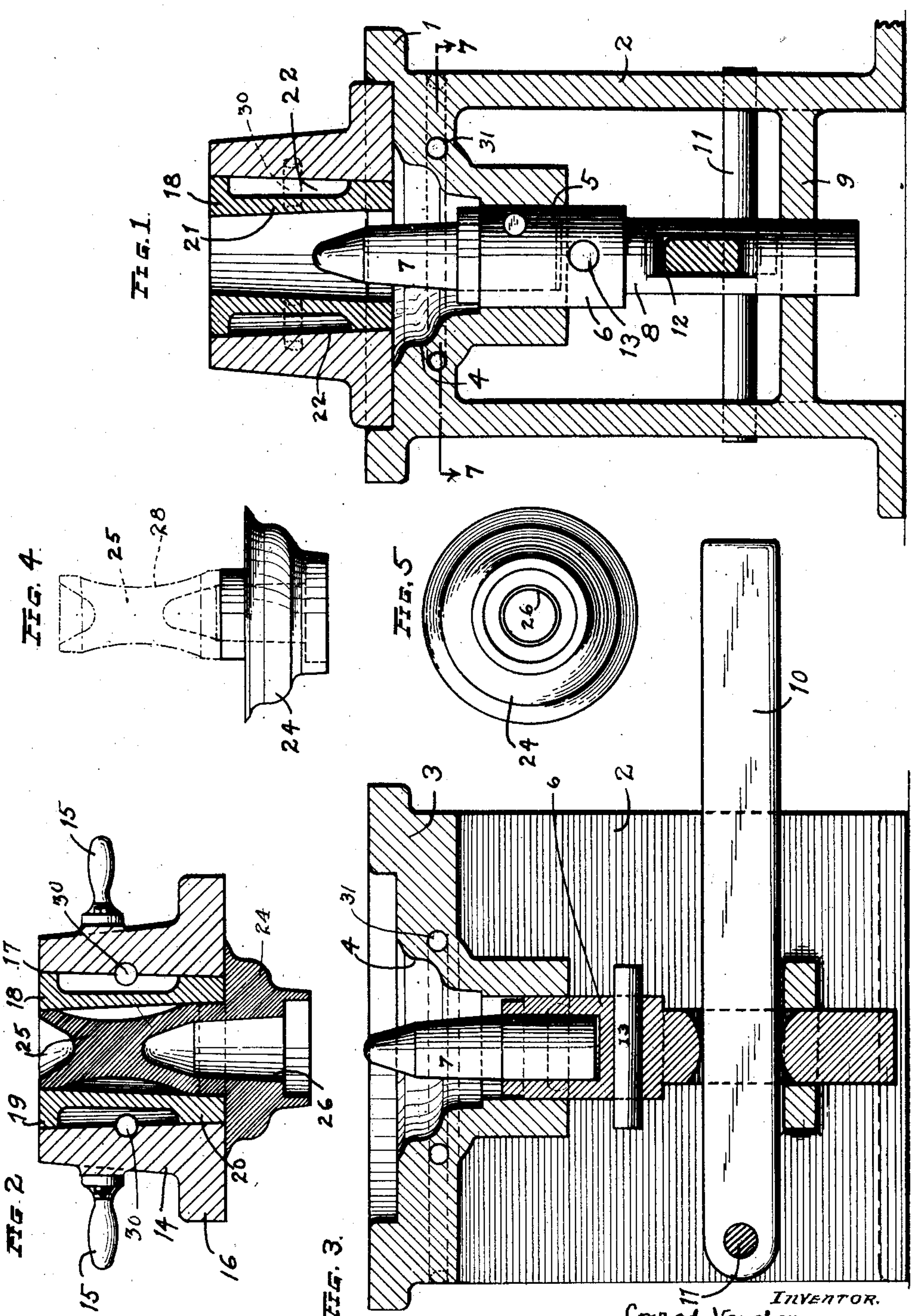
March 20, 1928. **1,663,286**

C. VAUGHAN

MOLD AND METHOD OF CASTING

Filed Feb. 7, 1923 2 Sheets-Sheet 1



INVENTOR.
Conrad Vaughan
By Lloyd L. Evans Attorney

March 20, 1928.

1,663,286

C. VAUGHAN

MOLD AND METHOD OF CASTING

Filed Feb. 7, 1923

2 Sheets-Sheet 2

FIG. 6.

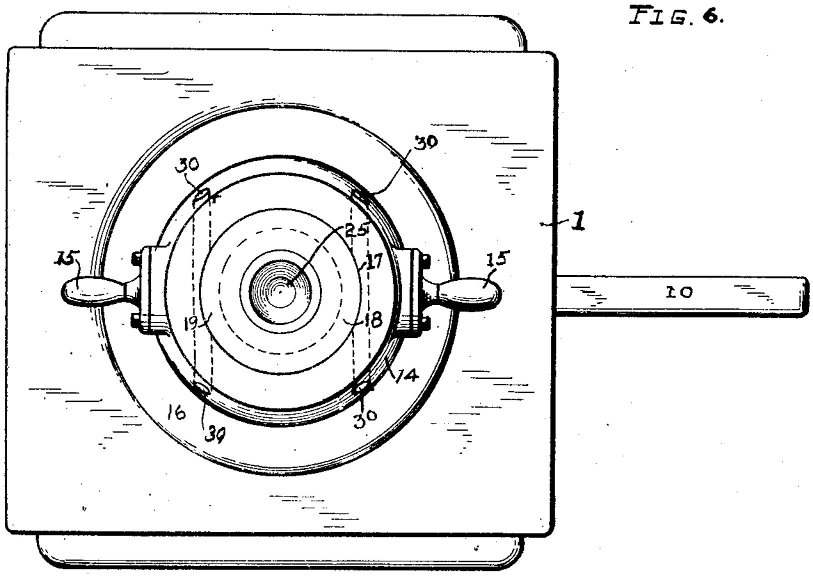
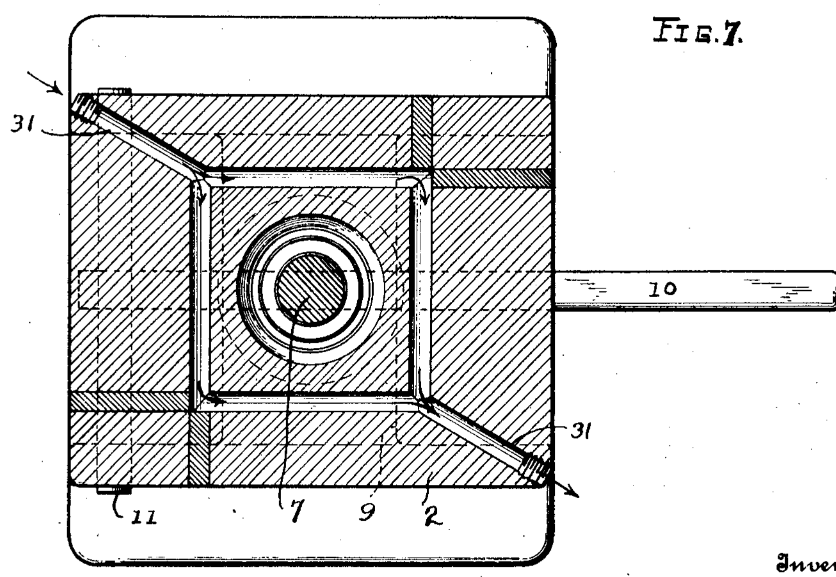


FIG. 7.



Inventor

Conrad Vaughan

By

Lloyd L. Evans

Attorney

Patented Mar. 20, 1928. **1,663,286**

UNITED STATES PATENT OFFICE.

CONRAD VAUGHAN, OF CLEVELAND, OHIO, ASSIGNOR TO THE PERMOLD COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF OHIO.

MOLD AND METHOD OF CASTING.

Application filed February 7, 1923. Serial No. 617,439.

This invention relates to permanent metal molds and a method of forming castings, the invention being particularly useful in forming castings of aluminum alloys or any alloys having relatively high crystallization shrinkage and relatively low freezing point.

An object of the invention is to retard the conduction of heat from that part of the mold forming the sprue cavity so that the freezing of the metal in the sprue cavity is retarded and a smaller amount of metal in the sprue is required for properly feeding the casting as it solidifies in the mold cavity.

A further object is to provide a mold in which the metal can be poured at a lower temperature and yet the castings will be properly fed because freezing of the molten metal in the sprue cavity is retarded until after the metal has solidified in the mold cavity.

Another object is to provide a mold in which perfect castings may be made in a relatively shorter time, due to the use of metal nearer the solidification temperature and in which there will be a smaller excess of metal in the sprue cavity.

A further object of the invention is to provide a mold in which the time for solidification may be shortened by cooling portions of the mold adjacent the heavier parts of the casting or the parts more remote from the sprue.

Another object of the invention is to provide a mold in which castings may be made having a relatively small amount of metal in the sprue and in which the cross-sectional area of the gate is relatively small due to the shape of the casting to be made.

Other objects will be apparent from the following description and annexed drawings.

Reference should be had to the accompany drawings forming a part of this specification, in which

Figure 1 is a vertical section through the assembled mold.

Figs. 2 and 3 are vertical sections through the upper and lower mold sections, the sections, shown in Figs. 2 and 3 being taken in a plane at right angles to that shown in Fig. 1.

Figs. 4 and 5 are a side elevation and bottom plan view, respectively, of a casting formed in the mold.

Fig. 6 is a plan view of the mold after the metal has solidified therein.

Fig. 7 is a section on line 7—7, Fig. 1.

Referring to the accompanying drawings, the lower section or base 1 of the mold is in the form of a stand with side legs 2 and a top 3 in which the mold cavity 4 is formed. The mold cavity 4 has an open cylindrical bottom portion 5 in which fits a plunger 6 which carries an upwardly projecting core 7 at its upper end. The plunger 6 has a downwardly extending stem 8 which fits in an opening in a cross bar 9 connecting the legs 2 adjacent their lower ends. A lever 10 is pivoted upon a cross pin 11 extending between the legs 2 adjacent one side thereof and extends through an opening 12 in the stem 8. A cross pin 13 extends through the plunger 6 and serves to positively limit the upward movement of the plunger. The upper and lower edges of the opening 12 are rounded so that the lever 10 does not bind therein when swung about its pivot. When the mold core is in operative position for casting, the pin 13 is in engagement with the bottom of the mold as shown in Fig. 1, the plunger 6 and core 7 being movable downwardly from this position to that shown in Fig. 2 to free the core from the casting. The upper mold section 14 has handles 15 by means of which it can be readily lifted off the bottom section 1 and has a lower flange 16 adapted to fit within the upper portion of the mold cavity 4.

The mold section 14 has a central bore 17 which tapers slightly toward the bottom to facilitate removal of the casting and sprue, as is well understood. The mold section 14 is also provided with an annular air chamber 22 preferably with outside openings therein. An easy method of providing such a chamber is to form a tubular liner 18 with a thin intermediate portion 21 spaced from the wall of the bore 17, and thick upper and lower edge portions 19 and 20 fitting tightly in the bore 17.

When the mold is assembled as shown in Fig. 1, the inner bore of the liner 18 forms the mold gate and sprue recess, the annular passage between the core 7 and the lower portion of the liner 18 forming the gate and the remainder of the bore the sprue recess. To facilitate the removal of castings from the mold both the core 7 and the inner bore of the liner 18 forming the sprue recess are tapered slightly toward the top so that the core can be pulled downwardly out of the casting and the sprue can be readily freed from the mold.

Surrounding the mold cavity and preferably located near the heavy section of the casting and remote from the gate is a fluid passage 31 to carry any suitable fluid, preferably a liquid such as water or oil, therethrough to cool the mold and consequently to cool the molten metal remote from the gate or in the heavy sections of the casting. This passage may follow the shape of the mold cavity and be formed in any suitable manner as by cores when casting the mold, or it may be formed of a rectangular shape, as shown in Fig. 7, by boring into the mold after the mold has been cast.

In operation, the mold sections will be assembled as shown in Fig. 1 and molten metal will be poured in at the top until both the cavity 4 in the lower section and the sprue cavity are filled. As the solidification of the metal in the mold cavity takes place, additional metal is supplied from the sprue cavity. It has heretofore been necessary to provide a rather large sprue recess to maintain a sufficient reserve supply of molten metal and to have a sprue recess of a sufficient diameter that the center of the sprue would remain fluid long enough to supply the necessary metal to the mold cavity. The present invention, however, provides a construction for the sprue cavity which retards the loss of the heat in the sprue and delays freezing until after the casting has hardened in the mold cavity and thus permits the relatively small amount of metal in the sprue cavity to properly feed the solidifying casting. The annular air chamber 22 surrounding the sprue cavity retards the loss of heat for it decreases the volume of metal for directly conducting the heat away from the sprue cavity so that the metal in the sprue may be maintained molten for a longer period of time and a relatively larger percentage of the sprue metal is available for feeding the casting.

That the metal for feeding the casting is drawn from sides of the sprue as well as down through the center, as is usual, is shown by the shape of solidified sprue metal in Figs. 2 and 4, wherein the side 28 is concaved all the way around. In Fig. 4 the casting 24 is shown in full lines and the sprue 25 in dotted lines, the casting 24 after the sprue is removed having a central aperture 26.

If it is desired to hasten the cooling and solidification of the metal in the sprue after the casting is solidified, any suitable fluid, such as compressed air, can be circulated around the passage 22 through the openings 30, thus greatly reducing the time of waiting after the casting is solidified and until the sprue is sufficiently solidified to remove the core 7.

It will thus be seen that by varying the size of the annular passage surrounding the sprue cavity, the length of time that the sprue metal may be held in molten condition can be varied. Also by varying the temperature or quantity of fluid supplied to the body of the mold, the cooling time of the casting itself may be varied. Also by the circulation of air through the annular passage 22 surrounding the sprue cavity, the time of solidification of the sprue after the casting is solidified may be decreased so that the core may be removed more quickly. By providing these variables it is possible to design molds for many shapes of casting which will greatly increase the production yield per mold per day for provision can be made for removing heat as fast as desirable from the heavier sections of the casting or sections more remote from the gate. And the sprue may be kept molten a sufficient length of time to properly feed the casting on solidification and may then be rapidly cooled to facilitate production. Or if desired, the annular passage may be designed to balance the time for keeping the metal molten in the sprue as long as necessary and permitting it to cool and solidify immediately thereafter without the use of a circulating fluid.

Furthermore, it will be noted that by providing means for retarding the cooling of the metal in the sprue a relatively less amount of metal is necessary for properly feeding the casting for a relatively larger percent of the metal in the sprue is available for this purpose. It will thus be seen that castings may be made according to this invention in which the gate is of relatively small cross sectional area or in which all parts of the gate are relatively narrow, so that the tendency to form pipes is prevented and the character of the metal in the casting is improved.

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. The method of forming castings of metal of a relatively high crystallization shrinkage and a relatively low freezing point which consists in introducing molten

metal of such characteristics into a permanent mold having a mold cavity and sprue cavity, cooling the mold adjacent the more remote sections of the casting and then cooling that portion of the mold surrounding the sprue cavity.

2. The method of forming castings having thin and thick sections of metal of relatively high crystallization shrinkage and relatively low freezing point, which consists in introducing molten metal of such characteristics into a permanent mold having a mold cavity and sprue cavity, retarding the escape of heat from the sprue cavity and facilitating the escape of heat from the thicker sections of the casting, and then accelerating the cooling of the metal in the sprue cavity after the metal in the mold cavity has solidified.

3. The method of forming castings of relatively high crystallization shrinkage and relatively low freezing point, which consists in introducing molten metal of such characteristics into a permanent mold having a mold cavity and sprue cavity, retarding the escape of heat from the sprue cavity until after the mold cavity is filled and the metal therein has substantially solidified.

In testimony whereof, I hereunto affix my signature.

CONRAD VAUGHAN.