Sept. 28, 1937. W. A. PARKER 2,094,079

DIE CASTING MACHINE

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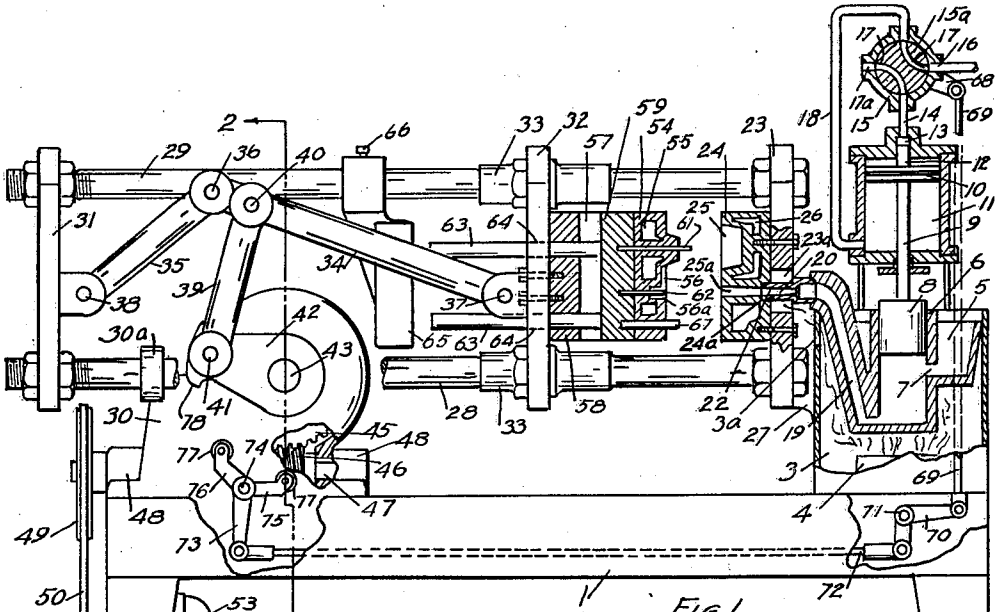


FIG. 1.

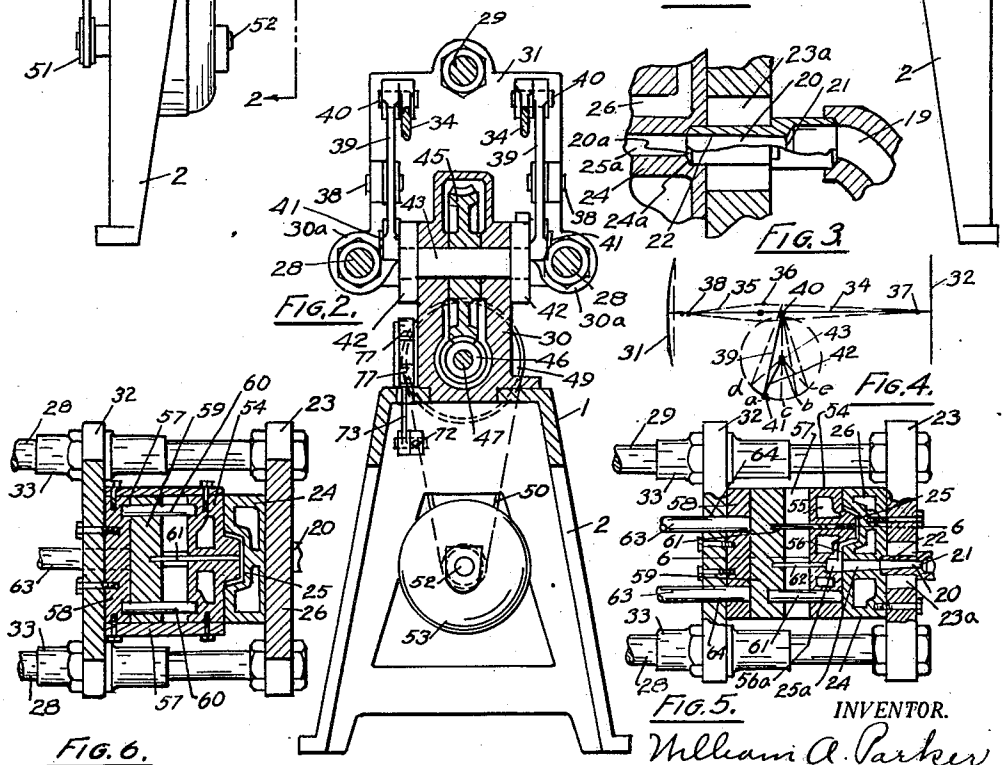


FIG. 2.



FIG. 3.



FIG. 4.



FIG. 6.



FIG. 5.

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## DIE CASTING MACHINE

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2 Claims. (Cl. 22—92)

The present invention is designed to improve die casting machines and has particular reference to the manner of closing and opening the die from a rotating driving means. With such a mechanism it is possible to speed up the operation to a point that is nearly sufficient to chill the casting, open and discharge the mold, close and re-charge it. In carrying out the invention a mechanism is preferably utilized which has no lost motion and which retains a continuous connection between the actuated mold member and the rotating driving means and at the same time holds the mold positively in closed position during the chilling dwell of the mechanism. Features and details of the invention will appear more fully from the specification and claims.

A preferred embodiment of the invention is illustrated in the accompanying drawing as follows:—

Fig. 1 shows a side elevation of the machine, partly in section.

Fig. 2 a section on the line 2—2 in Fig. 1.

Fig. 3 an enlarged view of the mold charging tube.

Fig. 4 a schematic view of the driving mechanism.

Fig. 5 a section of the mold with the parts in closed position.

Fig. 6 a section on the line 6—6 in Fig. 5.

1 marks the machine frame and 2 legs supporting the frame.

A heating chamber 3 is provided with a burner 4, the burner being adapted to heat the molten metal receptacle 5. A charging cylinder 6 is supported by the receptacle and communicates with the receptacle through a port 7. A plunger 8 operates in the cylinder, closing the port 7 in its downward stroke so as to force the molten metal to the mold. A piston rod 9 extends from a plunger 8 to a piston 10. The piston 10 operates in an air cylinder 11. The piston has an extension 12 which extends into an inlet socket 13. Air is admitted to the socket 13 by an inlet passage 14 extending from a four-way valve 15. The valve has an inlet passage 16 and has a valve plug 15a provided with two ports 17 which may be brought alternately to the supply opening 14 connecting the same with the inlet 16, or with a discharge opening 17a. A connection 18 also extends to the valve 15 and leads to the lower end of the cylinder 11. This passage is also alternately connected by the ports 17 with the inlet passage 16 and the discharge passage 17a so that as the valve is operated in proper timing with relation to the other operations of the machine by the mechanism hereinafter described the piston 10 is forced downwardly carrying with it the plunger 8 and expelling a charge for the mold. At the proper interval the piston 8 is returned with an initial suction action in its return movement to facilitate the separation of the molten metal from the chilled metal of the mold and to uncover the port so as to permit an inflow of molten metal. In the initial movement of the piston, the piston is retarded by the extension 12 which restricts the incoming air so that the filling of the air above the piston 10 is comparatively slow. This is desirable in that the plunger does not violently expel the molten metal from the port 7 and gives a gradual start to the flow in the passage. A communicating port 19 extends from the lower end of the cylinder 6 up to the charging tube 20. The charging tube is fixed on the walls of the receptable at the discharge end of the port 19. The charging tube has a restriction 21 formed by the taper 22 which has its smaller end at the restriction. This charging tube is arranged in an opening 23a in a mold supporting plate 23. A mold member 24 as shown has a mold cavity 25 and has a seat 24a adapted to seat on a seat 20a at the end of the charging tube. This connection permits of the ready charging of the mold. The mold member is provided with chambers 26 adapted to receive cooling liquid through connections (not shown). The mold supporting plate 23 is mounted on brackets 27 extending from the burner chamber 3. The hot gases from the burner are discharged through an opening 3a and deflected into the opening 23a. As a result the charging tube is subjected at one end to the heat of the hot gases and at the opposite end to the chilling effect of the cooling liquids in the chamber 26. There is, therefore, a chilling of the metal in the one end of the tube which metal is joined with the casting in the mold cavity and the molten metal at the opposite end of the tube is maintained in liquid state so that there is a ready separation, or backward movement of the molten metal at the completion of the casting operation. The taper passage of the tube 20 permits of the ready withdrawal of any chilled metal that may extend from the casting into the tube 20 and the inlet passage 25a of the mold member is also tapered so as to readily facilitate the removal of the charging plug of metal which may be attached to the casting. Lower guide rods 28 extend from the plate 23 to a cross member 30a. The cross member is fixed on a gear case 30 which case is mounted on the frame 1. Guide rods 28 extend beyond the

cross member 30*a* and into a rear pressure head 31 to which they are secured. An upper guide rod 29 is secured to and extends between the supporting plate 23 and the head 31. A reciprocating head 32 has bearings 33 which are slidingly mounted on the rods 28 and 29. A toggle lever has members 34 and 35 pivotally connected by pins 36. The forward end of the lever is pivotally connected at 37 with the reciprocating head 32. The rear member 35 is pivotally connected with the head 31 by a pin 38. A link 39 is connected by a pin 40 with the lever 34 adjacent to the pivotal connection at 36. The link is connected by a crank pin 41 with a crank 42. The crank 42 is fixed on a drive shaft 43. As indicated in Fig. 2, the toggle lever mechanism and crank are duplicated at each side of the machine, there being a crank at each end of the shaft 43. A worm gear 45 is fixed on the shaft 43 and meshes with a worm 46. The worm is arranged on a worm shaft 47 and the shaft 47 is journaled in bearings 48 in the case 30. A driving pulley 49 is fixed on the worm shaft and is driven from a belt 50 from a pulley 51. The pulley 51 is fixed on a rotor shaft 52 of a motor 53. Through this mechanism it will readily be seen that the crank is rotated and through its rotation reciprocates the link 39 swinging the toggle lever so as to open and close the mold. This toggle lever mechanism is brought to a position to close the mold with the members 34 and 35 in substantial alinement. As indicated in Fig. 4, the crank is at the points *a* and *b* when the parts 34 and 35 are in exact alinement. They are brought from slightly below that point in the travel of the crank represented at *c*. In actual operation the mold is maintained in closed position from the point *d* to the point *e*, the spring of the included mechanism permitting the very slight variation in this interval. In other words, while there is a continuous motion of the crank and while the toggle lever in its straightened position positively holds the molds under pressure and in closed position, a dwell in this closed position is accomplished by making the closed position in the part of the crank travel where the movement from the crank to the toggle levers and the movement of the toggle levers results in very little variation in the straight line arrangement of the toggle levers. Two important factors enter into this result. By making the throw center of the crank (the throw center being the points in the travel of the crank where the reciprocating parts actuated by the crank reverse) the more remote from the toggle the closing throw center, the swinging of the link on its pivot on the toggle and the swing of the crank on its center differ only as the length of the link differs from that of the crank, and the movement communicated during the dwell portion of the crank throw is simply the difference between the arcs struck from the link pivot and the crank center. This difference can be made smaller by making the link longer relatively to the crank. By carrying the toggle members past alignment during the dwell portion of the throw of the crank the maximum divergence from alignment of the members is reduced. Thus a simple, powerful driving connection is provided, comparatively fast during the opening and closing movements and with a dwell of sufficient length over a sufficient period to procure the chilling of the casting in the mold.

A movable member 54 of the mold has complementary mold parts completing the mold with the cavity 25. This is provided with water cooling chambers 55 connected with a source of cooling liquid (not shown). The movable mold member is provided with a socket 56*a* which, with the mold closed, is directly opposite the charging passage 25*a*. This socket is connected by a lead 56 which connects the charging passage with the mold cavity. The socket 56*a* has its walls shaped to so engage the metal of the plug formed in the socket as to assist in withdrawing the casting from the stationary mold member. The mold member 54 is connected by straps, or plates 57 with a block 58 secured on the head 32 so that the mold member 54 reciprocates with the head. A knock-out block 59 is slidingly mounted in the space between the member 54 and the block 58 on pins 60 which extend from the member 54 to the block 58. Knock-out pins 61 and 62 extend from the knock-out block 59 through the mold member into position to engage the casting and discharge it from the mold. One of these pins 62 operates on the end of the plug formed in the socket 56*a*. Push rods 63 are sliding mounted in perforations 64 in the head 32 and extend from the knock-out block 59. An abutment 65 is secured on the rod 29 preferably adjustable by means of a securing screw 66. A thrust pin 67 extends from the knock-out block 59 through the mold member 54 and is positioned to engage the face of the mold member 24 as the head 32 with the mold member 54 is advanced.

The molding operation is as follows: The movable member 54 is moved forward, closing the mold. With this forward movement, the pin 67 engages the mold member 24 and arrests the knock-out block 59 so as to retract the knock-out pins 61 and 62 and bring them back to the faces of the molding surfaces. After the mold is charged and the metal chilled the member 54 is retracted opening the mold and in this rearward movement the push rods 63 come into engagement with the abutment 65, thus arresting the knock-out block 59 prior to the completion of the rearward movement of the mold member. With the continued movement of the mold member the push-out pins 61 and 62 are projected through the mold member 54, thus disengaging the casting from the mold after which the operation of closing the mold is repeated.

The air on the cylinder is automatically controlled. A rock arm 68 is connected with the valve plug 15*a*. A rod 69 connects the arm 68 with a bell crank lever 70 pivotally mounted on a pin 71 in the frame. A rod 72 extends from the bell crank lever to a rock arm 73. The rock arm is mounted on a pin 74 mounted on the gear case 30. Rock arms 75 and 76 are fixed with the rock arm 73 and provided with rollers 77 at their ends. A cam 78 is arranged on the end of the crank 42 and the rollers 77 are in the path of the cam 78 as the crank is rotated. As the mold is closed the crank reaches the arm 75 and throws through the connecting mechanism the valve plug 15*a* to connect the upper end of the cylinder 11 with the air supply. The immediate downward movement of the piston and with it the plunger 8 charges the mold. After the mold is charged and at the completion of the dwell the cam 78 reaches the roller on the arm 76 and reverses the valve 15 so as to exhaust the upper end of the cylinder and connect the lower end of the cylinder with the air supply. The plunger 8 is then withdrawn and this withdraws the molten metal making the break somewhere in the charging tube 20, the exact position of the break depending somewhat on the speed at which the machine

is run and the consequent extension of the chilling in the tube passage from the mold member 24. The plunger in its return movement, as before stated, exerts initially a suction effect on the molten metal in the port 19 and this aids in the prompt return movement of the molten metal from the point of parting with the chilled metal. This suction effect is broken when the plunger passes the port 7. This action is repeated with each cycle of the machine.

The piston 10 is considerably larger than the plunger 6 so that there is a very decided pressure differential. This may be made as much as desired depending on the available air pressure for operating the piston and the proper pressure to be exerted on the molten metal in the mold. This pressure is increased by the fact that after the extension 12 leaves the socket 13 the air flow on the piston is rapid and there is a very great acceleration of the piston so that it reaches the point where the mold is filled at a very considerable velocity and this gives to the metal as it fills the mold an added and final pressure shock through the inertia of the plunger and piston. In this way the mold is filled rapidly and with a very high final pressure.

It will be noted in the present structure that the mold has a fixed member and a movable member and that the knock-out action on the formed casting is accomplished through a single reciprocating mechanism. Thus the operating mechanism is very much simplified.

What I claim as new is:—

1. In a die casting machine, a mold opening and closing mechanism comprising a reciprocating mold member; a continuously rotating driving crank provided with a crank pin; a driving connection between the mold member and the crank including a link journaled on the crank pin with a bearing maintaining the axis of the bearing constant with the axis of the crank pin and a toggle joint to which the opposite end of the link is connected, the toggle joint being connected to the mold member, said link and toggle joint communicating the throw of the crank to the mold member and related to open the mold as the crank passes its throw center the more nearly adjacent to the joint and to close the mold as the crank passes its throw center the more remote from the joint and with the members of the joint in approximate alignment, providing a casting chilling dwell at the closed position of the member.

2. In a die casting machine, a mold opening and closing mechanism comprising a reciprocating mold member; a continuously rotating driving crank provided with a crank pin; a driving connection between the mold member and the crank including a link journaled on the crank pin with a bearing maintaining the axis of the bearing constant with the axis of the crank pin and a toggle joint to which the opposite end of the link is connected, said link and toggle joint communicating the throw of the crank to the mold member and related to open the mold as the crank passes its throw center the more nearly adjacent to the joint and to close the mold as the crank passes its throw center the more remote from the joint and with the members of the joint in approximate alignment, providing a casting chilling dwell at the closed position of the member, the members of the joint being carried past alignment as the crank passes its throw center in closing the mold.

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