Sept. 3, 1957 A. TOWNHILL 2,804,667

CASTING METHOD

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Fig. 1

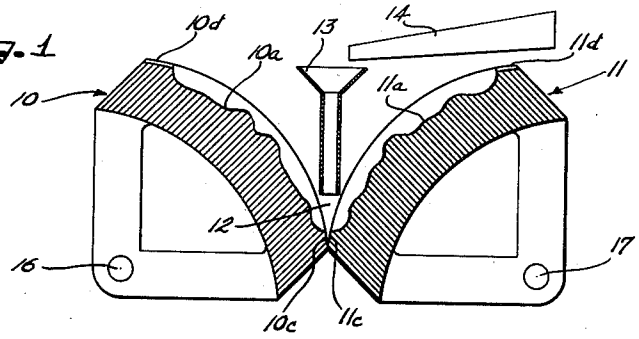


Fig. 2

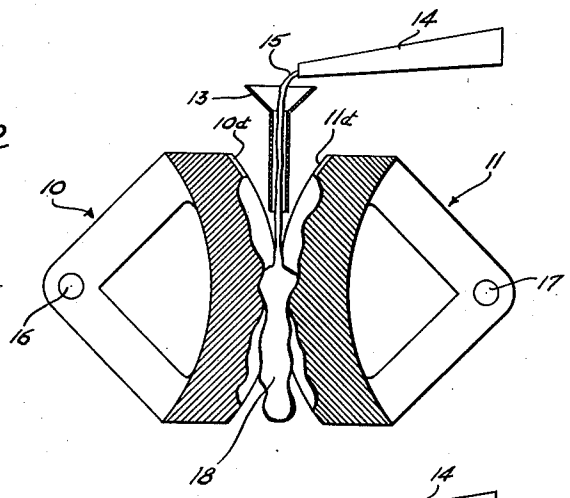
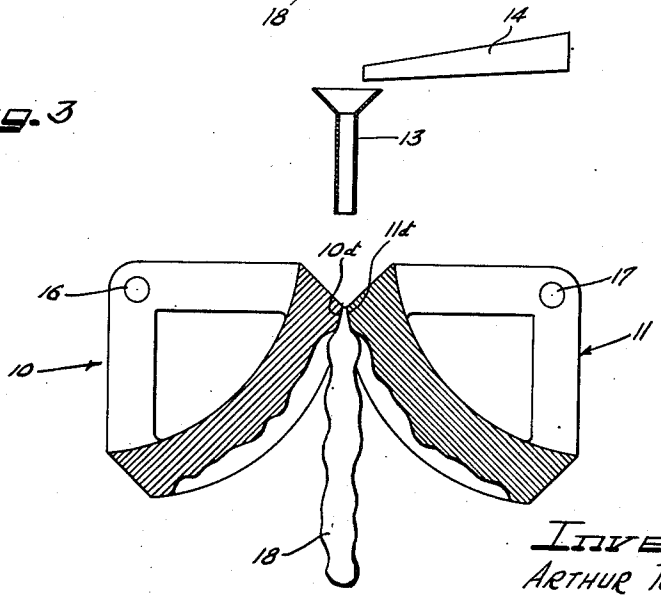


Fig. 3



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Fig. 4

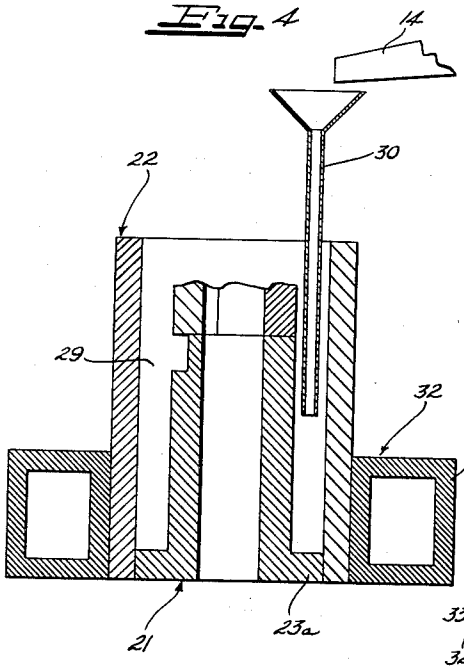


Fig. 5

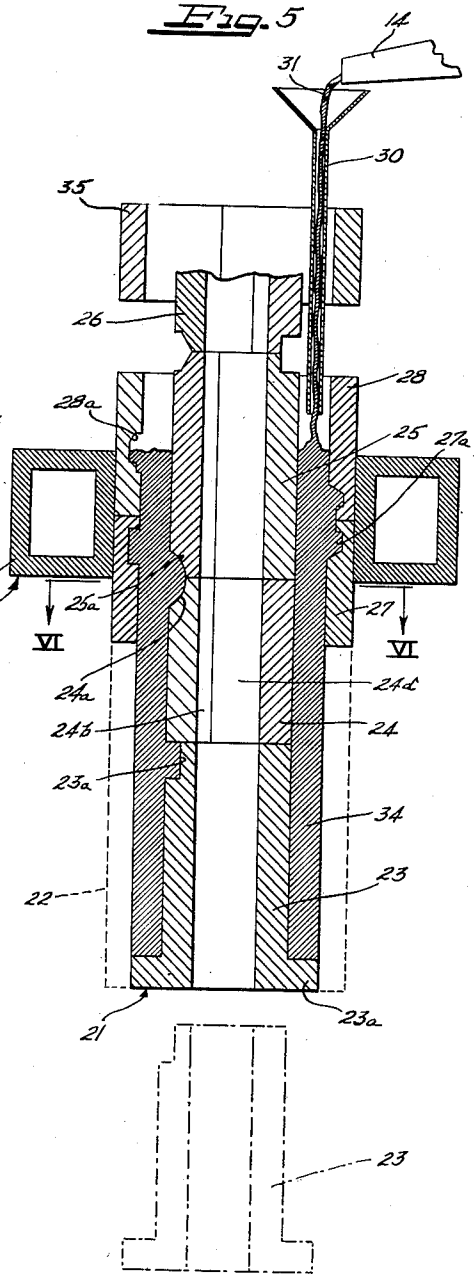
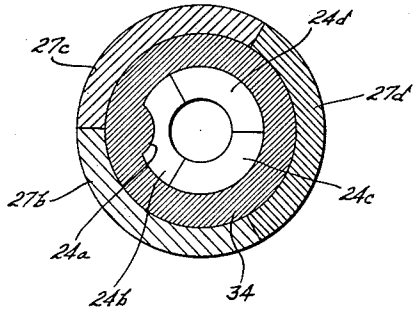


Fig. 6



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United States Patent Office 2,804,667
Patented Sept. 3, 1957

2,804,667

CASTING METHOD

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Application November 15, 1954, Serial No. 468,810

1 Claim. (Cl. 22—200)

The present invention is directed to a method of casting molten materials such as metals, plastics, and the like and is particularly directed to the casting of elongated members having complex shapes.

The casting of elongated shapes, particularly those having complex configurations including undercut surfaces and the like, has presented a number of distinct problems in the past. Since such castings frequently required a large number of gates on the molding cavity for proper distribution of metal, and since these gates were necessarily small in cross-sectional area, the problem of premature solidification was frequently presented.

The manufacture of elongated castings also presents the problem of uneven cooling, resulting in an excessive amount of solidification shrinkage. This, in turn, frequently causes internal porosity in the castings which result.

Most of the difficulties mentioned above could be eliminated by a casting process in which there is a constant feeding of the molten material into the molding cavity and continuous movement of the solidified casting out of the molding cavity. Several such systems of continuous casting have been devised, but these are necessarily limited to the casting of regular shapes, e. g. rods, tubes, and the like. The process and apparatus of the present invention, however, makes possible the casting of irregularly shaped objects on a substantially continuous basis and thereby provides not only a much more rapid casting procedure, but one which avoids the difficulties of excessive temperature drop and uncompensated solidification shrinkage previously encountered.

The process of the present invention comprises a molding cavity between a pair of spaced mold members, casting the molten material into the molding cavity, moving the resulting casting and the confronting molding surfaces jointly until such time as the casting solidifies, and thereafter disengaging the casting surfaces from the finished casting. The casting process described has the distinct advantage that it provides for pouring of the molten material on a continually formed molten surface, thereby avoiding the problems of solidification shrinkage normally associated in prior casting techniques.

It is then an object of the present invention to provide an improved casting process particularly adaptable to the casting of elongated shapes of irregular contour in a rapid manner.

Another object of the invention is to provide an improved casting process for metals, plastics, and the like which can be employed on "hot short" alloys and alloys which have only a small temperature differential between their liquidus and solidus points.

A still further object of the present invention is to provide a casting process for the manufacture of castings of complex configuration which heretofore required much more expensive molds than those used in the process of the present invention.

The process of the present invention and several types

of apparatus employed for carrying out this process are illustrated in the drawings in which:

Figure 1 is a fragmentary view of two cooperating molding dies according to the present invention, illustrating the condition in which the molten material is first poured into the mold;

Figure 2 is a view similar to Figure 1 but illustrating the condition of the mold members during an intermediate portion of the casting cycle;

Figure 3 is a view similar to Figures 1 and 2 but illustrating the condition of the mold pieces toward the end of the molding cycle;

Figure 4 is a fragmentary, cross-sectional view, with parts in elevation illustrating another form of apparatus which may be employed in the practice of the present invention, the parts being illustrated in a position in which the casting has just begun;

Figure 5 is a view similar to Figure 4, but illustrating the position of the mold members during an intermediate portion of the casting cycle; and

Figure 6 is a cross-sectional view taken substantially along the line VI—VI of Figure 4.

In Figure 1, reference numeral 10 and reference numeral 11 indicate generally two sector-shaped molding members having recessed, confronting face portions 10*a* and 11*a* respectively. Beyond the recessed portions 10*a* and 11*a*, on both sides thereof, the peripheries of the respective mold pieces are arranged to abut each other in a non-slipping sealing relation. The recessed portions 10*a* and 11*a*, when in alignment as illustrated in Figure 1 of the drawings, provide a central molding cavity 12 between the confronting faces of the mold pieces. The cavity is arranged to be fed with a molten metal or other moldable composition through a guide funnel 13 adjustably positioned above the cavity 12. A launder 14 is provided to direct molten metal 15 into the guide funnel 13 and eventually into the molding cavity 12.

The recessed portions 10*a* and 11*a* respectively have an outline which defines the ultimate shape of the object being cast. The lower ends of the recessed portions 10*a* and 11*a*, respectively, are closed as indicated at 10*c* and 11*c*, so that when the mold pieces 10 and 11 are in the position illustrated in Figure 1, the closed portions 10*c* and 11*c* provide a closed bottom for the molding cavity 12.

The mold pieces 10 and 11 are each pivotally mounted by means of pivot pins 16 and 17 respectively, so that as the two abutting mold pieces are rotated on their respective pivotal axes, a new section of the molding cavity 12 is defined by the opposed recessed portions 10*a* and 11*a* being brought into juxtaposition. In normal operation, therefore, the molten metal will be poured into the cavity 12 and will commence filling up the molding cavity. In a preferred form of the invention, both the mold pieces 10 and 11 are cooled by suitable cooling means (not shown) so that the material in the molding cavity solidifies quickly to produce a casting 18. Once the base of the casting 18 has solidfied sufficiently, the mold pieces 10 and 11 are stripped from the casting progressively by rotation of the mold pieces 10 and 11 about their pivotal axes 16 and 17. In effect, then, the casting 18 is continuously extruded from between the cooperating faces of the mold pieces, while molten metal is being continuously poured into the molding cavity, while maintaining a substantially fixed liquid level.

It should be noted that the metal immediately upon entering the molding cavity, once the casting has begun, mates with a continually formed active molten surface. In this way, the problems associated with solidification shrinkage are overcome.

The upper ends of the molding faces are recessed as indicated at 10*d* and 11*d* of the drawings to form a gate

for receiving the last portion of the molten material being introduced in the cavity, as best illustrated in Figure 3.

Thus, the pouring of the molten metal into the molding cavity **12** is continued, with joint rotation of the mold pieces **10** and **11** about their pivotal axes until such time as the entire molding cavity is filled with metal and the molten metal rises in the gate provided by the recessed portions **10***d* and **11***d*. The pouring is then terminated, and the remaining casting allowed to solidify in the mold. Finally, the mold pieces **10** and **11** are again pivoted about their pivotal axes **16** and **17**, which results in dropping the finished casting **18** from between the mold faces.

A somewhat modified form of apparatus suitable for the practice of the present invention is illustrated in Figures 4 through 6 of the drawings. This form of apparatus is particularly useful for the continuous casting of elongated members such as hollow tubes which have undercut surfaces, lugs, or other types of protuberances which are difficult to form in conventional molding assemblies.

In the form of apparatus illustrated in Figures 4 to 6, the molding assembly includes a pair of concentric hollow dies **21** and **22** respectively each of which may consist of a plurality of axially aligned sleeves, such as sleeves **23**, **24**, **25** and **26** which are shown making up the composite inner die member **21**.

The outer surfaces of the sleeves **23** to **26** may be formed with various recessed portions such as recesses **23***a*, **24***a* and **25***a*, these recesses defining the ultimate shape of the interior of the finished casting.

Similarly, the outer die member **22** may consist of a plurality of hollow sleeves **27** and **28** coaxial with the sleeves making up the inner die member **22**. The inner peripheries of the sleeves **27** and **28**, may also contain recesses **27***a* and **28***a* respectively, which determines the shape of the exterior surface of the finished casting.

The composite die members **21** and **22** are jointly slidable in fixed relation to each other, the annular space between the die members **21** and **22** providing a molding cavity **29**. A funnel **30** is provided to introduce molten metal **31** into the molding cavity **29**.

In order to provide a rapid cooling for the casting being formed in the molding cavity **29**, the assembly may be provided with a cooling means **32** consisting of a jacket **33** in which a coolant can be circulated. The jacket **33** receives the inner die **21** and the outer die **22** in sliding relation, so that as the metal is being poured into the molding cavity **29**, the molding dies themselves are moved downward in their same relative positions as illustrated in the drawings.

At the start of the pouring, the base of the molding cavity **29** is closed by means of an annular flange portion **23***a* on the sleeve **23** which is received against the base of the lowermost sleeve making up the outer die member **22**. A short time after the pouring of the metal has commenced, the base of the casting **34** will be hardened sufficiently to permit the two die members **21** and **22** to be moved jointly through the cooling means **32**.

As the pouring of the molten metal continues, while the die members **21** and **22** are moving through the cooling means **32**, additional molding sections can be added to the inner and outer die members **21** and **22** as schematically illustrated in the drawings. For example, an additional sleeve member **35** can be secured to the sleeve member **28** and similar sleeve members can be added to the inner die member **21** to build up a molding structure of any desired length.

As the casting solidifies, the die members can be disengaged from the casting in any convenient manner.

If the shape of the casting permits, the sleeves constituting the inner and outer die members may simply be slid off the finished casting, with the application of heat if necessary. This is illustrated on dotted outline in Figure 5, where the bottom sleeve **23** is shown after its removal from the casting. Where, however, the shape of the casting does not permit the use of such continuous molding dies, as for example in the portion of the casting identified at the protuberance **24***a*, it is desirable to form the corresponding sleeve **24** from a plurality of segmental, longitudinally extending sections **24***b*, **24***c* and **24***d*, as illustrated in the cross-sectional view of Figure 6. These interengaging segments may be provided with cooperating lugs and sockets or other releasable locking means between the sections to enable their easy removal after the solidification of the casting. Similarly, the outer sleeve **27** may be of the split type, consisting of the segmented sections **27***b*, **27***c* and **27***d*, as illustrated in Figure 6.

From the foregoing, it will be apparent that the present invention provides a convenient process for achieving rapid casting of irregularly shaped objects. The process is particularly applicable to the casting of metals which tend to be "hot short" and to those alloys which have only a limited casting range. By utilizing the apparatus of the present invention, the elongated castings which had been considered too difficult to cast in prior practice can be made without difficulty.

It will be evident that various modifications can be made to the described embodiments without departing from the scope of the present invention.

I claim as my invention:

The method of making elongated castings which comprises pouring molten metal into a zone surrounded by irregular mold cavity-defining walls to shape castings with contours of varying dimensions along the lengths thereof, positioning bottom forming walls in said mold cavity to initially support molten metal in the cavity, solidifying metal in said cavity on said bottom walls while continuing the pouring operation to deposit additional molten metal on the solidified metal, opening the bottom of the mold cavity to release a portion of the solidified metal from the mold while forming a mold cavity bottom with another solidified portion immediately trailing the released portion, moving additional irregular mold cavity defining side walls into the pouring zone, successively releasing additional solidified casting metal from the bottom of the mold cavity as the additional cavity defining side walls are moved to the pouring zone, continuing the pouring, solidifying, moving and releasing steps to produce an elongated body of irregular contour having a released leading end, an intermediate solid portion retained in the mold forming a mold cavity bottom, and a molten trailing end supported by the mold cavity defining walls, terminating said pouring operation, solidifying the trailing end of the body in the mold, and releasing a completed solid casting from the mold.

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