United States Patent Office.

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IMPROVED PROCESS OF COMBINING WROUGHT AND CAST METAL.

The Schedule referred to in these Letters Patent and making part of the same.

Be it known that I, EDWARD L. BROWN, of the city of Philadelphia, State of Pennsylvania, United States of America, have discovered a new and useful Metallurgical Process for use in the mechanic arts.

In order to enable the public to understand the nature of my invention, and those skilled in the arts to use the same, I describe it as follows:

Wrought metal is valuable in castings on account of its tensile strength, the tensile strength of wrought metal being nearly double that of cast metal. In efforts that have hitherto been made to introduce wrought metal into castings, for the purpose of imparting to them additional strength to resist various strains or concussions, the wrought metal has been first coated with tin, or some other metal easily fusible, to act, first, as a solder or means of union between the wrought and cast metal, and, second, to absorb a part of the heat of the cast metal, and thus prevent the crystallization or granulation of the wrought metal.

The use, in this connection, of a metal, or alloys of metal easily fusible, is, I believe, valueless; indeed worse than that, positively injurious, and for the following reasons:

It is unnecessary as a solder, for by my process the cast metal shrinks closely around the wrought metal, and forms a perfectly tight joint, and the compact combination of the metals is also further secured, as hereinafter mentioned. In order to have the fusible metal act as a solder, a considerable thickness of it must be used, and thus a layer of comparatively weaker metal, either the solder alone or the solder alloyed with the cast metal, must necessarily intervene between the wrought metal and the body of the cast metal.

The fusible metal or alloy, acting as a solder, does absorb some of the heat of the molten cast metal, but in so doing it melts, and allows the cast metal at a heat only slightly diminished to come in contact with the wrought metal. This melting of the fusible metal produces various injurious results.

The wrought metal, under the influence of the heat of the cast metal in contact with it, is crystallized either entirely or partially, and its fibre commensurately destroyed, and to a degree sufficient to materially reduce its tensile strength.

The tin or other fusible metal or alloy in melting is chemically decomposed, and a gas or gases generated, which, being very volatile and elastic, must expand and force their way into or through the molten metal. These gases generally showing their effects on the cope or upward side of the casting, force their way either entirely through the casting, thus forming blow-holes, visible from the outside, or partially through the casting, not discernible till the casting be broken. When broken, these castings present a honey-combed or spongy appearance, full of cells and holes of irregular shape, caused by the gases generated as above mentioned, and for this reason it is utterly impossible, as I believe, to make a solid compound casting with the use of any fusible metal, or alloys of metal, as a coating for the wrought metal.

If wrought metal be used without any coating, either heated or cold, polished or unpolished, the molten metal, by its heat, decomposes the oxide of iron, which, it is well known, is always present on all iron in a greater or less degree, and releases the oxygen gas. This gas forces itself into or through the casting in a similar manner as the gas generated from the fusible metal or alloy, as above mentioned, and causes the casting to present a similar appearance of honey-combing or sponge.

All these gases, whether evolved from the oxide of the wrought metal, or from the decomposition of the fusible metal, act as an elastic cushion, and prevent the close shrinkage of the cast metal around the wrought metal.

The true solution of the problem, which I claim to have discovered from my extensive researches and experiments, is this:

To present to the molten metal, instead of an easily fusible metallic surface, and one thus readily resolved by heat, a metal, alloy of metal, or metallic or mineral substance, difficult or impossible to melt at the degree of the heat of the molten metal poured about it. I thus secure important and essential results, and the following is a description of my process:

That all iron, though perfectly cleansed, is very easily, indeed almost instantaneously oxidized by expo-

sure to the atmosphere, and that the presence of a high heat on an oxidized surface releases the oxygen gas, and that oxygen gas is very volatile and elastic, are well-known facts. It is also true that the action of molten metal at a great heat on any easily-fusible metal, or on any metal fusible at a less degree of heat than the molten metal, evolves from that fusible metal, when heated to the point of fusion, a volatile and elastic gas. It is, therefore, essential, in order to produce a solid casting combined of wrought and cast metal, to prevent the formation of these oxygen or other gases during the process of casting. To accomplish this result I first thoroughly cleanse the wrought metal, by use of acids or otherwise, and immediately thereafter thoroughly and perfectly coat it with a non-oxidizable metal or substance very difficult to fuse. For this coating it is necessary to use a metal or substance that will melt only at a higher heat than the cast metal that is to be poured about it. I prefer to use nickel for this purpose, as this melts only at an exceedingly high heat, much higher than that of iron, and indeed is almost impossible to fuse. Other metals, such as platinum, can be employed, and I believe that such non-oxidizable and non-conducting substances as plumbago can be successfully used for this coating.

The wrought metal should be coated immediately after being cleaned to prevent oxidation from taking place, and is covered with its coating by means of a galvanic battery or other electric action, or by means of heat or other chemical process.

In order to obtain a perfect coating of the non-fusible metal, the wrought metal must be very thoroughly cleansed, and it may be first coated with copper, or other metal for which iron has a great affinity, to serve as a basis for the coating of the non-fusible metal.

The molten cast metal cannot, when it comes in contact in the mould with the wrought metal thus prepared, melt this coating, and cannot strike the wrought metal itself. No gas can be evolved either from the coating or from the wrought metal. The cast metal shrinks closely and tightly about the wrought metal, and not coming in contact with it, but with a coating that it cannot melt, that is not oxidizable, and does not readily conduct heat, it cannot impair the fibre of the wrought metal. No gas being evolved, no blow-holes, honey-combing, or cells are formed, and a perfect and solid casting is produced without difficulty.

My experiments justify the conclusion that neither gold, silver, copper, nor tin can be used for this coating in iron manufacture, as they all melt, and consequently oxidize and generate gas, at a much lower heat than the cast metal. Only such metals, alloys, or substances can be used as will not melt at the degree of heat required for casting metal.

By the process above described, the cast metal shrinks closely about the wrought metal, and holds it firmly without the intervention ot any solder. But to secure this result beyond any possible doubt, and prevent displacement under the heaviest concussions, before coating the wrought metal, I rag or barb it with a sharp chisel, or otherwise roughen or corrugate it. About each of these points, projections, or irregularities, however produced, the cast metal flows, and they thus act as internal rivets. By this means the wrought metal is more firmly embedded than can be done by any solder.

I believe that the above-described process of coating the wrought metal with a non-fusible metal or substance, is the exact opposite of all methods heretofore employed in the combination of wrought and cast metal in castings, and is the only one by which solid castings, composed of wrought and cast metal, can be made.

Therefore, what I claim as new and useful, and what I desire to secure by Letters Patent of the United States of America, is—

1. Preparing wrought metal for combining it with cast metal for castings of all descriptions, where great strength of any kind is required, by first thoroughly coating it, by galvanic action or other process, with nickel, or any other metal or metals, alloys of metals, or metallic or mineral substances, or their alloys, not easily oxidizable and very difficult to fuse, and which only melt, or whose point of fusion is at a higher degree of heat than the molten cast metal to be poured about it, the whole substantially as above described.

2. The production of castings, strengthened by the introduction of wrought metal coated with a metal, alloy of metals, or substance less fusible than the cast metal, substantially as above set forth.

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Witnesses:

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