Z. JEFFRIES.

METAL MOLD.

APPLICATION FILED OCT. 18, 1916.

1,296,598.

Patented Mar. 4, 1919.

3 SHEETS—SHEET 1.

Fig. 1.

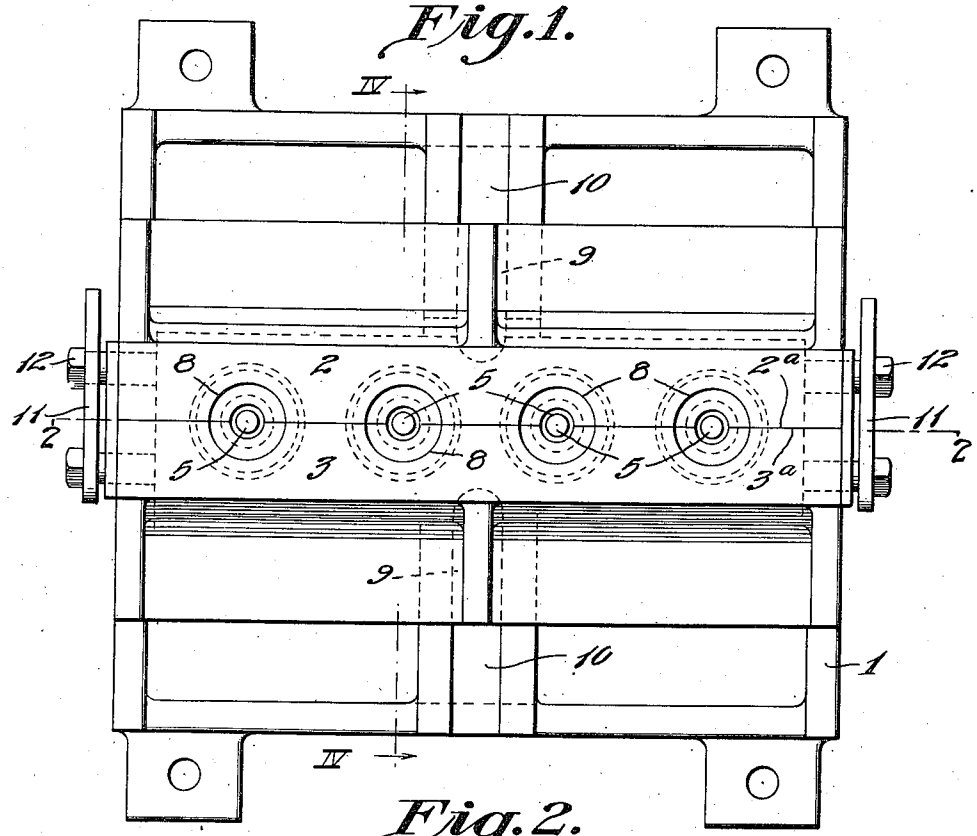
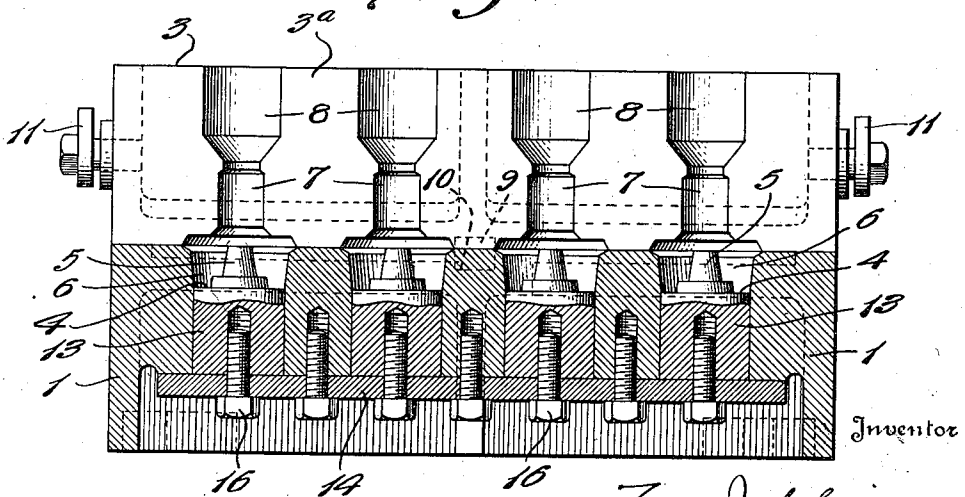


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

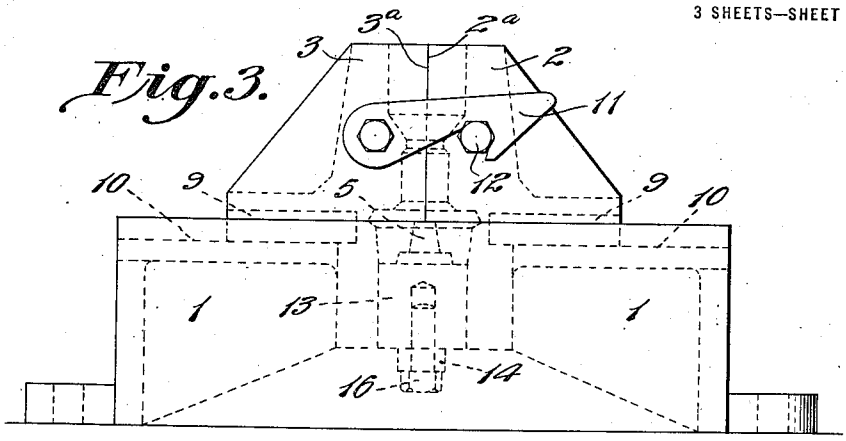


Fig. 4.

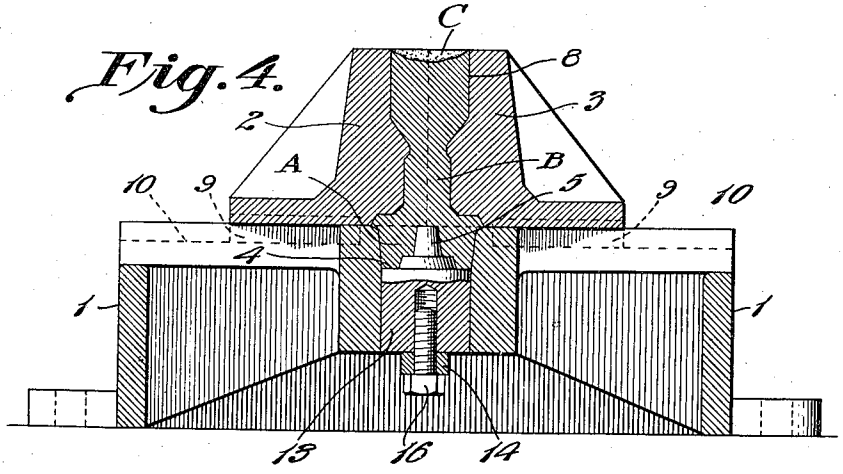
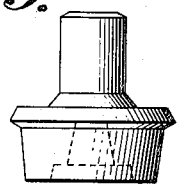


Fig. 5.



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3 SHEETS—SHEET 3.

Fig. 6.

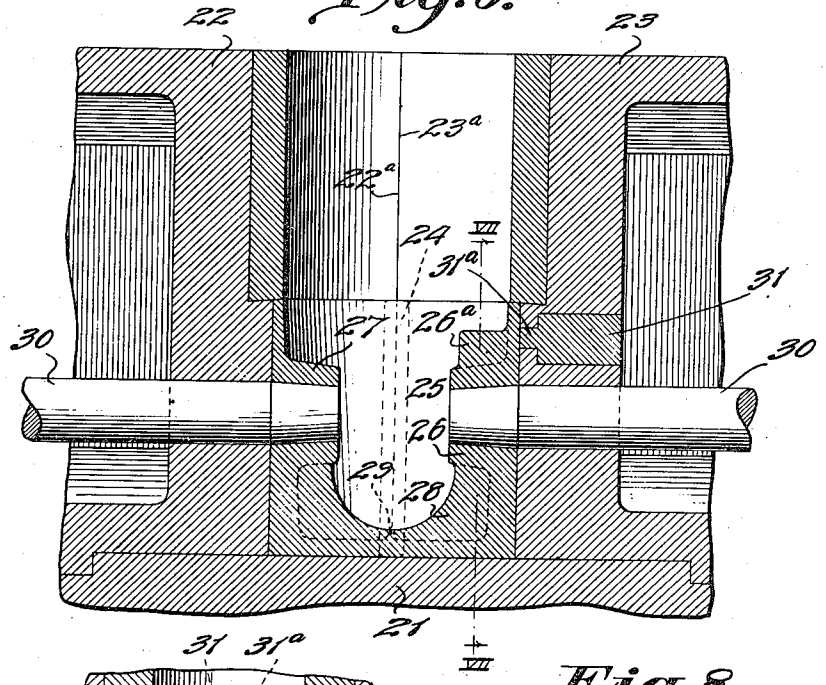


Fig. 7.

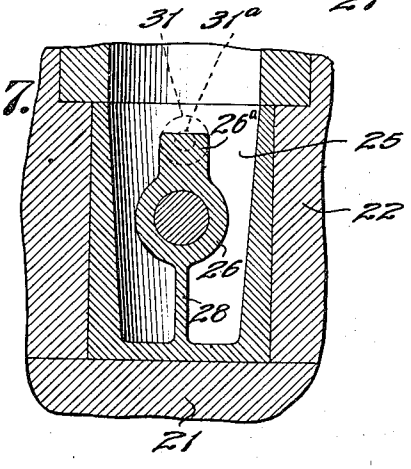
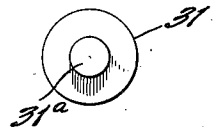


Fig. 8.



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UNITED STATES PATENT OFFICE.

ZAY JEFFRIES, OF EAST CLEVELAND, OHIO, ASSIGNOR TO THE ALUMINUM CASTINGS COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

METAL-MOLD.

1,296,598. Specification of Letters Patent. Patented Mar. 4, 1919.

Application filed October 18, 1916. Serial No. 126,358.

To all whom it may concern:

Be it known that I, ZAY JEFFRIES, a citizen of the United States, residing at East Cleveland, in the county of Cuyahoga and State of Ohio, have invented new and useful Improvements in Metal-Molds, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to improvements in permanent metal molds such as are used in making castings of low fusing point metals, such, for example, as aluminum alloys. In this class of work great difficulty has been experienced in securing sound castings in cases where the constituent material of the castings is necessarily unevenly distributed, the casting being relatively thick in some parts and thin in others. In the thicker part of the casting the metal remains molten after the metal of the thin part has solidified, and when finally the metal of the thicker part solidifies its resultant contraction tends to draw it away from the already solid metal of the thin part and cracking of the casting, or shrinking, or both, results.

The general object of the present invention is the provision of a permanent mold in which the above noted difficulty is overcome; and to this end I make a composite mold having different parts of its walls formed of different metals having different thermal conductivities, the metal of higher conductivity being disposed to contact with the thicker part or parts of the casting.

Further objects of the invention relate to the special form and arrangement of the mold parts in the production of certain types of castings.

In the following description I set forth, in connection with the accompanying drawings, two of the many possible applications of the invention.

In the drawings—

Figure 1 is a plan view of a mold constructed in accordance with my invention and adapted for the production of fuse bodies.

Fig. 2 is a vertical section on the line 2—2 of Fig. 1.

Fig. 3 is an end elevation of the mold shown in Fig. 1.

Fig. 4 is a vertical section on the line 4—4 of Fig. 1.

Fig. 5 is a side elevation of one of the finished castings produced in the mold.

Fig. 6 is a fragmentary vertical section through a mold embodying my invention and adapted for the production of metallic alloy pistons for engines.

Fig. 7 is a vertical section taken on the line 7—7 of Fig. 6.

Fig. 8 is an end view of one of the sections of the mold shown in Fig. 6.

Referring in detail to the construction illustrated in Figs. 1 to 5, inclusive, 1 designates the mold base and 2 and 3 top sections thereof mounted on the base. These parts are preferably iron castings. In the construction shown the mold is formed with a plurality of cavities so that several castings are made at one operation. Since the cavities are alike in all respects, a description of the mold structure with reference to one of the cavities will suffice. Each of the mold cavities is formed in part in the base section 1 and in part in the upper sections 2 and 3. That part of the mold cavity formed in the base has a bottom wall 4 formed with an upstanding core 5, and a side wall 6, the latter being circular in horizontal section. The top sections 2 and 3 have vertical abutting faces 2^a and 3^a, respectively, lying in a plane through the axis of the cavity in the base and each of the sections 2 and 3 are formed with alining cavities 7 which overlie the cavity in the base and complete the walls of the mold cavity proper. In the mold sections 2 and 3 are formed alining cavities 8 which extend upward from the cavities 7 to the top of the mold and serve to form a pouring gate.

The top sections 2 and 3 of the mold are slidably mounted on the base section, means being preferably provided to guide the top sections and position them accurately in relation to each other and to the base so that the several sections of the mold cavity are brought into proper alinement. For this purpose each of the top sections are fitted

with a tongue 9 which slidably fits in a groove 10 in the base section.

The top section 3 carries at its ends swinging hooks 11, 11, which are adapted to engage pins 12, 12 carried by the section 2 and secure the parts of the mold in operative position in relation to each other.

As molds of this character were constructed prior to my invention, the bottom wall 4 of the mold cavity was formed of the same material as the other walls, that is to say, of iron; but with these earlier molds the number of defective castings was exceedingly large. It will be observed that the mold cavity is so formed as to give a relatively large thick mass of metal at A which is separated from the large mass of metal in the pouring gate by a relatively constricted mass of metal at B. In consequence of this the metal of the casting at B tended to solidify earlier than the metal at A. Then when the metal at A later solidified its contraction caused it to draw away from the solid metal at B and cracking or shrinking of the casting resulted so that, as stated above, the losses were exceedingly heavy.

After the trial of many expedients to overcome this difficulty, I have devised a simple and highly effective means for overcoming the destructive shrinking and cracking of the castings. Instead of forming the base of solid iron, I form therein a cylindrical aperture beneath and concentric with each mold cavity, and in this aperture I snugly fit a cylindrical block or plug 13 formed of metal of relatively high thermal conductivity, and I preferably employ copper for this purpose. The upper end of this copper insert is formed to provide the bottom wall 4 with the upstanding core part 5 previously described. The insert may be secured in the base in any suitable manner. In the construction shown I secure a bar 14 to the bottom of the base, arranging the bar to underlie the copper inserts 13, and then secure the latter to the bar by means of screw bolts 16.

In the use of my improved mold, the top sections 2 and 3 having been secured in operative position on the base, the molten metal is introduced into the cavity by pouring through the gate. When the molten metal is poured into the cavity, heat is abstracted from that part of the metal at A more rapidly than from the part at B because of the relatively high thermal conductivity of the copper wall at 4 and 5 which contacts with the metal at A. By providing a suitable mass of copper the cooling of the metal at A is effected more rapidly than at B thus causing the metal to set or solidify at A while a portion at B is still molten. This molten center at B, furthermore, is connected with the gate metal C by an unbroken column of liquid metal and the final freezing is progressive toward the gate so that the latter receives the full crystallization shrinkage. Thus the shrinkage and cracking previously referred to is almost entirely obviated. When the metal of the castings is solidified, the top sections 2 and 3 are drawn back and the castings lifted out.

As previously indicated, the mold shown in Figs. 1 to 4, inclusive, is for the production of the bodies of fuses for explosive shells. These fuse bodies are commonly made of aluminum alloy. The finished casting, after removal of the gate metal, is shown in Fig. 5.

In Figs. 6, 7 and 8 I have shown my invention embodied in a mold designed for the casting of aluminum alloy pistons. Except for the special means which I employ for controlling the cooling of the casting, the mold shown is not of my invention and it need not therefore be described in full detail. Suffice it to say that the mold comprises a base section 21 and upper abutting sections 22 and 23. The necessary core parts of the mold are not shown and it will be understood that use may be made of any suitable core formed in sections to permit the withdrawal of the core parts around the bosses and ribs of the casting. The top sections 22 and 23 have vertical abutting faces 22^a and 23^a, respectively, and these sections, it will be understood, are slidable on the base 21 and are provided with suitable means for securing them in operative position thereon. The sections 22 and 23 are formed with a suitable pouring gate which communicates with the mold cavity at 24.

25 is a piston produced in the mold. It is of the well known skirted type and is formed with pin bosses 26 and 27 and with suitable strengthening ribs 28 and 29. The pin boss 26 is formed with an enlargement or lug 26^a which is designed to be drilled out and tapped to receive a set screw for securing the piston pin. 30, 30 are core pins for the bosses 26 and 27.

It will be observed that the formation of the boss 26, with its enlargement or lug 26^a, concentrates a relatively large or thick mass of metal at this point in the casting. Prior to my invention much difficulty was encountered in securing sound piston castings of this character because the thinner parts of the casting surrounding the boss enlargement solidified before the greater mass of the enlargement and when the latter later solidified, its shrinkage resulted in cracking of the casting which rendered it useless. This difficulty I have overcome by applying the expedient hereinbefore described. In the case of the piston mold I bore out the wall of the top section 23 to receive a cylindrical plug 31 of copper. As shown, this plug is formed with an extension or neck 31^a, the

end of which constitutes a part of the inner wall of the mold and contacts with the metal of the casting adjacent the boss enlargement 26ª.

In the use of my improved piston mold when the metal is poured in the usual and well known way, the copper insert, by reason of its high thermal conductivity, withdraws heat from the adjacent casting metal forming the boss 26 and its enlargement 26ª more rapidly than the remaining, iron, parts of the mold walls withdraw heat from the other parts of the casting and, with a copper insert properly proportioned, the rate of cooling of the metal of the thick boss parts of the piston is increased to such an extent that the freezing of said thick parts occurs sooner than the freezing of the thinner metal parts between the bosses and the pouring gate and consequently the local shrinking and cracking which marked the earlier practice is avoided.

It will be observed, both in the case of the fuse body mold and in the case of the piston mold, that the casting to be made is of such a form that the mold cavity has a greater volume at certain points than at other points intermediate the first-named points and the gate through which the molten metal enters the cavity and which, in the casting operation, maintains a body of molten metal in communication with said cavity. Often, as in the two typical cases herein presented, it is difficult, if not practically impossible, to arrange the gate in such a way as to obviate conditions such as last referred to; and it will be seen that where such conditions exist there is a tendency and in fact a practical certainty of the metal in the thinner part or parts of the cavity freezing before that in the parts of larger volume so that the molten metal in the last named parts is separated from the molten metal supply in the gate by the freezing of the intermediate metal and, when the more remote metal finally solidifies, the shrinking and cracking which is hereinbefore referred to results. But these results are practically entirely obviated by means of my invention, in accordance with which the mold walls are made of materials possessing different thermal conductivities, the material of higher conductivity being disposed to contact with the molten metal in the parts of the cavity of greater volume, while the wall material of lower conductivity is arranged to contact with the metal nearer the gate which is thus prevented from freezing until after the freezing of the more remote metal. In other words, by means of my invention, a progressive freezing of the metal is secured, beginning at points more remote from the gate.

It will be understood, in connection with the molds herein disclosed, that various changes in the form and proportion of the parts may be made and it will also be understood that my invention may be applied in a great variety of ways such as will suggest themselves to those skilled in the art. The constructions herein set forth are for purposes of illustration and explanation only and are not intended in any way as a limitation of my invention.

What I claim is:

1. A permanent mold for casting bodies having an irregular distribution of their constituent material, the said mold having walls of ferrous metal with a metallic insert of relatively high thermal conductivity arranged to be engaged by the thick part of the casting.

2. A composite metal mold for casting bodies having an irregular distribution of their constituent material, the said mold having its walls made up of different metals having different thermal conductivities with the metal of higher conductivity arranged to be engaged by the thicker parts of the casting.

3. A permanent mold for casting bodies of low fusing point metal having an irregular distribution of their constituent material, the said mold having walls of ferrous metal with an insert of copper arranged to be engaged by the thick part of the casting.

4. A composite permanent mold having its cavity forming walls formed in part of ferrous metal and in part of copper.

5. A composite mold for casting bodies having an irregular distribution of their constituent material, the said mold having its walls made up of different materials having different thermal conductivities with the material of higher conductivity arranged to be engaged by the thicker parts of the casting.

6. A mold for casting bodies having an irregular distribution of their constituent material, the said mold having walls formed with a cavity for the casting and with a gate adapted to afford a supply of molten metal in communication with the cavity, the said cavity having a lesser volume at points intermediate the gate opening and other points more remote from the gate opening than at said last named points, and the walls of the mold adjacent the latter points being formed of material having a higher thermal conductivity than the material forming the walls at the said other points nearer the gate.

7. A composite metal mold for casting bodies having an irregular distribution of their constituent material, the said mold having walls formed with a cavity for the casting and with a gate adapted to afford a

supply of molten metal in communication with the cavity, the said cavity having a lesser volume at points intermediate the gate opening and other points more remote from the gate opening than at said last named points, and the walls of the mold adjacent the latter points being formed of metal having a higher thermal conductivity than the metal forming the walls at the other points nearer the gate.

In testimony whereof I have hereunto affixed my signature.

ZAY JEFFRIES.