Sept. 24, 1968

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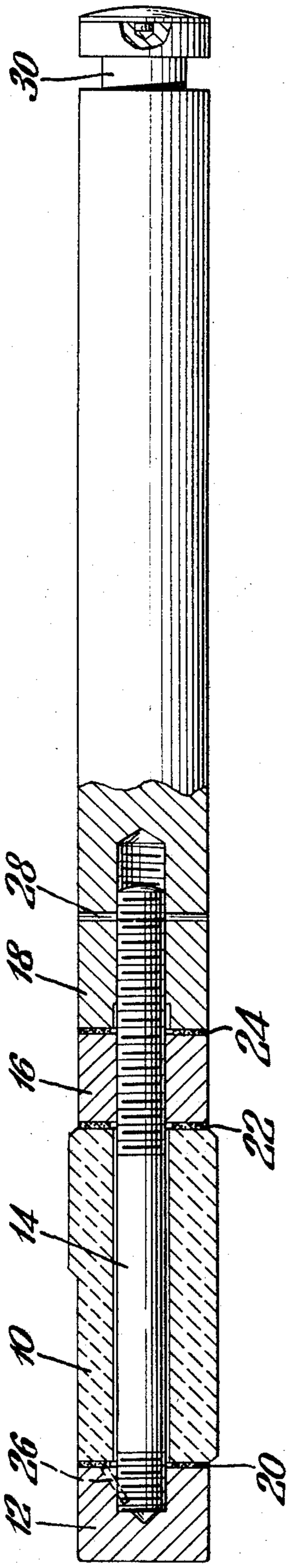
3,402,645

PISTON ASSEMBLY

Filed Oct. 3, 1966



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United States Patent Office

3,402,645

Patented Sept. 24, 1968

3,402,645
PISTON ASSEMBLY

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Filed Oct. 3, 1966, Ser. No. 583,874
7 Claims. (Cl. 92—258)

This invention relates to a novel piston assembly for use in a high temperature die casting apparatus. More particularly, it concerns a refractory piston assembly which is especially suited for use in a molten aluminum containing environment.

The die casting art is replete with apparatus for die casting low melting point metals such as lead, tin, and zinc. However, it discloses a limited number of apparatus which are suitable for die casting high melting point metals such as aluminum and magnesium.

In copending application Ser. No. 320,693, assigned to the same assignee, there is described an apparatus for efficiently and economically die casting such high melting point metals. Briefly, the die casting apparatus described therein comprises a pot containing molten metal to be cast, a substantially U-shaped gooseneck having an internal passageway therethrough suspended in the pot of molten metal, a die cavity communicating with one end of the gooseneck's internal passageway, a shot cylinder mounted upon the opposite end of the gooseneck and a piston positioned in the shot cylinder which when advanced into the shot cylinder forces the molten metal therein to move from the shot cylinder through the gooseneck into the die cavity.

In the before-described type of die casting apparatus, it is essential that the piston be fabricated from a material which is highly resistant to the erosive and corrosive action of the metal being cast.

It is well known that titanium diboride is essentially chemically immune to the action of molten metals such as aluminum and the like. However, it is equally well known that titanium diboride possesses certain inherent physical characteristics which often limit or prohibit its use as a material of construction.

For example, it is well known that although titanium diboride is characterized by its high compressive strength its use is often prohibited or limited due to its inherent low tensile or flexure strength.

Accordingly, it is the principal object of the invention to provide an improved piston assembly which is adapted for use in a high temperature die casting apparatus.

Another object of the invention is to provide a refractory piston assembly which is ideally suited for use in an apparatus for die casting molten aluminum.

A still further object of the invention is to provide a means of employing titanium diboride as a material of construction in the fabrication of a piston assembly adapted for use in an apparatus for die casting high melting point metals such as aluminum and the like.

With the foregoing and other objects in view, the invention will now be described in greater particularity and with reference to the sole drawing which is a cross sectional view of the piston assembly of the invention.

Referring to the drawing, there is shown the preferred embodiment of the piston assembly of the invention. This assembly comprises a piston sleeve **10** having an annular opening therethrough, a piston tie rod **14** having a front and a rear end axially positioned in the annular opening in the piston sleeve, a front end cap **12** attached to the front end of the piston tie rod which restrains the forward movement of the piston sleeve, a threaded rear locking nut **16** attached to the rear end of the piston tie rod which restrains the rearward movement of the

piston sleeve and a shank member **18** which is connected to the rear end of the piston tie rod and adapted at **30** to engage a means of reciprocating the piston assembly when it is mounted in a die casting apparatus. Resilient sealing members **20**, **22**, and **24** are positioned between the front end cap and the piston sleeve, the rear locking nut and the piston sleeve, and the rear locking nut and the shank member, respectively, to prevent the ingress of molten metal into the annular opening in the piston sleeve during the die casting operation. The piston tie rod and the front end cap are provided with registered or in line holes which are designed to receive a front locking pin **26** which prevents the front end cap from unscrewing from the piston tie rod. Likewise, the shank member and the rear end of the piston tie rod are also provided with registered or in line holes which are adapted to receive and hold a rear locking pin **28** which prevents the shank member from unscrewing from the rear end of the piston tie rod.

The piston sleeve is composed of titanium diboride and the piston tie rod of a material which has a lower coefficient of thermal expansion than that of titanium diboride. This material preferably is molybdenum. However, other materials such as tungsten and the like may also be employed. By so-fabricating the piston tie rod, in actual operation, it is possible to keep the piston sleeve under a continuous compressive load as the piston sleeve expands more than the piston tie rod and is accordingly squeezed between the front end cap and the rear locking nut. This type of piston assembly enables one to take advantage of titanium diboride's excellent compressive strength.

The front end cap, the rear locking nut and the shank member can be composed of any material which does not react with and is resistant to the metal being cast. In actual operation, it has been found desirable to fabricate both the front end cap and the rear locking nut of molybdenum and the shank member from machine steel. The front and rear locking pins were also made of machine steel. The sealing members were ring shaped and composed of expanded graphite produced as described in copending U.S. patent application Ser. No. 273,245, entitled "Chemical Products and Processes," which is also assigned to the same assignee as the present invention. However, other sealing or gasketing materials such as asbestos, glass fiber, carbon and graphite textiles and the like can be used with equal success. In fact, it is not necessary to use a sealing member at the various locations shown in the drawing if the corresponding mating parts are provided with lapped surfaces.

The average longitudinal coefficient of thermal expansion of the titanium diboride piston sleeve in the room temperature to 650° C. range was calculated to be 7.75×10^{-6} while that of the molybdenum piston tie rod was computed to be 6.4×10^{-6}.

It is this difference in thermal expansion coefficients which cause the titanium diboride piston sleeve to be squeezed or held in compression between the front and rear end caps.

It should be noted that it is possible to omit the rear locking nut shown in the drawing and still have a piston assembly which accomplishes the objects of the invention. This is achieved by extending the length of the shank member and bring it into contact with the rear portion of the piston sleeve.

The foregoing disclosure is posed for illustrative purposes only and there is intended here no unwarranted restrictions or limitations on the piston assembly of this invention, it being considered that in light of this disclosure numerous alternative embodiments will suggest themselves to persons familiar with the art. The intended limitations are those stated in the appended claims.

What is claimed is:

1. A piston assembly for use in an apparatus for die casting a high melting point metal comprising:

(a) a piston sleeve composed of titanium diboride, said piston sleeve having an annular opening therethrough;

(b) a piston tie rod composed of a metal having a lower coefficient of thermal expansion than the titanium diboride piston sleeve extending through said annular opening in said piston sleeve, said piston tie rod having a front and a rear end;

(c) a front end cap attached to the front end of said piston tie rod which is adapted to restrain the forward movement of said piston sleeve; and

(d) a means for restraining the rearward movement of said piston sleeve so that when said piston assembly is exposed to increasing temperatures said piston sleeve axially expands more than said piston tie rod thereby causing said piston sleeve to be maintained in compression between said front end cap and said means for restraining the rearward movement of said piston sleeve.

2. The piston assembly of claim 1 wherein said piston tie rod is composed of molybdenum.

3. The piston assembly of claim 1 wherein a resilient, refractory gasket is positioned both between said front end cap and said piston sleeve and said means for restraining the rearward movement of said piston sleeve.

4. The piston assembly of claim 3 wherein said resilient, refractory gasket is composed of expanded graphite.

5. The piston assembly of claim 1 wherein said means for restraining the rearward movement of said piston sleeve comprises:

(a) a rear locking nut attached in close proximity to the rear end of said piston tie rod adapted to restrain the rearward movement of said piston sleeve; and

(b) a shank member which engages the end of said piston tie rod and is adapted to communicate with a means for reciprocating said piston assembly.

6. The piston assembly of claim 5 wherein a resilient, refractory gasket is positioned between

(a) said front end cap and said piston sleeve,

(b) said rear locking nut and said piston sleeve, and

(c) said rear locking nut and said shank member.

7. The piston assembly of claim 6 wherein said resilient, refractory gasket is composed of expanded graphite.

References Cited

UNITED STATES PATENTS

2,219,989	10/1940	Gimm	92—221 X
3,277,797	10/1966	Tyree	92—252 X

FOREIGN PATENTS

975,401	10/1961	Germany.
1,108,231	1/1956	France.

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