

J. H. BAMBERG & H. H. DOEHLER.
METAL CASTING AND THE METHOD OR ART OF MAKING SAME.
APPLICATION FILED FEB. 12, 1917.

1,299,655.

Patented Apr. 8, 1919.

Fig. 1.

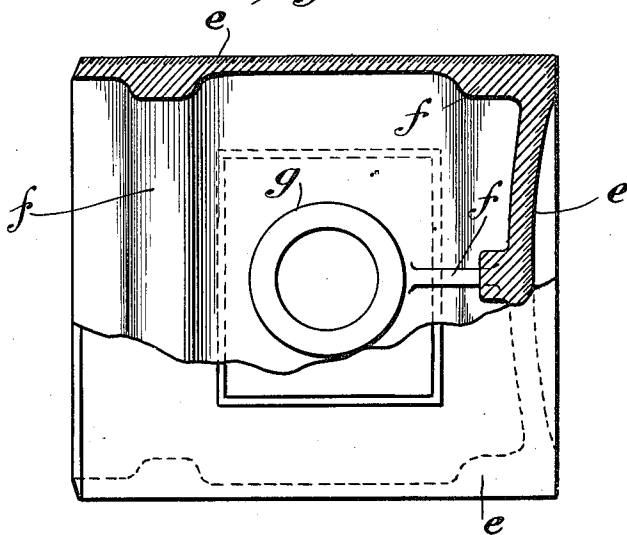
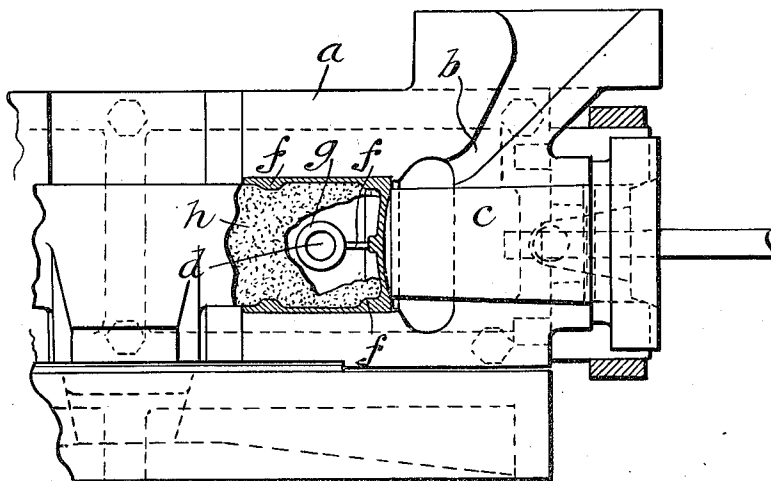


Fig. 2.



WITNESSES:
E. M. ...

Joseph H. Bamberg INVENTORS,
Heinrich A. Doehler
BY
Frank O. Wentworth
their ATTORNEY.

UNITED STATES PATENT OFFICE.

JOSEPH H. BAMBERG, OF TOLEDO, OHIO, AND HERMAN H. DOEHLER, OF BROOKLYN, NEW YORK, ASSIGNORS TO DOEHLER DIE-CASTING COMPANY, OF BROOKLYN, NEW YORK, A CORPORATION OF NEW YORK.

METAL CASTING AND THE METHOD OR ART OF MAKING SAME.

1,299,655.

Specification of Letters Patent.

Patented Apr. 8, 1919.

Application filed February 12, 1917. Serial No. 148,026.

To all whom it may concern:

Be it known that we, JOSEPH H. BAMBERG and HERMAN H. DOEHLER, both citizens of the United States, residing, respectively, at Toledo, county of Lucas, State of Ohio, and the borough of Brooklyn, city of New York, county of Kings, and State of New York, have jointly invented certain new and useful Improvements in Metal Castings and the Method or Art of Making Same, of which the following is a specification, reference being had therein to the accompanying drawings, which form a part thereof.

Our invention relates to metal castings and the method or art of making same; and more particularly to the production of semi-finished castings, as distinguished from finished castings, or rough sand castings, said semi-finished castings when drawn from the mold being substantially to the required dimensions but require surface finishing for the purpose of securing nicety of fit with other machine parts used in connection therewith.

The method or art of our invention is designed to produce a metal casting having one portion thereof, (that portion requiring machining), of greater density and hardness than the remainder of the casting, thus entirely eliminating that well defined line of demarcation between portions of a casting, ordinarily found in castings formed in a metal mold, or in other words avoids stratification of the metal of the casting in a manner to present in the casting two hard strata separated by a relatively softer and weaker stratum. It is possible by the practice of our method or art of producing castings, to have undercut portions formed by means of removable cores, thus permitting the formation of webs, or fillets, in different parts of the casting for the purpose of adding strength to, and of increasing the bulk of the metal in, certain portions of the casting.

The method or art of our invention while closely related to the pressure die casting art, as to the character of the mold used, nevertheless differs therefrom in that the chilling or solidification of the casting is controlled in a manner to impart to the product different characteristics adjacent different surfaces thereof. It further differs from the pressure die-casting process, in that the mol-

ten metal is permitted to flow by gravity into the mold and to build up in a manner somewhat similar to that present when casting in sand molds.

A casting made in accordance with the method or art of our invention possesses the characteristics that the metal adjacent one of the surfaces of the casting will have a much deeper chill than is ordinarily found in castings formed with metal molds while the metal adjacent the other surface of the casting will be somewhat softer than if the casting were formed in metal molds, there being no decided line of demarcation between these two portions of the casting, the hardness and density of the metal of the casting gradually ranging from the greater hardness and density on the outside, to the greater softness and lower density on the inside.

The invention consists primarily in a metal casting composed of a high fusing alloy having a deep chill on one surface thereof and no chill on the other surface thereof, with a gradual reduction in the hardness and density of the metal in the casting between one surface thereof and the other; and in such other novel characteristics and in such novel steps and practices employed in producing such castings, as are hereinafter set forth and described and more particularly pointed out in the claims here-

For the purpose of this application we have illustrated our invention as applied to the production of a piston for internal combustion engines, and will describe the invention in particular reference thereto, although it is apparent that the invention is one of general application to the method or art of casting fluid metal.

Referring to the drawings, Figure 1 is a cross section of a, so called, aluminum piston made by the method or art of our invention; and Fig. 2 is a sectional view of a portion of a mold used in the practice of the method or art.

Like letters refer to like parts in both of said views.

In the practice of the method or art of the invention, we employ a sectional mold formed of any material having high heat conductivity, preferably a mold *a* similar to

that ordinarily used in pressure die casting. The cavity of the mold is given the desired surface finish and its dimensions closely approximate those of the casting after it has been machine finished in fitting it to the other cooperating machine parts. This mold is provided with a suitable ingate *b* through which molten metal is poured so as to permit it to flow by gravity into the mold cavity, so as to cause the casting to build up from the bottom of the mold cavity.

Openings, and under cut surface depressions upon the outside of the casting are formed by means of movable metal cores *c-d*, in the same manner as in making pressure die castings.

Thus it will be observed that the entire wall of the mold cavity is composed of a material having high heat conductivity so that the chilling of the molten metal will proceed from the outer surface of the casting and will be fairly rapid. This condition is present in pressure die casting, and to avoid a too rapid chilling action, it is a common expedient to raise the temperature of the mold to an extent determined by the fusing point of the alloy being cast.

In pressure die casting, however, the chilling or solidification of the metal of the casting is not controlled except by the drawing of the casting from the mold, and both surfaces of the casting are chilled to the same extent.

By our method or art, however, the chilling action of the mold is limited to one surface thereof, the core *h* or other portion of the mold forming the other or inner surface of the casting being formed of refractory material, such as ordinary molding sand, or plastic compositions used in making molds. In this manner we secure good venting through the core and prevent heat radiation except through the metallic portions of the mold. Hence chilling of the metal can proceed in one direction only and the radiation of the heat will proceed in a manner to cause the metal of the casting to be more dense and harder upon the outside thereof with a gradual reduction of both density and hardness toward the opposite surface of the casting, and the chill adjacent the outer surface to be somewhat deeper than is possible to secure with all-metal molds. Furthermore the porosity, contractibility and frangibility of the refractory material will permit solidification shrinkage to proceed without likelihood of rupturing or fracturing the casting, and at the same time, will permit projecting undercut surfaces, such as bosses, grooves, ribs or fillets to be formed upon the inner surface of the casting. By the use of a yieldable core, the casting may be allowed to remain in the mold longer than is possible with rigid cores, and for a sufficient time to effect a deep chilling

upon the outer surface of the casting and the graduation, in the hardness and density of the casting above referred to.

After pouring the molten metal into the heated mold, and after the initial solidification shrinkage, the metal cores are drawn, when this is necessary to prevent rupture or fracture of the casting, and when sufficient time has elapsed to insure the proper conditioning of the metal of the casting, which time will vary according to the size and bulk of the casting and the alloy being used, the mold is opened and the casting drawn therefrom. Thereafter, the porous core is removed by breaking it down.

In addition to the porous core, as a venting means, it may be necessary to provide the metal portions of the mold with the usual vents.

The method or art of our invention is particularly adapted for making hollow, cylindrical and cup-like castings for various purposes, which castings either by reason of interior projections or depressions, and likelihood of cracking as a result of shrinkage, can not be successfully made in one piece by ordinary casting methods using metallic molds.

The deep chill of the outside of the casting is highly desirable as it permits surface machining as in hand finishing, grinding, scraping, etc., without material loss in the strength and wearing qualities of the finished product.

The varying density and hardness of the metal of the casting, gives great strength to the casting in its entirety, and avoids a weak stratum in the body of the casting. Furthermore, it is possible to vary the bulk of the metal at different points of the casting for the purpose of resisting the stresses incidental to the use of the casting.

The alloy used in the practice of our method or art, is immaterial. Ordinarily we employ aluminum alloys which are old and well known in the metallurgical arts, and which are ordinary commercial products.

In illustrating the invention, we have shown a piston for an internal combustion engine, as this exemplifies clearly the desirable characteristics of the invention since its outer surface *e* must be machine finished; exactitude in its inside dimensions is not necessary; reinforcing ribs *f* are desirable, and the wrist pin bosses *g* project well within the casting.

As shown, by the cross sectioning of Fig. 1, the outer portion of the casting is harder and more dense than the inner portion, and as shown in Fig. 2, metal cores for forming openings in the wrist pin bosses, and for shaping portions of the outer surface of the casting, are used.

In the production of the complete casting, it is necessary to cut away or otherwise re-

move the sprue after drawing the casting from the mold.

Another characteristic of a casting made by the method or art of our invention, is that there is little likelihood of its warping either in the mold or from temperature changes while in use.

Having described the invention, what we claim as new and desire to have protected by Letters Patent is:—

1. A semi-finished metallic alloy casting having a cup-like cylindrical structure with projections extending inwardly from the inner surface thereof, the outer surfaces of the casting having a deep chill, permitting surface machining or hand finishing, the casting having no chill at the inner surfaces thereof, with a gradual reduction in the hardness and density of the metal in the casting from all the outer to the inner surfaces.

2. A semi-finished metallic alloy casting of a hollow piston for internal combustion engines, having wrist pin bosses extending into the same, the outer surfaces of the casting having a deep chill permitting surface machining or hand finishing, the casting having no chill at the inner surfaces thereof, with a gradual reduction in the hardness and density of the metal in the casting from all the outer to the inner surfaces.

3. The method of making hollow metal castings comprising, flowing molten metal into a metallic multiple part mold having a movable metallic core for forming a portion

of the casting, and about a refractory heat insulating yieldable core, drawing said metal core after the initial solidification shrinkage of the metal, allowing the casting to remain in the mold until the metal is conditioned, separating the mold parts, removing the casting with the refractory core from the metallic portion of the mold, and finally removing said refractory core from within the casting.

4. A method or art of making metal castings consisting in flowing molten metal into a metallic multiple part mold, having movable metallic cores for forming portions and openings in the outer surface of the casting and about a refractory, heat insulating core, drawing said metal cores after the initial solidification shrinkage of the metal, allowing the casting to remain in the mold until the metal is conditioned, separating the mold parts, removing the casting and the refractory or heat insulating core from the metallic portion of the mold and finally removing said refractory or heat insulating core from within the casting.

In witness whereof, we have hereunto affixed our signatures in the presence of two subscribing witnesses, this third day of February 1917.

JOSEPH H. BAMBERG.
HERMAN H. DOEHLER.

Witnesses:

J. A. TALLMAN,
H. W. GRIFFIN.