

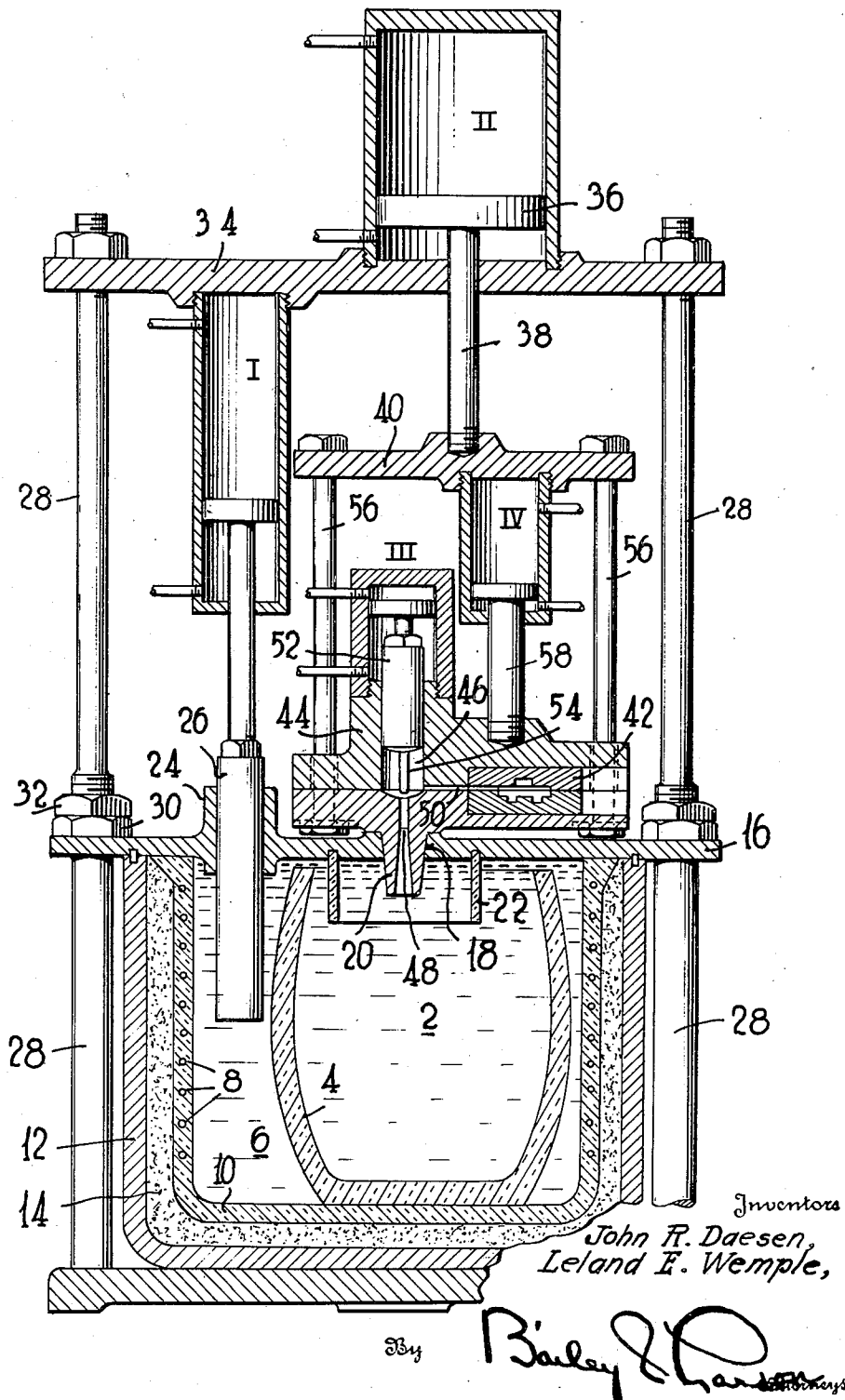
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J. R. DAESEN ET AL

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DIE CASTING APPARATUS

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DIE CASTING APPARATUS

John R. Daesen, Oak Park, and Leland E. Wemple, Chicago, Ill.

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Our invention relates to an apparatus for die casting metals and other substances and more particularly to a method and apparatus for die casting zinc base alloys.

The outstanding advantage of forming metal articles by die casting is that it is inexpensive as compared with other methods. Accordingly, the first die castings were made of low-melting metals such as lead and tin. A desire for greater strength brought about the use of zinc, which has a considerably higher melting point but has a strong corrosive effect on the metals used in handling the molten zinc. While it was found that corrosion could be greatly reduced by adding aluminum to the zinc, this, however, led to an unstable alloy which failed because of intercrystalline oxidation and corrosion. Great improvements in the stability of the zinc aluminum alloy have been made by regulating the natural impurities and making various additions to the alloy without, however, securing a completely stable alloy.

In order to die cast zinc alloys not containing aluminum, and which alloys would therefore corrode the parts of the die casting machine coming in contact therewith, die casting machines have been constructed which avoided continuous contact between the molten metal and the metallic parts of the machine. This has been accomplished by providing a melting chamber separate from the machine and ladling an amount of metal sufficient for one charge or casting into a cavity in a mold. A solid plunger operating in the cavity is usually employed to compress the molten or pasty metal into the mold cavity. While such machines in a degree avoided the corrosion caused by aluminum-free zinc, and brass and aluminum, they possessed the disadvantage that they were fed manually and were thus limited to operating speeds considerably less than the earlier types.

An alternate method of avoiding corrosion of the die casting machine by the molten metal is illustrated and described in our prior Patent No. 1,999,961. Because of its construction, it possesses one disadvantage, namely, that the amount of pressure which can be exerted is limited. Inasmuch as its operation is automatic and does not require manual feeding, it is free from the objection of slow speed of operation and it is, therefore, a useful method especially in its corrosive preventing feature.

Our present invention, although it can, as will be seen, be used to great advantage in connection with other methods and apparatus, is especially designed as an improvement for use with the

invention disclosed in our Patent No. 1,999,961. When so employed it makes possible an automatic high speed production of castings, particularly zinc alloy castings molded under very high pressures. This is the principal object of the invention.

According to our invention, the molten material is passed from a crucible or reservoir through a duct into a cylinder and thence through a gate or passageway on one side of the cylinder into the mold cavity. A plunger operating in the cylinder has an extension or stud on its end which closes the duct after a sufficient quantity of metal has been drawn into the cylinder. The plunger then continuing its downward movement, compresses the metal through the gate or passageway and into the mold cavity with as much pressure as is desired since because of its construction, the plunger and cylinder can be built strong enough to resist tremendous pressures. The stud extending from the plunger besides closing the duct and preventing the molten metal from running back into the crucible, operates as it continues its downward movement to pinch off and eject the solidified metal left in the duct ahead of the cylinder causing the same to drop back into the crucible. This action is of advantage particularly in connection with the method disclosed in our Patent No. 1,999,961 where the duct is kept at a relatively low temperature.

It will be noted that one single downward stroke of the plunger and stud effects three essential steps; first, closing the duct; second, compressing the molten metal into the mold cavity; and third, ejecting the solidified metal in that part of the duct leading to the cylinder. All three steps are accomplished quickly and simply.

So that the nature of invention shall be perfectly clear an arrangement by which it may be carried out has been illustrated in the accompanying drawing in which the single figure is a vertical section of a die casting machine embodying the invention.

Referring specifically to the arrangement illustrated, the metal 2 to be melted and cast is placed in a graphite crucible 4 which may be heated by any suitable means, such as through a salt bath 6, by electrical resistance elements 8. These elements may be embedded in the inner wall 10 of a pressure tight chamber 12. The inner wall of the chamber is preferably insulated from the outer wall by means of suitable insulating material 14. Obviously, the metal may be melted in other ways.

The cover 16 of the pressure tight chamber 12

is provided with an opening 18 for the insertion of the duct 20. Depending from the under side of the cover around the edge of the opening is a ceramic ring 22. This is for the purpose of keeping the salt bath 6 clear from the metal surface beneath the duct opening.

The cover 16 is also provided with an enlarged portion 24 having a cylindrical bore therein through which slides a pressure operated piston 26 supplied with power from any suitable source as from the hydraulic or compressed air cylinder I.

The uprights 28 support the cover 16 which is held securely in place on the chamber 12 by means of the nuts 30 and lock nuts 32. The uprights 28 extend upwardly above the cover 16 but these extended portions are of lesser diameter than the portions which support the cover 16 so that the nuts 30 and 32 can be loosened thus permitting the cover 16 to be raised and the crucible 4 to be refilled or replaced. The upper extensions of the uprights 28 rigidly support a plate 34 to which the cylinder I is secured.

The plate 34 supports a compressed air or hydraulic cylinder II provided with a piston 36 which is connected by the rod 38 to a plate 40, a suitable opening being provided in the plate 34 to enable the rod 38 to pass therethrough.

The die 42 is disposed in a recess in the cylinder member 44. The die and cylinder member are preferably made up of upper and lower halves.

The cylinder member is provided with a cylindrical space 46 and this space is connected to the duct 20 by the opening 48. The cylindrical space 46 is connected to the mold cavity in the die 42 by means of a gate or passageway 50.

A pressure piston 52 is disposed in the cylindrical space 46. This piston is adapted to be moved up or down by any suitable means such as by the hydraulic or air cylinder III. The piston 52 is provided at its lower end with a stud 54 which is so disposed as to enter and close off the opening 48 to the duct 20 when the piston 52 is moved downwardly. The stud 54 is dimensioned, however, so as to permit the piston 52 to move downwardly for some distance even after the duct opening 48 has been closed.

The die and the cylinder member are preferably split horizontally. The lower half of the cylinder member 44 is connected rigidly with the plate 40 by means of the rods 56. These rods pass through suitable openings in the upper half of the cylinder member so that the upper half can be raised and lowered vertically while being guided by these rods. This raising and lowering of the upper half of the cylinder member may be accomplished by the compressed air or hydraulic cylinder IV connected to the plate 40 and which is provided with the piston 58 secured to the upper half of the cylinder member.

The operation of the arrangement will be described in connection with the casting of zinc alloys or other metals. The zinc or other metal to be cast is placed in the crucible and melted through the salt bath 6 by heat from the resistance elements 8. The salt bath extends over the molten zinc in the crucible 4 except for that portion of the latter which is directly below the duct opening 18. This excepted portion is kept clear by reason of the ceramic ring 22 which depends from the chamber cover 16 extending down below the upper surface of the molten zinc or other material in the crucible.

The die and cylinder member as a unit are

lowered by operation of cylinder II and piston 36 so that the duct 20 enters the opening 18 and contacts with the molten metal in the crucible. The pressure piston 26 is then forced downwardly into the chamber 12 by operation of cylinder I and this in turn causes the molten metal in the crucible to enter the duct 20 and rise upwardly into the space 46 in the cylinder member 44. When a sufficient amount of molten metal to make one charge or shot has entered the space 46, the piston 52 which moves in this space is moved downwardly by operation of the cylinder III so that the stud 54 thereon closes the opening 48. Instead of having the piston and stud integral the piston may be provided with a vertical bore to receive a separately operated stud capable of moving up and down therein.

The piston then continues its downward movement and as it does so it pinches off and ejects from the opening 48 any metal which has solidified therein. This ejected metal falls back into the crucible. The opening 48 is thus kept clean at all times. Simultaneously the downward movement of the piston 52 causes pressure in any desired amount to be applied to the molten or plastic metal in the space 46 to force a sufficient amount of such metal through the gate or passageway 50 into the mold cavity in the die 42 to fill the mold cavity completely. The two halves of the cylinder member and die are during this time held tightly together by means of pressure within the cylinder IV.

In order to avoid compressing a considerable volume of air in making a shot, the salt bath in the chamber 12 should completely fill the surface in the chamber with the exception, of course, of the area thereof within the ceramic ring 22.

We have found that a pressure of 500 lbs. per square inch in the pressure chamber may be used to force the molten metal into the die by way of the space in the cylinder member. After the duct has been closed by the stud 54 it is possible to compress the metal in the space in the cylinder member and consequently in the mold cavity with the greatest pressure it is possible to build into the machine.

If the invention is employed in the type of arrangement specifically described and if corroding metals like zinc are being cast, it is highly desirable to immerse only a small portion of the duct 20 and to raise the duct from the surface of the molten metal in the crucible as soon as a sufficient amount of metal has passed to the space in the cylinder member and as soon as the stud has closed the opening 48 to the duct. This is accomplished by raising the cylinder member and die as a unit by operation of the cylinder II and piston 36. This will aid considerably in avoiding or lessening corrosion of the duct. Moreover, the duct can advantageously be kept at a temperature enough lower than the melting point of the metal to freeze the contacting layer of molten metal rapidly before corrosive action takes place between it and the duct. This feature is described and claimed in our prior Patent No. 1,999,961.

Where, of course, the metal being cast is not corrosive, or where it is possible to protect the nose of the duct from corrosion by other means, it will not be necessary to break the contact between the molten metal and the duct immediately after the space 46 has been filled with enough metal for one charge. Where such is the case the duct and lower half of the cylinder member and die may be secured so as to remain

stationary at all times with the duct immersed in the metal.

Thus also where the material being molded is a plastic such as a phenolic condensation product or the like, it is not necessary to raise the duct each time after the space in the cylinder member has been provided with a charge since such plastics do not exert a corrosive influence on the duct.

After the casting operation has been completed in an arrangement such as illustrated, the die and cylinder member may be split by operation of cylinder IV and upward movement of the piston 58, one of the real advantages of the invention being that it is capable of use for automatic high pressure rapid operating die casting of various metals, alloys, plastics, and particularly of zinc, zinc alloys, and the like. When the die is opened the casting in the mold cavity and gate and surplus in the cylinder member may be removed in one piece. This however may also be effected in an arrangement in which the die splits vertically.

It will be noted that a single downward movement of the piston 52 effects three important steps. First, it closes the opening to the duct; secondly, it ejects the metal which has solidified in the duct opening, and; thirdly, it applies a very great pressure to the molten metal as it forces the same into the mold cavity. This construction is both simple and effective as well as extremely adaptable for high speed, high pressure castings in which all the steps are automatic.

Naturally, changes in the apparatus may be made which do not affect the real nature of the invention and we do not intend to be limited by the exemplary disclosure herein except within the scope of the appended claims.

Having now described our invention what we claim as new and wish to protect by Letters Patent of the United States is:

We claim:

1. In a die casting machine, a member having a space therein for receiving molten metal, a duct through which molten metal may pass to said space, means for momentarily contacting a portion of said duct with a source of molten metal and for forcing a quantity of said metal under hydrostatic pressure into said space during the momentary period of contact, a mold, a passage between said space and said mold, and means movable in said space to close said duct and to force molten metal in said space through said passage and into said mold under pressure.

2. In a die casting machine, a chamber for receiving molten material, a casting apparatus in non-continuous contact with said chamber, said apparatus comprising a member having a space therein for receiving molten metal, a duct through which molten metal may pass to said space under hydrostatic pressure, a mold, a passage between said space and said mold, and a single means movable in said space, said means during the first part of its movement closing the entrance to said duct and thereafter applying pressure to molten metal within said space to force the same through said passage into said mold, said means also acting to shear from the entrance to the duct any metal which may have solidified therein.

3. In a die casting machine, a chamber for receiving molten material, a casting apparatus in non-continuous contact with said chamber, said apparatus comprising a member provided with a cylinder, a duct leading to said cylinder

from below to permit molten metal to pass into said cylinder, a mold, a passage connecting said mold and the lower portion of said cylinder, a piston movable up and down in said cylinder, said piston having a stud extension on its lower end for closing said duct, and means to move said piston downwardly first to close said duct, and secondly on continued downward movement to force molten metal in said cylinder through said passage and into said mold under pressure.

4. In a die casting apparatus for die casting zinc base alloys and the like, which consists of a crucible for molten metal, a die unit consisting of a mold, a cylinder connected to said mold, a passageway between them, and a duct leading to said cylinder from below, means for lowering said die unit so that said duct contacts momentarily with the molten metal in said crucible, means for forcing the molten metal under pressure through said duct and into said cylinder during the brief period of contact between the duct and the molten metal, a piston movable in said cylinder, a stud extending from the lower end of said piston, means for moving said piston downwardly as soon as a charge of metal has entered said cylinder to close the entrance to the same and before the contact between duct and metal is broken, further actuation of said means and consequent downward movement of said piston acting to pinch off and eject from the opening in said duct any metal which has solidified therein and to force the molten metal through the passageway and into the mold cavity under great pressure.

5. An apparatus as claimed in claim 4, and means for automatically splitting said mold and cylinder as soon as the casting has been completed so that the molded article, the metal in the passageway and in the cylinder may be removed in one piece.

6. In a die casting apparatus for die casting zinc base alloys and the like, which consists of a crucible for molten metal, a die unit consisting of a mold, a cylinder connected to said mold, a passageway between them, and a duct leading to said cylinder from below, said die unit being split horizontally into upper and lower halves, hydraulic means for lowering said die unit so that a small portion of said duct contacts momentarily with the molten metal in said crucible and for then raising said die unit, hydraulic means for forcing the molten metal under pressure through said duct and into said cylinder during the brief period of contact between the duct and the molten metal, a piston movable in said cylinder, a stud extending from the lower end of said piston, hydraulic means for moving said piston downwardly as soon as a charge of metal has entered said cylinder to close the entrance of the same and before contact between duct and metal is broken, further actuation of said means and consequent movement of said piston acting to pinch off and eject from the opening in said duct any metal which has solidified therein and to force the molten metal through the passageway and into the mold cavity under great pressure, and hydraulic means for automatically splitting said mold and cylinder horizontally to separate the same as soon as the casting has been completed and so that the molten article, the metal in the passageway and in the cylinder may be removed in one piece.

7. A method of die casting zinc alloys and the like which comprises momentarily submerging the inlet end of a duct of a die in a source of

molten metal, forcing by hydrostatic pressure a quantity of said molten metal through said duct and into a space adjacent the die cavity while the contact between the duct and molten metal exists, simultaneously closing the duct opening, breaking the contact, and forcing the molten metal in said space into the die cavity.

8. A method as defined in claim 7 in which the temperature of the duct is maintained low enough below the temperature of the molten metal to freeze the contacting layer of molten metal rapidly before corrosive action takes place between it and the duct.

9. In a die casting machine, a chamber adapted to hold a source of molten material, side, top, and bottom walls for said chamber, an aperture in one of said walls, a die supporting member, a die upon said member, duct means extending from said die, means to engage momentarily one end of said duct means with said aperture, means to force molten material from said chamber into said duct means, and means within said duct means to close the passageway of said duct means to said chamber and to force the molten material in said duct means into said die.

10. In a die casting machine, a source of molten material, a die supporting member spaced from said source of material, a die supported upon said member, a passageway extending from said die to a piston space, a duct extending from said space to an opening in said member, piston means in said space, means to bring said duct in contact with said source of material, means to fill said space through said duct with molten material, means to operate said piston to close said duct while maintaining said contact and to force said material in said space into said die, and means to separate said duct from said source of material.

11. In a die casting machine as in claim 10, said piston means comprising a piston and a stud

on said piston, said stud being adapted to close said duct while said piston forces said material into said mold, whereby said duct is freed of frozen material.

12. In a die casting machine as in claim 10, said source of material comprising a chamber, an aperture in a wall of said chamber, said duct engaging said aperture to make an airtight joint.

13. In a die casting machine as in claim 10, said source of material comprising a chamber, an aperture in a wall of said chamber, said duct engaging said aperture, and hydrostatic means in said chamber adapted to force said molten material through said duct into said space.

14. In a die casting machine, a chamber for holding molten material, heating means for said chamber, a crucible within said chamber, said crucible containing said material, a heating bath surrounding said crucible, a top wall for said chamber, an aperture in said wall above said crucible, a ceramic ring depending from said wall into said crucible, said ring extending around said aperture whereby said bath is prevented from passing through said aperture, and plunger means in said bath adapted when operated to force molten material under hydrostatic pressure through said aperture.

15. In a die casting apparatus a source of molten material, a die casting member, and means moving said member into intermittent contact with said source of material, said member comprising a receiving chamber for said material communicating with said source, a mold in communication with said chamber, and a single movable means in said chamber closing communication between said chamber and said source while said member contacts said source and forcing material in said chamber into said mold while said member is out of contact with said source.

JOHN R. DAESSEN.
LELAND E. WEMPLE.