

Feb. 25, 1958

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2,824,732

APPARATUS FOR MELTING AND POURING METAL

Filed Dec. 21, 1956

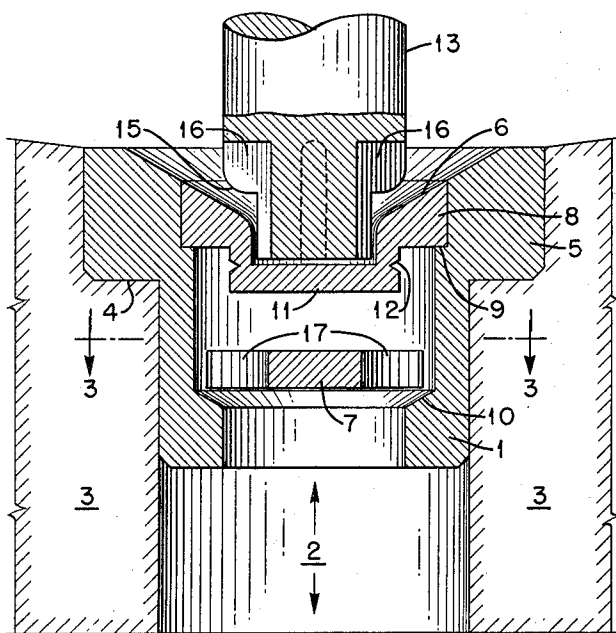


Fig. 1.

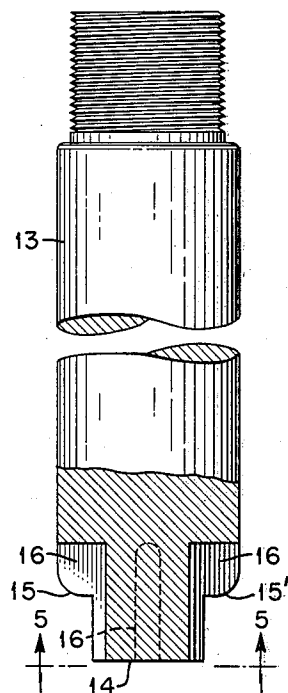


Fig. 4.

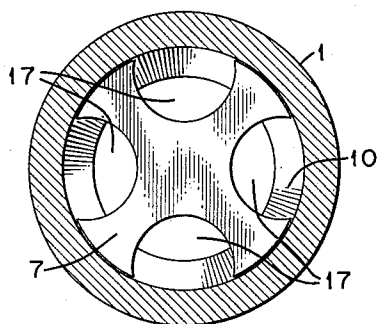


Fig. 3.

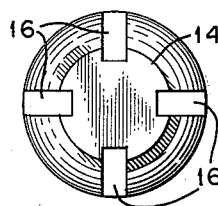


Fig. 5.

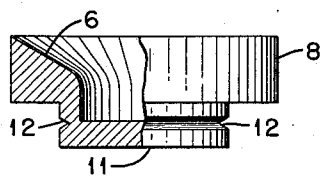


Fig. 2.

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2,824,732

APPARATUS FOR MELTING AND POURING METAL

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Application December 21, 1956, Serial No. 630,011

5 Claims. (Cl. 266—33)

My invention relates generally to a liquid metal pouring device and more specifically to an apparatus that may be used to pour molten metals by gravity through an opening in the bottom of a crucible. My invention may be used in any pouring situation but it is especially adapted to pour molten metal that must be kept under an inert atmosphere, under a vacuum, or in any instance in which the melt must be isolated.

In situations of the above type, it is advantageous to pour by gravity through an opening in the bottom of the melting crucible. This practice simplifies the pouring operation and the apparatus in that the liquid metal receiver may be placed directly under the crucible opening thereby eliminating the necessity for a crucible tipping mechanism.

In the prior art, a pouring rod was placed in the opening at the bottom of the crucible to provide a closure for that opening. The pouring rod extended upwardly and protruded over the upper edge of the melting crucible. Small pieces of solid material were then stacked around the pouring rod until a charge of the proper size was obtained. The metal was then heated to the melting point and the rod was withdrawn upwardly from the lower opening allowing the molten metal to flow from the crucible into a mold. Since metal pouring involves high temperatures, it is necessary to use material for construction that will withstand temperatures in the molten metal range. Unfortunately most of the materials that meet the temperature criterion are weak materials structurally. The structural weakness of the material manifests itself in several inherent disadvantages.

The operation of the prior apparatus failed in the event that the pouring rod was broken before it was pulled from the closure. The rod could be broken during the loading operation by a large piece of the charge. It could also be broken by a charge piece during the melting operation if the material at the bottom of the crucible melted in an uneven manner. A failure of this type meant the failure of the process because the crucible had to be shut down and the pouring rod replaced. Pouring rod failures are costly both in time and in money.

The mere presence of the pouring rod at the center of the crucible constituted another disadvantage. Charge pieces had to be small enough to fit the radius of the crucible. In the absence of the pouring rod, it is obvious that the crucible could take charges of fragments as large as the diameter of the crucible. It is apparent that if one compares the size of two crucibles that are capable of handling the same size of charge piece, one with a pouring rod and one without, that the crucible containing a pouring rod would have to be of a diameter twice as large as the crucible that didn't contain the pouring rod. The practice in the prior art was to select a crucible of the proper volume and cut any fragment of charge that wouldn't fit between the pouring rod and the crucible wall. This is a serious monetary and time-consuming disadvantage.

With knowledge of the disadvantages of the prior art

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it is an object of my invention to provide a pouring apparatus that will eliminate the possibility of a failure caused during the crucible loading operation. It is another object of my invention to provide a pouring apparatus that will eliminate the possibility of a mispour caused by uneven melting of the charge. A further object of my invention is to provide a pouring apparatus that will reduce the necessity for cutting the charge fragments prior to loading.

A still further object of my invention is to provide a pouring apparatus that will pour by gravity through a lower crucible opening but will eliminate the presence of a pouring rod in the crucible until the charge has been melted.

Other objects and a more complete understanding of my invention may be had by referring to the following description of a preferred embodiment, read in conjunction with the attached drawings in which Fig. 1 is a sectional view of the lower portion of an apparatus designed to fulfill the aforesaid objects, Fig. 2 is a detail drawing in partial section of a closure for my apparatus, Fig. 3 is a sectional view of the assembled apparatus showing the retaining disc in plan, Fig. 4 is a drawing of the knock-out rod in partial section, and Fig. 5 is a bottom view of the knock-out rod.

In accordance with my invention, the melting crucible is provided with a lower opening in the form of an elongated passageway, the upper portion of the passageway is closed by a frangible plug, and means are provided for fracturing this plug after the charge is melted and for retaining the fragments of the fractured plug while allowing the melted charge to flow from the crucible. The crucible and the other components may be fabricated from any suitable refractory material.

Referring now to Fig. 1, which shows one embodiment of my invention in which all parts are fabricated from graphite, a knock-out plug housing 1 is press fitted into an opening 2 in the bottom wall 3 of the crucible. The opening 2 comprises a vertical, cylindrical hole through the bottom of the crucible 3, the uppermost portion of the hole being of a larger diameter than the lower portion.

The larger diameter at the top of opening 2 provides a shoulder 4. The flanged upper portion 5 of the knock-out plug housing 1 rests on the shoulder 4. The outer diameters of the knock out plug housing 1 are slightly larger than the diameters of the opening 2; thus, the housing 1 is positioned by press fitting.

The inner portion of the knock-out plug housing 1 contains a knock-out plug 6 (see also Fig. 2) and a retaining disc 7. (See also Fig. 3 which includes a plan view of the retaining disc.) The flanged portion 8 of the knock-out plug 6 rests on an upper interior shoulder 9 of the plug housing 1 and is press-fitted therein. The retaining disc 7 rests on a lower interior shoulder 10 of the knock-out plug housing 1. The aforesaid lower interior shoulder 10 of the plug housing 1 is funnel shaped to allow free flow of molten metal through the openings 17 (see also Fig. 3) in the periphery of the retainer disc 7 during the pouring operation.

Referring now to Fig. 2, the knock-out plug 6 comprises two main parts, a flanged portion 8 and a knock-out disc 11, the entire plug 6 being normally fabricated in one piece. A groove 12 is provided at the junction of these parts to weaken the material at this point so that an excessive downward force on the inside of the knock-out plug 6 will cause the knock-out disc 11 to drop away from the flanged portion 8 and thus allow the flow of molten metal through the opening.

The interior of the knock-out plug 6 is funnel shaped, the neck portion being cylindrical in shape. The termination of the conical portion provides a shoulder which prevents excessive penetration of the knock-out rod 13

into the knock-out plug 6. Also, the slope of the conical portion cooperates with the slope of the housing 1 to provide a smooth draining surface.

Referring now to Fig. 4 and Fig. 5, the knock-out rod 13 is designed specifically for use with the knock-out plug assembly. The rod is cylindrical in shape and the lower extremity has a reduced diameter 14 so that it will fit loosely into the neck portion of the knock-out plug 6. In order to allow unrestricted flow of the molten metal immediately when the knock-out disc 11 is broken away from the plug 6, a plurality of slots 16 are provided in the end of the knock-out rod 13 as indicated in Fig. 4 and Fig. 5. The slots 16 provide a plurality of shoulders as illustrated by 15 and 15' in Fig. 4. The reduced diameter 14 extends upwardly a distance such that when the bottom of the rod 13 is positioned on the upper side of the knock-out disc 11, the rounded shoulders 15 and 15' of the knock-out rod will be a short distance above the flange portion 8 of the plug 6. The knock-out rod 13 is illustrated having a threaded upper portion. The threaded portion serves as a means for attaching the knock-out rod to a driving means for remote operation.

Referring again to Fig. 1, the operation or practice of my invention is as follows: After assembly of the device, as indicated in this figure and by the above description, the metal is loaded into the crucible in any convenient manner. The crucible is then placed in the furnace and the metal reduced to the molten state. The knock-out rod 13 is then forced downward through the molten metal until the bottom of the knock-out rod 13 comes to rest against the upper side of the knock-out disc 11. Additional pressure on the rod 13 then breaks the knock-out disc 11 away from the flanged portion 8 of the knock-out plug 6 at the groove 12 causing it to drop onto the upper side of the retainer disc 7 and allows the aforesaid rod 13 to come to rest with its shoulders 15 and 15' on the flanged portion of the plug. The metal flows through the slots 16 in the knock-out rod 13, downward through the plug 6, and on through the openings 17 in the retainer disc 7 and into the mold. After breaking the disc 11, the rod 13 is immediately raised away from the opening in order to allow a greater open area for the flow of the metal.

Although I have set forth one specific embodiment of my invention, it should be noted that numerous changes, additions, or deletions may be made within the scope of my present invention. For example, the knock-out plug 6 may be replaced by various forms of frangible closures. A thin frangible disc may be used. A grid type retaining member may be used or the material of construction may be changed to fit the needs of other processes. The scope of my invention should be limited only by the appended claims.

Having thus described my invention, I claim:

1. An improved apparatus for melting metal and pouring the resulting liquid metal comprising a melting crucible having a lower portion defining an outlet with an elongated passageway, a frangible closure positioned in the passageway of said outlet and fragment retaining means

permanently positioned in the passageway below said frangible closure to hold segments of said frangible closure while allowing the liquid metal to flow out of said crucible.

2. An improved apparatus for melting metal and pouring the resulting liquid metal comprising a melting crucible having a lower portion defining an outlet with an elongated passageway, a closure provided with a frangibly detachable portion positioned in the passageway of said outlet, and means permanently positioned in the passageway below said closure to retain the detachable portion of said closure while allowing the liquid metal to flow out of said crucible.

3. An improved apparatus for melting metal and pouring the resulting liquid metal comprising a melting crucible having a lower portion defining an outlet with an elongated passageway, a closure provided with a frangibly detachable portion positioned in the passageway of said outlet, and a retaining member permanently positioned in the passageway of said outlet below said closure, said retaining member being of substantially greater diameter than said frangibly detachable portion and said retaining member defining a plurality of openings distributed over an area greater than the area of said frangibly detachable member.

4. An improved apparatus for melting metal and pouring the resulting liquid metal comprising a melting crucible having a lower portion defining an outlet with an elongated passageway, a graphite closure provided with a frangibly detachable portion positioned in the passageway of said outlet, and a graphite retaining member permanently positioned in the passageway of said outlet below said closure, said retaining member being of substantially greater diameter than said frangibly detachable portion and said retaining member defining a plurality of openings distributed over an area greater than the area of said frangibly detachable member.

5. An improved apparatus for melting metal and pouring the resulting liquid metal comprising a melting crucible having a lower wall portion defining an elongated outlet passageway, said wall portion being provided with upper and lower annular shoulders, a circular plug carried by said upper shoulder to close said passageway, said plug having a weakened central portion, means to strike said plug at the weakened portion to knock-out said weakened portion, and a retaining disc of greater diameter than said weakened central portion carried by said lower shoulder, said retaining disc being provided with peripheral apertures to allow the liquid to flow from said crucible.

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