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APPARATUS FOR PRESSURE INJECTING CASTING MATERIAL BY DIAPHRAGM PUMPS

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Fig. 1.

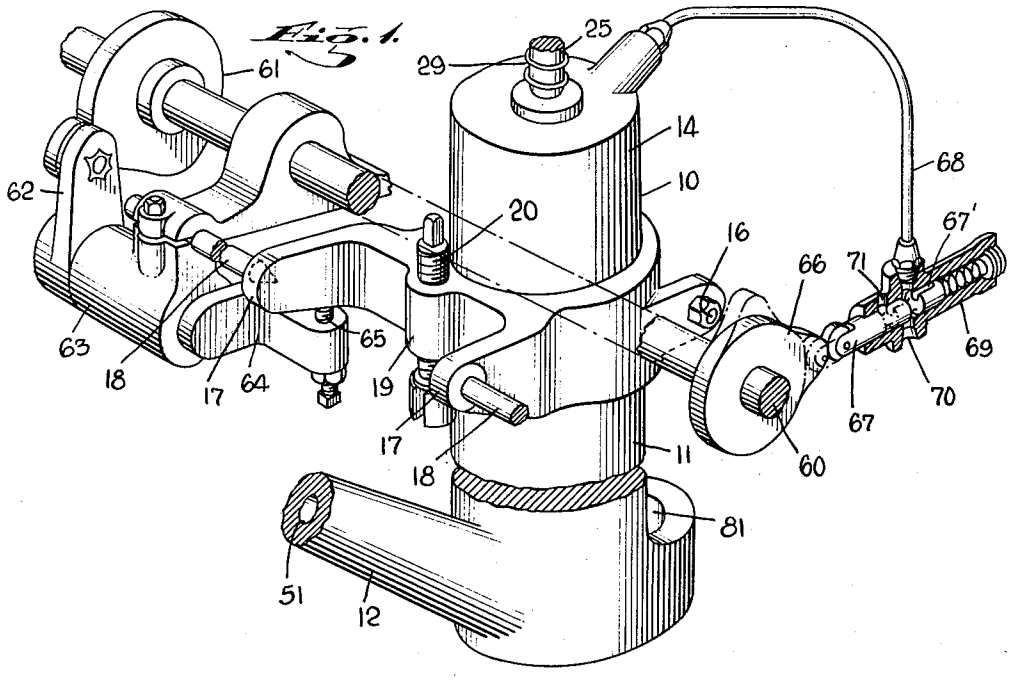


Fig. 2.

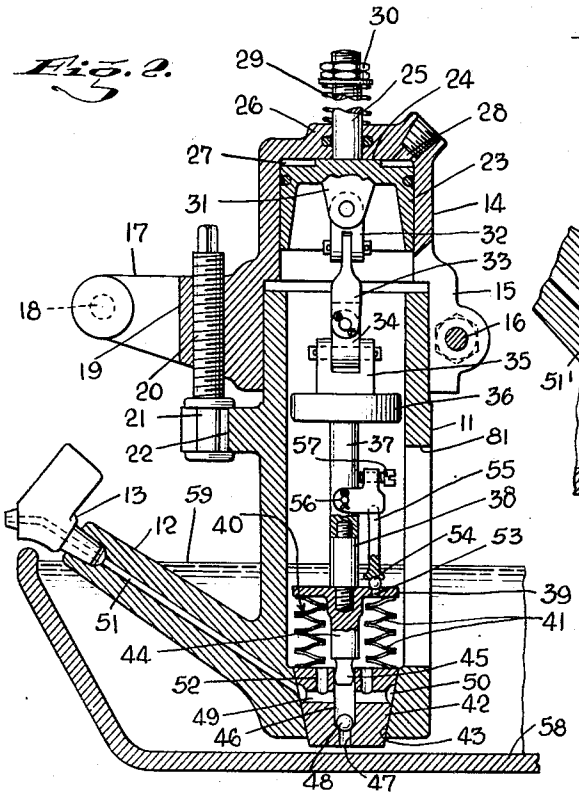
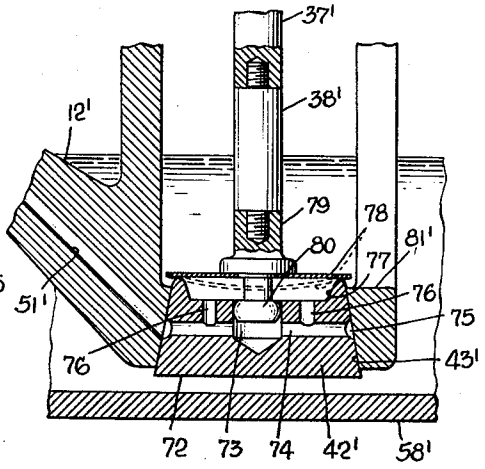


Fig. 3.



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APPARATUS FOR PRESSURE INJECTING CASTING MATERIAL BY DIAPHRAGM PUMPS

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14 Claims. (Cl. 22—70)

1

This invention relates to die casting machines wherein molten metal is forced, under pressure, through a gooseneck into the cavities of dies in forming die castings. More particularly, the invention deals with casting machines of the character defined and capable of use for the high speed formation of castings of aluminum and aluminum alloys.

The novel features of the invention will be best understood from the following description when taken together with the accompanying drawing in which certain embodiments of the invention are disclosed, and in which the separate parts are designated by suitable reference characters in each of the views, and in which:

Fig. 1 is a schematic perspective view of a gooseneck diagrammatically illustrating the mounting and operation of parts thereof, part of the construction being broken away and in section.

Fig. 2 is a vertical section through the gooseneck, indicated in Fig. 1, and showing the same disposed in part of a pot containing molten metal; and

Fig. 3 is a view similar to Fig. 2, showing only a part of the construction and showing a modification.

In Fig. 1 of the drawing, I have illustrated schematically, a perspective view of a gooseneck 10 and parts associated therewith to mount and actuate said gooseneck. The gooseneck comprises a main lower tubular body 11 having an upwardly and outwardly directed discharge spout 12, on the upper discharge end of which is mounted a discharge nozzle 13, note Fig. 2. On the upper end of the body 11 is mounted an inverted cup-shaped casting 14 having a lower split end 15 adapted to be clamped upon the upper end of the body 11, as by means of the bolt 16. The lower portion of the member 14 has at one side a pair of outwardly extending arms 17 forming a pivotal mounting for the gooseneck to swing on pivot pins indicated at 18, in Fig. 1 of the drawing. This pivotal mounting is provided to facilitate movement of the nozzle 13 toward and from the dies in the operation of injecting casting material into the cavity of the die. Between the arms 17, the member 14 has a boss 19 in which is mounted a screw 20, the lower flanged end 21 of which engages a forked portion 22 on the upper end portion of the body 11. The screw 20 serves to hold the parts or members 11 and 14 in adjusted position with respect to each other and this adjusted position is definitely fixed by the clamp bolt 16.

2

The member 14 forms a cyclinder in which is mounted a piston 23, having a raised central portion 24 from which extends a rod 25, the latter passing through the head 26 of the cylinder. The annular chamber 27 is designed to receive air under pressure, from port 28, as later described.

Mounted on the rod 25 is a spring 29, the tension of which is adjusted by nuts 30. Depending from the head of piston 23 is a forked bearing portion 31 with which is pivotally coupled a link 32. Another link 33 is coupled with the link 32 and the latter with a link 34 pivoted to the upper forked end 35 of the enlarged disc head 36 of a plunger 37.

Coupled with the lower end portion of the plunger rod 37 is a spacer or coupling 38 which couples the plunger 37 with the upper disc portion 39 of a bellows-type pump 40. The bellows pump 40 is formed from a series of ring-like plates 41 having their inner and outer edges welded together, the top disc being welded to the plate 39, and the bottom disc welded to a tapered plug 42. The plug 42 has a drive fit in a tapered socket 43 in the lower end of the gooseneck body 11.

The disc 39 also includes centrally thereof, a rod extension 44 which passes downwardly and freely through the bellows 40 and has a rounded end 45 which operates in a bore 46 in the plug 42. The plug 42 has an inlet port or passage 47 in its lower end which registers with the bore 46 and a ball check valve 48 is employed which controls communication between the port 47 and bore 46.

The plug 42 has a transverse bore 49 which intersects the vertical bore 46 and which opens into an annular groove 50 in the periphery of the plug, the latter also registering with the bore 51 of the gooseneck extension or arm 12. Also communicating with the transverse bore 49 is a pair of vertical ports 52 which open into the interior of the bellows. The plate 39 has an air vent 53 opening into the interior of the bellows, the air vent being controlled by a ball-valve 54 seated in the lower end of a rod 55. The rod 55 has a pivotal support, as at 56 on the plunger 37 and an adjustable screw 57 is employed to maintain the ball valve 54 in seated position. Thus, the operating piston 23 and the connections to and including bellows 40 and associated parts are all housed within the tubular gooseneck body 11.

At 58 I have shown part of a melting pot in which the lower end of the gooseneck 10 is arranged. Suitable means is provided, not shown, for heating and maintaining the pot 58 at a temperature suitable to maintain the metal

which is indicated at 59, at a desired temperature for injection into the cavity of the dies. It will also be noted that the level of the metal in the pot is maintained at a point above the top of the disc 39 and preferably below the lower end of the plunger 37.

To withstand attack, as by molten aluminum, the working and related parts of the pump, such as disc 39, bellows 40, rod 44 and plug 42, are made of a suitably resistant material, it having been found that tungsten is particularly desirable for this purpose. However, to avoid oxidation on exposure to atmosphere, its use is confined to those parts which are kept submerged; and the intermediate parts, such as spacer 38 and rod 55 are desirably formed of ceramic material, which, at the same time, is able to withstand the high temperatures involved.

Returning now to Fig. 1 of the drawing, I have diagrammatically shown at 60, a cam shaft having a cam 61 for actuating a rocker arm 62 mounted in a suitable bearing 63. At the other end of the bearing is an arm 64 actuated by the rocker arm 62, the arm 64 supporting an adjustable pin 65 engaging one of the arms 17 and by this means the gooseneck is swung on its pivots 18 to the slight extent necessary to move the nozzle 13 into and out of engagement with the dies. On the shaft 60 is another cam 66 for actuating an air valve 67 to control the admission of air under pressure, from inlet 70 and any suitable source of supply, to pipe 68 and inlet 28. Valve 67 is channeled, as at 67', so that when the high point of cam 66 moves on and permits the valve to move to the left (as viewed in Fig. 1) to close off the air supply by way of inlet 70, pipe 68 will be vented by way of channel 67' and outlet 71.

In Fig. 3 of the drawing, I have shown a modified form of pump and in said figure, 12' represents part of a gooseneck spout similar to the gooseneck spout 12. In this instance the lower end of the tubular body of the gooseneck is closed by a plug 42', which has a short center vertical bore 73 communicating with a horizontal bore 74, the latter opening into an annular groove 75 in the periphery of the plug 42'. The groove 75 registers with the port or passage 51' of the gooseneck spout. The plug 42' also has vertical passages 76 placing the horizontal bore 74 in communication with a recess 77 formed in the upper end of the plug and serving as a pump chamber. Cooperating with chamber 77 is a flexible diaphragm or disc 78. The disc is fixedly supported on a flanged post 79 having a rounded plunger end 80 which operates in the bore 73. At 37' is shown a plunger rod similar to the rod 37 and at 38' is shown a ceramic coupling between the rod 37' and the post 79. As in the previously described construction, the parts 42', 78 and 79 are composed of tungsten or similar material.

In Fig. 3, I have shown a part of the molten metal pot 58', showing the relationship of the gooseneck spout 12' therewith, as in Fig. 2 of the drawing. It will be apparent from a consideration of Fig. 2, that the cylinder 11 of the gooseneck is open, as seen at 81, at one side thereof, a similar opening 81' being employed in Fig. 3. This opening allows free admission of the molten metal into the gooseneck and also renders the parts in the cylinder of the gooseneck accessible, as will be apparent. With the structure in Fig. 3, it will be apparent that no air valve or bleeder, as at 53 and 54, is necessary and that in the action of the diaphragm pump 78, the diaphragm raises sufficiently to admit molten metal into the chamber 77 in the various bores and passages and up through the bore 51', and this metal is pressure injected into the die in the downward movement of the diaphragm or in flexing the same into the dotted line position shown in Fig. 3.

With the construction shown in Fig. 1, the interior of bellows pump 40 is completely filled with molten metal by relieving the pressure of rod 55 on ball 54 and permitting any trapped air to escape. The ball 54 is then clamped down tight to seal the vent 53. Upon admitting air, under pressure, into the chamber 27, by actuation of the valve 67 by the cam 66, the piston 23 is forced downwardly, which motion is transmitted to the bellows unit 40 through the linkage and plunger rod described, and downward movement of the bellows unit will operate to seat the valve 48 and thus force the molten metal, under pressure, through the discharge nozzle 13 into the cavity of the dies. In other words, in each cycle of operation of the casting machine, a charge of the molten metal is introduced into the die cavity to form a casting. As will be understood, the nozzle 13 is moved toward the face of the die in readiness for the injection of the charge and thereafter is withdrawn from contact with the die. While the movement is slight, the repeated removal of the nozzle from the die between injections minimizes the transfer of heat from the nozzle to the die.

In the Fig. 3 construction, no preliminary venting of the pump chamber is necessary. Otherwise, the operation is substantially as above described.

In both forms, the injection pressure is applied positively to the molten metal itself; that is, without any intervening air cushion at the pressure-receiving surface of the metal. And the compressed air used for actuating the pump is applied to a piston operating in a separate cylinder, which latter can be relieved or vented quickly without creating any suction effect on the molten casting metal.

In the formation of aluminum die castings, and here reference to aluminum is to be interpreted to mean aluminum or aluminum alloys, difficulty has been experienced between relatively movable parts due to the formation of aluminum iron oxide cn the parts. The formation of this oxide produces what might be termed an abrasive, which would result in relatively quick wear between the parts, or on the other hand, might also seize or freeze the parts against normal action.

To overcome these objectionable features, I employ a metal, such as tungsten, which when operated in submersion in the molten aluminum, avoids the objectionable features above mentioned, or in other words, is not susceptible to attack. From this standpoint and in a descriptive fashion, the expression of a material capable of withstanding the attack of molten aluminum will characterize materials of the kind under consideration. With my present construction, no real close fitting of parts is essential, but relatively movable parts are employed, and it is desirable to maintain constant and free action or functioning of such parts one with respect to the other.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a gooseneck for die casting machines capable of casting aluminum, a pump unit mounted in the lower portion of the gooseneck

and submerged in molten metal to be discharged from the gooseneck by said unit, movable means extending upwardly through the gooseneck and above the surface of the molten metal for actuating the pump unit, said unit having a resilient, deformable, sheet material member as the effective pumping element for the molten metal, said member being flexible in the direction of movement of said movable actuating means, said member being in continuous contact with the molten metal and being resistant to the action of molten aluminum, and said member being engageable and periodically flexed by said movable actuating means to force molten metal through the gooseneck to be discharged therefrom.

2. In a casting machine capable of casting aluminum and wherein a gooseneck is employed mounted for swinging movement in a reservoir of molten metal, the lower portion of said gooseneck being immersed in and in communication with said reservoir, said gooseneck having a discharge nozzle movable into and out of casting position and spaced from and in communication with the lower portion of the gooseneck, the improvement comprising a sealing member for said lower portion of the gooseneck, a yieldable sheet material member supported on the sealing member, means for actuating the yieldable member including a post member extending substantially centrally of the yieldable member and engageable with the sealing member, each of said members being immersed in the molten metal and being resistant to the action of molten aluminum, said sealing member having a passageway connecting the yieldable member with the nozzle so that said yieldable member upon actuation by the actuating means may force molten metal through the passageway to the nozzle, said sealing member also having means for receiving molten metal from said reservoir after each actuation of the yieldable member, and said actuating means also including a ceramic coupling member for connecting the post member with that portion of the actuating means not immersed in the molten metal.

3. In a casting machine capable of casting aluminum and wherein a gooseneck is employed mounted in a reservoir of molten metal, the lower portion of said gooseneck being immersed in said molten metal, and said gooseneck having a discharge nozzle movable into and out of casting position, the improvement comprising a sealing member in said lower portion of the gooseneck, a flexible sheet material member supported on the sealing member, means for actuating the flexible member, said flexible member and sealing member being immersed in the molten metal and being resistant to the attack thereof, said sealing member having a passageway connecting the flexible member with the nozzle so that said flexible member upon actuation by the actuating means may force molten metal through the passageway to the nozzle, and said actuating means including a ceramic portion partly immersed in the molten metal.

4. In a casting machine employing a gooseneck mounted in a reservoir of molten metal, the lower portion of said gooseneck being immersed in said molten metal, and said gooseneck having a discharge nozzle movable into and out of casting position, the improvement comprising a sealing member in said lower portion of the gooseneck, a flexible sheet material member supported on the sealing member, means for actuating the flexible member including a post member extending through the flexible member and engageable with the sealing member, each of said members being immersed in the molten metal and being resistant to the attack thereof, said sealing member having a passageway connecting the flexible member with the nozzle so that said flexible member upon actuation by the actuating means may force molten metal through the passageway to the nozzle.

5. In a casting machine employing a gooseneck mounted in a reservoir of molten metal, the lower portion of said gooseneck being immersed in molten metal, said gooseneck having a discharge nozzle movable into and out of casting position, the improvement comprising a flexible resilient sheet material member supported in the lower portion of the gooseneck, means for actuating said flexible member to force molten metal from the reservoir to said nozzle, said flexible member being submerged in the molten metal and being resistant to the attack thereof, and said actuating means including a ceramic coupling portion extending from a point below to a point above the surface of the molten metal.

6. In a casting machine of the character described, the combination of a gooseneck mounted for swinging movement in a reservoir of molten metal comprising aluminum, the lower portion of said gooseneck being immersed in and in communication with said molten metal, said gooseneck having a discharge nozzle movable into and out of casting position and spaced from and in communication with the lower portion of the gooseneck, a flexible sheet material member supported in said lower portion of the gooseneck, means for actuating the flexible member to force molten metal from the reservoir to said nozzle, said flexible member and a portion of said actuating means in engagement therewith being immersed in the molten metal and being formed of tungsten, and said actuating means including a ceramic coupling element for connecting said portion of the actuating means with a portion of the actuating means not immersed in the molten metal.

7. A casting machine according to claim 6 in which the flexible member is a diaphragm.

8. A casting machine according to claim 6 in which the flexible member is a bellows.

9. In a casting machine of the character described for casting metals of relatively high melting point such as aluminum, the combination of a gooseneck the lower end of which is adapted to be submerged in a reservoir of molten metal, a discharge nozzle on the gooseneck, a cylinder adjustably coupled with the upper portion of the gooseneck, a piston in said cylinder, a pump unit in the lower portion of the gooseneck and normally submerged in the molten metal, said pump unit having a flexible, resilient sheet material member as the effective pumping element for pumping molten metal to said nozzle, a plunger rod for placing the piston in operative engagement with said unit, the parts of said unit being resistant to molten aluminum, and a ceramic coupling element for connecting said unit with said plunger rod at a point adjacent the level of molten metal in said reservoir.

10. In a casting machine of the character described, the combination of a gooseneck mounted for swinging movement in a reservoir of molten metal such as aluminum or aluminum alloys, the lower portion of said gooseneck being immersed in and in communication with said reservoir, said gooseneck having a discharge nozzle movable into and out of casting position, a tung-

sten sealing member in the lower portion of the gooseneck, a tungsten flexible, resilient member supported on the sealing member, said flexible member being deformable to enable it to be periodically flexed, means including a tungsten post member for actuating the flexible member by periodically flexing the same, said sealing, flexible, and post members being immersed in the molten metal, said sealing member having a passageway connecting the flexible member with the nozzle so that said flexible member upon actuation by the flexure means may force molten metal through the passageway to the nozzle, and said actuating means also including a ceramic coupling member for connecting the post member with a portion of the actuating means not immersed in the molten metal.

11. In a casting machine of the character described, the combination of a gooseneck mounted for swinging movement in a reservoir of molten metal such as aluminum or aluminum alloys, the lower portion of said gooseneck being immersed in and in communication with said reservoir, said gooseneck having a discharge nozzle movable into and out of casting position, a sealing member in the lower portion of the gooseneck, a flexible bellows member supported on the sealing member, means including a post member for actuating the bellows member, said sealing, bellows, and post members being immersed in the molten metal and being resistant to the action thereof, said sealing member having a passageway connecting the bellows member with the nozzle so that said bellows member upon actuation by the actuating means may force molten metal through the passageway to the nozzle, said sealing member having a second passageway connecting the bellows member with said reservoir, means in said sealing member for closing and opening the second passageway during and after actuation of the bellows member, respectively, and said actuating means also including a ceramic coupling member for connecting the post member with a portion of the actuating means not immersed in the molten metal.

12. In a casting machine of the character described, the combination of a gooseneck mounted for swinging movement in a reservoir of molten metal such as aluminum or aluminum alloys, the lower portion of said gooseneck being immersed in and in communication with said reservoir, said gooseneck having a discharge nozzle movable into and out of casting position, a sealing member in the lower portion of the gooseneck having a chamber in the upper portion thereof, a flexible diaphragm member supported on the sealing member, said diaphragm being disposed over and flexible into said chamber, means including a post member for actuating the diaphragm member, said sealing, diaphragm, and post members being immersed in the molten metal and being resistant to the action thereof, said sealing member having a passageway connecting the chamber with the nozzle so that said diaphragm member upon actuation by the actuating means may force molten metal through the passageway to the nozzle, and said actuating means also including a ceramic coupling member for connecting the post member with a portion of the actuating means not immersed in the molten metal.

13. In a casting machine of the character described, the combination of a gooseneck mounted for swinging movement in a reservoir of molten metal, the lower portion of said gooseneck being immersed in and in communication with said reservoir, said gooseneck having a discharge nozzle movable into and out of casting position, a sealing member in the lower portion of the gooseneck, a bellows member supported on the sealing member, said bellows member being provided with a closed upper end having a vent therein, means for actuating the bellows member, means adjustably secured to said actuating means for closing said vent, said sealing and bellows members being immersed in the molten metal and being resistant to the action thereof, and said sealing member having a passageway connecting the bellows member with the nozzle so that said bellows member upon actuation by the actuating means may force molten metal through the passageway to the nozzle.

14. In a casting machine of the character described for casting metals such as aluminum and aluminum alloys, the combination of a gooseneck the lower end of which is adapted to be submerged in a reservoir of molten metal, a discharge nozzle on the gooseneck, a cylinder adjustably coupled with the upper portion of the gooseneck, a piston in said cylinder, a pump unit in the lower portion of the gooseneck and normally submerged in the molten metal, said pump unit including a flexible, resilient sheet material member actuatable to pump molten metal to the discharge nozzle, said unit being resistant to molten aluminum, a plunger rod for placing the piston in operative engagement with said unit, a plurality of movable links connecting said plunger rod with said piston, and a ceramic coupling element connecting said unit with said plunger rod at a point adjacent the level of molten metal in said reservoir.

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