UNITED STATES PATENT OFFICE.

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ARTICLES SUBJECTED TO HIGH EXTERNAL TEMPERATURES.

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To all whom it may concern:

Be it known that I, JOHN C. HENDERSON, a citizen of the United States, residing at Washington, D. C., have invented a certain new and useful Improvement in Articles Subjected to High External Temperatures, of which the following is a full, clear, and exact description.

My invention relates to improvements in articles of manufacture which are subjected, when in use, to external heat at high temperatures, such temperatures ranging from 1000° F. upward.

It has for its object to produce an article which shall be strong and durable and capable of resisting injurious corrosion, pitting and oxidation at such temperatures to a remarkable extent.

It also has for its object to produce articles which, when in use, will have remarkable qualities as hereinafter specified.

My invention relates to such cast articles as molds for die casting and other uses, valves and valve seats for internal combustion engines, crucibles, outer casings for crucibles, linings for molds and crucibles, annealing boxes, case hardening or carburizing boxes, articles including tables, molds, plungers and conveyers for use in the working of glass and other massive articles, and consists of forming such articles from an alloy containing nickel or cobalt and chromium in certain proportions. The alloy requires a very high melting heat, but when once sufficiently melted can be cast in the ordinary manner.

In carrying out my invention I use an alloy containing from 5 to 30 per cent. of chromium and from 50 to 90 per cent. of nickel (or cobalt), the combined nickel (or cobalt) and chromium being at least 60 per cent. and the greater part of the remainder being of iron. The following is the preferred composition of the alloy used in carrying out my invention, viz.—nickel 60 per cent., iron 26 per cent., chromium 12 per cent., manganese 1½ per cent. When the article is to be machined the alloy should be substantially carbon-free, the carbon not exceeding .40 per cent. Iron, nickel and cobalt belong to the same group of metals in Mendeleef's table and have approximately the same atomic weights, to wit, iron 55.85, nickel 58.68, and cobalt 58.97 and cobalt may be substituted for nickel in carrying out my invention, since it has substantially the same properties as nickel.

In forming an article such as a valve according to my invention, I first cast a blank composed of the alloy above referred to and then machine it or grind it into proper shape. In forming annealing boxes, case hardening or carburizing boxes, the boxes may be cast without requiring subsequent machining of their surfaces.

Internal combustion engine valves formed according to my invention do not become pitted or corroded or warped, so as to require frequent scraping or periodic regrinding, as is the case with valves as at present made.

Molds embodying my invention are not liable to serious oxidation or other injury when used in casting brass or other similar metals and are so strong that they can be used for long periods for die casting. They produce smooth castings for the reason that the surface remains smooth even under the trying conditions of temperature changes and high temperatures, and they resist chemical actions to which old types of molds are liable. On account of their low heat conductivity they prevent the castings from chilling before removal, thereby producing castings of materials such as iron that can be easily machined. Molds embodying my invention are particularly useful in the manufacture of glass articles, such as glass bottles, since they withstand the high temperature and abrasion to which they are subjected in a remarkable manner and produce more highly polished glassware because they can be used at a higher temperature than other materials without the glass sticking or adhering thereto, and also resist the chemical action due to the constituents of glass. On account of the strength of the material they can be made much lighter than cast-iron molds.

Tables, rolls, drawing dies for glass working when made according to my invention are so slightly oxidized or corroded when in use that they can be used for a very long time without refinishing. Conveyer links for conveyers employed in moving or transmitting hot sheets of glass are also remarkably enduring when made according to my invention.

Crucibles when made according to my invention easily withstand temperatures sufficiently high for melting of brass or other materials of similar high melting point and are substantially unaffected by the molten metal. While the alloy specified is of relatively low heat conductivity when compared with other alloys or metals, it is of much higher heat conductivity than graphite or magnesite heretofore used in the construction of crucibles, so that for this reason and also for the reason that the crucible, when made according to my invention, may be thinner than crucibles heretofore used, the contents of the crucible can be more quickly brought to the melting point. The material of the crucible does not affect the quality of the molten content. Furthermore, crucibles made according to my invention can be heated and cooled quickly without damage to the crucible so that with crucibles embodying my invention not only can a purer product be obtained, but a great saving in time can be achieved. A very considerable saving can also be achieved by reason of the fact that the crucibles are not liable to be broken and retain their strength when heated to temperatures that would destroy ordinary iron or steel. Moreover, the stock or crucibles necessary to be kept on hand can be much smaller. The same is true of the stock of molds for glass making and annealing boxes. In glass making, as heretofore practised, the renewal of molds is necessarily frequent and necessitates the stopping of the glass casting machine, resulting in a great loss of time, which is saved by using molds embodying my invention, and the doing away with the necessity of frequent refinishing of the molds by the use of my invention results in a further great saving of labor and expense.

The manganese appearing in the preferred form of the alloy as above specified is not essential in producing my results but is merely the remnant of manganese used in forming the alloy. Where the article in its course of manufacture is to be machined, the carbon should preferably not exceed .40 per cent., but where the article is cast and does not require machining, it may be considerably higher, such for instance, as 2 per cent.

When subjected to oxidizing atmosphere of high temperature, a slight film of oxid forms on the surface of the article which is strong and durable and strongly resistant to the action of acids such as sulfuric and hydrochloric and of alkalis. This oxid is non-flaking, adhering strongly to the mass and when formed offers an increased resistance to corrosion, pitting and further oxidation. The mass when low in carbon is easily machined and may be rolled and forged.

What I claim is:

1. A cast article of manufacture subjected when in use to external heat at high temperatures composed of an alloy containing chromium and iron and another metal of the iron group of substantially the same atomic weight as iron, the chromium being from 5 to 30 per cent. and the metal last referred to from 50 to 90 per cent., and the combined third metal and chromium amounting to at least 60 per cent.

2. A cast article of manufacture subjected when in use to external heat at high temperatures composed of an alloy containing nickel and chromium and iron, the chromium being from 5 to 30 per cent., and the nickel from 50 to 90 per cent., and the combined nickel and chromium amounting to at least 60 per cent.

3. A cast article of manufacture subjected when in use to external heat at high temperatures composed of a ferrous alloy containing substantially chromium 12 per cent., iron 26 per cent., and 60 per cent. of another metal of the iron group of substantially the same atomic weight as iron.

4. A cast article of manufacture subjected when in use to external heat at high temperatures composed of an alloy containing chromium and iron and another metal of the iron group of substantially the same atomic weight as iron, the chromium being from 5 to 30 per cent., and the metal last referred to from 50 to 90 per cent., and the combined third metal and chromium amounting to at least 60 per cent., the alloy being substantially carbon-free.

5. A massive article of manufacture subjected when in use to external heat at high temperatures composed of an alloy containing chromium and iron and another metal of the iron group of substantially the same atomic weight as iron, the chromium being from 5 to 30 per cent., and the metal last referred to from 50 to 90 per cent., and the combined third metal and chromium amounting to at least 60 per cent.

6. A cast internal-combustion-engine valve subjected when in use to external heat at high temperatures composed of an alloy containing chromium and iron and another metal of the iron group of substantially the same atomic weight as iron, the chromium being from 5 to 30% and the metal last referred to from 50 to 90% and the combined third metal and chromium amounting to at least 60%, the alloy being substantially carbon free.

JOHN C. HENDERSON.