June 12, 1934. E. G. FAHLMAN 1,962,491

ARTICLE AND METHOD OF CASTING THE SAME

Filed Oct. 12, 1931

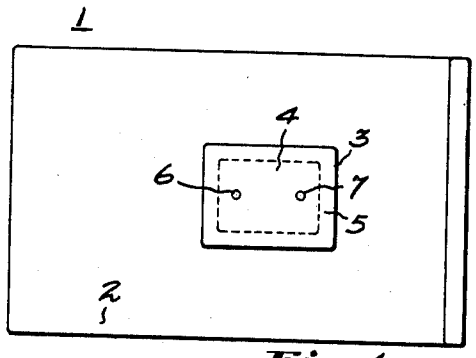


Fig. 1.

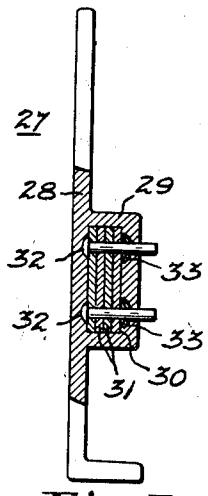


Fig. 5

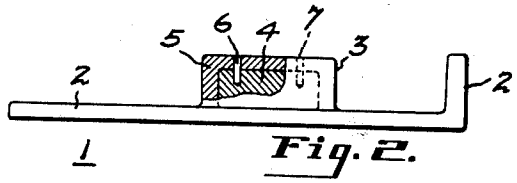


Fig. 2.

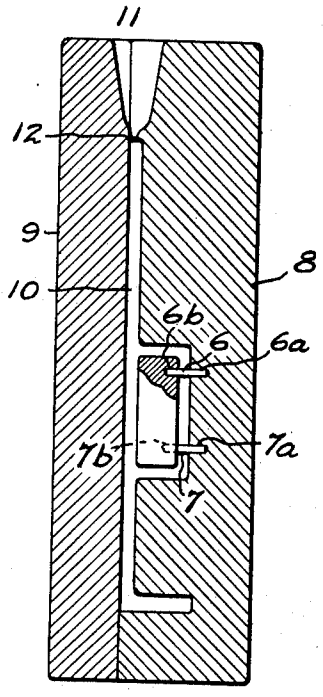


Fig. 6.

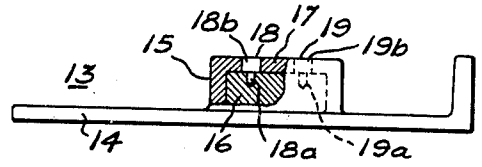


Fig. 3.

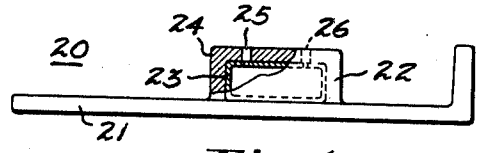


Fig. 4.

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ARTICLE AND METHOD OF CASTING THE SAME

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11 Claims. (Cl. 22—203)

This invention relates to a method of facilitating the casting in permanent molds of metals of high casting shrinkage and especially of aluminum and alloys thereof, and more particularly where these articles are to be of thick and thin section.

The casting of aluminum and alloys thereof in permanent molds (usually iron) involves many problems due to the high crystallization shrinkage of the casting metal in the permanent mold. The difficulties are intensified when the casting to be formed has portions of relatively thin section and other portions of relatively heavy section, and particularly when the changes in section are relatively abrupt, due to the difficulty of "feeding" the heavy section during solidification thereof, and the tendency for the formation of cracks and shrinks at the portions of the casting adjacent the junctions of the heavy and thin sections. Such "feeding" has ordinarily been accomplished by locating sprues conveniently adjacent to the heavy section whereby molten metal readily may be transmitted from the sprue cavity to said heavy section during the solidification of the metal therein. In certain cases, however, it has been difficult or impossible, due to the shape of the casting, to part the mold and hence to locate sprues adjacent said heavy sections, wherefore it has not been feasible or possible to produce such castings in permanent molds.

An object of my invention is to provide a new and novel composite cast article whereby aluminum castings of hitherto difficultly cast shapes readily may be formed.

Another object is to provide an aluminum or alloy casting having heavy and thin sections, and having a homogeneous exterior of uniform fine grain structure.

A further object is to provide an aluminum or alloy casting having abrupt changes from light to heavy section and having improved structural characteristics.

Another object of my invention is to provide an advantageous method of forming from aluminum and alloys thereof castings having relatively abrupt changes from thin to heavy section.

Another object of my invention is to control the chilling of a thick portion of a casting having a generally thin section, whereby such portion will have a structure substantially similar to that of the rest of the casting.

Another object is to provide a method of forming in permanent molds, without the aid of feeding sprues, aluminum or aluminum alloy castings of widely variant section and with a surface of solid nonporous fine-grained metal.

Other objects of the invention will be apparent to those skilled in the art from the disclosures herein made.

My invention contemplates the formation from aluminum or alloys thereof of composite castings wherein a metal insert defines the interior of an enlarged or heavy section of the casting, and wherein the exterior to the cast article is unitary and substantially encloses the insert. The casting is formed by suitably supporting the insert in the casting cavity of a permanent mold, and by pouring the casting metal which is to define the exterior of the casting around said insert to enclose the same and embody said insert within the casting. The insert may be of any suitable metallic composition and may be solid, laminated, or hollow, depending upon the circumstances of the individual case. For example, when employing a hollow insert, the thickness thereof may be regulated to give any predetermined desired chilling effect. The insert may be of any suitable ferrous or non-ferrous material, and may be made in any convenient manner, as by casting, rolling, forging, etc.

The insert is preferably of such dimensions that the thickness of the casting metal enclosing the insert and the thickness of the casting metal forming the remainder of the cast article, will be of substantially the same order of magnitude. Thus, the metal to be cast in the final casting operation will be of relatively uniform section, and the finished article, although of non-uniform section and having abrupt changes of section, will be actually formed by an exterior casting of substantially uniform section, with the resulting advantage of uniform fine grain structure and correspondingly improved mechanical and physical properties.

The metal insert furthermore constitutes also a chill to assist in cooling uniformly the metal cast around the insert, whereby the metal forming the exterior casting may be relatively uniformly chilled throughout its extent. The insert and the metal cast therearound thus constitute together for all practical purposes a unitary cast construction.

In the drawing, Figure 1 is a top plan view of a casting formed in accordance with this invention:

Fig. 2 is an elevation partly in section, of the casting shown in Fig. 1;

Fig. 3 is an elevation partly in section, illus-

trating a modified form of casting contemplated by my invention;

Fig. 4 is an elevation partly in section, illustrating another modified form of casting contemplated by the invention;

Fig. 5 is an elevation partly in section, illustrating still another modified form of casting contemplated by the invention; and

Fig. 6 is a vertical section through a permanent mold showing an insert in place for the casting operation.

In Figs. 1 and 2 I have shown a cast article 1 such as contemplated by my invention formed from an aluminum alloy in a permanent mold. The casting 1 is shown as having a portion 2 of relatively thin section and relatively great extent. Well away from the edges of the casting is shown an enlarged portion 3 of relatively heavy section, the change in section from the portion 3 to the portion 2 being relatively abrupt. The heavy section forming the portion 3 is shown as comprising a metal insert 4 and an outer layer 5 integral with the remainder of the casting. In the portion 3 are shown pins 6 and 7 which extend to the surface of the outer layer 5, the pins 6 and 7 being preferably of a composition similar to that of the aluminum alloy constituting the body of the casting. The insert 4, as shown, is of any suitable ferrous or non-ferrous metal, for example brass, and as shown is of substantially the same shape as the exterior of the portion 3 and of substantially uniformly smaller dimension, such that the thickness of the outer layer 5 is of about the same thickness as that of the portion 2.

In Fig. 6 I have illustrated the manner of casting the article 1. Thus, the mold sections 8 and 9 are shown as shaped to define the casting cavity 10, sprue cavity 11, and communicating gate 12. The mold section 8 is shown as provided with the recesses 6*a* and 7*a* which receive the aluminum metal pins 6 and 7 carried by the insert 4 and extending into the insert recesses 6*b* and 7*b*, whereby the insert 4 is supported in molding position within the mold. The casting metal is poured into the sprue cavity 11 to fill the casting cavity 10, the casting metal surrounding the insert 4 and incorporating the same within the casting.

In Fig. 3 I have shown a modification of the invention wherein the finished casting is provided with apertures which may be threaded to receive screws, bolts or the like. Thus, I have shown a casting 13 having a relatively thin section 14 and a heavy boss section 15 disposed relatively remote from the edges of the casting 13. The boss section 15 is shown as comprising an insert 16 of any suitable metal and an outer portion 17. The casting 13 is shown as provided with the apertures 18 and 19 which comprise the aperture portions 18*a* and 19*a* in the insert 16 and aperture portions 18*b* and 19*b* in the outer portion 17. The apertures 18 and 19 may be formed by suitable core members serving also to support the insert 16 within the mold during the casting operation.

A further modification of the invention is shown in Fig. 4, wherein a hollow metal insert is employed. Thus, the casting 20 has a relatively thin section 21 and a relatively thick section 22. The thick section 22 comprises a hollow metal insert 23 and an outer cast portion 24. Shouldered pegs 25 and 26 are shown as carried by the insert 23 and extending to the outer surface of the portion 24. The pegs 25 and 26 may preferably be composed of aluminum metal similar in composition to that of the casting metal whereby the outer surface of the cast article may be of uniform composition. The insert 23 may be of any suitable ferrous or non-ferrous metal and the thickness thereof may be regulated to impart any predetermined desired chilling effect during the casting operation.

A further modification of the invention is shown in Fig. 5, wherein the insert is modified as to its heat conductivity as, for example, by being laminated, whereby the heat conductivity normal to the lamination becomes very much less than otherwise would be the case. As shown, the casting 27 has a relatively thin portion at 28 and a relatively thick portion 29. The thick section 29 has cast within it the laminated block 30 composed of individual laminations 31 assembled on the rivets 32. These rivets or bolts may be provided with the spring washer 33 to hold the laminations 31 temporarily together. The protruding portions of the rivets serve the same purpose as the pins 6, 7, 25 and 26 in the other structures. It is to be understood that the laminations may extend in any direction corresponding to the chilling effect desired, and that more than one series of laminations may be used in a given insert.

It is to be understood that such an insert may be only partially laminated, as for example, being generally solid metal placed in a shell, or between thin laminations which may be formed in a press so as to fit it.

In the forms of castings shown in Figs. 1, 2 and 4, the pins 6, 7, 25 and 26 may be provided with irregularly shaped portions in order to prevent loosening or movement of the pins in the finished article.

In carrying out my invention the metal surrounding the insert is, of course, chilled by the metal mold on one side and by the metal of the insert on the other. The size of the insert for any given case is preferably made such that the metal surrounding the insert will chill and solidify at approximately the same rate as the metal constituting the remainder of the casting. The actual proportions of the insert will therefore vary to some extent, depending upon the actual size and mass of the insert, and the mass and thickness of section of the casting as a whole. In general, the smaller the mass of the insert the smaller the chilling effect thereof. Consequently, the smaller the heavy section of the casting the more closely the insert may approximate or approach the outer dimension of said heavy section, and consequently the thinner may be the section of metal which is to be cast around the insert. For an average case, however, the thickness of the metal to be cast around the insert may be approximately the thickness of the adjacent thin section of the casting.

Depending upon the conditions to be met, the chilling effect of the insert may be controlled by previously heating it to a greater or less degree before placing it in the casting. In this way its chilling properties may be modified in any desired manner, depending upon the temperature to which it is raised.

It will be readily understood that by my invention inserts may be utilized and heavy sections formed in castings in locations where in many cases it would not be feasible, and in cases indeed where it would be impossible, to locate

the feeding sprues to compensate for the heavy shrinkage involved in the casting of heavy casting sections adjacent to thin casting sections.

It will further be seen that I have provided by my invention a composite cast aluminum alloy casting of unitary exterior and possessing the advantages of solidity and homogeneity.

It will further be noted that by my invention aluminum castings of irregular and unusual shape readily may be made to form cast articles having a uniform exterior free from cracks, shrinks and other imperfections frequently accompanying the casting of articles of irregular section.

It will further be noted that I have provided an advantageous method of solving the difficult problem of casting articles having sudden changes from thick to thin sections by forming a composite casting of an entirely unitary exterior.

Furthermore, it is to be understood that the particular forms of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. As a new article of manufacture, an aluminum or aluminum alloy permanent-mold casting of generally thin section having a heavy section projecting therefrom, said article having a unitary homogeneous exterior of substantially uniform thickness and uniform fine grain structure, and a metal insert embedded in the projection, said insert being substantially completely surrounded by the exterior unitary cast metal.

2. As a new article of manufacture, an aluminum or aluminum alloy permanent-mold casting having a heavy section, said article having a unitary homogeneous exterior of substantially uniform thickness and uniform fine grain structure and a hollow metal insert embedded in the casting at the thick section thereof and substantially completely surrounded by the exterior cast metal, the thickness of said metal insert being such as to provide a predetermined chilling effect upon said exterior cast metal during the casting operation.

3. As a new article of manufacture, a composite permanent-mold cast article comprising a metal insert and an exterior aluminum or aluminum alloy portion cast around said insert to provide a thickened section having uniform fine grain structure, and extending beyond said insert to provide a thinner section, the thickness of the metal about said insert being of the same order as the thickness of the metal extending beyond the insert whereby to provide a cast article of substantially uniform exterior thickness having improved physical and mechanical properties.

4. As a new article of manufacture, a composite permanent-mold cast article of aluminum or alloy thereof, said article changing relatively abruptly from a thin to a relatively heavy section, said article comprising a cast exterior of uniform fine grain structure and of approximately uniform thickness, the interior of said thick section comprising a metal insert closely surrounded and rigidly engaged by the outer cast portion to form a rigid homogeneous cast article having an exterior of superior surface characteristics and metallurgical structure.

5. As a new article of manufacture, an aluminum alloy permanent-mold casting of generally thin section having a heavy section, said article having a unitary exterior of substantially uniform thickness and a metal insert formed of a plurality of laminations, said insert being placed within the thick section of said casting, the metal of the casting substantially surrounding said insert being of similar metallurgical characteristics to that of the thin section, particularly as to grain size.

6. The method of casting articles having relatively thin and thick sections from metals having comparatively high shrinkage characteristics, which comprises providing a permanent mold having a thin casting cavity of substantially uniform cross section and a recess communicating therewith, supporting an insert entirely within said recess so as to provide a cavity substantially surrounding said insert and casting the metal having a comparatively high shrinkage characteristic in the said cavities to form an article having a relatively thin section and a relatively thick section.

7. The method of casting articles having relatively thin and thick sections from metals having comparatively high shrinkage characteristics, which comprises providing a permanent mold having a thin casting cavity of substantially uniform cross section and a recess communicating therewith, supporting an insert of hollow cross section in said recess so as to provide a cavity surrounding said insert and casting metal in said cavities to form an article having a relatively thin section and a relatively thick section.

8. The method of casting articles having relatively thin and thick sections from metals having comparatively high shrinkage characteristics, which comprises providing a permanent mold having a thin casting cavity of substantially uniform cross section and a recess communicating therewith, supporting a laminated insert in said recess so as to provide a cavity surrounding said insert and casting metal in said cavities to form an article having a relatively thin section and a relatively thick section.

9. The method of casting articles having relatively thin and thick sections from aluminum or aluminum alloys, which comprises providing a permanent mold having a thin casting cavity of substantially uniform cross section and a recess communicating therewith, supporting an insert in said recess so that the casting cavity surrounding said insert will have substantially the same cross section as the thin casting cavity, and casting metal in said mold to form an article having a relatively thin section and a relatively thick section.

10. The method of casting articles having relatively thin sections from aluminum or aluminum alloys, which comprises providing a permanent mold having a thin casting cavity of substantially uniform cross section and a recess communicating therewith, supporting an insert in said recess in such a manner that the combined chilling effect of the insert and the walls surrounding said insert will be substantially the same as the chilling effect of the mold sections surrounding the thin casting cavity and casting metal in said mold to form an article having a relatively thin section and a relatively thick section.

11. The method of casting articles having relatively thin and thick sections from metals having comparatively high shrinkage characteristics, which comprises providing a permanent mold having a thin casting cavity of substantially uniform cross section and a recess communicating therewith, supporting an insert entirely within said recess by means of supporting structures having substantially the same composition as the metal to be cast to form a cavity substantially surrounding said insert and casting metal in said cavities to form an article having relatively thick and thin sections.

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