A. W. MORRIS.

PRESSURE CASTING APPARATUS.

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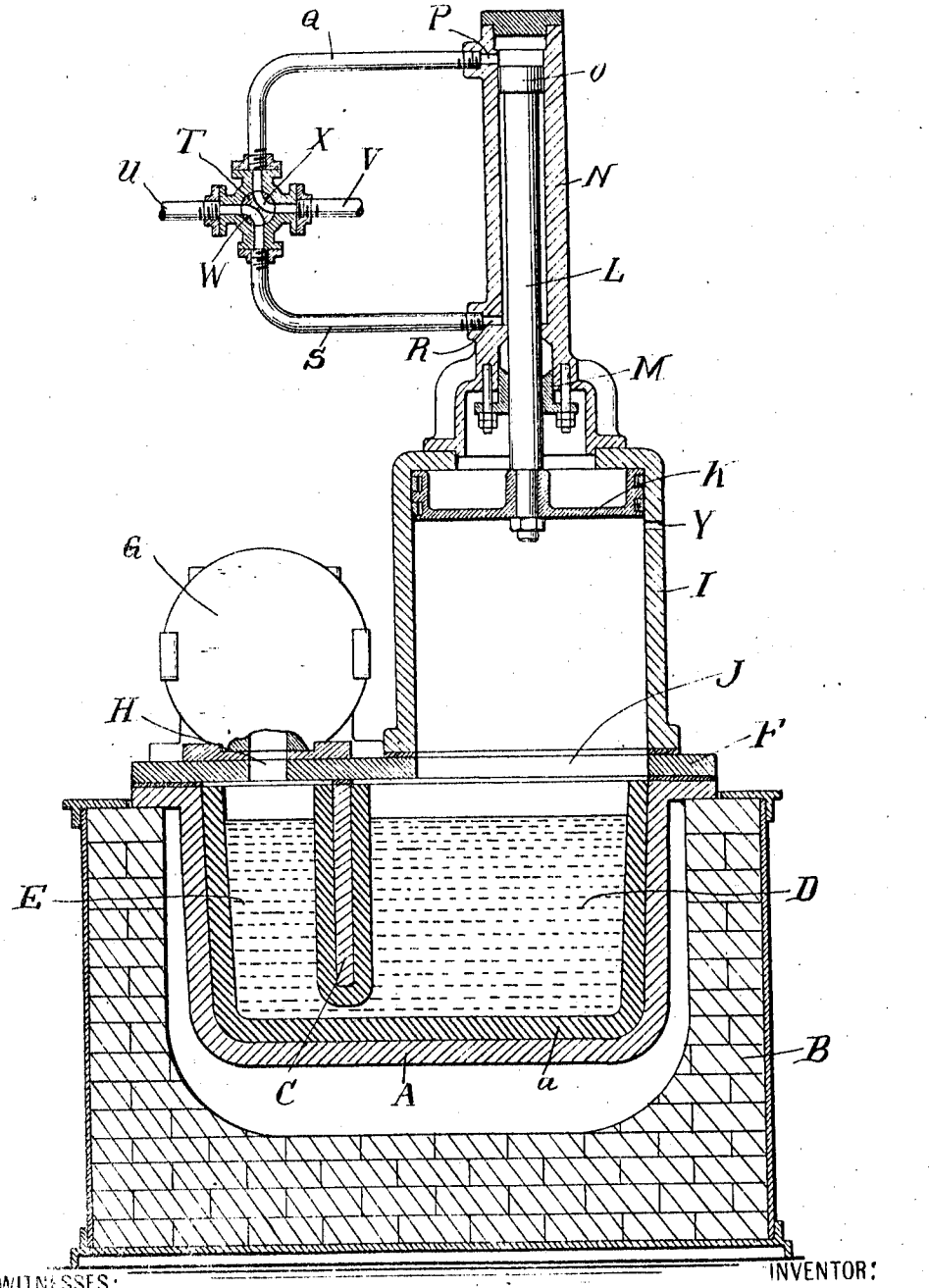

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PRESSURE CASTING APPARATUS.

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To all whom it may concern:

Be it known that I, ALBERT W. MORRIS, a citizen of the United States, residing at Philadelphia, county of Philadelphia, State of Pennsylvania, have invented certain new and useful Improvements in Pressure Casting Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This improvement in the art of pressure casting consists primarily in providing a cylinder in open communication with the air or other elastic fluids in the melting chamber above the molten metal, and a piston in that cylinder which is capable of producing, by its inward movement, a progressive increase of density of the air and a corresponding progressive increase of pressure, from low to high, upon the molten metal, thereby causing the molten metal to enter quietly, but promptly, through the uptake provided for the purpose, into the mold, filling it completely and subjecting it therein to the pressure necessary during cooling, setting and shrinkage to insure flawless and homogeneous castings.

In admitting air under pressure to the melting chamber through pipes and valves, the manipulation of the pressure apparatus has heretofore required considerable skill, for the reason that too sudden an application of pressure tends to cause the metal to spurt into the mold in a divided state and to quickly cool therein, leaving imperfections in the finished casting where the mold was not completely filled, and in some instances causing subsequent warping in the finished casting because of the non-homogeneous condition of its metal. It is possible that the difficulty in securing a gradual application of pressure upon the metal in the melting chamber through the admission of any considerable quantity of compressed air thereto is increased by the sudden expansion of the large volume of air as it comes in contact with the molten metal. This disadvantage is absent when the air or other elastic fluid to which the pressure is applied is already in contact with the heated metal, as is the case when the before-mentioned cylinder and piston or their equivalents are employed.

The invention further contemplates the employment of valve-controlled hydraulic means for actuating the piston, with the advantage that this mode of control contributes to the uniformity in the successive cycles of operation essential to the production of the best results.

In the accompanying drawing, I have illustrated by a vertical sectional view, a pressure casting furnace embodying the invention.

Referring to the drawing, A represents the melting chamber preferably of metal having a refractory lining *a*, and supported upon a suitable foundation B. The melting chamber A is divided by a partition C into a main compartment or reservoir D and a smaller compartment E constituting an uptake for the metal into the mold. The two compartments D and E communicate below the partition, so that molten metal may pass under said partition from one to the other. A top plate F closes the melting chamber A and has pressure-tight joints with the outer walls of the chamber and the top edge of the partition C.

A mold G is mounted above the up-take E, and a port H in the top plate F permits the passage of the metal from E into the mold. An open-ended cylinder I is mounted on the top plate F above the reservoir D and communicates therewith through an aperture J in the top plate, this aperture J, however, being of such size that the bore of the cylinder I and the reservoir D practically form one chamber.

A piston K working in the cylinder I, when in its upper position as shown, uncovers a port Y in the walls of said cylinder communicating with the outer atmosphere, so that atmospheric pressure may be established within the melting chamber before the mold is opened to remove a finished casting.

The cylinder I is open at the top and the piston rod L, upon whose lower end the piston K is secured, passes up through a stuffing box M into a hydraulic cylinder N and is provided upon its upper end with a piston O closely fitting cylinder N. The cylinder N has a port P, above the travel of piston O, into which port a pipe Q leads. The cylinder N has also a port R, below the travel of piston O, into which a pipe S

leads, and these pipes Q and S, lead from two of the passages of the casing of a four-way valve T, the other two passages thereof being connected to a water-pressure supply pipe U and an exhaust V. The valve T has two ports W and X which allow the water above the piston O to exhaust through pipe Q, port X and exhaust V, while water under pressure passes from supply pipe U through port W and pipe S to the underside of piston O. This raises the piston O, piston rod L and piston K to the position shown in the drawing, when the contents of reservoir D will be at atmospheric pressure as before stated and the mold may be safely opened.

The operation of filling the mold and the formation of a completed casting is as follows: The valve T is turned to allow the exhaust of the water under piston O through pipe S, port W and exhaust V, and the simultaneous admission of water under pressure from the supply pipe U through port X and pipe Q to the upper side of piston O, which will force piston O, its piston rod L and the piston K downwardly. The hydraulic control being positive in its action permits a particularly delicate control in this organization either by hand or automatic means, as the expansion and compression of the air acted upon do not react prejudicially upon the source of power. Immediately after the piston K starts down, under the action of the water pressure above piston O, it closes the port Y to the reservoir D and its continued downward movement builds up a constantly increasing pressure in the reservoir D, acting progressively, though promptly, upon the surface of the molten metal therein to lower its level and to quietly raise the metal in up-take E into the mold G until the mold is entirely filled with metal. The piston K continues to descend after the mold is filled, increasing the pressure upon the cooling metal in the mold as contraction of the metal takes place, and finally applying the highest pressure as the metal solidifies. The valve T is then reversed to raise the piston K to its upper position, lowering the pressure in the melting chamber again to that of the atmosphere, when the mold may be opened and the casting removed. The molten metal does not at any time come into contact with the piston or cylinder nor with any working part other than the mold itself, and the air compressed is that already in contact with the heated metal so that sudden and violent expansion of the air and any consequent disturbance of the metal is avoided. The action of the piston on the down stroke is to progressively diminish the volume of the heated body of air entrapped between it and the upper surface of the molten metal in the reservoir D, thereby correspondingly increasing its pressure, and, on the up-stroke the air regains its original volume, and is, in fact, of somewhat greater volume because of the lowering of the normal level of metal in the reservoir due to the filling of the mold. To provide for supplying to the body of entrapped air a further amount sufficient to compensate for the enlarged capacity due to the lowering of level referred to, the port Y suffices each time that it is uncovered at the termination of the up-stroke of the piston.

Having thus described my invention what I claim is:

1. In pressure casting apparatus, the combination with a mold, of a molten metal reservoir for supplying metal to the mold, a cylinder containing a trapped body of air heated by contact with the upper surface of the molten metal in the reservoir, a piston for progressively diminishing the volume and increasing the density of said heated trapped body of air, so as to raise the metal quietly into the mold, and means for restoring the trapped body of air to its original volume and for supplementing its volume by the admission of additional air to said trapped body, after a mold is filled, to compensate for the lowering of the normal level of the metal in the reservoir and the increase in size of the air chamber incident to such filling; substantially as described.

2. In pressure casting apparatus, the combination with a mold, of an up-take communicating therewith, a molten-metal reservoir for supplying metal to the up-take and mold, an open-ended cylinder whose bore is in direct and unrestricted communication with the reservoir, and a piston operating in the cylinder to progressively diminish the volume of the body of air trapped between the piston and the upper surface of the molten metal; substantially as described.

3. In pressure casting apparatus, the combination with a mold, of an up-take communicating therewith, a molten-metal reservoir for supplying metal to the up-take and mold, an open-ended cylinder whose bore is in direct and unrestricted communication with the reservoir, a piston operating in said cylinder to alternately diminish and increase the volume of the body of air trapped between the piston and the upper surface of the molten metal, and means for actuating said piston hydraulically; substantially as described.

4. In pressure casting apparatus, the combination with a mold, of an up-take communicating therewith, a molten-metal reservoir for supplying metal to the up-take and mold, an open-ended cylinder whose bore is in direct and unrestricted communication with the reservoir, a piston operating in said cylinder to alternately diminish and

increase the volume of the body of air trapped between the piston and the upper surface of the molten metal, and means for actuating said piston hydraulically, said means consisting of a second cylinder, a piston in said second cylinder connected to said first-named piston, and controlling mechanism for the admission of a suitable liquid supply under pressure to said second cylinder; substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

ALBERT WOOD MORRIS.

Witnesses:

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