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H. F. SCHROEDER

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MECHANISM FOR REDUCING POROSITY OF DIE CASTINGS

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Fig. 1.

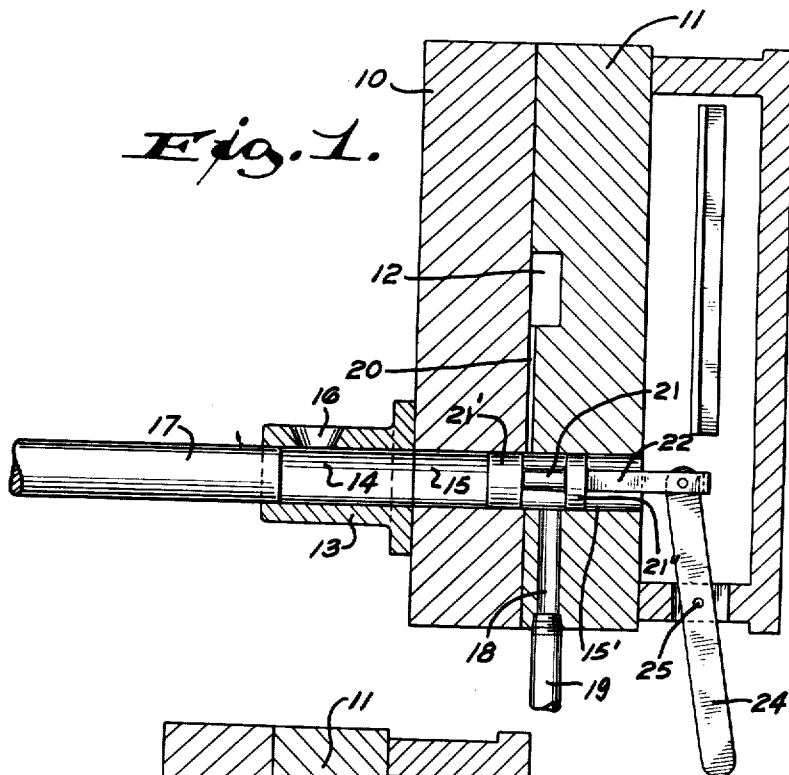
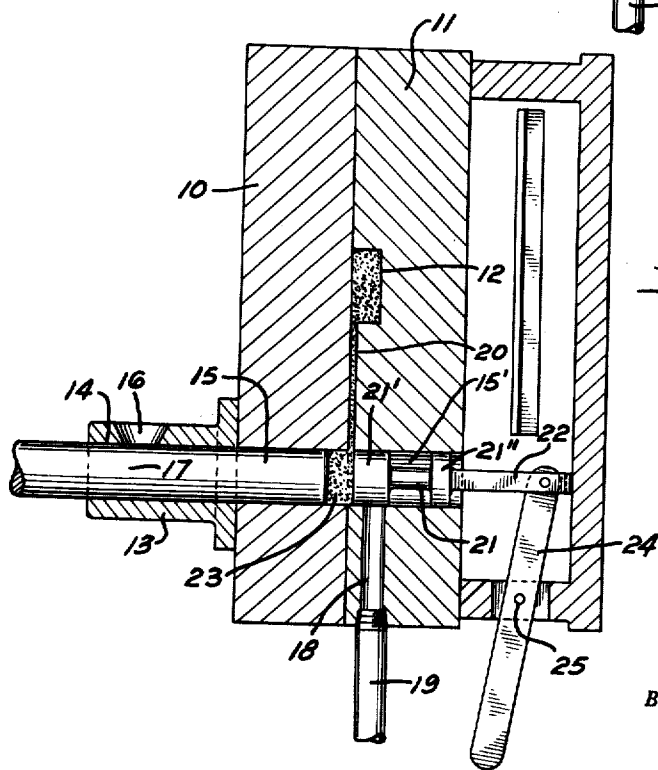


Fig. 2.



INVENTOR.
BY *Henry F. Schroeder,*
Morsell & Morsell
ATTORNEYS

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MECHANISM FOR REDUCING POROSITY OF DIE CASTINGS

Henry F. Schroeder, Milwaukee, Wis.

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5 Claims. (Cl. 22—68)

This invention relates to improvements in mechanism for reducing the porosity of die castings.

In the manufacture of die castings molten metal is usually forced into the die cavity under relatively high pressures. The air and gases in the die are greatly compressed by the molten metal which renders it difficult for the molten metal to enter the die cavity to produce a solid casting. Entrapped air and gas will cause undesirable porosity in the resultant casting.

Porosity reduces the strength of castings and tends to cause leakage when the castings are used to contain fluids under pressure. Porosity is particularly undesirable in castings which are to be plated because platers demand castings with such perfect surfaces that only one polishing operation thereon is required, namely the removal of the parting line.

All pressure die castings have a chilled surface or skin which is several thousandths of an inch thick. At times, in order to shape a casting or to remove an imperfection, it is necessary to polish a portion of the surface other than at the parting line. Should porosity be encountered when the polishing wheel breaks through the skin, the casting cannot be plated and must be scrapped. In addition to the scrap which results from porosity encountered during the polishing operation, many castings are also scrapped because of porosity encountered when the castings are sawed or broken from the gate.

An expedient heretofore tried in an attempt to reduce porosity in castings and to achieve soundness and dense grain structure therein was the use of higher pressures for injecting the molten metal into the die. Some of the machines now in use exert over thirty thousand pounds per square inch injection pressure. These machines require an extremely high die locking pressure running up to twelve hundred tons. The cost of very high pressure machines is excessive as compared to the earlier lower pressure machines which results in accordingly higher cost of the completed castings. Additionally, the use of extremely high pressures forces molten metal into minute cracks in the die and into the joint between meeting surfaces of the die blocks to a much greater extent than is occasioned when lower pressures are used. For example, in many cases high pressures on a given die will produce a pronounced parting line, whereas relatively low pressures will produce a casting substantially free of a parting line in the same die.

With the above problems in mind, it is, therefore, a general object of the present invention to provide an improved mechanism for manufacturing die castings whereby the porosity of the finished casting is reduced by removing air and gas from the die cavity before the molten metal is injected therinto.

A further object of the invention is to provide a mechanism for reducing the porosity of die castings which will result in a reduction in the trimming costs in the castings and which will produce sound die castings having dense grain structure without the use of high injection pressures.

A further specific object of the invention is to provide a

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mechanism of the character described which produces die castings wherein the parting line is minimized, thereby reducing the cost of polishing and also enhancing the appearance of the finished casting.

A further object of the invention is to provide an improved die construction having incorporated therein a suction conduit in controlled communication with the die cavity and arranged so that the inward movement of the shot plunger to inject molten metal into the die cavity automatically shuts off the suction conduit after air and gas has been withdrawn from the die cavity immediately prior to the injection of metal.

A further object of the invention is to provide, in a die construction of the character described, means whereby the shot plunger operates to push the metal biscuit formed on the inner end of the shot plunger, toward the ejector half of the die.

A further object of the invention is to provide an improved mechanism for reducing the porosity of die castings which is applicable to multiple cavity dies as well as to single cavity dies.

A further object of the invention is to provide a die construction which will result in reduced porosity of castings, which is simple, which may be easily incorporated in various types of dies, which is automatic and efficient in its operation, and which is well adapted for the purposes described.

With the above and other objects in view, the invention consists of the improved mechanism for reducing the porosity of die castings, and its parts and combinations as set forth in the claims, and all equivalents thereof.

In the accompanying drawing in which the same reference characters indicate the same parts in both of the views:

Fig. 1 is a fragmentary vertical sectional view through a die casting machine equipped with the improved mechanism for evacuating the air and gas from the die cavity before the injection of molten metal therinto, said view showing the condition of the mechanism and control valve for the suction conduit before the injection stroke of the shot plunger; and

Fig. 2 is a similar fragmentary vertical sectional view showing the arrangement of the mechanism upon the inward movement of the shot plunger to inject molten metal into the die cavity.

Referring now more particularly to Figs. 1 and 2 of the drawing, wherein is shown fragmentary vertical sectional views of a cold chamber-type of die casting machine, the numeral 10 designates the cover portion of the die and the numeral 11 indicates the complementary ejector portion of the die having a die cavity 12 therein. Fixedly associated with the cover portion 10 of the die is a cold chamber 13 whose cylindrical cavity 14 is aligned with and forms a continuation of a cylindrical valve chamber 15 in the cover portion 10 of the die, and which has a registering valve chamber continuation 15' in the ejector portion 11 of the die. The cold chamber 13 has a metal pouring slot or opening 16 therein through which molten metal can be introduced into the cylindrical cavity 14 of the cold chamber 13 in advance of the inner end of an initially retracted shot plunger 17. Although a cold chamber type of die casting machine has been illustrated and described, the improved mechanism for reducing the porosity of castings, forming the subject matter of the present invention, may be incorporated in any of the other conventional and available types of die casting machines. Also, the die casting machine, in addition to the mechanism of the present invention, to be described, may be also equipped with the apparatus of United States Patent No. 2,610,372.

The mechanism for reducing the porosity of die cast-

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ings incorporated in the die casting machine illustrated in the accompanying drawing has, for sake of illustration, been reduced to a very simple form, but it should be understood that the shot plunger and associated valve mechanism may be positioned vertically, if desired, instead of horizontally, and the mechanism to be described may deviate, within the scope of the appended claims, from the precise mechanism shown and described.

The cover portion 10 of the die is formed with a suction conduit 18 which establishes communication between the interior of the valve chamber continuation 15' and an external pipe 19 which extends to a conventional vacuum pump (not shown). Also, there is provided in the inner face portion of the ejector portion 11 of the die a runner 20 which extends from the die cavity 12 to the valve chamber 15—15'. Mounted within the valve chamber 15—15' for reciprocal movement therein is a valve 21 which in the embodiment illustrated takes the form of a spool valve, although it could be of any other desirable form, and could also be positioned in some cavity communicating with the valve chamber 15—15' and be synchronized with the movement of the shot plunger 17.

Fig. 1 illustrates the positions of the elements of the mechanism prior to the injection of the molten metal into the mold cavity 12. As so arranged, the shot plunger 17 is retracted to permit the introduction of molten metal into the cold chamber cavity 14 through the inlet 16. Also, the valve 21 is in the position shown in Fig. 1, wherein the enlarged head 21' of the spool valve is in a position within the valve chamber portion 15 to shut off communication between said chamber 15 and the runner 20. However, the reduced diameter portion of the valve registers with the lower end of the runner 20 and provides direct communication between the runner 20 and the suction conduit 18. The other end portion 21'' of the spool valve prevents fluid flow therebeyond in the valve chamber continuation 15'.

At about the time that a charge of molten metal is introduced into the cold chamber cavity 14, through the operation of the suction pump, air and gas is withdrawn from the empty die cavity 12 through the runner 20, the portion of the chamber continuation 15' between the heads of the spool valve, the suction conduit 18 and the pipe 19. Immediately after the die chamber has been evacuated of air and gas, the shot plunger 17, through proper mechanism conventional in die casting machines, is caused to move to the right relative to Fig. 1 to approximately the position of Fig. 2, pushing forward the charge of molten metal which exerts a force on the outer face of the enlarged head 21' of the spool valve and causes the spool valve to reciprocate from the position of Fig. 1 to the position of Fig. 2. Movement of the spool valve 21 to the right relative to Fig. 2 is limited by the abutment of the end of a spool valve-carried arm 22 with an inner surface portion of an extension on the ejector portion of the die. Such movement of the spool valve is sufficient to cause the enlarged end 21' of the same to cover and close the inner end of the suction conduit 18 and to clear the inner end of the runner 20, with the result that the inward movement of the shot plunger 17 forces molten metal inwardly or upwardly through the uncovered runner 20 and into the die cavity 12 to fill the same. Metal remaining in the inner end of the valve chamber 15 forms a biscuit on the inner end of the shot plunger 17, as indicated at 23 in Fig. 2, which is easily removed when the die sections are separated, through a further movement toward the right (relative to Fig. 2) of the shot plunger which projects the biscuit 23 free of the cover portion of the die, for removal. It is also obvious that the head portions 21' and 21'' of the spool valve 21 may carry conventional piston rings to enhance their sealing effect.

As is shown in the drawing, the valve carried arm 22 may have pivotally connected thereto the inner end por-

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tion of a lever 24 which is intermediately pivotally mounted, as at 25, on a portion of the die and which extends externally of the die for operation manually or by power means applied thereto.

After the casting is formed in the die cavity 12 by the injection of molten metal therein, and the separation of the ejector portion of the die from the cover portion, the die casting is removed after it is formed and the runner 20 can be freed of metal solidified therein. The die is then closed, and through a movement of the lever 24 from the position of Fig. 2 to the position of Fig. 1 the valve 21 is returned to the original position of Fig. 1 which establishes communication between the die cavity 12, the runner 20, and the suction conduit 18. Also, the shot plunger 17 is retracted and the die and associated mechanism is in condition to receive another charge of molten metal for the formation of the next die casting.

From the foregoing description it will be apparent that a die casting machine equipped with the improved mechanism for reducing the porosity of castings operates efficiently to evacuate air and gas from the die cavity immediately prior to the injection of molten metal into the die cavity. This means that the metal will completely and efficiently fill the die cavity and will set therein to form the finished casting without the influence of undesirable air and gas therein. It is, therefore, possible to make die castings of definitely higher density than were made on the same type of die casting machines which were devoid of the present improvements, and in such die castings porosity is substantially eliminated. A die casting machine equipped with the present improvements can utilize relatively low pressures, but sound castings result, devoid of objectionable porosity. There is also no objection as to parting lines formed which result when high injection pressures are utilized.

Elimination of porosity in the finished die castings greatly reduces the amount of material scrapped and the elimination of parting lines and "flash" reduces the trimming cost of the finished casting.

The improved mechanism for reducing the porosity of die castings may be utilized in conventional casting machines, is simple, expeditious and effective in operation, and is well adapted for the purposes described.

What is claimed as the invention is:

1. In combination, a die formed with a cavity and being separable into two sections along a plane through said die, said die being formed with an inwardly extending molten metal chamber and a valve chamber, there also being in the die an externally extending suction conduit whose inner end communicates with the interior of the valve chamber, said die being formed in one of its meeting faces with a runner affording communication between the die cavity and the interior of the valve and molten metal chambers, a valve movably mounted within the valve chamber and having a first and second position, the first position of the valve uncovering the inner ends of the runner in the valve chamber and suction conduit but closing communication between the runner and molten metal chamber so as to permit the evacuation of gas from the die cavity via the runner, a portion of the valve chamber and the suction conduit, the second position of the valve uncovering the inner end of the runner's connection with the molten metal chamber so as to establish communication between said runner and the molten metal chamber and closing the inner end of the suction conduit, and means within the molten metal chamber to apply pressure to a charge of molten metal therein to react directly against the valve to move the latter from its first position to its second position whereby molten metal is injected into the die cavity through the runner after the die cavity has been evacuated of gas.

2. In combination, a die formed with a cavity and being separable into two sections along a plane through said die, said die being formed with an inwardly extending molten metal chamber and a valve chamber in com-

munication with the molten metal chamber, there also being in the die an externally extending suction conduit whose inner end communicates with the interior of the valve chamber, said die being formed in one of its meeting faces with a runner affording communication between the die cavity and the interior of the valve chamber, a valve reciprocally mounted within the valve chamber and having a first and second position, the first position of the valve uncovering the inner ends of the runner and suction conduit but closing communication between the runner and the molten metal chamber so as to permit evacuation of gas from the die cavity via the runner, a portion of the valve chamber and the suction conduit, the second position of the valve uncovering the inner end of the runner and establishing communication between the runner and the molten metal chamber and closing the inner end of the suction conduit, and a reciprocating shot plunger within the molten metal chamber to apply pressure to and advance a charge of molten metal in said chamber between the plunger and valve whereby the metal charge reacts directly against the valve to move it from its first position to its second position whereby molten metal is injected into the die cavity through the runner after the die cavity has been evacuated of fluid.

3. In combination, a die formed with a cavity and being separable into two sections along a plane through said die adjacent a side of the die cavity, said die being formed with an inwardly extending molten metal chamber and a valve chamber in direct communication with the molten metal chamber, there also being in the die an externally extending suction conduit whose inner end communicates with the interior of the valve chamber, said die being formed in one of its meeting faces with a runner affording communication between the die cavity and the interior of the valve chamber, a sliding spool valve movably mounted within the valve chamber and having a first and second position, the first position of the valve uncovering the inner ends of the runner and suction conduit but closing communication between the runner and the molten metal chamber so as to permit evacuation of gas from the die cavity via the runner, a portion of the valve chamber and the suction conduit, the second position of the valve uncovering the inner end of the runner and establishing communication between the runner and the molten metal chamber and closing the inner end of the suction conduit, a reciprocating shot plunger within the molten metal chamber to apply pressure to and advance a charge of molten metal in said chamber whereby said metal reacts against the valve to move it from its first position to its second position whereby molten metal is injected into the die cavity through the runner after the die

cavity has been evacuated of gas, and means for thereafter moving the valve from its second to its first position.

4. In combination, a die formed with a cavity and being separably into two sections along a plane through said die adjacent a side of the die cavity, said die being formed with an inwardly extending molten metal chamber and a valve chamber in communication with the molten metal chamber, there also being an externally extending suction conduit communicating with the interior of the valve chamber, said die being formed in one of its meeting faces with a runner affording communication between the die cavity and the interior of the valve chamber, a valve movably mounted within the valve chamber and having first and second positions, the first position of the valve uncovering the inner ends of the runner and suction conduit so as to permit evacuation of gas from the die cavity via the runner, a portion of the valve chamber and the suction conduit, the second position of the valve uncovering the inner end of the runner and establishing communication between the runner and the molten metal chamber and closing communication to the suction conduit, a reciprocating shot plunger within the molten metal chamber to apply pressure to and advance a charge of molten metal in said chamber whereby said metal reacts directly against the valve to move it from its first position to its second position to inject molten metal into the die cavity through the runner after the die cavity has been evacuated of gas, and means for returning the valve from its second position to its first position.

5. In a die formed with a cavity, an inwardly extending molten metal chamber, and a valve chamber, there also being in the die an externally extending suction conduit whose inner end communicates with the interior of the valve chamber, and a runner affording communication between the die cavity and the interior of the valve and molten metal chambers; a valve slidably mounted within the valve chamber to control the runner, suction conduit, and molten metal chamber, an end portion of the valve having a head, and a reciprocal shot plunger slidably mounted in the molten metal chamber to react against molten metal in the molten metal chamber between an end of the shot plunger and the head of the valve to cause the confined molten metal to exert a force against the valve to move the latter.

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