This invention relates to die casting machines, and more particularly to die casting machines of the type in which the die cavity is evacuated prior to each casting operation.

Objects of the invention are to provide a simple, inexpensive and efficient die casting machine by means of which substantially non-porous castings having smooth surface finishes may be produced economically and with a minimum amount of manual effort.

In accordance with the above objects, one embodiment of the invention contemplates the provision of a die casting machine having means for quickly evacuating the die cavity prior to each casting operation, simple and reliable means for preventing the flow of molten metal into the die cavity during the evacuation of the air therefrom and means for preventing the passage of molten metal into the evacuating system during the injection of the metal into the die cavity.

Other features and advantages of the invention will become apparent from the following detailed description when read in conjunction with the accompanying drawing, in which:

Fig. 1 is a fragmentary vertical sectional view of a die casting machine embodying the invention, the pneumatic and electrical operating systems being illustrated schematically, and Fig. 2 is a detail sectional view taken on line 2—2 of Fig. 1.

Referring now to the drawing, the invention is illustrated therein as embodied in a die casting machine comprising a stationary die supporting plate 10 and a movable die supporting member 14 to which are attached complementary stationary andmovable die sections 13 and 14, respectively. The adjoining faces of the die sections are formed to provide a die cavity 15 of the required shape, and the stationary die section 13 is provided with a sprue opening 16 leading into the die cavity.

A suitably heated receptacle or melting pot 20 is provided for containing a supply of molten metal to be cast, and a die charging pump 21 is mounted within the pot. The charging pump comprises a vertically disposed charging cylinder 22 having a goose-neck nozzle portion 23 formed with a discharge passage 24 leading from the bottom of the cylinder. A connecting nozzle 25 connects the discharge passage 24 with the sprue opening 16, and it will be understood that this connecting nozzle, as well as the exposed upper end portion of the goose-neck nozzle, may be heated by any suitable means (not shown) to insure that the molten metal is maintained at the proper temperature as it passes therethrough.

The charging cylinder 22 is provided near its upper end with an inlet port 27 which leads from the melting pot into the interior of the cylinder. A vertically reciprocable piston or plunger 28 is arranged to operate within the cylinder for forcing the molten metal into the die cavity under the required pressure. The plunger is operatively connected to a vertically reciprocable piston 30 of an air cylinder 31 mounted above the charging cylinder. From its uppermost position, the piston 30 is adapted to be moved downwardly a predetermined distance by a vertically reciprocable rod 32 attached to a piston 33 of an air cylinder 34 mounted above air cylinder 31. It will be seen that the piston rod 32 extends through the top of cylinder 31 and is adapted to engage the top of piston 30. An exhaust port 35 is provided in the lower end of cylinder 34 below the piston 33 and the upper end of the cylinder is connected by a pipe 37 to a valve 38, through which high pressure air from a supply line 40 may be delivered to the upper end of the cylinder. The valve 38 is operated by a cam 41 mounted on a cam shaft 42.

The upper end of air cylinder 31 is connected by a pipe 43 to a double poppet valve 44, through which high pressure air may be delivered to the upper end of cylinder 31. The valve 44 is operated by a pair of cams 45 and 46 mounted on cam shaft 42. The lower end of cylinder 31 is connected by a pipe 48 to a double poppet valve 49, through which relatively low pressure air from a supply line 50 may be delivered to the lower end of the cylinder. The valve 49 is operated by a pair of cams 51 and 52 mounted on cam shaft 42.

For sealing the die cavity against ingress of air, an air excluding manifold 55 is provided which comprises complementary sections 56 and 57 adapted to completely surround the die sections 13 and 14, respectively. The manifold sections are removable attached to the respective die sections by means of clamping screws 58, 59, and rubber gaskets 53, 59 are interposed between the manifold sections and the die sections to provide air tight seals. The adjacent faces of the manifold sections are provided with cooperating means for establishing an air tight seal therebetween when the die is closed. This means, in the illustrated embodiment of the invention, comprises a rubber gasket 60 in the face of manifold section 57, which is adapted to be engaged by a bead 61 in the adjacent face of manifold section 56.
When the die is closed, the manifold sections 63 surrounding the die cavity and the die cavity form a chamber 65 in the die section 14. A reciprocable shutter 66 is provided for closing the passage 65 to prevent escape of metal therethrough during casting operations. The manifold 63 is mounted on cam 42 by an arm 93 and is connected to the vacuum pump 78. Also, valve 38 is positioned so that the upper end of cylinder 34 is open to the atmosphere while the lower end of this cylinder is connected to the low pressure air line 50. At this time, the valve 73 is positioned so that it connects the upper end of cylinder 68 with the high pressure air line 45 and opens the lower end of this cylinder to the atmosphere. To operate the apparatus, the die is closed by suitable means (not shown) and the hand lever 56 is moved to the intermediate position shown in dotted outline in Fig. 1. Upon closing of the die, the switch 89 is closed by the switch actuating bracket 91, thus conditioning the energizing circuit for the solenoid 87. Movement of the hand lever to the intermediate position causes rotation of cam shaft 42 to a position in which cam 41 operates valve 38 to deliver high pressure air from supply line 40 to the upper end of cylinder 34, whereupon its piston 30 is moved downwardly to piston 30 of cylinder 31 is thereby also moved downwardly, thus moving the plunger 28 to the intermediate position indicated by the broken line 99. In moving to this intermediate position, the plunger closes the molten metal inlet port 27 of the cylinder 22 and forces molten metal in the goose-neck discharge passage 24 approximately up to the sprou opening 16 of the die, as indicated by the broken line 100, thus expelling air from the goose-neck and connecting nozzles. This reduces the time required for evacuating the die cavity, since it reduces the amount of air that must be exhausted. It will be obvious that the movement of the hand lever to the intermediate position also causes cams 51 and 52 to operate double poppet valve 49 so as to open the lower end of cylinder 34 to the atmosphere. Upon movement of the plunger 28 to the intermediate position, the switch actuating arm 93 closes the switch 89, thus completing the previously conditioned energizing circuit for solenoid 87, whereupon the solenoid operates valve 95 to connect the upper end of cylinder 31 to the low pressure air line 50. The piston 82 in cylinder 33 is thus moved downwardly, whereby the valve 71 is operated to connect the die cavity 15 with the vacuum pump 78.

It has been found that in some instances satisfactory castings may be produced when the air is expelled from the goose neck and connecting nozzles by the preliminary movement of the pump plunger, even though the die cavity is not evacuated, but generally more satisfactory results are obtained when the die cavity is evacuated. After a brief interval of time sufficient for the evacuation of the die cavity, the hand lever is moved to its final operative position and upon movement of the hand lever to this position the valves 73 and 44 are operated. The valve 73 is operated slightly in advance of valve 44 so as to deliver high pressure air to the cylinder 68 for closing the shutter 66 prior to the injection of the molten metal into the die cavity. Following the closing of shutter 66, the valve 44 is operated to deliver high pressure air to the upper end of cylinder 31, thus causing further downward movement of piston 30 and thereby the plunger 28, whereby the molten metal is forced into the die cavity. The hand lever is then returned to its original or starting position in which all of the parts are returned to their original or "at rest" positions and the casting is removed, thus completing one cycle of operation of the apparatus.
It will be obvious from the above description that a simple and inexpensive arrangement is provided for quickly evacuating the die cavity prior to each casting operation and that simple and reliable means are provided for preventing the flow of molten metal into the die cavity during the evacuation thereof and for preventing the escape of molten metal from the die cavity during the casting operation. It should be understood, of course, that the invention is not limited to the particular embodiments thereof herein illustrated and described, except as defined by the appended claims.

What is claimed is:

1. In a die casting machine including a die having a casting cavity, a die charging means comprising a charging cylinder having an inlet port for material to be cast and a discharging passage communicating with said die cavity, a reciprocable plunger in said cylinder, means for imparting an initial movement to said plunger to close said inlet port and advance the casting material into said die cavity through said inlet opening, said charging cylinder having an inlet port for material to be cast, a die charging means comprising a charging cylinder in constant communication with said die cavity through said inlet opening, said charging cylinder having an inlet port for material to be cast, a reciprocable plunger in said cylinder, means for imparting an initial movement to said plunger to close said inlet port, means rendered effective automatically by said plunger moving means upon the completion of said initial movement for evacuating said die cavity, and means for thereafter imparting further movement to said plunger to forcibly inject casting material from said cylinder into the evacuated die cavity.

2. In a die casting machine including a die having a casting cavity, a die charging means comprising a charging cylinder having an inlet port below the surface of said material, said cylinder having a discharging passage communicating with said die cavity, a reciprocable plunger in said cylinder, means for imparting an initial movement to said plunger to close said inlet port, means rendered effective automatically by said plunger moving means upon movement of said die cavity, electromagnetic means for controlling said evacuating means, an electrical energizing circuit for said electromagnetic means, two normally open control switches connected in series in said energizing circuit, means for closing one of said switches upon movement of said die cavity, and means for closing the other of said switches upon movement of said reciprocatory means in said direction.

3. In a die casting machine including a die having a casting cavity provided with an air outlet passage and an inlet opening for material to be cast, a die charging means comprising a charging cylinder in constant communication

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