This invention relates to zinc base alloys and more particularly to a zinc base alloy having improved characteristics.

Zinc base alloys have found considerable application particularly in the production of die or gravity castings. In the gravity casting process the molten metal which may be in the form of an alloy is poured into molds and flows into, and fills the cavities thereof by the action of gravity. In the die-casting process the molten metal which may be in the form of an alloy is introduced into the molds or dies and is injected into, and fills the cavities thereof, under pressure. In order to produce castings of good quality by these methods, a high degree of fluidity in the molten state is desirable, particularly when castings having intricate shapes or fine detail are to be produced. Additionally, fine grain size in the metal has been found to reduce the amount of occluded air or gases in the finished casting thereby reducing the tendency of the cast product to deteriorate and providing a smoother surface thereon as well as increasing the tensile strength thereof.

A particularly desired characteristic in such alloys is one which will produce castings wherein pores or cavities at the surface are reduced or eliminated. Such pores or cavities tend to trap portions of the plating solutions in which the castings may be immersed during the plating process as a result of which undesirable "split-outs" or breaks in the plated surface are formed. The reduction or elimination of pores or cavities at the surface of the castings also permits of the production of a plated casting capable of presenting a highly lustrous finished surface.

It is an object of this invention to form zinc base alloys having a high degree of fluidity in their molten state whereby such alloys are particularly suitable for use in forming cast objects particularly by gravity and die casting methods.

It is a further object of this invention to produce such alloys capable of producing castings having a fine grain structure.

An additional object of this invention is the production of alloys wherein surface pores or cavities are largely reduced or eliminated as is the degree of air or gases occluded therein.

In order to accomplish these and other purposes zinc base alloys are produced by the addition of zirconium thereto during the alloying process. The zirconium may be introduced in the form of a master or pre-alloy or it may be in the form of a zirconium salt.

The use of zinc base alloys as has heretofore been indicated is conventional in the gravity casting art. As presently practiced, such alloys are generally formed of approximately 95% zinc and 5% aluminum or approximately 94½% zinc and 5½% aluminum. Such zinc base alloys have found wide application and the invention will therefore be described as applied to alloys of the above general type.

In forming the alloys comprising the invention, it has been found advantageous to incorporate the zirconium therein in the form of a zirconium salt, preferably potassium zirconium fluoride, K2ZrF6, during the alloying process. The alloys may be prepared by introducing the zinc and aluminum together with the potassium zirconium fluoride into a crucible or similar vessel and then melting the whole. The alloys have also been prepared by forming a bath of a portion of the ultimate zinc content thereof together with a portion of the zirconium salt. The additional metal to be alloyed therewith, such as aluminum, is then added and followed by the addition of the remaining zinc and zirconium salt. The zirconium salt may also be introduced into the bath after the components of the alloy are in molten state.

The alloys in accordance with the present invention have been prepared by forming an alloying bath containing approximately 94½% zinc and 5½% aluminum and adding from .0125% to 1.0% of potassium zirconium fluoride thereto. The zirconium salt may be added in the manner indicated. Similar improvements in the characteristics of the alloy have been achieved by the use of approximately 95% zinc and 5% aluminum and the addition of from .0125% to 1.0% of potassium zirconium fluoride thereto.

The alloys may also be advantageously prepared by forming a bath of approximately 10% of the ultimate zinc content and about 50% of the ultimate amount of zirconium salt, the aluminum may then be added and followed by the remaining zinc and zirconium salt after the aluminum has been incorporated into the bath. The alloying bath may then be fluxed by conventional methods as by the addition of salammoniac and charcoal.

It has been found advantageous to utilize zinc of the type commercially designated as "Special High-Grade," 99.99-1% pure.

Comparisons of the alloys thus produced with control alloys of the prior art containing zinc and aluminum in said proportions demonstrate a marked improvement in the fluidity during the casting process. The cast products thus pro-
duced have finer grain structure as compared with those of the prior art and manifest a lower porosity and a smoother surface which is characterized by a reduction or elimination of pores or cavities. The tensile strength of the product is similarly improved.

Specific batches of the alloy having the improved characteristics have also been prepared by introducing 2,000 pounds of zinc, 100 pounds of aluminum and 4 ounces of potassium zirconium fluoride into a crucible and forming a common melt therefrom.

In addition the alloy having the improved characteristic has been prepared by using 2,000 pounds of zinc, 90 pounds of aluminum and 20 pounds of potassium zirconium fluoride.

As has heretofore been indicated, zinc base alloys for die casting purposes are generally utilized in the art. Typical examples of alloys suitable for this purpose are enumerated in A. S. T. M. specification B53-43 and designated as alloys XXI, XXII, XXIII and XXV. These alloys have as their principal components aluminum, magnesium, copper and zinc. Impurities may be present in the maximum quantities indicated in the said specifications. Since such zinc base alloys have found wide application, the invention will also be described as applied to alloys of this general type.

The principal components of the alloys as specified in the above A. S. T. M. specifications may vary within the limits of the following percentages:

<table>
<thead>
<tr>
<th></th>
<th>XXI</th>
<th>XXIII</th>
<th>XXV</th>
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<tbody>
<tr>
<td>Copper</td>
<td>2.5 to 3.5</td>
<td>0.1 Max</td>
<td>.70 to 1.25</td>
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<tr>
<td>Aluminum</td>
<td>2.5 to 4.3</td>
<td>3.3 to 4.3</td>
<td>3.3 to 4.3</td>
</tr>
<tr>
<td>Magnesium</td>
<td>.02 to .10</td>
<td>.00 to .06</td>
<td>.00 to .06</td>
</tr>
<tr>
<td>Zinc</td>
<td>Remainder</td>
<td>Remainder</td>
<td>Remainder</td>
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The maximum percentages of impurities in said alloys being iron .100%, lead .007%, cadmium .005% and tin .005%.

In practicing my invention zirconium or a zirconium salt in an amount varying from .0125% to 1.0% is added to alloys prepared according to the above specifications. The zirconium may be introduced into the alloy bath in the form of a master or pre-alloy as in the form of a commercially available pre-alloy with magnesium. It may also be advantageously incorporated in the form of potassium zirconium fluoride in the manner heretofore indicated. The zirconium salt is added in the amounts indicated by the above percentages for zirconium.

Comparison of the alloys thus produced with control die casting alloys of the prior art demonstrate a marked improvement in the fluidity during the casting process. The cast products thus produced have finer grain structure as compared with those of the prior art and manifest a lower porosity and a smoother surface which is characterized by a reduction or elimination of pores or cavities. The tensile strength of the product is similarly improved.

Specific batches of the alloy having the improved characteristics have also been prepared by using 2,000 pounds of zinc, 80 pounds of aluminum, 12.8 ounces of magnesium, 80 pounds of copper and 5.0 % of zirconium.

The alloy having the improved characteristics has additionally been prepared by using 2,000 pounds of zinc, 78 pounds of aluminum, 17.6 ounces of magnesium, 1 pound of copper and 8 ounces of zirconium.

The alloy has also been prepared by using 2,000 pounds of zinc, 78 pounds of aluminum, 13 ounces of magnesium, 20 pounds of copper and 6 ounces of zirconium.

Substitution of a like amount of potassium zirconium fluoride for the zirconium in the above batches results in alloys of similarly improved characteristics.

The percentages herein stated are percentages by weight.

I claim:

1. In the casting of a zinc base alloy consisting of from 94½% to 95% zinc and from 5% to 5½% aluminum, the step of adding potassium zirconium fluoride to said alloy, and casting an object therefrom.

2. In the process according to claim 1 adding said potassium zirconium fluoride in an amount from .0125 to 1.0% of the weight of said metals.

3. In the casting of a zinc base alloy consisting of from 3.5% to 4.5% aluminum, from 0.2% to 1% magnesium, from 2.5% to 3.5% copper and the remainder zinc, the step of adding potassium zirconium fluoride to said alloy and casting an object therefrom.

4. The process according to claim 3 wherein said zinc base alloy comprises from 3.5% to 4.3% aluminum, from 0.3% to 0.6% magnesium, from .76% to 1.25% copper and the remainder zinc.

5. A zinc base casting alloy characterized by a high degree of fluidity in molten state and the substantial elimination of surface porosity in the objects cast therefrom consisting of from 94½% to 95% zinc and from 5% to 5½% aluminum to which has been added zirconium in an amount from .0125% to 1.0% of the total weight of the other metals comprising the alloy.

SIDNEY KORNBLUM.

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