

## UNITED STATES PATENT OFFICE

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## METAL CASTING

Byron E. Eldred, New York, N. Y.

No Drawing. Original application June 3, 1930,  
Serial No. 459,040. Divided and this applica-  
tion January 29, 1932, Serial No. 589,548

4 Claims. (Cl. 148—32)

This invention relates to cast shapes of copper, aluminum and other metals and alloys and is a division of my copending application Serial No. 459,040, filed June 3, 1930, issued as Patent 1,868,099.

It is well known that molten copper has the property of absorbing gas which is given up on congelation of the metal. Molten copper also has the property of passing quickly from the liquid to the solid state on chilling. These combined properties have made it difficult to cast copper by the prior methods.

The methods of the prior art produce more or less porous billets, the defects of which enter into the formed shapes rolled or drawn therefrom.

I have discussed the disadvantages of such prior methods in my copending application filed September 28, 1929, Serial No. 395,821, and in that application I have disclosed methods of and apparatus for overcoming these difficulties and which obtain improved results by continuously casting the rods, plates and other shapes directly from the molten metal in such a way as to cause the congelation to proceed from the bottom upwardly.

Also in those prior methods the crystals in the congealed metal of the billet had their primary axes arranged in various directions. When these billets were subsequently heated and fabricated into shapes the crystals had no definite predetermined alignment. The primary axes of certain of the crystals might extend across the shapes while others might extend longitudinally therein or in a multiplicity of directions. This more or less heterogeneous arrangement of crystals is detrimental to subsequent working.

By my invention a superior product can be obtained while obviating expensive operations. Both small and large shapes may be obtained directly from the furnace by a continuous casting method with congelation proceeding from the bottom upwardly, thus eliminating gas defects. In carrying out the method I so control the congelation by proper cooling that I may continuously form a rod, plate or other shape from molten metal with the primary axes of the crystals extending substantially in the same direction, preferably longitudinally of such shapes and of the same order of size throughout the length of the casting. This improvement enables one to produce shapes which on subsequent working provide articles of superior quality. I also have found that copper shapes produced by my method have increased density at 20° centigrade the density of the casting is substantially nine.

The various objects of the invention will now be generally set forth.

It is an object of this invention to cast rods, plates and other shapes with large macro crystals having their primary axes extending in the same general direction.

Another object of the invention is to produce cast metal shapes of higher than usual density which is usually given as between 8.93 and 8.95 (see Hand Book of Chemistry, by Hodgeman and Lange, 1929 Ed.).

Another object is to produce cast metal shapes with the foregoing properties by a continuous forming method which is called draw-casting herein.

Other objects will appear in the following description:

The products claimed herein may be made, for example, by the process of my said Patent 1,868,099 and it need not be described in complete detail herein.

In the process molten metal passes into one end of the mold and congealed metal is drawn out of the other end. The congealed metal is chilled to congeal additional superposed metal onto the previously congealed metal. The withdrawal of the heat of congelation (latent heat) is thus in the direction of the motion of the congealed metal, that is, lengthwise of the casting. This chilling and withdrawal is so controlled as to maintain a substantial planar congealing zone substantially normal to the length of the casting.

By the continuous and orderly withdrawal of latent heat longitudinally of the casting, large macro crystals are continually grown from the congealing zone, which in the case of copper and other elementary metals are orientated longitudinally of the casting in a very pronounced manner. In some metals, particularly alloys, the crystals are large macro crystals having their primary axes directed in a general longitudinal direction, but the length of their primary axes is not so great. Hence, their orientation is not so pronounced but in all cases the castings are distinguished by large macro crystals with absence of small equi-axed crystals in the central portions and in substantially all other portions of the casting.

Since the castings are made continuously from a supply of molten metal out of contact with oxidizing atmosphere, they are substantially oxygen free and there is in the case of copper a remarkable freedom from oxides at the crystal boundaries. It is apparent that this freedom from oxy-

gen would also be the case with other metals and alloys.

Having described my invention, what I claim is:

- 5 1. A draw-casting having substantially all its crystals progressively formed from one end thereof, said crystals as cast being large macro crystals of the same order of size throughout the length of the casting, and said casting being substantially free of small equi-axed crystals.
- 10 2. A draw-casting consisting throughout its length substantially entirely of large macro crystals congealed together with their primary axes of crystallization orientated, longitudinally of the casting, in the same general direction, said crystals as cast being of the same order of size
- 15 throughout the length of the casting, and the

casting being substantially free of small equi-axed crystals in the central portion thereof.

3. A copper draw-casting having large macro crystals substantially all being progressively formed from one end thereof and having a density greater than 8.95 at 20° C. and being substantially free of oxygen and small equi-axed crystals.

4. A copper draw-casting as removed from the mold and before working, having a density at 20° C. greater than 8.95 and consisting substantially throughout its length of a plurality of large macro crystals congealed together with their primary axes of crystallization orientated longitudinally of the casting, in the same general direction and being substantially free of small equi-axed crystals.

BYRON E. ELDRED.