

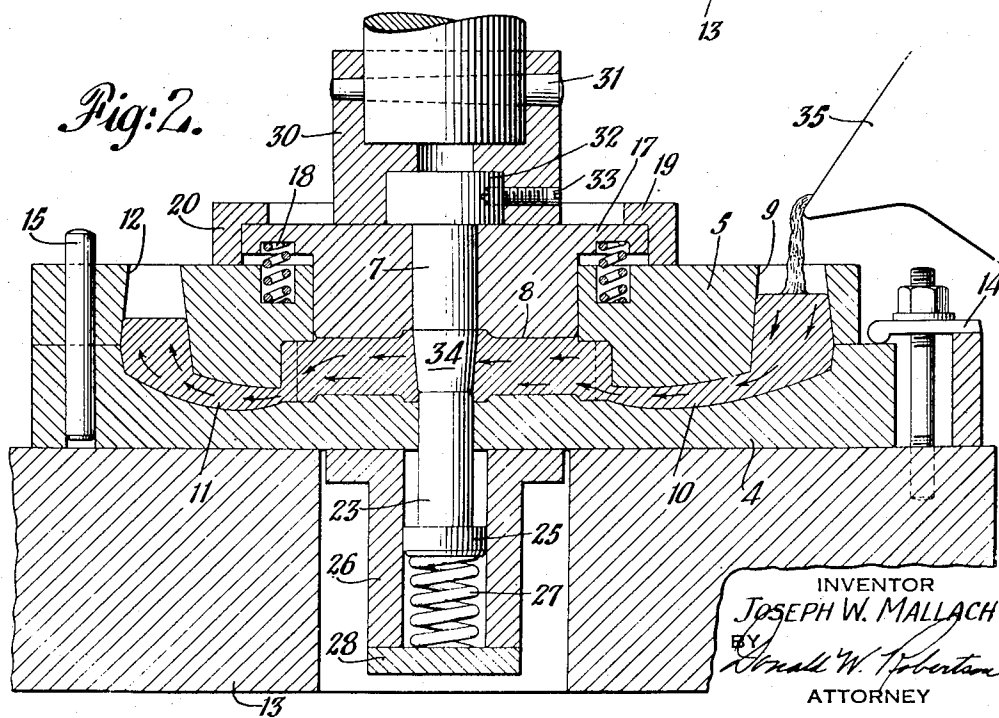
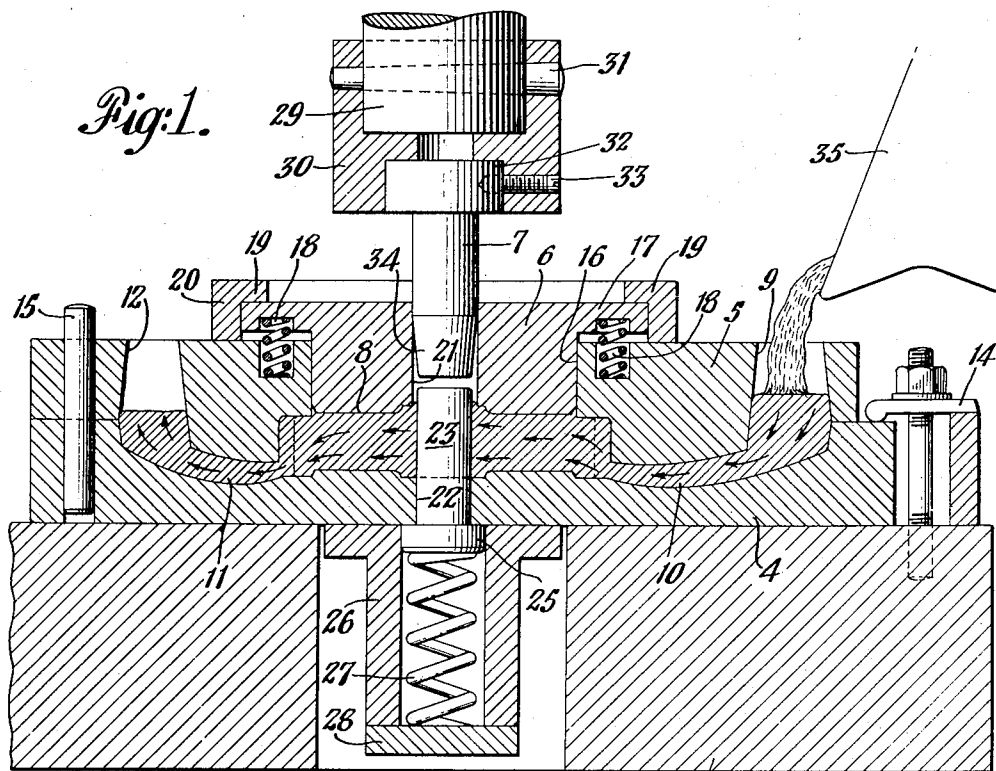
March 14, 1950

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METHOD OF CASTING

2,500,556

Filed April 24, 1946

2 Sheets-Sheet 1



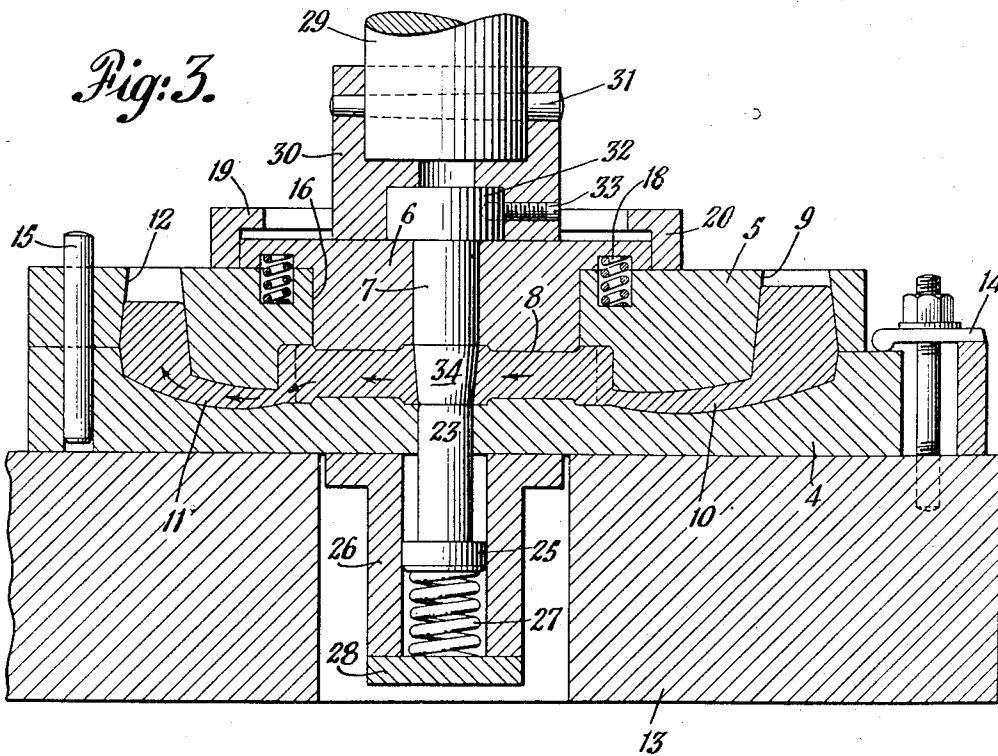
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METHOD OF CASTING

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The invention relates to improvements in pressure casting methods as applied to the molding of nonferrous metals in particular.

Conventional die casting methods are adapted to high speed production, but the castings are not very strong, large castings cannot readily be produced, and the process is subject to other limitations recognized in the art. Conventional permanent mold casting is adapted to production of somewhat larger castings, but is slower in operation and does not produce as good a surface finish or maintain as close tolerances on finished sizes. It, too, is subject to other limitations recognized in the art. Ordinary sand casting produces inferior surface finish and requires machining wherever close tolerances or smooth surfaces are required. This process is very slow and requires renewal of the molds, adding to the expense of castings so produced.

The primary object of my invention is to provide a new molding method which combines advantageous features of these several older methods while eliminating certain of the disadvantages of each. In particular I have sought to combine the feature of rapid production with strength, close tolerance, accuracy of detail and good surface finish in the castings produced. Other objects and advantages will appear as the description proceeds.

I am aware that attempts have been made heretofore to achieve somewhat similar objects by so-called "pressure casting" methods wherein molten metal is forced into a metal mold by a plunger, or the parts of a metal mold are forced toward one another after the metal is cast but still fluid, or a hammer blow effect is secured by suddenly applying high pressure to cast metal in a sludge state. None of these expedients has found general acceptance in the art, although perhaps being useful for special purposes of limited application.

I have discovered in the molding of aluminum and other nonferrous metals that if the metal is flowed through a mold while parts of the mold are separated slightly, and the mold parts are closed during this operation, castings of superior characteristics are obtained. It is important that at least an initial fraction of the mold closing movement be performed while the metal is still flowing through the mold. The metal at the moment of application of the pressure produced by the closing of the mold parts should be at a temperature approaching its solidus. Also I prefer that the closing of the mold parts be performed after the mold is completely filled with

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metal although the metal may still be in motion through the mold to a certain extent as the mold parts begin to come together, and even during substantially the entire mold closing operation. The metal is thus literally "stopped in its tracks" by the mold closing step in conjunction with the freezing of the metal. This produces a strong, dense casting with excellent surface finish and conforming to close tolerance limits. Yet the method is extremely simple and rapid in operation, contributing to low cost of product. This low cost is further abetted by the circumstance that little if any machining is required on castings so produced. I have found that it is even possible to produce castings having fine double or triple threads which will mate perfectly without machining as, for example, in tiny parts used on photographic cameras. I am not aware of the possibility of accomplishing such remarkable results by any methods known to the art prior to the time of my invention.

In the drawings:

Fig. 1 is a central vertical cross-sectional view through one form of apparatus adapted for practicing my improved method in its preferred form or otherwise. In this view parts of the mold die are shown in the position which they occupy at the beginning of the pouring of the metal.

Figs. 2 and 3 are similar views of the same apparatus. However Fig. 2 shows parts of the mold die in the position which they occupy at an intermediate stage of the method, whereas Fig. 3 shows parts of the mold die in their fully closed positions.

The apparatus which I have selected for the purpose of illustrating my invention is designed more particularly for the molding of precision gears having smooth finished teeth as cast and capable of being used without machining or with minimum surface finishing treatment.

The mold consists of a metal die comprising in its general arrangement a lower die member 4, a stationary upper die member 5, and movable upper die members 6 and 7, the upper and lower die members coacting to form a casting cavity 8. A pouring opening 9 in upper die member 5 communicates with a feeder or feeders 10 gated to the casting cavity. At the opposite side of the casting cavity a runner or runners 11 lead to a riser or risers 12 formed by the upper and lower die members 5 and 4.

The lower die is suitably mounted on the bed 13 of a casting machine and is secured thereto, for example by means of clamps 14. (The drawings have been simplified by showing only one

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clamp but it will be appreciated that a series of such clamps ordinarily will be employed.) A guide pin or pins 15 received in aligned apertures of the die members 4 and 5 provide proper registry between these parts.

The movable upper die part 6 has a sliding fit in an opening 16 of the upper die member 5. This opening may be of cylindrical form as where a gear casting is to be produced. The upper end of the die member 6 has a lateral flange 17 overlying the upper surface of die member 5. The opposed faces of this flange and die member 5 are recessed as shown to receive a number of coil springs 18 which serve to hold movable die member 6 in the slightly raised or withdrawn position shown in Fig. 1. This upward movement of die member 6 is limited in its extent by contact with the inwardly projecting flange 19 of the retaining ring 20 secured to the stationary die member 5.

The other movable die member 7 slides in an opening 21 of the die member 6 and forms a hub punch for the gear casting. Opposed to the opening 21 is an opening 22 in the lower die member 4 to receive the hub core 23. The hub core has a flange 25 at its lower end for limiting its upward movement. This flange part of the hub core slides in a housing 26 secured to the lower die member 4 or to the bed 13 of the machine by bolts or otherwise. A coil spring 27 arranged within housing 26 bears at one end against the base 28 of the housing and at the other end against the hub core 23, holding it normally in the position shown in Fig. 1.

Suitable power means are provided for operating the movable die members 6 and 7 to bring them successively into the positions illustrated in Figs. 2 and 3. In the construction illustrated the ram 29 of a hydraulic press is coupled to the hub punch as by means of a coupling 30 secured to the ram 29 by tapered lock pin 31 and to the upset end 32 of the hub punch as by the set screw 33.

The hub punch preferably is provided with a tapered end 34 for forming a finished bore in the hub of the gear casting to be produced.

The molding operation

While parts of the die are separated from their fully closed positions, molten metal is flowed through the mold. This is illustrated diagrammatically in Fig. 1 wherein 35 illustrates a ladle tilted to pouring position. The metal flows through the feeders, gates, casting cavity and on into the riser 12 as indicated by the arrows. While the metal is flowing through the mold, the mold parts are moved toward their fully closed positions. At least an initial fraction of this closing movement is performed while the metal is flowing through the mold, and in accordance with my preferred method the closing movement is substantially entirely performed while the metal is flowing through the mold, and also after the mold is completely filled with metal. This is the condition illustrated in the drawings.

During the closing movements of the mold parts, one or more of the movable parts may be advanced toward closing position ahead of one or more of the remaining movable parts. Thus it will be observed with reference to Fig. 2 that the initial closing movement affects only the hub punch 7 which, as it advances through the mold cavity, pushes the hub core 23 ahead of it. Upon engagement of the base of coupling 30 with the top of mold part 6, this part advances together

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with the hub punch 7 from the position shown in Fig. 2 and these two members 6 and 7 continue to move as a unit until they reach the final position shown in Fig. 3.

It is important that the flow of the metal through the mold be continued during at least a substantial part of the mold closing movement. The continued flow of the metal through the mold during the initial closing movement is indicated by the arrows in Fig. 2. At this point if desired the rate of pouring of the metal may be decreased, and if such sufficient head of metal has been built up in the pouring opening 9, pouring may be discontinued at this point. However the metal may still continue to flow through the casting cavity to a certain extent as indicated diagrammatically by the smaller number of arrows in Fig. 3 due to the differential in head between the risers 9 and 12. At the moment of application of the pressure produced by the closing of the mold parts the metal should be at a temperature approaching its solidus. Thus the metal within the casting cavity is subjected to high pressure just as its flow through the mold is being arrested due to solidification. The maintenance of this particular relationship of the mold closing step to the freezing of the metal as it flows through the mold produces a strong dense casting with exceptionally fine surface finish, and close tolerances can be readily maintained. The operation is rapid and the cost is low.

My process is applicable to the production of very small castings as well as to castings of considerable size. It will be understood that the construction of the mold may vary widely in accordance with the nature of the casting, use of cores, tolerance requirements, etc. Generally speaking, the moving parts of the die should be arranged to apply pressure at or closely adjacent to those portions of the casting which are to be finished to the closest tolerances—that is, the portions which with ordinary casting operations would need to be machined. The die parts themselves preferably are made of hardened steel but if desired can be made of other materials.

My process is particularly advantageous in the molding of nonferrous metals. Excellent results have been obtained in the casting of aluminum and magnesium alloys, and it has been found possible to produce parts which do not have to be machined. This is true even in the case of small castings which have threaded engagement with one another.

The terms and expressions which I have employed are used in a descriptive and not a limiting sense, and I have no intention of excluding such equivalents of the invention described, or of portions thereof, as fall within the purview of the claims.

I claim:

1. The method of casting metals which comprises flowing the metal through and beyond a mold cavity having at least one pouring opening leading therefrom while parts of the mold are separated from their fully closed positions, and moving the mold parts to their fully closed positions, at least a fraction of the closing movement being performed while the metal is near its freezing point and after the mold is completely filled with metal so as to subject the metal within the mold cavity to pressure just as its flow through the mold cavity is being arrested due to solidification, maintenance of the defined relationship

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between the closing movement and the freezing of the metal serving to produce a strong dense casting with fine surface detail.

2. The method of casting metals which comprises flowing the metal into a mold cavity having at least one riser leading therefrom while parts of the mold are separated from their fully closed positions, and moving the mold parts to their fully closed positions while the metal at the entrance to the mold cavity is free to move outwardly for displacement of excess metal from the mold cavity, at least a fraction of the closing movement being performed while the metal is near its freezing point and after the mold is completely filled with metal so as to subject the metal within the mold cavity to pressure just as its flow is being arrested due to solidification, maintenance of the defined relationship between the closing movement and the freezing of the metal serving to produce a strong dense casting with fine surface detail.

3. The method of casting metals which comprises flowing the metal through and beyond a mold cavity while parts of the mold are separated from their fully closed positions, and moving the mold parts to their fully closed positions, at least a fraction of the closing movement being performed while the metal is near its freezing point and after the mold is completely filled with metal so as to subject the metal within the mold cavity to pressure just as its flow into at least one riser is being arrested due to solidification, maintenance of the defined relationship between the closing movement and the freezing of the metal serving to produce a strong dense casting with fine surface detail.

4. The method of casting metals which com-

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prises flowing the metal by gravity into a mold cavity having at least one riser leading therefrom while parts of the mold are separated from their fully closed positions, and moving the mold parts to their fully closed positions, at least a fraction of the closing movement being performed while the metal is near its freezing point and after the mold is completely filled with metal so as to subject the metal within the mold cavity to pressure just as its flow by gravity into at least one riser is being arrested due to solidification, maintenance of the defined relationship between the closing movement and the freezing of the metal serving to produce a strong dense casting with fine surface detail.

JOSEPH W. MALLACH.

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