

May 16, 1967

J. HARTWIG ETAL

3,319,702

DIE CASTING MACHINE

Filed Nov. 1, 1963

5 Sheets-Sheet 1

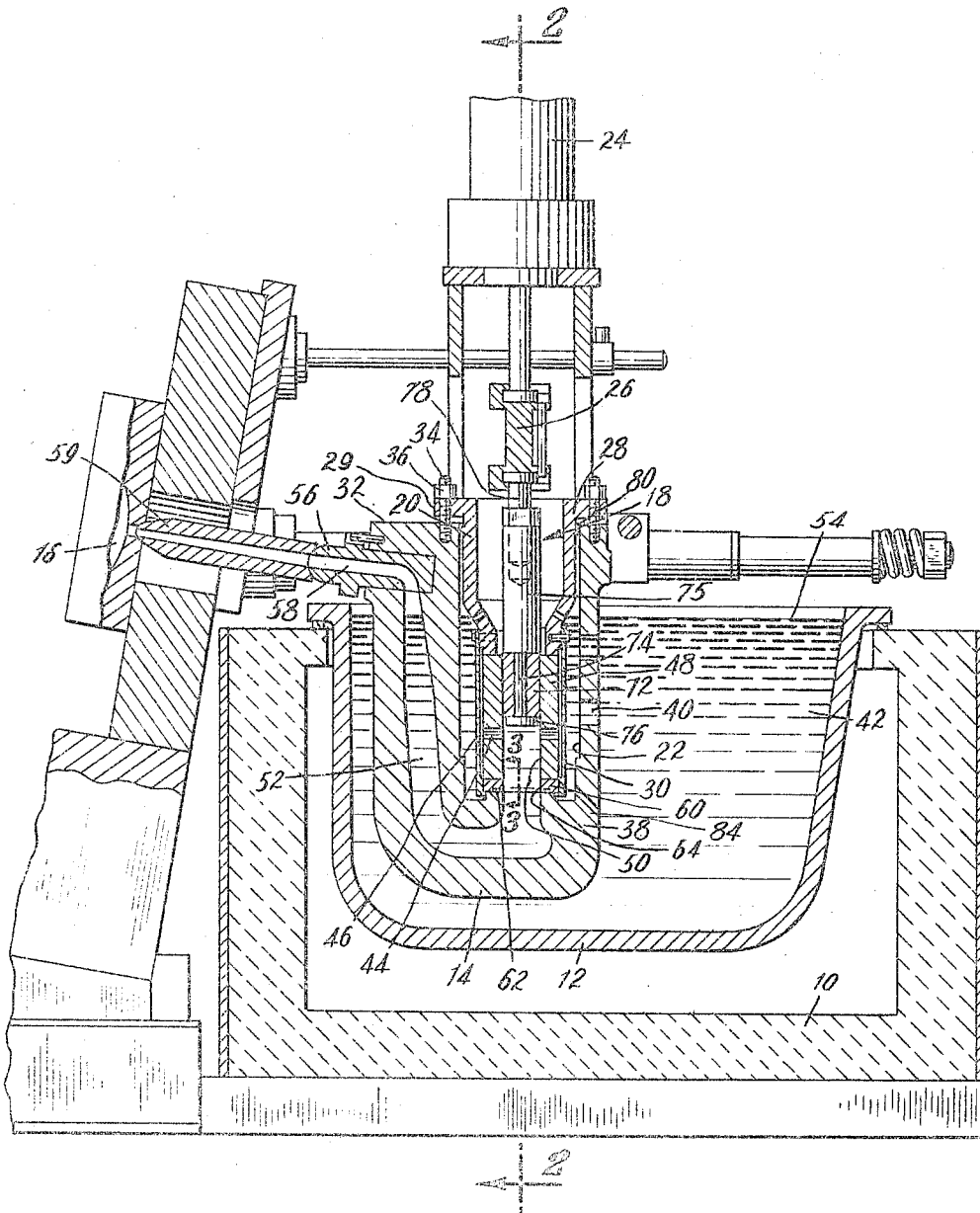


Fig. 1.

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5 Sheets-Sheet 2

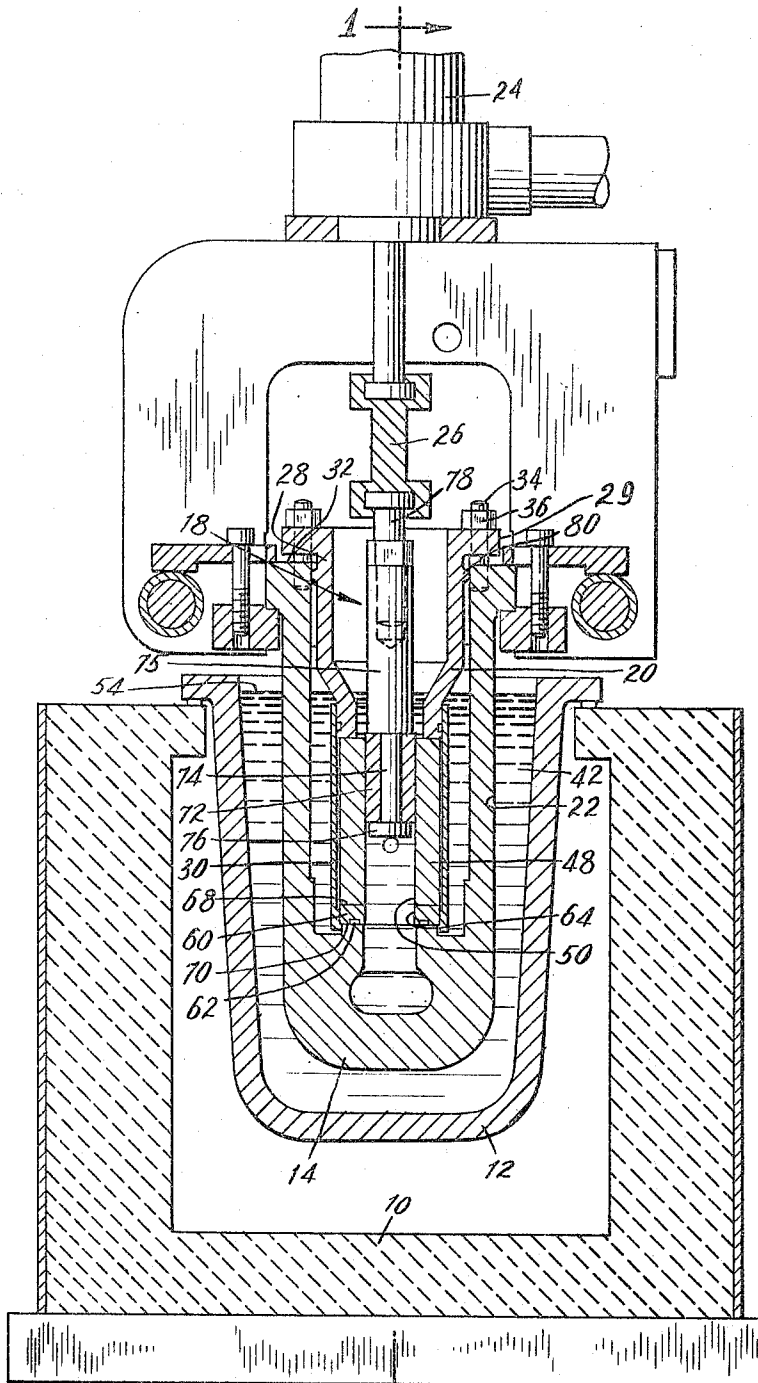


Fig. 2.

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5 Sheets-Sheet 5

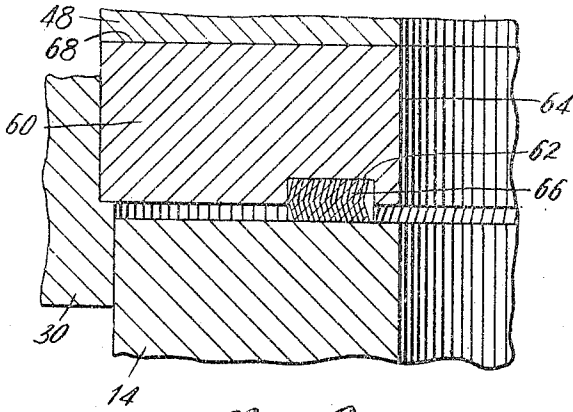


Fig. 3.

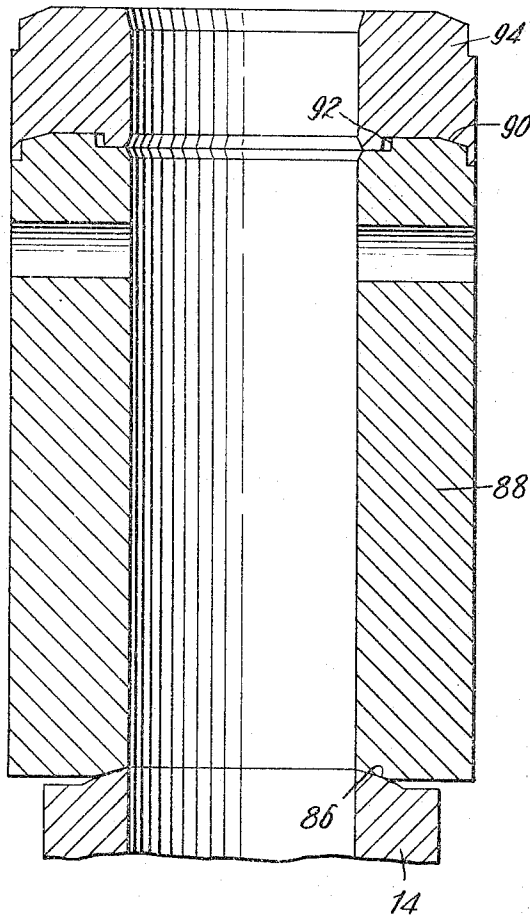


Fig. 4.

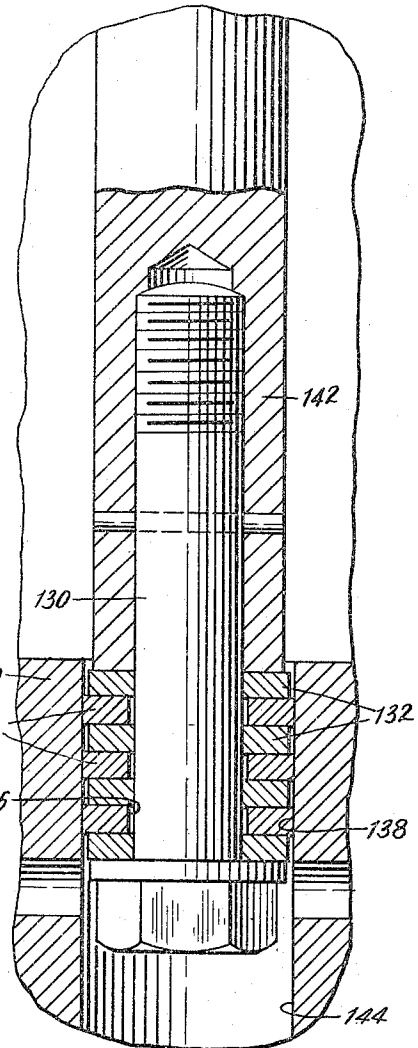


Fig. 7.

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5 Sheets-Sheet 4

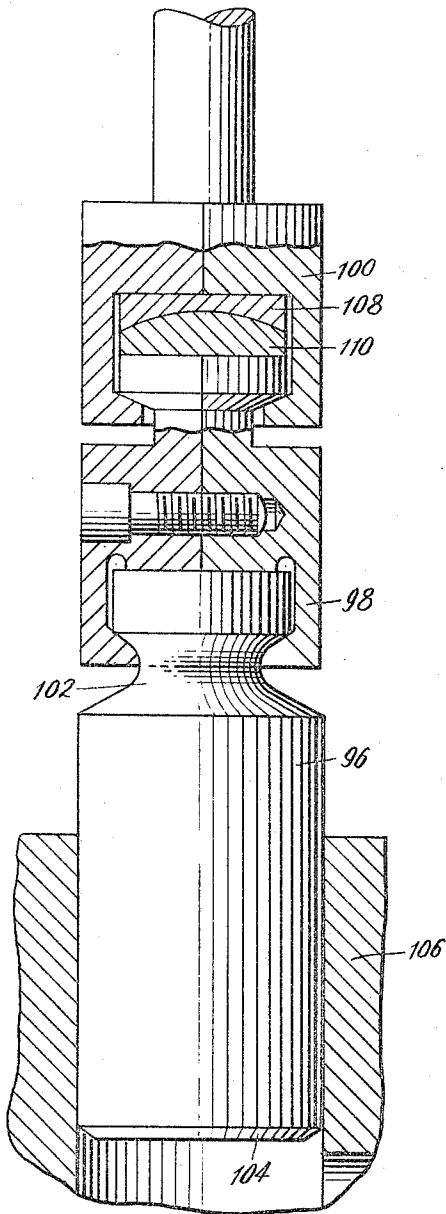


Fig. 5.

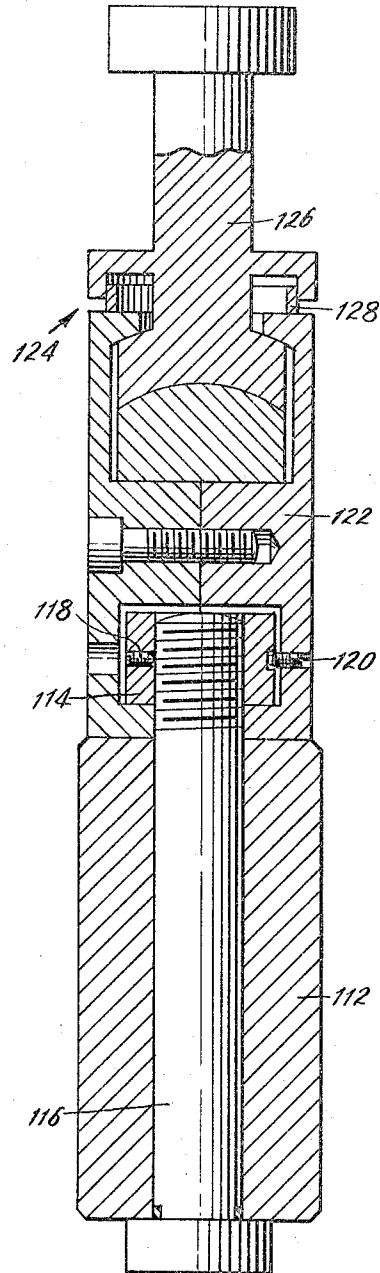


Fig. 6.

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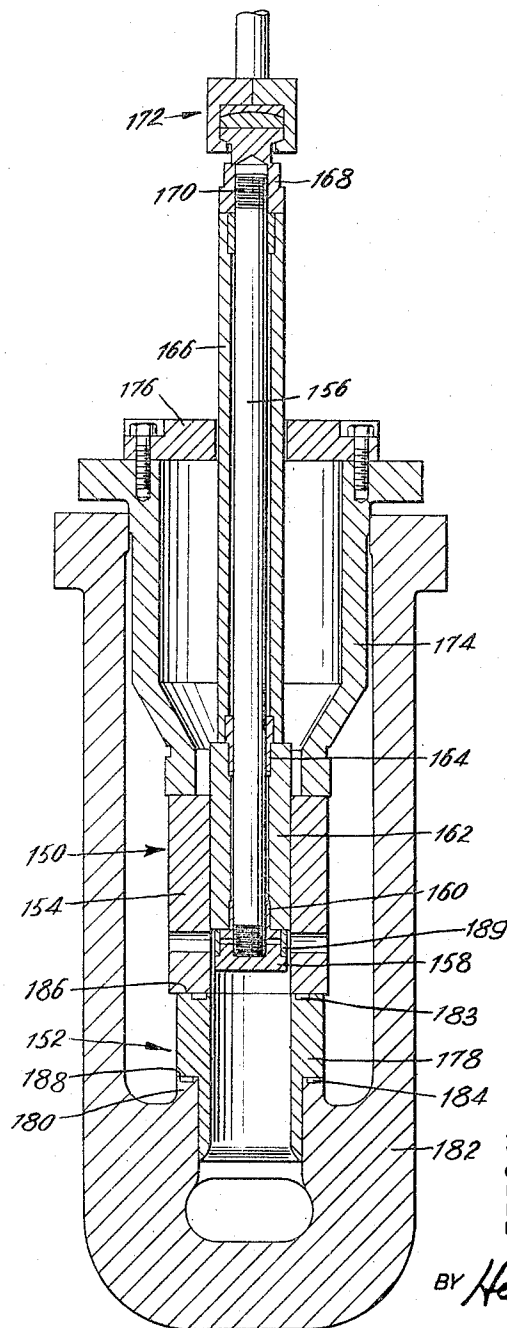
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Fig. 8.



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3,319,702

DIE CASTING MACHINE

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Filed Nov. 1, 1963, Ser. No. 320,693
12 Claims. (Cl. 164—316)

This invention relates to an apparatus for die casting high melting point die casting alloys such as aluminum, magnesium, and the like. More particularly this invention is directed to a novel "hot chamber" die casting apparatus of the submerged-plunger type.

In the art of die casting high melting point die casting alloys, the production rates are much lower than those used in die casting low melting point alloys such as lead, tin and zinc. In order to produce the most economical die casting, high production rates must be utilized. Up to the present time all aluminum die castings are made either by employing an air injection machine or a cold-chamber machine both of which exhibit certain disadvantages which will be discussed hereinafter. Unfortunately heretofore high melting point alloys could not be die cast in high speed submerged-plunger machines inasmuch as the casting temperatures of such alloys are exceedingly high (1115° F.—1250° F.) and since the aluminum alloys have such an affinity for iron which is the common material of construction that they quickly attack and dissolve it by corrosive and erosive action.

In the air injection machine, there is a cast-iron closed vessel or chamber, conventionally known as a gooseneck disposed above a large metal pot or holding furnace containing the molten metal to be die cast. The gooseneck is filled prior to each casting operation by dipping the spout of the gooseneck below the metal level. After filling the gooseneck, the spout is locked against a metallic mold or die and pressure is applied against the metal by compressed air admitted through a valve which forces the metal through the spout to fill the die. When the valve is subsequently closed, the air above the metal is released and exhausted, and the gooseneck then may be lowered and refilled again to repeat the casting cycle.

One of the disadvantages of this type of machine is its susceptibility to iron erosion and corrosion and its relatively low operating pressures. Although the air injection machine can be used for high melting point alloys, owing to the lower pressures used, the casting is likely to be less dense and more porous than when made in a submerged-plunger (hot chamber) machine. Another disadvantage of this type of machine is that if casting aluminum iron pickup is relatively high since the "gooseneck" is tilted and moved in the molten aluminum both during each casting cycle thus causing severe agitation which is conducive to high erosion rates.

In the cold-chamber machine which is predominately used for aluminum alloys the molten-metal reservoir is separated from the casting machine, and just enough metal for one casting is normally ladled by hand through a port or pouring slot of a small chamber, from which it is then forced into the die under high pressure usually by a hydraulically operated plunger. As the plunger initially advances, it seals the port, and forces the charge into the locked die under high pressure which commonly ranges from about 6,000 to 20,000 p.s.i., and in some cases pressures as high as 60,000 p.s.i. are used, depending upon the size and type of castings made. Some of the disadvantages of the cold-chamber machine are the necessity for high injection pressures and the metallurgically poorer casting which results due to the chilling of the molten metal in the chamber. Moreover, for the

same size casting the cold chamber machine is somewhat slower than the submerged-plunger type because of ladling time.

The "hot chamber" machines presently available are mainly suited for zinc alloys and other low melting point alloys. In this type of machine, there is a main metal pot in which is immersed a fixed cylinder having a spout firmly connected to a nozzle locked against a die cavity. A piston operating in the cylinder is raised to uncover an inlet port below the metal level in the pot. Once the molten metal fills the interior of the cylinder, the piston is forced downward causing the metal to flow out through the spout into the die. As soon as the metal solidifies in the die, the piston is withdrawn, the die opened and the die casting is thereafter ejected. Then the die is closed and locked again and the cycle is repeated. This type of machine is extremely rapid in operation and gives excellent results and as a result there has been a marked tendency and continued effort on the part of the die casting industry to develop a "hot chamber" machine also for the casting of aluminum. This has not been possible to date because of the corrosion problems associated with handling molten aluminum and of the numerous design problems encountered in the use of refractory materials.

Many of prior art patents are illustrative of the difficulties which are inherently associated with die casting high melting point alloys, as for instance, aluminum. For example, United States Patent No. 2,195,360 is devoted to minimizing the contact with the molten metal by conveying it from a crucible to the feed tube of the die by means of compressed air; thereafter, the metal is forced into the die by operation of a plunger as is conventionally done in a cold chamber machine. Since only momentary contact with the molten metal is experienced, this type apparatus attempts to solve the problem of deleterious corrosive effect on the working parts of the assembly by simply avoiding and minimizing contact with the molten metal. In United States Patent 1,954,775 a similar apparatus impresses a vacuum across the die cavity, gate, etc. to permit the molten metal in the crucible to be forced upwardly by atmospheric pressure through a feeder tube and into the plunger chamber at which time the plunger will be activated to force the metal from the chamber into the die cavity; and United States Patent 2,837,792 discloses a like apparatus which produces a sub-atmospheric pressure in the plunger-cylinder sufficient to draw molten metal into the cylinder through a supply tube. It is noteworthy to remark at this time that all these patents teach away from a "hot chamber" or submerged-plunger machine and instead refer specifically to means for increasing the casting rate of a cold chamber machine by utilizing compressed air or a vacuum to fill the pouring slot of same. Even with such apparatus, there is much to be desired with respect to increasing the rate of production of aluminum die castings, improving casting quality and die life, minimizing scrap rates, and of being able to die cast larger sizes than those presently cast.

Although numerous attempts have been directed at adapting the "hot chamber" principle for casting the high melting point alloys such as aluminum, none were successfully achieved since the shot cylinders of such machines invariably failed in a very short period of time due to the extremely corrosive and erosive action of the molten aluminum, and because of the apparently insurmountable design problem associated with the use of various refractory materials.

It can be surmised that these failures occurred because of the many leakage problems which developed, since the high melting point die casting alloys corrode and erode most metallic engineering materials such as tool steels and cast iron, especially if the elements of the apparatus exposed to the molten aluminum are subject

to a rubbing action. An interesting observation of molten aluminum in this regard is that in a stagnant or quiescent state the molten aluminum attacks the metallic container at a substantially lower rate than when the metal is agitated.

Refractory materials, in general, possess much better resistance to corrosion when compared to metallic engineering materials. Some refractory materials, such as certain metallic oxides and nitrides, were found to be undesirable and unsuitable for use with molten aluminum because they do not possess the requisite attributes required of them, such as high strength, hardness and density, resistance to thermal shock, oxidation at high temperatures and other forms of corrosion and erosion, and to other conditions that normally bring about the deterioration and failure of such refractories. For materials which do possess the said requisite attributes, it has been extremely difficult to design a "shot cylinder" for a hot chamber die casting machine, since the physical properties of the refractories used for making the shot cylinder were incompatible with those of the conventional materials of construction, as for example iron and steel. The fabrication of refractories and ceramics in usable shapes has not been developed to a point where they can be utilized as engineering materials for this type of application. Moreover, because of the wide differences between the coefficient of thermal expansion of iron versus most refractories appeared to restrict the use of most refractories to at most limited applications especially to those of a static nature such as crucibles, vaporizing boats, etc.

Accordingly, it is the principal object of the present invention to provide a hot chamber die casting machine for casting primarily high melting point, lightweight die casting alloys.

Another object of the invention is to provide a shot cylinder assembly which is adaptable to hot chamber die casting machines of otherwise conventional construction.

A further object is to provide means for the solution of the thermal expansion problems which also allow for the precision alignment and operational stability of the assembly.

A still further object is to provide means for protecting the shot cylinder assembly from mechanical damage and from thermal shock and to provide practical means for the necessary maintenance and for the replacement of parts.

The novel apparatus of the invention by means of which these and other objects are achieved comprise a shot cylinder composed of a cylindrically shaped housing member having a bored cavity therein and a piston assembly slidably engaged within the cavity both of which are composed of a refractory material which is resistant to corrosion and erosion by the metal to be cast. The cylinder is surrounded by a protective sleeve which is secured to means for maintaining a seal between the housing and a gooseneck which connects the cylinder to a die cavity, said means applying a clamping pressure upon the shot cylinder which in turn bears upon a seal ring which seals the shot cylinder from the gooseneck of a die casting machine.

The shot cylinder of the instant invention will be made more readily apparent by reference to the accompanying drawing of which FIGURE 1 is a side elevational view partly in section of a conventional die casting apparatus embodying the invention.

FIGURE 2 is a somewhat enlarged cross sectional view of the shot cylinder of the invention taken along the line 2—2 of FIGURE 1.

FIGURE 3 is an enlarged detail view in section taken on the line 3—3 of FIGURE 1.

FIGURE 4 is a cross sectional view in elevation of a slightly modified shot cylinder.

FIGURE 5 is a side elevational view of a modified piston assembly for use in the apparatus of FIGURE 1.

FIGURE 6 is a side elevational view partly in section of another modified piston assembly for use with the apparatus of FIGURE 1.

FIGURE 7 is also a side elevational view in section of yet another modified piston assembly; and

FIGURE 8 is a side elevational view in section of a modified piston and shot cylinder assembly.

As shown in FIGURE 1, a die casting machine in general consists of a holding furnace 10 which supports and maintains a melting basin or pot 12 at the desired casting temperature. A gooseneck assembly 14 is suspended within the pot 12 and it communicates with a die cavity 16. The die cavity 16 represents only a small portion of an overall die structure of conventional design be it a single cavity, multiple-cavity or combination die. Other portions of the die structure such as the movable platen, ejector plate and toggles or hydraulic mechanism are not shown inasmuch as this equipment is of a standard nature and since it does not aid in contributing to an understanding of the invention. As best shown in FIGURE 2, the shot cylinder of the invention comprises a pump unit or package including a piston assembly 18 and a housing assembly 20 disposed inside the main cavity 22 of the gooseneck assembly 14. The piston assembly 18 is connected to a suitable power cylinder 24 by means of a coupling 26.

The means for maintaining a seal between the shot cylinder and the gooseneck consist of said housing assembly 20 which comprises an upper holddown member 28 and preferably a lower sleeve 30 which is suitably connected to the holddown member 28. The sleeve 30 serves to protect and align the shot cylinder assembly. The upper holddown member 28 is provided with a flange 29 about its larger diameter; which flange 29 is secured to the top surface 32 of the gooseneck assembly 14 by means of the threaded studs 34 and compatible nuts 36, preferably of hex head shape. Of course, other suitable fastening methods may also be employed so long as they are capable of adjustment which must be made periodically during starting up operations which will be discussed hereinafter. As best shown in FIGURE 1, at the rear end 38 of the gooseneck assembly 14, apertures 40 are provided which enable the molten metal 42 situated in the pot 12 to enter the main cavity 22 thereof. The molten metal level 54 is constantly maintained in the pot 12 by conventional means. A cylinder 48 and the lower protective sleeve 30 are provided with apertures 44 and 46 respectively. These apertures 44 and 46 enable the molten metal to fill passageway 52 and cylinder bore 50 upon the upstroke of the piston assembly 18.

A replaceable nose insert 56 is provided in the upper end of the gooseneck assembly 14. The nose insert 56 is provided with a passageway 58 which communicates through a nozzle 59 with the die cavity 16. If any wear takes place in these passageways, it will most likely occur at the uppermost portion of the approximate right angle turn of the passageway 58. This is probably so since the severest rubbing and frictional action of the molten metal is caused to occur in this area.

The bottom seal assembly which seals the cylinder 48 to the gooseneck 14 is best seen in FIGURE 3. An annular shaped ring 60 is provided with a groove 62 preferably nearer to the inside diameter 64 of the ring 60 and a resilient corrosion resistance metal-ceramic composite seal member 66 is disposed in the groove 62. The ring 60 distributes the compressive load on the cylinder 48 thereby precluding any overstressing or fracturing of corners. The top 68 surface of the ring 60 as well as the mating surface of the cylinder 48 are provided with fine surface finishes. A suitable seal member 66 is a spirally wound laminate of asbestos and stainless steel and its inner and outer peripheral portions are reinforced by a few layers of stainless steel. The spiral is suitably tack or spot welded together and ground to eliminate any burrs or beads formed by the weld. This seal member is resist-

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ant to the attack of molten aluminum and possesses sufficient compressibility and resilience so as to allow for some misalignment.

The piston assembly 18 comprises a sleeve 72 mounted on a stud 74 having a flanged head 76. The stud 74 is preferably composed of a corrosion and heat resistant material. The tolerance between the inside diameter of the sleeve 72 and the diameter of the stud 74 is such that a positive seal is maintained at operating temperatures between the bore of the sleeve 72 and the stud 74.

It should be pointed out at this time that the sleeve 72 and the cylinder 48 are composed of a hard, dense, high strength refractory material which is resistant to high melting point die casting alloys such as aluminum, magnesium and the like. Some of the materials suitable for these elements are the borides, carbides, and nitrides from the Groups IV-A, V-A, and VI-A of the periodic chart of the elements, aluminum oxide, and carbonaceous bodies coated with silicon carbide. Titanium diboride is a preferred material although the other materials are also not affected by molten aluminum, zinc, copper and alloys thereof. The sleeve 30 in particular aids in protecting the brittle cylinder 48 from mechanical damage and also from thermal shock if the pump unit is removed from the gooseneck assembly 14 to the surrounding environment.

The stud 74 is secured to a member 75 which is in turn connected to the coupling 26 by means of an adjustment stud 78. As best shown in FIGURE 2, the holddown member 28 is centered in the main cavity 22 of the gooseneck 14 by means of a finished pad 80. This hold-down member 28 and the protective sleeve 30 in turn center and maintain in alignment the cylinder 48 and seal ring 60, with respect to the lower neck portion of the gooseneck 14.

Preparatory to the actual operation of the apparatus, the entire unit must be gradually brought up to its operating temperature by starting up the holding furnace and by positioning suitable gas burners at predetermined positions in order that the nozzle section may also be brought up to desired casting temperature. Once the molten metal is dispensed into the holding furnace, a soak period allows the temperature of the equipment to become uniform throughout and to be stabilized. Thereafter the apparatus is constantly maintained at the casting temperature by the furnace alone. No external heat sources are needed once the apparatus is in operation. The apparatus cools down gradually once the furnace is turned off and of course the pump unit is removed therefrom so as not to cause it to be frozen in the remaining bath of metal left over in the pot. Thus, when the apparatus is normally restarted, the holding furnace is heated so as to melt the metal in the pot. The pump assembly is also heated to temperature independently and then it is assembled into the apparatus. Due to the different coefficients of thermal expansion for the refractory material and for the gooseneck and associated components which are generally of cast iron, it is necessary at predetermined intervals to retorque the nuts 36 so as to maintain a constant seal pressure at the bottom seal ring 60. If desired, springs may be used so that the holddown member 28 is constantly forced against the cylinder 48.

In operation, the molten metal 42 passes through the apertures 40 in the rear wall of the gooseneck 14 and through suitable apertures 46 in the protective sleeve 30 and thence through the inlet aperture 44 of the cylinder 48. Once the bore 50 of the cylinder 48 is filled, the apparatus is activated whereby the piston assembly 18 is driven down into the bore 50 thus causing the molten metal in the cylinder 48 to be forced under high pressure into the passageways 52, 58 and then into the die cavity 16. As the piston 18 returns on its upward stroke it uncovers the inlet apertures 44 of the cylinder 48 and the cycle is thus repetitive thereafter. Of course, the molten metal level 54 in the holding furnace 10 must be maintained above a minimum level. It is pointed out at this

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time that inclined apertures 84 are also provided in the gooseneck 14 in order that the molten metal 42 in the main cavity 22 may be drained therefrom as the gooseneck 14 is raised from the pot 12.

A modified cylinder assembly which may be employed in the practice of the invention is shown in FIGURE 4. In this construction, the bottom seat of the cylinder 88 consists of a conical surface 86. This surface 86 mates with a corresponding spherical or conical surface machined on the lower neck portion of the gooseneck 14. At the upper end of the cylinder 88 are two alignment surfaces 90 and 92, one at about the outside diameter and the other at about the inner diameter. The seats are of a design such that when the apparatus is cold, the overall alignment is governed by the outside surfaces 90 which are in contact with each other whereas the inner surfaces 92 have some clearance between them. As the apparatus becomes hot, the top portion 94 of the cylinder assembly being made of metal expands radially faster than the refractory cylinder 88, thus as the inner surfaces 92 come into contact with each other and control the overall alignment the outer surfaces 90 begin to part. If desired, a protective sleeve may also be provided with this particular shot cylinder arrangement.

In FIGURE 5 a modified piston assembly is illustrated. This assembly is adapted for use in the apparatus of FIGURE 1. As shown therein, the piston 96 is a monolithic refractory member releasably secured to a lower holder 98 which in turn is swivelly connected to an upper holding device 100. The lower holder 98 comprises two halves which are bolted together about the head and reduced neck portion 102 of the piston 96. The lower end of the piston may be suitably beveled as at 104 in order to facilitate assembly into the cylinder 106 and to preclude chipping and burring of the edges thereof. The upper holding device 100 is of conventional design and comprises a pair of mating conical discs 108 and 110 which permit a slight amount of misalignment between the piston 96 and the cylinder 106.

As shown in FIGURE 6 another modified piston assembly is illustrated. In this embodiment, the piston 112 is similar in construction to the piston assembly shown in FIGURES 1 and 2 except for the upper portion thereof. In FIGURE 6, the nut 114 is threaded onto the end of the stud 116 and locked in place by means of a suitable set screw 118 bearing against the threaded stud 116. The nut 114 in turn is prevented from rotation by means of a second set screw 120 disposed in the holder 122. The nut 114 and stud 116 once locked are free to move axially the distance permitted by expansion and operating temperatures; set screw 120 serving as a key to prevent rotation. The upper portion 124 of the holder 122 is swivelly connected to the connecting rod 126 in a manner similar to the construction shown in FIGURE 5. End cover 128 maintains the seal between the connecting rod 126 and the holder 122.

In FIGURE 7, a modified piston assembly comprising a plurality of rings is shown. This type of structure is also suitable for use in the apparatus in FIGURE 1. As shown therein, the stud 130 is similar to the studs of FIGURES 1, 2 and 6 although it contains alternate rings 132 and 134 composed respectively of metal and a refractory material, preferably titanium diboride. The titanium diboride rings 134 are provided with a slight clearance on their inside diameters 136 and the outside diameters 138 are such that the piston assembly may be readily assembled into the cylinder 140. The metal rings 132 are fit about the stud 130 and provided with clearances on their inside and outside diameters. These rings are held together in interface contact by means of the connecting rod 142 which is threaded and pinned to the stud 130. By this construction, a greater degree of misalignment of the piston assembly in the cylinder 140 can be tolerated and yet a good sliding fit is maintained between the rings 134 and the bore 144 of the cylinder

140. Although it is disclosed that the rings are alternately of a metal and a refractory material, all of the rings may suitably be composed of a refractory material.

In FIGURE 8 another embodiment of the invention is illustrated. As shown there the die casting machine is generally of the same construction as that shown in FIGURE 1 except for the piston assembly 150 and the bottom seal assembly 152 which are somewhat different. The cylinder 154 is basically identical to the cylinder described hereinbefore. The piston assembly 150 includes a rod 156 threaded at both ends, the lower end of which contains a head 158 threaded thereon and suitably pinned thereto. The head 158 is provided with an inner alignment sleeve like bearing portion 160 which is used for aligning and centering the refractory sleeve portion 162 of the piston assembly 150 at its lower end thereof. Another similar sleeve portion 164 is likewise provided at the top of the refractory sleeve 162. A tubular member 166 fits about the rod 156 and bears against the top surface of the cylinder 154. The top of the member 166 is suitably connected to the upper end of the rod 156 which is in turn attached to a holder 168 by means of the threads 170. The holding device 172 is identical to the device shown in FIGURE 5. The holddown member 174 is also similar to the member shown in FIGURES 1 and 2. If desired, a top centering and alignment plate 176 may be provided above the holddown member 174 and is suitably secured thereto. The bottom seal assembly 152 consists of a pair of sealing members and an insert 178. The insert 178 is mounted by means of an interference fit in the neck portion 180 of the gooseneck 182 and seal members 183 and 184 are provided at the interface surfaces 186 and 188 respectively. A refractory cup or sleeve 189 may be employed to protect the head 158 against corrosion by impinging metal during the filling cycle. The operation of this embodiment is no different from the operation of the apparatus described with reference to FIGURES 1 and 2 and therefore no further description is required for an understanding of it.

The following examples illustrate the successful operation of an apparatus embodying the invention and they are not intended to limit the invention. In all of the examples the refractory components were of titanium dioxide.

Example I

A half pound casting was cast in the apparatus shown in FIGURE 1 at a rate of 240 castings per hour. The die casting alloy which was cast at 1225° F. was a 380 aluminum alloy and the casting pressure was 1400 p.s.i. All castings exhibited good surface finish, and were of excellent density, exhibiting low porosity. Three thousand castings were manufactured in this run. Subsequent inspection of the shot cylinder and the piston indicated no measurable wear.

Example II

A half pound casting was cast in the apparatus shown in FIGURE 1 using the same material as noted in Example I except that the piston arrangement used was that as shown in FIGURE 5. Casting temperature of the aluminum was 1250° F. and an injection pressure of 1200 p.s.i. was used. A total of 1000 castings were made in this run and all castings exhibited excellent surface finish and were of extremely high density. Castings were made at a rate of 240 per hour and subsequent inspection of the refractory components showed no measurable wear.

Example III

A half pound casting composed of grade 380 aluminum alloy was cast using the type of apparatus shown in FIGURE 1, and the refractory piston of the type shown in FIGURE 5, except that a slot placed on the O.D. of the bottom section of the piston was used as the filling port for the molten aluminum; the cylinder in this case had

no apertures for filling with molten aluminum. The casting temperature of the aluminum was 1270° F. and the injection pressure was 1200 p.s.i. A casting rate of 240 castings per hour was maintained. Subsequent inspection of the refractory parts showed no measurable wear.

Example IV

A half pound casting composed of grade 380 aluminum alloy was cast using the type of apparatus shown in FIGURE 1 except that the refractory piston was of the configuration shown in FIGURE 7. The casting temperature of the aluminum was 1250° F. and the injection pressure was 1000 p.s.i. Castings were made at a rate of 240 per hour. Subsequent inspection of the refractory components showed no measurable wear.

Example V

A pump or refractory cylinder, used in the apparatus shown in FIGURE 1 with piston type shown in FIGURE 5, was used to cast several hundred half pound castings with grade 380 aluminum. The casting temperature of the aluminum was 1250° F. and an injection pressure of 1200 p.s.i. per square inch was maintained. After several hundred castings were made, the refractory parts were removed. The same refractory cylinder and piston were used a second time in the same type of apparatus as shown in FIGURE 1. A total of 1000 castings were made in this run at a casting rate of 240 castings per hour. The temperature at which the aluminum was cast was 1250° F. and the injection pressure was 1200 p.s.i. The castings exhibited excellent surface finish and were of high density with a porosity less than that of cold chamber castings. Subsequent to removal, the same refractory cylinder and piston was used a third time to make identical castings of the same material used heretofore. This time the casting temperature was 1170° F. and the injection pressure was 1200 p.s.i. The castings exhibited excellent surface finishes again. A fourth and fifth run using the same piston and cylinder were made at a casting temperature of 1170° F. and at an injection pressure of 1200 p.s.i. These castings also exhibited the excellent properties described hereinbefore. Subsequent to all five runs, the refractory parts were removed and upon inspection, showed no measurable wear.

It should be apparent from the foregoing that many modifications and changes in the construction and arrangement of the parts may be made without departing from the spirit and scope of the invention and therefore it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense. For example, the piston and cylinder assembly may be fed from a reservoir instead of being submerged in the molten metal and the die casting apparatus may be of horizontal or inclined construction rather than the vertically described embodiment disclosed herein.

What is claimed is:

1. The combination of a die casting machine for casting high melting point die casting alloys including a holding furnace having a pot containing molten metal to be cast and a gooseneck suspended from a yoke into said pot and communicating with a die cavity, a shot cylinder assembly comprising a cylinder having a cavity therein and at least one intake aperture, a piston reciprocally mounted in said cavity, means for reciprocating said piston in said cavity whereby the upward stroke of said piston opens said intake allowing said molten metal to fill said cavity and the downward stroke closes said intake forcing said molten metal from said cavity through said gooseneck and into said die, and means for maintaining a fluid tight seal between said cylinder and said gooseneck comprising a resilient gasket member disposed between said cylinder and said gooseneck, said resilient gasket comprising a spirally wound laminated ring shaped metal-ceramic composite body.

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2. The combination of claim 1 wherein said piston comprises a monolithic member having a main cylindrical portion, a reduced neck portion and an enlarged head portion for enabling said piston to be secured thereabout by said means for reciprocating said piston.

3. The combination of claim 1 wherein said piston comprises a metal stud having a cylindrically shaped refractory sleeve member positioned thereabout, a nut threadably secured to said stud, a split holding device having two cavities therein, the lowermost cavity being used for holding said nut in an immovable position and the uppermost cavity being used for clamping onto a connecting rod communicating with said means for reciprocating said piston.

4. The combination of claim 1 wherein said piston comprises a metal rod having a head portion and a removable end portion, a refractory sleeve portion and a tubular member disposed about the upper portion of said rod and above said sleeve portion for maintaining said sleeve between said head portion of said rod and said removable end portion.

5. The combination of a die casting machine for casting lightweight, high melting point die casting alloys including a holding furnace having a pot containing molten metal to be cast, and a gooseneck suspended from a yoke into said pot, said gooseneck having a cavity and a connecting passage communicating with a die cavity, a shot cylinder assembly disposed within said cavity of said gooseneck and comprising a cylinder having a cavity therein and at least one intake aperture, a piston assembly reciprocally mounted in said cavity of said cylinder and comprising a stud having a cylindrically shaped sleeve member fixedly positioned to said stud, means reciprocating said piston assembly in said cavity whereby the upward stroke of said piston assembly opens said intake aperture allowing said molten metal to fill said cavity of said cylinder and the downward stroke closes said intake aperture forcing said molten metal from said cavity through said passage of said gooseneck and into a die, means for maintaining said cylinder and said gooseneck in alignment and means for maintaining a fluid tight seal between said cylinder and said gooseneck comprising disposing a seal ring between said gooseneck and said cylinder, said seal ring being provided with an annular groove containing a seal member.

6. The combination of claim 5 wherein said seal member is a corrosion resistant, resilient metal-ceramic composite body.

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7. The combination as defined in claim 5 wherein said seal member is a spirally wound laminated ring shaped metal-ceramic composite body.

8. The combination as defined in claim 5 wherein said seal ring is provided with an annular groove containing a seal member.

9. The combination as defined in claim 5 wherein said seal member is a resilient, corrosion resistant, spirally wound laminated ring shaped metal-ceramic composite body.

10. The combination of claim 5 wherein said means for maintaining a fluid tight seal between said cylinder and said gooseneck and for maintaining said cylinder and said gooseneck in alignment comprises a cylinder head and a holddown clamping member, said cylinder head being provided with a set of conical surfaces which respectively mate with corresponding conical surfaces on the inner diameter of said cylinder while said die casting machine is at high temperatures and on the outer diameter while at lower temperatures.

11. The combination of claim 10 wherein said cylinder is provided with a protective sleeve secured to said holddown clamping member.

12. The combination of claim 5 wherein said piston assembly comprises a stud having a cylindrically shaped refractory sleeve member positioned thereabout, a nut threadably secured to said stud, a split holding device having two cavities therein, the lowermost cavity being used for holding said nut in an immovable position and the uppermost cavity being used for clamping onto a connecting rod communicating with said means for reciprocating said piston.

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