, we may employ the process as above described. The casting is raised to a temperature above its critical temperature and is held at such temperature for a predetermined time, say for one-half or three-quarters of an hour after the temperature of the metal passes its critical or carbon combining temperature. The free carbon which is mixed with the ferrite, small particles of free carbon being scattered throughout the interior of the metal, combines with the ferrite to form iron carbide or pearlite. This combination goes on throughout the mass except in the surface layer or skin of the casting. Owing to the methods of production of malleableized cast iron the outer layer of the metal is substantially free from carbon and therefore the components necessary for the above described combining action are absent, and the outer shell is substantially unchanged.

In applying our process to wear taking parts where a hard surface is necessary, we associate with the main process above described a supplemental and accompanying process whereby the surface layer of the metal is also hardened. In many circumstances it may be necessary or desirable to provide a surface layer substantially harder or more resistant to wear than the interior of the casting. We may effect this result by associating with the casting a suitable carburizing agent or source of carbon. In practice, when the metal is heated in the presence of such a carburizing agent, the resultant proportion of combined carbon in the outer layer is larger than in the body of the casting. It may for example be one-half of one per cent in the interior of the casting and be as high as eight-tenths of one per cent, or one per cent, in the exterior skin.

In the practical carrying out of our process malleableized iron castings are first cleaned in any suitable manner, as by tumbling, sand blasting or the like. The castings may be placed in any furnace or suitable heating means, being therein raised to a temperature higher than the critical or carbon combining temperature of the metal. The time of exposure to such heating must depend upon the cross-sectional area of the castings, but in practice it should exceed by three-quarters of an hour the time necessary for the castings to attain a furnace temperature of about 1475° Fahr. In other words the castings are heated to a temperature

higher than their critical or carbon combining temperature and are held at such higher temperature. Thereafter the castings are cooled, and preferably they are removed from the furnace and cooled in containers, for example covered steel barrels. We suggest this expedient as being a ready means or method for controlling the rate of cooling, but obviously any other method may be employed whereby the cooling rate can be controlled. In employing the suggested covered steel barrels we are able to maintain a cooling rate which is slower than air cooling and faster than furnace cooling. We find in practice that this eliminates on the one hand the tendency of the carbon to escape from combination with the ferrite, and on the other hand prevents the formation of a product which is too hard or brittle.

As above suggested, our simple process may be carried on without the use of additional agents, where a wear taking part is not desired. If the finished casting is to be exposed to wear, we may expose the castings to some agent or agents, during heating, in order to harden the outer layer or shell of the casting after cooling. For example we may heat the metal in the presence of a carburizing agent. Thus the castings may be heated in a rotary retort furnace or in a curburizing box in a furnace, in the presence of such an agent. We may also employ a bath of molten sodium or potassium cyanide salts which may be diluted with other sodium or potassium salts. When such a bath is employed it should be at a temperature or be raised to a temperature higher than the critical or carbon combining temperature of the iron to be treated, for example approximately 1475° Fahr., and the castings should be held in the bath for a length of time varying with the cross-sectional area of the castings. In general practice the time necessary when a molten bath is employed is less than the time necessary for heating the metal without such a bath.

In employing a solid carburizing agent the castings and the agent may be taken together from the furnace and cooled, as above suggested, in closed containers. When a bath is employed as a carburizing agent the castings are quenched and are then drawn at any temperature which will give the desired properties. In practice approximately 550° Fahr. is a suitable temperature for obtaining the desired properties in the iron. By quenching we mean cooling in air, oil or water.

The result of the treatment or treatments above outlined is on the one hand to increase the combined carbon content of the iron, and to increase the yield point and ultimate strength of the iron. On the other hand, when the supplemental or surface treating process is employed the effect is to also increase the resistance of the iron to abrasive wear and to increase the combined carbon content of the outer layer of the iron. A wear taking casting, when so hardened in accordance with our process, has an outer shell or layer higher in combined carbon than the original malleableized casting and higher in combined carbon than the body or interior of the casting after processing.

We claim:

1. The process of heat treating malleableized cast iron which includes heating the iron to a temperature sufficient to cause the formation of iron carbide.

2. The process of heat treating malleableized cast iron which includes heating the iron to a temperature sufficient to cause the formation of iron carbide, and subsequently controlling the rate of cooling of the iron to prevent the escape of any substantial amount of the carbon from the iron carbide so formed.

Signed at Chicago, Illinois, this 27th day of December, 1926.

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