L. G. WOODS.

FORMING CASTINGS.

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1,166,167.

Patented Dec. 28, 1915.

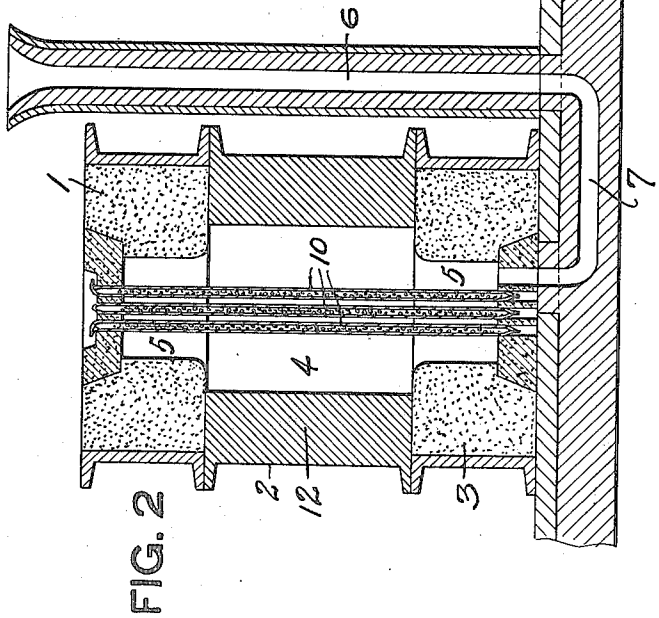


FIG. 2

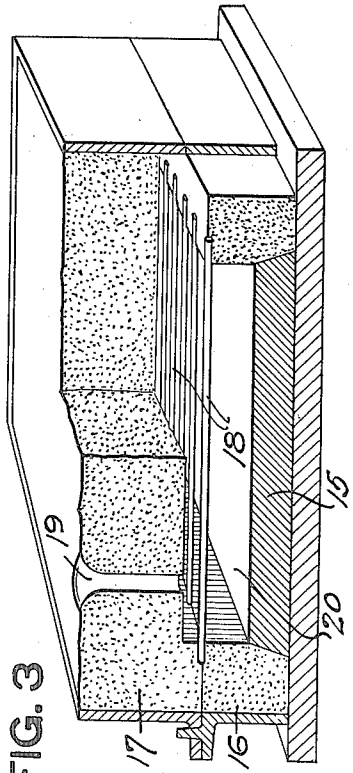


FIG. 3

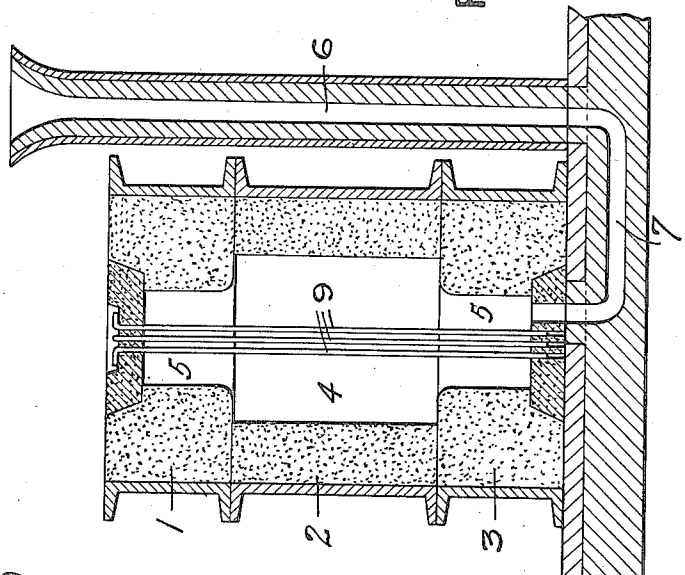


FIG. 1

WITNESSES.

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FORMING CASTINGS.

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To all whom it may concern:

Be it known that I, LEONARD G. WOODS, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Forming Castings; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the forming of castings. It is a well known fact that it is very desirable to form certain castings with the metal in different portions of the casting differing in physical character from that in another portion of the casting, for example, in armor plate, agricultural steels and the like, it is desired to form one face extremely hard to sustain wear, while another portion is tough and strong to sustain the hard wearing surface. In rolls, dies and other castings it is also extremely desirable to have a very hard working surface and have the body of the casting tough and strong to sustain the same. It has been found practicable to produce a very hard steel having great wearing power but it is usually so brittle that it will not sustain the heavy strains brought upon rolls and other similar details of machinery. Probably the best metal which has yet been used for such articles is what is known as chilling cast iron, where the iron when quickly cooled or chilled against a metal surface assumes a peculiar crystalline condition which gives a hard wearing surface, and the unchilled portion of the metal has considerable tensile strength; but even such rolls are liable to crack under very heavy strains. By my invention I am enabled to employ these very hard metals such as steel or chilling cast iron so as to obtain hard wearing surface and form the body portions of the castings of relatively great toughness or tensile strength. I am also enabled to reverse the physical character of the metal in the castings as may be desired, for example, forming a tough exterior and a hard interior.

My invention proceeds upon the opposite theory from that usually followed in attempting to produce ingots or castings formed of metal having varying physical characteristics, in that by alloying certain metals with the molten metal forming the castings I vary the chemical composition of the metal thereof instead of depending on differences of structure due to differences in heat treatment.

It consist in producing such castings by varying the composition of the metal in the mold while in a molten state, such as by inserting into certain parts of the mold an alloying metal which will melt and alloy with certain parts of the molten metal after the other parts thereof have become solidified.

It also consists in forming ingots, castings or the like by supporting within the mold cavity an alloying metal of a lower melting point than that of the metal to be cast, and casting the molten metal around or in contact with the same, so that it unites with a certain portion of the molten metal within the mold, the other portion of the molten metal being solidified, such as in contact with the outer walls of the mold, and remaining in its unalloyed state, and in this way changing the character of the metal of the casting itself by forming the alloy within the mold and during the casting of the article.

In the accompanying drawings Figure 1 is a vertical section illustrating the casting of a roll within a sand mold in accordance with the invention; Fig. 2 is a like view illustrating the casting of a mold wherein a chill or metal mold is employed; and Fig. 3 is a sectional view illustrating the formation of a slab or plate, for example, an ingot or the like.

The invention can most easily be illustrated in connection with the formation of steel rolls, though it is to be understood that it is not limited to the use of steel or to the formation of any form of ingot or casting, as the principle involved may be employed with any metal and in the formation of any article. Considering the invention, however, as applied to the formation of a steel roll, such as illustrated in Fig. 1, where the roll is formed in a sand mold, the mold parts are formed in the usual way, it being preferred in such type of mold that it shall be formed in three sections 1, 2, 3, the middle section 2 forming the body 4 of the roll, and the top and bottom sections forming the necks 5 thereof. The molten metal is fed to the roll through a runner 6 and a side runner 7. In this case it is desirable to provide a very hard wearing surface and this can be obtained from a very hard steel, and to that end the cast steel

is formed high in carbon, and may be rendered still harder by the use of certain other alloys. It is desirable that the central portion and the necks shall be made tough and strong to sustain the strain brought upon the roll body. To accomplish this I employ a metal, or alloy or metals, having a lower melting point than the steel and which when alloyed with the steel will greatly increase its toughness and strength. This metal may be used in the form of thin bodies such as rods, wire, or metal strips 9, or even of the metal in small particles contained in inclosing tubes 10 having a lower melting point than the steel. As illustrated in the drawing these thin bodies of metal are properly seated in the ends of the two end mold sections 1 and 3. This may be accomplished in any suitable way, for instance by seating the same in core pieces at the top of the mold section and carrying them down and seating them in a like core piece in the bottom mold section, or, for that matter support the thin bodies, wires, rods, strips 9 or tubes 10, and so hold them in place. Any suitable metal or alloy having a lower melting point than the molten metal may be employed for this purpose, it being preferred that the metal will not melt too rapidly but will gradually melt off and alloy with the molten metal in the mid-portion of the mold as the metal rises within the mold cavity. Indeed, in forming some steel castings where the steel can be raised to a heat higher than the melting point of the alloying metal, an alloying metal of as high a melting point as that of steel may be employed, the only requirement being that the outer portion of the steel casting shall solidify before the alloying metal becomes molten to alloy with the other part of the molten metal poured. For example, thin bodies of copper or alloys of copper having a suitable melting point, may be employed, or nickel or an alloy of copper and nickel in suitable proportions having a sufficiently low melting point for the purpose. For castings of sufficient size the alloying metal may be contained within a suitable holder, for example, within the tubes 10, the holder itself being formed of metal which will melt so as to feed the alloying metal to the steel body. After the mold has been formed in the manner above described and the thin bodies of alloying metal been properly supported therein, the molten steel is poured through the runner and rises around the rods or thin bodies, inclosing the same, the steel, however, in the example shown, filling the main body portion of the mold and its outer portion contacting with the cold outer face of the mold being sufficiently chilled or congealed as to cause its solidification without its being acted upon by the alloying metal, while the interior of the castings remains sufficiently molten to be acted upon by the alloying metal as it is melted and dissolved within the mass of the molten steel. In this way, by proper manipulation as is learned by experience, the casting can be formed with the outer face or periphery of a very hard steel and the inner body of a tough strong steel resultant from the alloying therewith of the thin bodies of metal supported within the body of the mold.

In Fig. 2 I have illustrated the mold as used in the practice of the invention with an iron chill portion forming the mold for the body of the roll. This figure has the same reference numerals as Fig. 1 except that the metal chill is marked 12, it being formed of suitable iron casting. The mold is made up in the same way and the molten metal may be either the hard steel or a chilling cast iron. In either case it is practicable to toughen and strengthen the interior portion of the casting while the chill 12 provides for the immediate setting or solidification of the outer portion or wall of the casting and prevents possibility of the alloying of the same during the formation of the casting.

Fig. 3 is intended to illustrate other uses of the invention, for example, the formation of an ingot block or the like. In said figure the mold has a metal bottom plate 15 for chilling or congealing the metal poured within the mold and an inclosing drag flask 16, and a top or cope 17, and the thin bodies of alloying metal, bars, rods or the like, 18, are laid upon the drag mold and the cope is then placed upon the same to hold them in place. The metal is poured through the runner 19 and as it strikes the bottom chilling face it is quickly chilled and reduced to a temperature below that at which it will be alloyed, while when the molten metal rises and surrounds the thin bodies or rods 18 of the alloying metal it will melt and unite with the molten metal poured, so producing a casting the lower portion 20 of which is of hard metal according to the composition of the steel or other metal employed while the upper portion of the molten steel melts the bodies or rods and causes an alloying of the molten steel therewith and so increases the strength and toughness thereof and forces a tough backing to the hard metal of the casting.

It is believed that the above are sufficient illustrations of the general principles of the invention involved, which includes the changing of the physical character of the metal in certain parts of the casting by alloying with that portion of the metal and metal or alloy of a lower melting point the action of which is limited to that part of the casting, it being my intention to cover this principle broadly with any metals to which it is applicable. In the practice of

the method it is also evident that by selecting or forming an alloying metal or compound thereof melting at a known heat I am enabled to control the depth of the metal in its original molten state which is set or chilled before the alloying action commences and in this way to assure a certain thickness of the unalloyed metal in the wall or outer face of the casting or of a certain part thereof.

What I claim is:

1. The method of changing the character of the molten metal forming a casting, consisting in supporting within the mold an alloying metal and pouring the molten metal in direct contact therewith so as to entirely surround and alloy said alloying metal with the molten metal.

2. The method of changing the character of the molten metal forming a casting, consisting in supporting within the mold an alloying metal having a lower melting point than that of the molten metal and pouring the molten metal in direct contact therewith to completely alloy said alloying metal with said molten metal.

3. The method of changing the character of the molten metal forming a casting, consisting in supporting within the mold a thin body or bodies of alloying metal and pouring the molten metal entirely around and in contact therewith.

4. The method of changing the character of the molten metal forming a casting, consisting in supporting within the mold a thin strip or strips of an alloying metal having a lower melting point than that of the metal to be cast and pouring the molten metal around and in contact therewith.

5. The method of increasing the strength of the interior of a casting, consisting in supporting within the mold cavity an alloying metal which when alloyed with the molten metal of a casting increases its strength, and casting the molten metal around and in direct contact therewith and thereby melting the strengthening metal and causing it to alloy with the molten metal.

In testimony whereof, I, the said LEONARD G. WOODS, have hereunto set my hand.

LEONARD G. WOODS.

Witnesses:

A. STUCKI,

ROBERT C. TOTTEN.