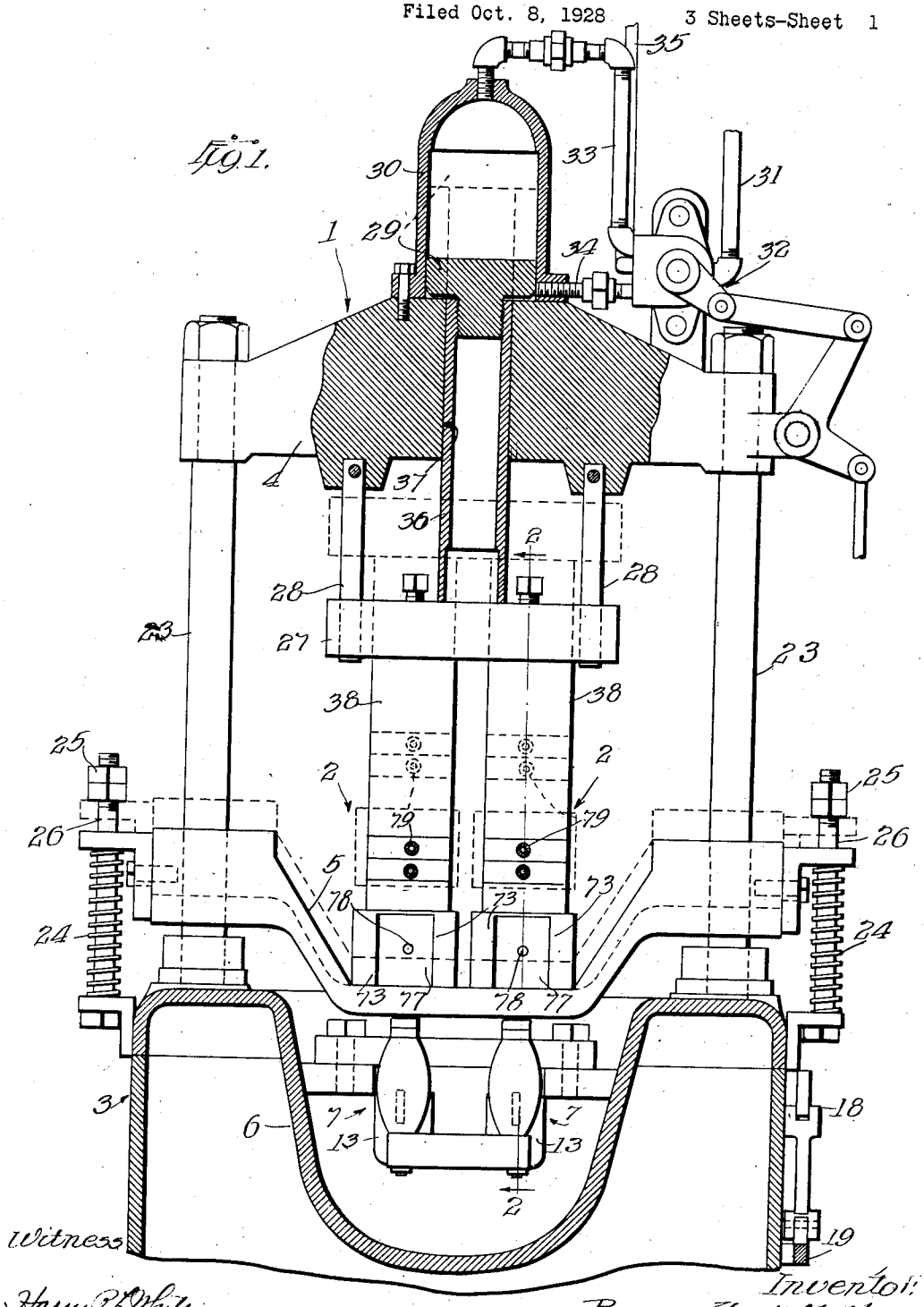
March 29, 1932. B. STOCKFLETH 1,851,935

MEANS FOR DIE CASTING

Filed Oct. 8, 1928 3 Sheets-Sheet 1

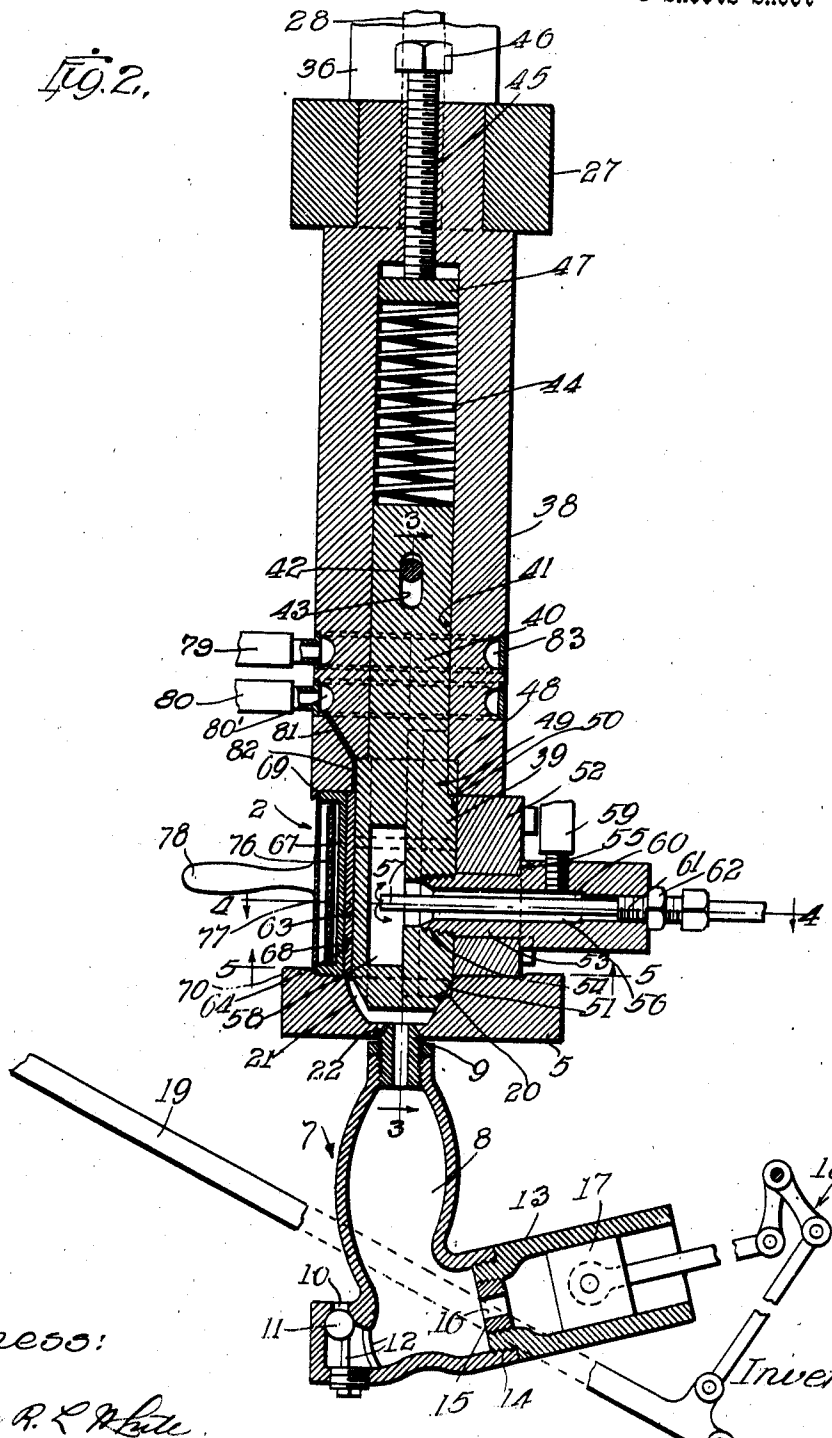


March 29, 1932. B. STOCKFLETH 1,851,935

MEANS FOR DIE CASTING

Filed Oct. 8, 1928 3 Sheets-Sheet 2

Fig. 2.



Witness:

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March 29, 1932. B. STOCKFLETH 1,851,935

MEANS FOR DIE CASTING

Filed Oct. 8, 1928 3 Sheets-Sheet 3

Fig. 3.

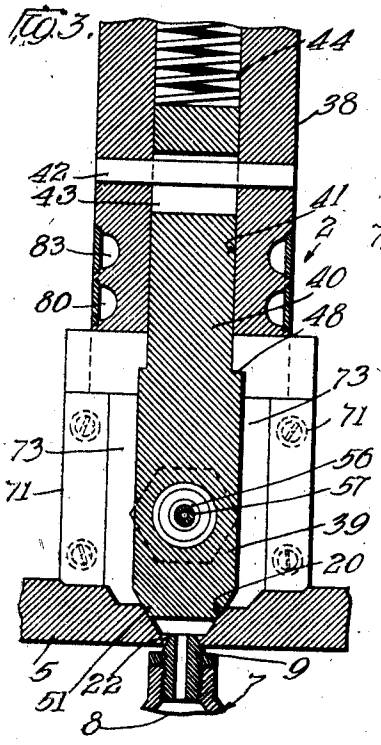


Fig. 4.

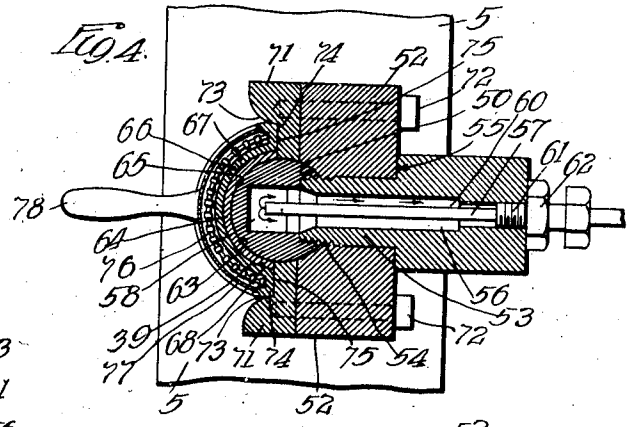


Fig. 5.

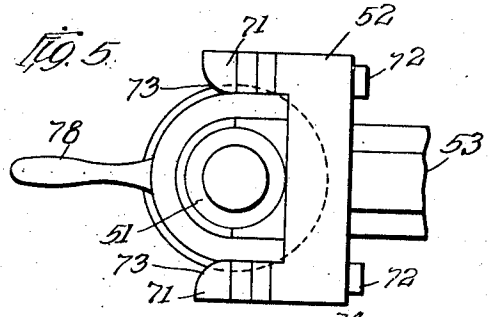


Fig. 6.

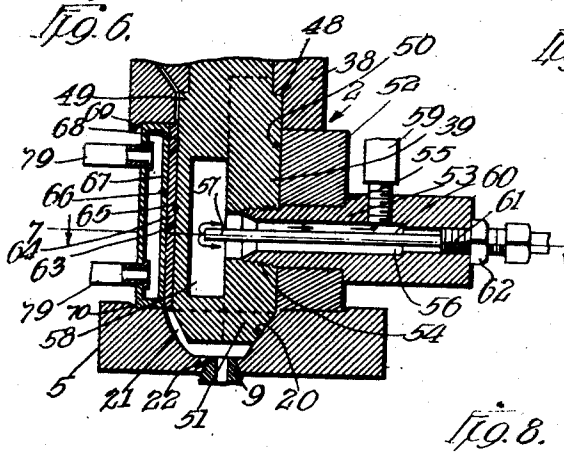


Fig. 7.

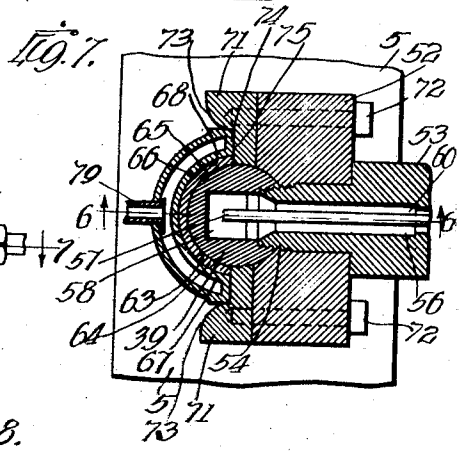
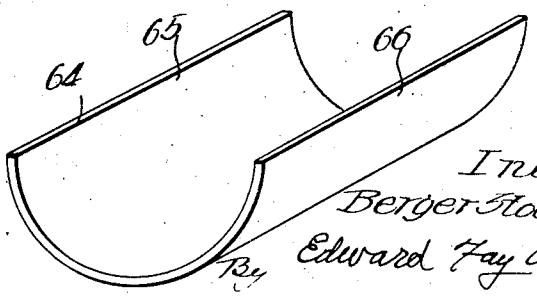


Fig. 8.



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UNITED STATES PATENT OFFICE

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MEANS FOR DIE CASTING

Application filed October 8, 1928. Serial No. 311,181.

This invention relates to improvements in methods and means for die casting and has special reference to the rapid production of castings which have relatively thin walls of relatively large areas.

The object of this invention is to provide means and methods by means of which bearing linings or shells or other articles which are of relatively large superficial area but of relatively small cross-sectional area can be produced rapidly and which will result in a maximum of perfect castings.

Another object of my invention is to provide means and methods whereby the cooling of the metal in the die mold is so controlled that certain desired qualities of internal structure shall be attained in the castings.

The novel die casting means by which the novel method of this invention is practiced includes a die mold formed to produce the article wanted together with means for forcing molten metal into the mold cavity at its lower end and means for withdrawing the air from the mold cavity at its upper end.

Furthermore the die mold is so constructed that one side of a thin mold cavity can be water cooled and the opposed side can be heated.

So far as I am aware die castings are made by forcing the molten metal into the die cavity by pressure and relying upon the metal itself to force out the contained air. Satisfactory results are attained with many shapes of castings by the pressure method, especially in such castings as are not too thin, but in making thin walled castings, notably the linings for bearings or other thin walled articles, the pressure method has not given entire satisfaction.

In this present invention the forcing of the molten metal into the die space by pressure is combined with vacuum means for withdrawing the air from the mold cavity, and this results not only in clearing the mold of air but also in assisting the influx of the molten metal, thereby hastening the casting operation and resulting in practically one hundred percent perfect castings.

In other words, an important feature of this invention is the combination with the pressure method of making die castings of vacuum or suction pressure means for withdrawing the air from the mold cavity and assisting in the rapid influx of the metal.

This combination of pressure and vacuum becomes of vital importance when it is advantageous to use other features of the invention especially that of controlling the rapidity of cooling the body of the casting.

In the casting of Babbitt metal in the making of bearing linings or shells, it has been found advantageous to chill the metal in the casting operation. If the metal cools rapidly from a molten state to a solid state, the crystals will be finer and more regularly distributed than if the metal is cooled slowly. Furthermore if the Babbitt metal is cooled slowly it becomes less brittle and more tough.

This present invention combines these desirable features and in order to make the cooling feature a success on such castings as bearing linings, the combination of this feature with the pressure, plus vacuum method, is very valuable. This is for the reason that in such thin castings the metal is apt to chill to a degree that prevents it rising to the top of the mold unless the air is removed in advance of the metal. Also the combination of the heated side of the mold opposed to the chilling side of the mold assists in the production of perfect castings because it prevents such a solidifying of the metal in the mold as would hinder its rise to the top of the mold.

My invention will be more readily understood by reference to the accompanying drawings forming part of this specification and in which—

Fig. 1 is a front elevation partly in vertical section of a die casting machine particularly adapted for practicing my novel method;

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

Fig. 3 is a fragmentary vertical central section on the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary, horizontal section on the line 4—4 of Fig. 2;

Fig. 5 is a fragmentary, bottom plan view of the mold as seen from the line 5—5 Fig. 2;

Fig. 6 is a fragmentary, central, vertical

section of the mold similar to Fig. 2 but showing a water cooled outer member instead of a heated outer member;

Fig. 7 is a fragmentary, horizontal section on the line 7—7 of Fig. 6; and

Fig. 8 is a perspective view of the article which I have chosen as illustrative of those to the casting of which my improved method is particularly applicable.

In said drawings, 1 illustrates generally a die casting machine having a pair of die casting molds 2 which are made in accordance with this invention and which are especially adapted for practicing the novel method herein disclosed and claimed.

The molds 2 are arranged between the base 3 of the machine and an upper fixed cross-bar or head 4. A movable cross-bar 5 is arranged between the lower ends of the molds and the base. A pot 6 for molten metal is carried by the base below the molds 2 and suitable apparatus is provided for forcing the liquid molten metal from the pot 6 into the molds 2.

As best shown in Fig. 2, liquid metal pumps 7 are provided, one for each mold. These pumps are fixed in the pot 6 and each comprises a chamber 8 provided at its upper end with a delivery nozzle 9 and at its lower end with an inlet opening 10 for the molten metal. The inlet 10 is controlled by a ball valve 11 which is made of such a metal as will not melt when in contact with the molten metal and which is of such a relative specific gravity that it will float in the molten metal. As shown, the inlet 10 is in an upper wall of the device and is closed at its lower end by the valve 11 which rises against the seat surrounding the valve. The valve 11 is retained by bars 12 which provide free passage for the molten metal from the inlet 10 to the chamber 8. Connected with the chamber 8 is a pump cylinder 13 which is preferably made in a separate piece and connected to the chamber 8 by a screw-threaded connection 14 so that the pump cylinder can be readily removed for repairs. The adjacent end of the pump cylinder is provided with a removable bushing 15 having a central opening 16 for connecting the pump cylinder with the chamber 8.

For regulating the action of the pump, the bushing 15 may be changed for another with a smaller or a larger connecting opening as may be desired.

A pump piston 17 is provided operable by a system of levers 18 having a hand lever 19 by a downward movement of which the molten metal is forced out of the pump cylinder into the chamber 8 which being already full the liquid metal is forced up into the mold 2. A reverse movement of the lever 19 again fills the pump cylinder with molten metal. The valve 11 operates automatically permitting the free flow of metal into the pump device and upon the inward movement of the piston 17 rising and closing the opening 10 and preventing the escape of the metal through the opening 10. After the cast is made the first part of the reverse movement of the pump piston drops the valve 11 down from its seat and the liquid metal above the chamber 8, that is, between the chamber 8, and the casting can drop down to the level of the liquid metal in the pot 6. This action assists in freeing the casting of any superfluous metal at its lower end.

The cross bar 5 is provided with a coned opening 20 in its upper side for each mold 2 and in which the lower end of the mold is adapted to seat. This opening also provides a passage 21 through which the metal flows to the mold cavity. The lower end 22 of the opening 20 is coned to receive the upper end of the nozzle 9, as best shown in Fig. 2. The nozzle 9 is made removable so that it can be readily renewed if necessary.

The cross-bar 5 is made movable up and down so that the contacts between the nozzle 9 and the mold can be readily produced. The cross-bar 5 is guided by fixed vertical posts 23 which support the head 4 and is normally held at the upper limit of its movement by springs 24 arranged beneath its ends.

The bar 5 is limited in its upward movement by nuts 25 on the upper ends of fixed vertical rods 26 upon which the springs 24 are retained in position.

The molds 2 are carried by and depend from a cross-head 27 arranged beneath the fixed head 4 and which is movable up and down. The head 27 is guided on fixed guide pins 28 dependent from the head 4. The head 27 with the molds is moved up and down by means of a piston 29 arranged in a cylinder 30 fixed on top of the head 4. The piston 29 is moved up and down in the cylinder 30 by fluid pressure from a source 31 of fluid pressure and controlled by a hand operated valve mechanism 32 of usual construction. The valve mechanism is connected to the upper end of the cylinder by a pipe 33 and with the lower end of the cylinder by a pipe 34 and an exhaust pipe 35 is connected to the valve mechanism.

The piston 29 is connected to the head 27 by means of a piston rod 36 which is guided in a vertical guide opening 37 in the head 4 and serves as a thrust member in closing the molds.

Dependant from the cross-head 27 are two relatively fixed tubular guide members 28 which carry the molds 2 at their lower ends. These serve as thrust members between the head 27 and the molds 2.

Each mold 2 consists of a substantially cylindrical core member 39 formed on the lower end of a stem 40 which extends up in a central guide opening 41 formed in its member 38.

The mold core is retained against removal

from its position by a cross-pin 42 secured in the member 38 and extending through a longitudinal slot 43 provided in the shank 40. The core member 39 is yieldingly retained at the lower limit of its movement by a push spring 44 arranged in the upper end of the opening 41. The spring is adjustable by means of a screw-threaded member 45 mounted centrally in the upper end of the guide member 38 and having a head 46 arranged above the cross-head 27. A spring abutment member 47 is arranged between the adjustable member 45 and the upper end of the spring.

The mold core 39 is provided at its upper end with a circumferential shoulder 48 against which the thrust member 38 contacts for transmitting closing pressure to the core. The upper end portion 49 of the core 39 enters into a guide opening 50 in the lower end of the thrust member 38 and in which it fits with a certain small degree of looseness for a purpose to be made clear hereinafter. The lower end 51 of the core member is formed to fit within the coned opening 20 in the cross-bar 5 to provide a tight closure at this point.

Mounted in the core member 39 is a distance block or separator 52 which is of a length to be tightly bound between the lower end of the thrust member 38 and the cross-bar 5 when the mold is closed. This is for the purpose of preventing too much pressure being applied to the mold parts. This block 52 is connected to the core member 39 by a central clamping bolt 53 having a threaded end 54 which screws into a threaded opening in the core member 39 and has a shoulder 55 for engagement with the block 52.

This bolt 53 is provided with a central passage 56 through which projects a tube 57 through which cooling fluid such as water can be supplied. The inner end of the tube 57 projects into a chamber 58 in the core member and circulation of the cooling fluid into and out of the chamber 58 is made possible by a second connection 59 connected with the outer end 60 of the central passage 56.

The outer end 61 of the tube 57 is screw-threaded into the outer end of the passage 56 and it is rigidly held in place by a jam-nut 62.

As shown in the drawings, each mold as a whole provides a mold space 63 which is semi-cylindrical in form and is adapted to produce semi-cylindrical thin-walled shells 64. The inner surface 65 of this shell is produced by the core 39 which, as shown, is cylindrical in form.

The casting, as shown, is extremely thin, it is quite long and it has a large amount of superficial area, and it is this character of castings that this novel method is particularly adapted for producing, that is, castings of relatively large superficial area and relatively thin walls.

For forming the outer surface 66 of the casting there is provided an outer mold part 67 which is adapted to be sealed to the inner part or core and also to be sealed between the lower end of the thrust member 38 and the cross bar 5. In the form shown, this mold member 67 has an inner surface 68 opposed to the cylindrical surface of the core and adapted to be spaced therefrom sufficient to provide the mold space 63.

For sealing the mold member 67 between the thrust member 38 and the cross bar 5 these members are provided with inclined shoulders 69 on the lower end of the thrust member 38 and 70 on the upper side of the cross bar 5 which contact with the outer corners of the mold member 67 and force it inwardly toward the core member as the mold closes.

Upon the inner face of the spacer block 52 are secured mold parts 71 one at each side by bolts 72 and which extend vertically and are provided with inclined inner surfaces 73 for receiving the outer vertical edges 74 of the mold part 67. Furthermore, the flat narrow edge surfaces 75 of the mold part 67 are pressed tightly against opposed flat surfaces of the parts 71 and effectively seal the mold space at its vertical edges.

As stated hereinbefore the relative temperatures of the mold parts effect the character or internal characteristics of the casting and for this purpose the mold part 67 is preferably heated. This may be accomplished in any suitable manner, but I have shown an electric heating means 76 arranged within the body of the mold member 67. As shown, the member has an outer cover plate 77 which carries a suitable handle 78 by which the member can be placed in position and removed.

For some purposes it is desirable to hold down the temperature of the mold part 67 and for this purpose, as shown in Figs. 6 and 7, it may be made hollow and provided with means, such as the connections 79, for causing a circulation of cooling fluid through same. It is obvious also that a heating fluid could be as readily circulated through this member to maintain it heated.

In the production of the character of castings mentioned, it is particularly important that the metal be caused to completely fill the mold in the quickest possible time and for the purpose of causing this result reliance is not placed solely on the pumping of the metal into the mold space from the bottom but in addition to this the air is withdrawn from the mold space. This relieves the incoming metal from the air pressure in the mold and actually assists in the influx of the hot metal. For this purpose a source 80 of vacuum pressure is provided connected to a

passage 80′ provided in the thrust member 38. This in turn is connected by a small passage 81 to the cylindrical space 82 between the upper end 50 of the core member and the lower end of the thrust member. This cylindrical space is but a few thousandths in radial thickness and as this part is relatively cool the hot metal cannot enter this space.

To assist in the prevention of the molten metal rising into the outlet passage to the vacuum connection, it is sometimes desirable to prevent this part of the mold becoming too hot. For this purpose a water circulation passage 83 may be provided near the lower end of the thrust member.

The addition of the vacuum pull to the pumping thrust on the molten metal is particularly valuable in making castings when it is desirable for any reason to keep one or more walls of the mold cavity relatively cool. Such walls of course tend to quickly cool the entering metal and prevent the complete filling of the mold cavity but by the addition of the vacuum action the mold is completely filled even when one or both walls are of relatively low temperature.

As stated hereinbefore, the effect of relatively cool walls is the more rapid cooling of the casting with the result that the hard crystals embedded in the base material of the casting, are finer, more numerous and more evenly distributed, while on the other hand, the slower solidifying due to a relatively warm or hot wall produces a tough quality to the casting which is invaluable in many situations, such as the backing of bearing shells or one surface of castings which are to be submitted to further forming or pressing operations.

The operation of the machine is as follows: The several parts being in their separated positions, the outer members 67 of the molds are placed by hand in position against the mold strips 71, then the pressure valve 32 is operated to put pressure upon the top of the pressure piston 29. This causes the thrust members 38 to be pushed down carrying the mold cores 39 down upon the cross bar 5 and pushing it down upon the delivery nozzles 9. As the closing goes forward, the outer mold members are engaged by the lower ends of the thrust members 39 and the upper surface of the cross-bar 5 and the final movement of the parts closes the mold tightly as explained. Then the metal pump mechanism is operated to force the metal up into the mold spaces and the vacuum suction assists in the filling of the mold spaces as explained.

As many modifications of the invention will readily suggest themselves to one skilled in the art, I do not limit or confine the invention to the specific steps or order of steps or to the specific construction or combinations of structures herein mentioned, shown or described.

I claim:

1. A die casting mold having a metal inlet and an air outlet, the air outlet opening being relatively long and thin, and means for maintaining at least one wall of said outlet relatively cool.

2. A die casting mold of the kind described and provided with a mold chamber, the chamber provided with a metal inlet at its lower end and with an air outlet at its upper end, the air outlet adapted to be connected with suction means, and means for maintaining at least one wall of the outlet relatively cool.

3. A die casting mold having a metal inlet and an oppositely disposed air outlet, the outlet opening being relatively long and thin, suction means connected with said outlet, and means for maintaining one wall of said outlet relatively cool.

4. A die casting mold provided with a mold chamber, the body of the mold provided with an air removal passage which has an elongated thin connection with the chamber at one end and a discharge at its opposite end, and divided into a plurality of small area passages between the connection with the chamber and the discharge end, the discharge end adapted to be connected with suction means.

5. In a die casting mold, the mold provided with a long and thin air exit leading into a similar shaped passage, relatively small suction passages leading into said exit passage at points removed from the mold, a suction chamber into which said suction passages lead, and means for maintaining at least one wall of said exit passage relatively cool.

6. A die casting mold for the purpose described, the mold space being relatively thin and arranged vertically, the mold provided with a metal inlet at the bottom of the mold cavity and with a suction gas passage connected to the top of the mold cavity by an outlet which is quite thin and long, and a means for maintaining at least one of the vertical walls of the mold space relatively cool.

7. A die casting mold for the purpose described, the mold space being relatively thin and arranged vertically, the mold provided with a metal inlet at the bottom of the mold cavity and with a suction gas passage connected to the top of the mold cavity by an outlet which is quite thin and long, and means for cooling at least one wall of the outlet passage.

In witness that I claim the foregoing as my invention, I affix my signature this 25th day of August, A. D. 1928.

BERGER STOCKFLETH.