United States Patent

[11] 3,613,772

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[54] **INJECTION PISTON FOR DIECASTING**
10 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** ..... **164/312,** 18/12 P, 18/30 QZ, 92/156, 92/157, 164/113
[51] **Int. Cl.** **B22d 17/08**
[50] **Field of Search** ..... 164/113, 312, 313, 315, 317; 18/12 P, 30 QM, 30 QZ; 92/156, 157

[56] **References Cited**

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128,049	10/1928	Switzerland	164/313
924,494	4/1963	Great Britain	164/312

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ABSTRACT: An injection piston is provided with automatic lubrication at any location in an injection chamber. A central conduit communicates with flow passages on the piston wall. Within the conduit is a spring-loaded valve to control the flow of lubricant through the flow passages and onto the chamber wall.

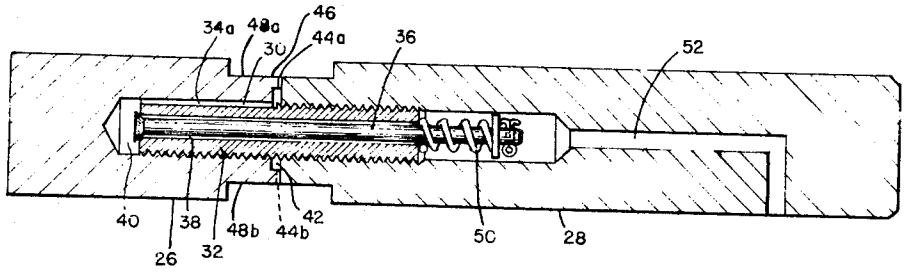
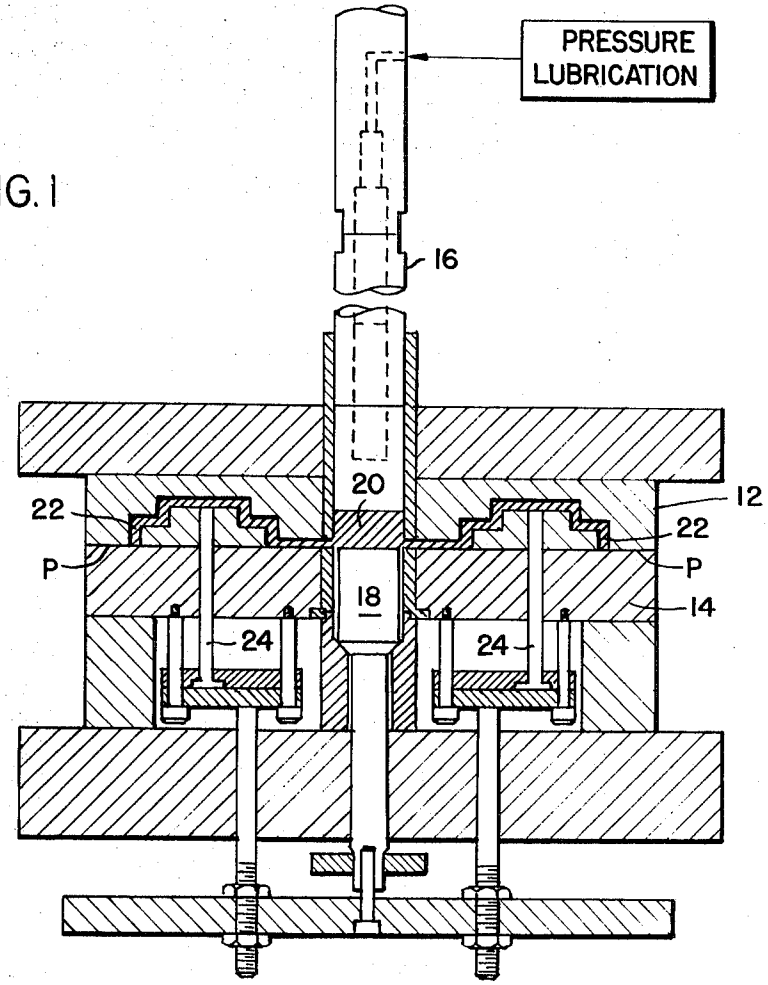


FIG. 1



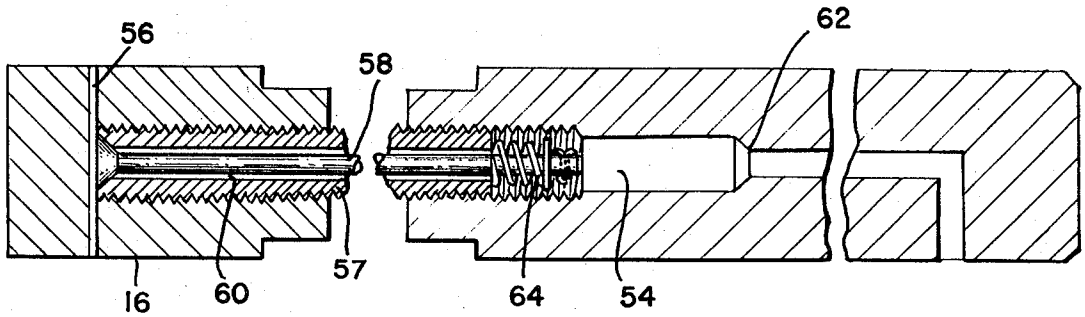


FIG. 4

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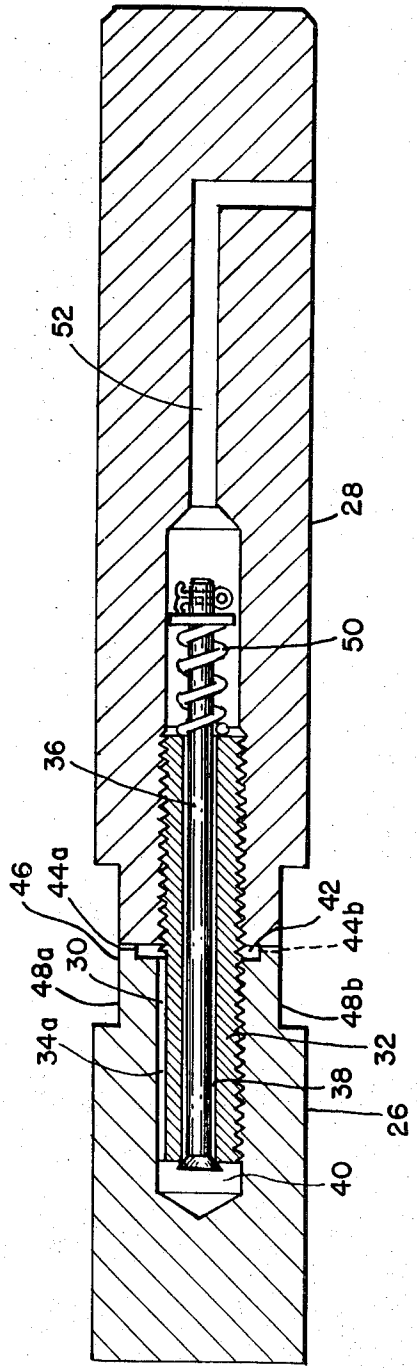

FIG. 2

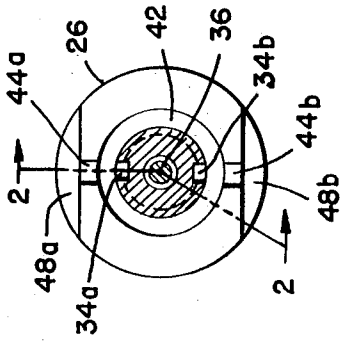

FIG. 3

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INJECTION PISTON FOR DIECASTING

BACKGROUND OF THE INVENTION

Horizontally operated pressure-casting cold-chamber machines and vertical die-casting apparatus such as described and shown in my copending application Ser. No. 576,288 filed Aug. 31, 1966, now U.S. Pat. No. 3,443,628 and similar apparatus are normally provided with automatic injection pistons. Owing to the unusually disadvantageous stresses caused by pressure and temperature fluctuations for such machines, difficulties have been encountered for satisfactory lubrication of the injection piston or ram.

One method used heretofore has been to apply lubricants by hand to the part of the ram or injection piston issuing from the end of the injection chamber on the return stroke. However, this is laborious and time consuming and results in too great an expenditure of lubricant and overlubrication of the ram. Also this has the particularly disadvantageous effect of resulting in soiled castings. One method to provide automatic lubrication on a reciprocating injection piston is disclosed in British Pat. No. 924,494. The injection chamber is provided in the region of the injection piston travel, upstream of the charging aperture, with a peripherally extending lubricating groove which is connected to a pressure-lubricating means or pressure-lubricating pump. However, this annular groove within the injection chamber is continually filled with lubricant and after a period of operation becomes filled with lubricant residues and small particles of metal, thus preventing a continuous supply of lubricant to the piston periphery. Further, since the major portion of the lubricant is picked up by the injection piston on the downward stroke to inject the molten metal into the casting cavity, then a considerable amount of the lubricant mixes with the molten metal thereby causing occluded gases and resulting deterioration of the final cast product.

Another automatic ram lubrication in die-casting machines is disclosed in British Pat. No. 981,654. In this specification lubricating ducts which terminate on the injection chamber walls are provided with valves or enclosure elements which are actuated by the downward movement of the injection piston to allow the lubricants to contact the circumferential wall of the injection piston. Generally, a spring-tensioned ball valve is disposed at the outlet of the lubricating ducts. As the injection piston proceeds downwardly to inject the molten metal into the casting cavity it strikes the ball valve pushing the ball back against the spring allowing the lubricant to be released into the chamber. This method of automatic lubrication is an improvement over, the earlier referenced British patent but it is still subject to the major drawbacks of the common methods of lubricating. That is, the injection piston on the downward stroke picks up the lubricant and carries it into contact with the molten metal with the resultant occluded gases and deterioration of the cast product. Further, because of the reciprocating action of the injection piston the tension valve in the walls of the chamber is subjected to an extreme high-wear rate and must be replaced frequently.

SUMMARY OF THE INVENTION

I have discovered a new method and apparatus for lubricating an injection piston in a continuous die-casting operation, whether of the horizontal cold chamber type or of the vertical type, which overcomes the difficulties and problems inherent in prior art devices. My invention comprises an injection piston or ram which provides for automatic lubrication from the inside of the piston and at any location in the chamber wall and at any cycling time. Within the piston itself is a valve responsive to changes in pressure. The valve further controls the flow of the lubricant from a source to ducts within the injection piston which ducts terminate on the circumferential wall of the piston thereby coating both the piston and the injection chamber.

My design avoids the dependence of the lubrication on the initial or downward stroke of the injection piston and provides for lubrication when the piston is in any position. That is, the piston may be in a fixed position while the casting is cooling and be lubricated at this, or at any time during the stroke as desired. These unique features incorporated into my injection piston avoid deterioration of the molten metal with the lubricant thereby preventing occluded gases and resulting low-quality castings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of my improved injection piston in a vertical die-casting apparatus;

FIG. 2 is an enlarged sectional view of my improved piston;

FIG. 3 is an end view of FIG. 2 taken along lines 2—2; and

FIG. 4 is an alternative embodiment of my invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a vertical diecasting apparatus which comprises an upper mold element **12** and a lower mold element **14** which face on parting line PP. However, my invention may be used in horizontal and inclined axised die-casting apparatus. The upper mold element is characterized by an injection chamber **20** with an injection piston **16** therein. The lower mold element **14** is characterized by an ejection chamber **17** with a ejection piston **18** therein. The upper and lower mold elements when in the closed position define a casting cavity **22** which communicates with the injection chamber **20**. The injection piston is adapted to reciprocate within the injection chamber from a first open position wherein molten metal can be poured into the injection chamber and a second closed position whereby the molten metal in the injection chamber is displaced and fills the casting cavity **22**. As shown, the injection piston is in the second or downward position and the casting cavity is filled with the molten metal.

Referring to FIGS. **2** and **3** the injection piston **16** is shown in greater detail and comprises a first section **26** and a second section **28**.

The first section **26** is characterized by a partially threaded tubular opening **30**. Threaded in the opening is a tubular stud **32** characterized by longitudinal slots **34A** and B on the outer surface thereof, and within the stud is a spring-loaded valve **36**. The external wall of the valve **36** and the internal wall of the stud define a flow passage **38**. The valve **36** extends beyond the lower portion of the stud **32** and extends into the lower portion or recess **40** of the opening **30**. The end of the valve is flanged and is adapted to seal the flow passage **38** from the recess **40** when in a closed position. The upper portion of the section **26** is characterized by an annular groove **42** and extending radially outward from the annular groove are ducts **44** A and B which terminate on the circumferential wall of the reduced cross-sectional area **46** of the section **26**. These circumferential walls of the reduced cross-sectional area terminate in the wrench flats **48** A and B. When the valve **36** is in the open position, the flow passage **38**, slots **34** A and B, the annular groove **42** and the ducts **44** A and B are all in fluid flow communication. A spring **50** is secured about the upper portion of the valve **36** and maintains the valve biased in the closed position.

The upper section **28** is characterized by a central conduit **52** therethrough the lower portion of which is threaded. The threaded portion of the section **28** engages the stud **32** and, as with the lower section **26**, the external wall of the stud **32** and the internal wall of the conduit **52** define the flow passage **38**. The upper nonthreaded portion of the conduit **52** provides clearance for the upper portion of the spring-loaded valve **36** and further is adapted to receive lubricants.

In the operation of my invention the injection piston **16** is withdrawn to its first position and molten metal is poured into the injection chamber. The injection piston then moves to its second position whereby the molten metal is displaced from the injection chamber and into the casting cavity as shown in FIG. 1 . Control means (not shown) are actuated and the lubricant is introduced under pressure into the conduit **52** at the inlet. The pressure acts against the spring-loaded valve **36**

which is biased in the closed position, forcing it downwardly whereby the lubricant flows through the flow passage **38** into the recess **40** and travels upwardly through the slots **34** A and B. The lubricant then fills the annular groove **42** and flows radially outward to the ducts **44** A and B along the sides of the circumferential wall **46** and then onto the chamber wall. Of course, it is obvious that the circumference of the injection piston may be uniform throughout whereby the ducts **44** A and B would communicate directly with the chamber wall.

After a predetermined time, the pressure on the valve **36** is released and it then returns by the action of the spring **50** to the closed position sealing the flow passage **38** from the slots **34**A and B. This embodiment by having the lubricant flow upwardly and then outwardly onto the chamber wall eliminates dripping of excess lubricant since the lubricant in the slots and annular groove will flow downwardly by gravity to fill the void in the recess **40** caused by the retraction of the flanged portion of valve. The upper mold element **12** and the upper piston **16** are retracted in sequence, and then the casting is ejected.

Therefore, the length of time during any cycle, the piston and the chamber wall are lubricated is controlled by the duration of the injection pressure. Also, the lubrication of my injection piston is not dependent upon the forward movement of the piston and the piston may be lubricated while in any position.

FIG. **4** shows an alternative embodiment of my invention wherein an injection piston **16** is shown in greater detail and is characterized by a central conduit **54**. The upstream or first section of the conduit is adapted to receive the lubricants. The downstream or second section of the conduit communicates with lubricant ducts **56**. The ducts **56** terminate in the circumferential wall of the injection piston **16**.

Threaded in the lower section of the conduit **54** is a tubular stud **57**, and within the stud is a spring-loaded valve **58**. The external wall of the valve and the internal wall of the stud define a flow passage **60**. The valve **58** extends beyond the downstream end of the conduit and into the ducts **56**. The end of the valve is flanged and is adapted to seal the flow passage from the ducts when in a closed position. The upstream section of the conduit **54** is of reduced cross-sectional area in reference to the downstream section of the conduit and forms a shoulder **62**. Of course, if desired, the entire cross-sectional length of the conduit may be uniform. The upper end of the valve **58** extends slightly beyond the stud **57**. A spring **64** is about the upper portion of the valve **58** and secured thereto to maintain the valve **58** biased in the closed position.

In the operation of my invention in this embodiment, the lubricant is introduced in the conduit **54** at the inlet and at an increased pressure. The pressure acts against the valve **58**, which is biased in the closed position, forcing it downwardly whereby the lubricant flows through the conduit **54** and then the flow passage **60** and outwardly through the ducts **56** and onto the chamber wall. After a predetermined time, the pressure on the valve **58** is released and it then returns by the action of the spring **64** to the closed position sealing the flow passage from the lubricant ducts.

Although my invention has been described and shown with two ducts functioning in combination with a spring-biased valve, it is obvious that the number, position, and arrangement of ducts may be varied and further that any type of valve mechanism may be employed within the injection piston. Also, the valve mechanism may be responsive to motivating means other than pressure. However, the pressure-actuating means has been found the most convenient since the pressure in addition to actuating the valve which seals the flow passage from the lubricant ducts it also aids in ejecting the material from the ducts onto the chamber and piston wall.

Further, the entire central passageway or conduit may be filled with lubricant at all times and valves placed on or about the terminal ends of the ducts. Also, the lubricant may be kept under pressure at all times and coat the injection piston continuously by seeping through annular flow passages disposed on the circumferential wall of the piston. In addition, it is obvious that pressure or other means to force the lubricant through the ducts would not be necessary if the viscosity of the lubricant is low enough whereby it may flow by gravity or under vacuum.

What I now claim is:

1. In a die-casting apparatus provided with an injection chamber and an injection piston adapted for reciprocating action, the improvement which comprises:

a. outlet means on the circumferential wall of the injection piston;

b. means to feed a lubricant to said outlet means;

c. conduit means disposed in the piston having an upstream end and a downstream end, said downstream end located closer to the head end of said piston than said outlet means;

d. slot means in said piston having a first end and a second end said slot means substantially parallel to the conduit means the first end of said slot means in fluid flow communication with the conduit means and the second end of the slot means in fluid flow communication with the outlet means; and

e. means for controlling the flow of the lubricant from the conduit means to the slot means and then to the outlet means whereby the lubricant flows from the upstream end of the conduit means to the downstream end into the slot means and then flows upwardly towards the second end of the slot means and subsequently through the outlet means to lubricate the piston walls wherein after the lubricant has flowed through the conduit and slot means in sufficient quantity to lubricate said piston any excess lubricant will flow back downwardly from the second to the first end of the slot means.

2. The piston of claim **1** wherein the means to control the flow of lubricant to the outlet means includes valve means.

3. The piston of claim **2** wherein the valve means is disposed within the conduit means and is biased to a closed position to seal the conduit means from the outlet means and further said valve means is responsive to pressure means to provide for the flow of lubricant through the conduit means, the slot means and into the outlet means.

4. The piston of claim **1** wherein the outlet means includes flow passages disposed on the circumferential wall of the injection piston which flow passes are in communication with the slot means.

5. The piston of claim **1** wherein the outlet means includes a plurality of ducts extending radially outward from and in communication with the slot means, and includes valve means disposed in the conduit means adapted to close the conduit means from the slot means when in a closed position, and further said valve means is responsive to changes in pressure.

6. The piston of claim **1** wherein the means to control the flow of lubricant includes spring-biased valve means disposed in the conduit means, the conduit means are centrally disposed within the piston whereby when the valve means is moved from a closed to an open position lubricant flows through the conduit means, the slot means and the duct means to lubricate the chamber wall in the piston; and further when the valve means retracts to the closed position any excess lubricant in the duct and slot flows back into the piston.

7. The piston of claim **1** wherein the casting apparatus includes:

an upper mold element in which element is the injection chamber with an injection piston disposed therein, a lower mold element characterized by an ejection chamber having an ejection piston disposed therein, said elements defining a casting cavity when in the closed position, said casting cavity in communication with the injection chamber, whereby the injection piston may be lubricated for any length of time independent of the piston of the injection piston.

8. The piston of claim **1** wherein the downstream end of the conduit means terminates in a recess and the first end of the slot means is in communication with said recess whereby when

the valve means is in a closed position, excess lubricant in the ducts will flow through the slots and into the recess.

9. An injection piston in a die-casting apparatus adapted for reciprocating action which comprises:

a first lower section having a central tubular opening therein terminating in a recess in the lower portion of the section, the section further characterized by at least one slot generally parallel to the opening and in communication with the recess; an annular groove disposed within the upper portion of the section, and intersecting the slot; ducts extending radially outward from the groove and terminating on the piston wall;

a second upper section characterized by a central conduit therein and adapted to be secured to the first section the opening of the first section and the conduit of the second section forming a continuous flow passage when the first and second sections are secured; and

valve means to control the flow of lubricant through the first and second sections whereby when the lubricant is introduced under pressure into the second section through the conduit, the lubricant flows through the tubular opening in the first section and into the recess through the slot into the annular groove and then outwardly through the ducts and onto the chamber wall to provide lubrication.

10. The piston of claim 9 wherein the outer wall of the first section is characterized by a peripheral recessed portion therein and the ducts terminate in said recessed portion.