Aug. 31, 1965 W. E. THOMPSON ETAL 3,203,056

DIE CASTING APPARATUS

Filed Oct. 25, 1962

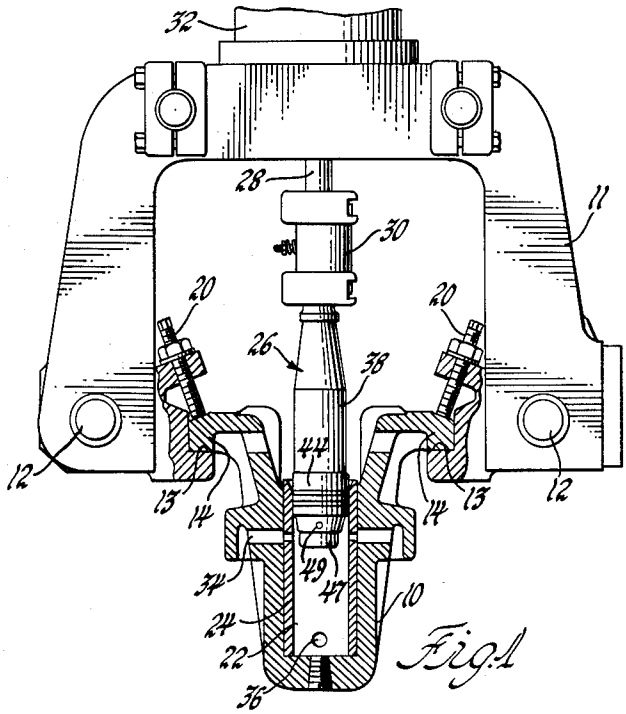



Fig. 1

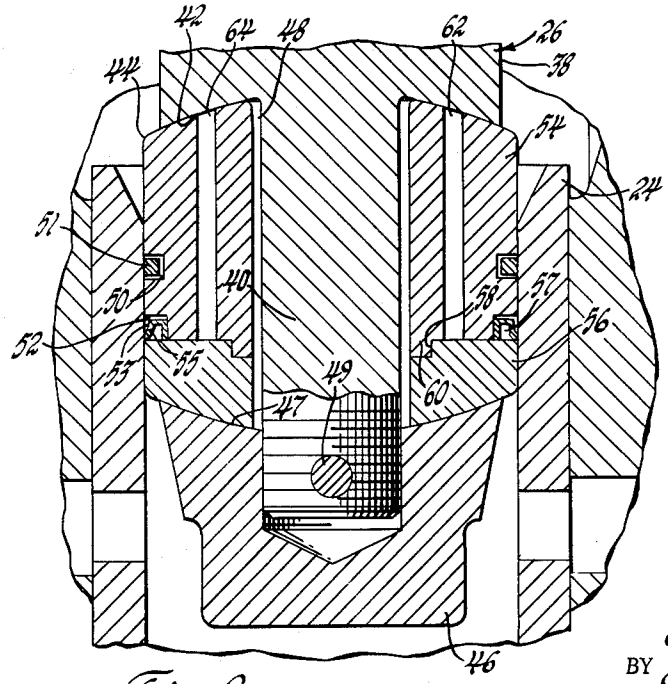



Fig. 2

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3,203,056

# DIE CASTING APPARATUS

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Filed Oct. 25, 1962, Ser. No. 233,121
6 Claims. (Cl. 22—70)

This invention relates to die casting apparatus and more particularly to the shot plunger construction of a hot chamber type die casting apparatus.

It is an object of this invention to provide a hot chamber type die casting apparatus having a pressure chamber and shot plunger arrangement in which the plunger is self-aligning during operation of the appartus. It is a more specific object of the invention to provide the combination of a hot chamber die casting apparatus including a pressure chamber and a plunger reciprocably operable therein in which a portion of the plunger carrying the sealing rings for effecting a seal between the plunger and the pressure cylinder is permitted a limited degree of universal movement.

These and other objects are accomplished by the provision of a shot plunger comprising a main body portion having a reduced diameter section intermediate its length terminating in abutments on each end thereof and a generally annular independently movable carriage carrying sealing rings disposed about the reduced diameter section of the plunger and snugly engaging the plunger abutments which is capable of limited universal movement with respect to the main body of the plunger. The universal movement of the carriage portion with respect to the main body of the plunger is accomplished by making the opening through the carriage of greater diameter than the reduced diameter section of the plunger in which it is received and providing partially spherical surfaces on each axial end of the carriage and the engaging abutments of the plunger body.

Other objects and advantages of the invention will be apparent from the following description, reference being had to the drawings, in which:

FIGURE 1 is a cross-sectional view of a portion of a hot chamber type die casting machine in which the pressure cylinder thereof is shown in cross section; and

FIGURE 2 is an enlarged fragmentary view in cross section showing the shot plunger of this invention positioned in a pressure cylinder.

Hot chamber type die casting apparatus of the type involved in this invention is disclosed in the co-pending patent application Serial No. 241,771, William E. Thompson, filed December 3, 1962, and assigned to the assignee of the present invention.

Die casting machines of the hot chamber type typically used for making zinc castings consist generally of horizontally disposed components including a base, a stationary die support on which is mounted four horizontally extending rods, a movable die support slidably mounted on these rods, a cover die attached to the stationary die support and an ejector die mounted on the movable die support facing the cover die so that a reciprocal motion of the movable die support moves the ejector and cover dies between open and closed positions. An opening is provided through the stationary support to the cover die whereby molten metal may be injected into the die cavity through a sprue in the cover die from the rear side of the stationary die support. A furnace containing a melting pot is provided immediately back of the stationary die support in which there is mounted in partially submerged relationship a molten metal pump in the form of a pressure chamber including a cylinder and plunger and a restricted conduit commonly called a gooseneck extending from the base of the pressure chamber to a nozzle which



extends from the gooseneck opening to the sprue of the cover die through the opening of the stationary die support. When the plunger is in its uppermost or withdrawn position, the plunger uncovers one or more ports in the pressure chamber below the molten metal level through which casting metal fills the chamber due to the force of gravity and vacuum due to cavitation. The die casting operation involves moving the plunger forcibly downward under a pressure of approximately 1100 p.s.i. by means of a hydraulic cylinder. The downward movement of the plunger first closes the metal entry ports and thence forces the molten metal in the pressure cylinder through the gooseneck conduit and nozzle into the die cavity. Since considerable pressures are involved in the injection procedures, it is essential that the plunger and means for connecting the plunger to the hydraulic cylinder be maintained in accurate alignment or that some means be provided to compensate for misalignment. One of the main problems in maintaining hot chamber die casting apparatus in good operating condition is misalignment due to the misplacement of the various components which maintain the pressure chamber and piston or plunger operating therein in proper alignment. In the event of slight misalignment between the parts, the walls of the pressure chamber are soon worn to an oblong shape which results in a loss of the seal between the plunger and the pressure chamber walls whereby the high pressure needed in the metal injection procedure is lost.

A preferred method of supporting the pressure chamber so that the gooseneck and pressure chamber are maintained in proper alignment with respect to the stationary die support is disclosed in the aforementioned patent application Serial No. 241,771. The shot plunger arrangement of this invention may be beneficially associated with the apparatus described in the above patent application as well as with conventional die casting machines.

Referring to the drawings, a common method of supporting the pressure chamber **10** involves the provision of an A-frame structure **11** which is slidably supported on a pair of spaced rods **12** bolted to the back side of the stationary die support member (not shown). The A-frame **11** includes a shoulder **13** upon which outwardly extending flanges **14** of the pressure chamber **10** rest. The pressure chamber is securely clamped to the frame **11** by means of the bolts **20**.

The pressure chamber consists of a cylinder **22** preferably having a replaceable liner **24** fixed therein. Within the cylinder **22** there is disposed the vertically reciprocable shot piston or plunger **26** rigidly attached in longitudinal alignment to a connecting rod **28** by means of a connector **30**, preferably of the type disclosed in the aforementioned patent application. The connecting rod **28** is in turn connected to a piston of the hydraulic cylinder **32** mounted on the A-frame which is operative to cause the plunger **26** to reciprocate vertically in a manner well known in the art. The pressure cylinder **10** is provided with ports **34** whereby the cylinder **22** is filled with molten metal by force of gravity when the plunger is raised to the position shown in FIGURE 1. A gooseneck (not shown) beginning with the opening **36** at the base of the pressure cylinder extends to a point above the level of molten metal and into communication with the nozzle leading to the cover die sprue as previously described.

As previously indicated, the basic feature of this invention resides in a piston structure **26** which is self-aligning in that it automatically makes allowance for minor misalignment between the plunger **26** and the cylinder **22** due to a displacement of any of the components providing a mechanical connection between the hydraulic cylinder **32** and the pressure cylinder **22** and the various components supporting these elements. As shown in the detail of FIGURE 2, the plunger **26** consists of an assembly

which includes the main body portion 38 having a reduced diameter portion 40 formed at the lower portion thereof preferably in the form of a rod having a threaded end portion. The radial wall 42 between the reduced diameter portion 40 and the main body 38 forms an abutment having a partially spherical configuration. Mounted around the reduced diameter portion 40 is an annular carriage 44 which has a partially spherical configuration at each axial end thereof. The carriage 44 is held on the reduced portion 40 by means of a screw cap 46 having an end surface 47 forming an abutment or shoulder of approximately the same diameter as the plunger body which likewise has a partially spherical configuration. The screw cap is preferably held in place by a pin or bolt 49 extending transversely through the cap 46 and the reduced diameter portion 40 of the plunger. The carriage 44 is constructed to have an annular space or tolerance 48 between the inner diameter thereof and the reduced portion 40 of the plunger so that when the partially spherical end 47 of the screw cap 46 and the abutment 42 of the plunger body are in snug engagement with the partially spherical ends of the carriage 44, the latter is capable of limited universal movement with respect to the plunger 38 as permitted by the annular space 48.

The carriage 44 includes a plurality of grooves 50 and 52 which carry the seals 51 and 53 respectively to effect a fluid seal between the carriage portion 44 of the piston and the cylinder liner 24 of the pressure cylinder. Preferably the first seal 53 which is the first seal exposed to the molten metal pressure during the metal injection operation consists of an annular U-cup type having a flexible lip 55 in engagement with the cylinder liner wall. As is well known in the art, the flexible lip 55 will flex outwardly against the liner 24 to insure a tight seal when the space 57 within the seal is subjected to pressure. The subsequent seal 51 is of an ordinary piston ring type which is added as a safety factor. The seal 51 may be of the split ring type which may be readily slipped into the groove 50 in the usual manner. In order that the annular U-cup seal 53 is readily inserted in the groove 52, the carriage 44 is made up of two parts, an upper part 54 and a lower part 56. The lower part 56 includes a counterbore 58 which receives an annular shoulder 60 formed integrally with the upper portion 54 of the carriage. These parts are dimensioned so that the counterbore 58 of the lower section is press-fitted over the shoulder 60 of the upper section. The groove 52 is in the form of an offset in the upper section 54 which, together with the wall of the lower section 56, forms a peripheral groove. It is readily apparent that the lower section 56 may be readily detached from the upper section 54 whereby the seal 53 may be installed or replaced. Preferably the upper section 54 is provided with a pair of oppositely spaced longitudinally extending holes 62 and 64 therethrough through which tools may be inserted to force the lower section 56 from the upper section 54 in an obvious manner. The carriage 44 may be used as a replacement unit whereby the seal elements may be readily replaced with a minimum of labor and machine down time.

While the embodiment of the present invention as disclosed herein constitutes a preferred form, it is to be understood that other forms may be adopted without departing from the spirit of the invention.

We claim:

1. A piston construction comprising a cylindrical body having an external radial shoulder at one end, a connecting rod rigidly secured to said body in axial alignment therewith, an end plate having an outside diameter substantially the same as said outside diameter of said shoulder, means for removably securing said end plate to the side one end of said body remote from said shoulder and in axial alignment with said body, a piston ring assembly having a greater diameter than said body including an axially removable annular carriage on said body and spaced therefrom between said shoulder and said end plate, a circumferential groove in said carriage, a seal ring in said groove, said anular carriage having partially spherical axial end surfaces, said end plate having partially spherical surfaces engaging one of said partially spherical carriage ends, said shoulder having partially spherical surfaces engaging the other of said partially spherical carriage ends whereby said carriage is capable of limited universal movement without any substantial transverse or relative axial movement.

2. A shot plunger for use in high pressure die casting apparatus comprising a cylindrical body having an external radial shoulder at one end, a connecting rod rigidly secured to said body in axial alignment therewith, an end plate having an outside diameter substantially the same as said outside diameter of said shoulder, means for removably securing said end plate to the said one end of said body remote from said shoulder and in axial alignment with said body, a piston ring assembly having a greater diameter than said end plate including an axially removable annular carriage on said body and spaced therefrom between said shoulder and said end plate, a circumferential groove in said carriage, a seal ring in said groove, said annular carriage having partially spherical end axial surfaces, said end plate having partially spherical surfaces engaging one of said partially spherical carriage ends, said shoulder having partially spherical surfaces engaging the other of said partially spherical carriage ends whereby said carriage is capable of limited universal movement without any substantial transverse or relative axial movement.

3. A shot plunger for use in high pressure die casting apparatus comprising a main body portion having a first rod of reduced diameter integrally attached to one end thereof in axial alignment therewith whereby a shoulder is formed between the said first rod and the said body portion, and a connecting rod rigidly secured to the opposite end thereof in substantial axial alignment therewith, an end cap removably secured to the end of said first rod remote from said shoulder, a piston ring assembly including an axially removable annular carriage having an external diameter greater than said body portion and said end cap disposed about said first rod extending between said end cap and said shoulder and having an internal diameter greater than the diameter of said rod whereby an annular space is formed therebetween, a circumferential groove in said carriage, a seal ring in said groove, said annular carriage having partially spherical axial end surfaces, said end cap having partially spherical surfaces snugly engaging one of said partially spherical carriage ends, said shoulder having partially spherical surfaces snugly engaging the other of said partially spherical carriage ends whereby said carriage is capable of limited universal movement without substantial transverse or relative axial movement as permitted by the said annular space between said carriage and said rod.

4. In a hot chamber die casting machine the combination of a pressure cylinder adapted to be immersed in molten metal means for supporting said pressure cylinder in a predetermined position, a piston reciprocable in said pressure chamber connected in substantial axial alignment to a hydraulic cylinder, said piston comprising a main body portion having a first rod of reduced diameter integrally attached to one end thereof in axial alignment therewith whereby a shoulder is formed between the said first rod and the said body portion, and a connecting rod rigidly secured to the opposite end thereof in substantial axial alignment therewith, an end cap removably secured to the end of said first rod remote from said shoulder, a piston ring assembly including an axially removable annular carriage having a greater diameter than said body portion and said end cap disposed about said first rod extending between said end cap and said shoulder, and having an internal diameter greater than the diameter of said first rod whereby an annular space is formed therebetween, a circumferential groove in said

carriage, a seal ring in said groove, said annular carriage having partially spherical axial end surfaces, said end cap having partially spherical surfaces snugly engaging one of said partially spherical carriage ends, said shoulder having partially spherical surfaces snugly engaging the other of said partially spherical carriage ends whereby said carriage is in contact with said pressure chamber and is capable of limited universal movement relative to said body portion and said end cap without substantial transverse or relative axial movement as permitted by the said annular space between said carriage and said rod.

5. A piston construction comprising a piston body portion having a connecting rod rigidly attached thereto, said body portion having an annular recess located intermediate the length thereof defined by an axial portion of reduced diameter and oppositely disposed radial walls having concave spherical surfaces, an annular carriage having a greater diameter than said body portion adapted to carry at least one seal ring and having convex partially spherical radial end faces snugly engaging said concave radial walls, said carriage being spaced from said axial portion along its length whereby said body portion concave surfaces and said carriage convex surfaces are movable relative to each other and said carriage is



capable of limited universal movement relative to said body portion.

6. A shot plunger for use in high pressure die casting apparatus comprising a main body portion having a connecting rod rigidly attached thereto, said body portion having an annular recess located intermediate the length thereof defined by an axial portion of reduced diameter and oppositely disposed radial walls having concave partially spherical surfaces, an annular carriage having a greater diameter than said body portion adapted to carry at least one seal ring and having convex partially spherical radial end faces snugly engaging said concave radial walls, said carriage being spaced from said axial portion along its length whereby said body portion concave surfaces and said carriage convex surfaces are movable relative to each other and said carriage is capable of limited universal movement relative to said body portion.

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MARCUS U. LYONS, *Primary Examiner.*

# UNITED STATES PATENT OFFICE

# CERTIFICATE OF CORRECTION

Patent No. 3,203,056 August 31, 1965

William E. Thompson et al.

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 71, for "side" read -- said --; column 4, line 58, after "metal" insert a comma.

Signed and sealed this 5th day of April 1966.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents