

Jan. 18, 1944.

P. M. HULME

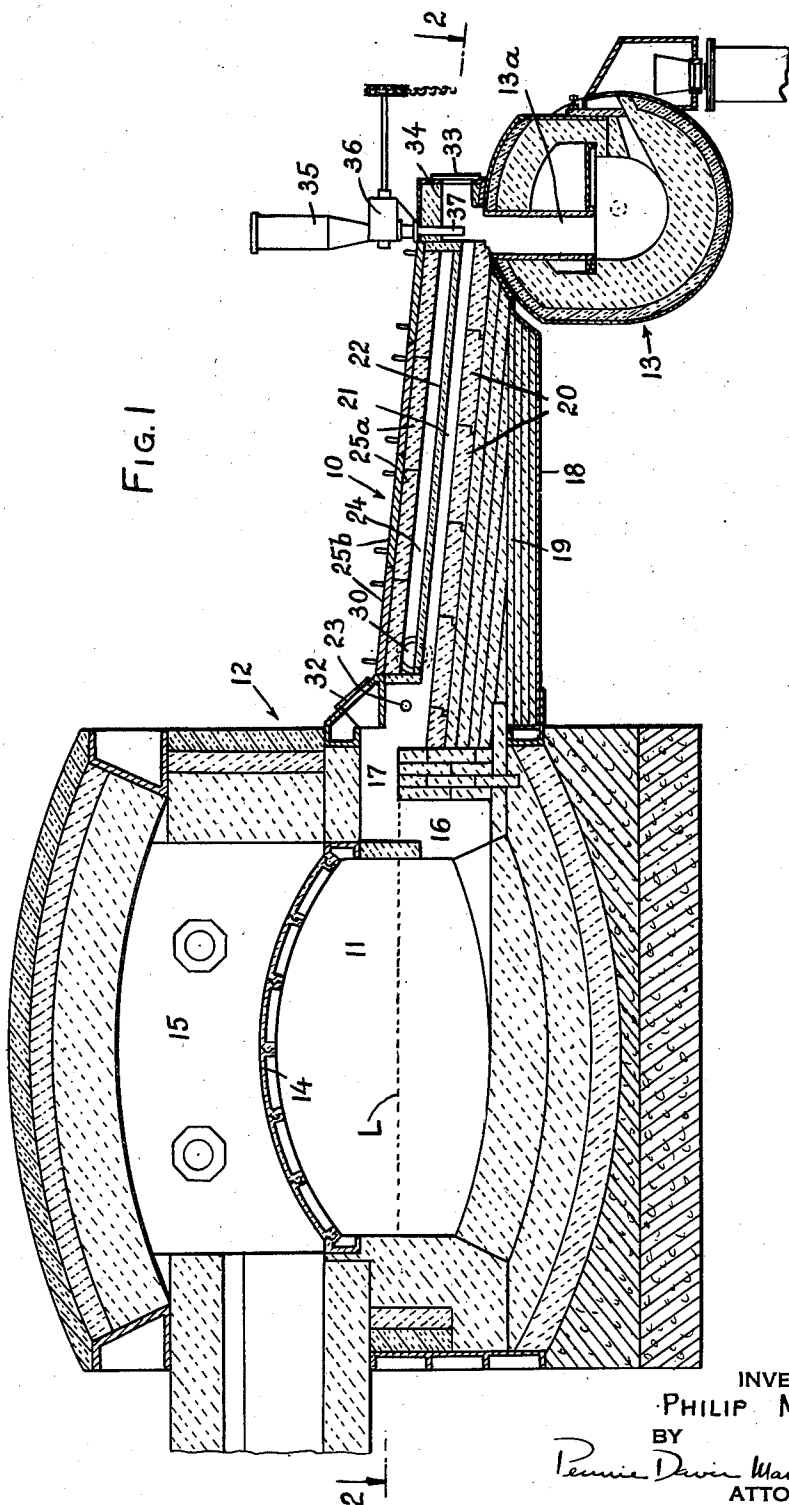
2,339,337

FURNACE LAUNDER CONSTRUCTION

Filed March 14, 1942

2 Sheets-Sheet 1

FIG. 1



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2 Sheets-Sheet 2

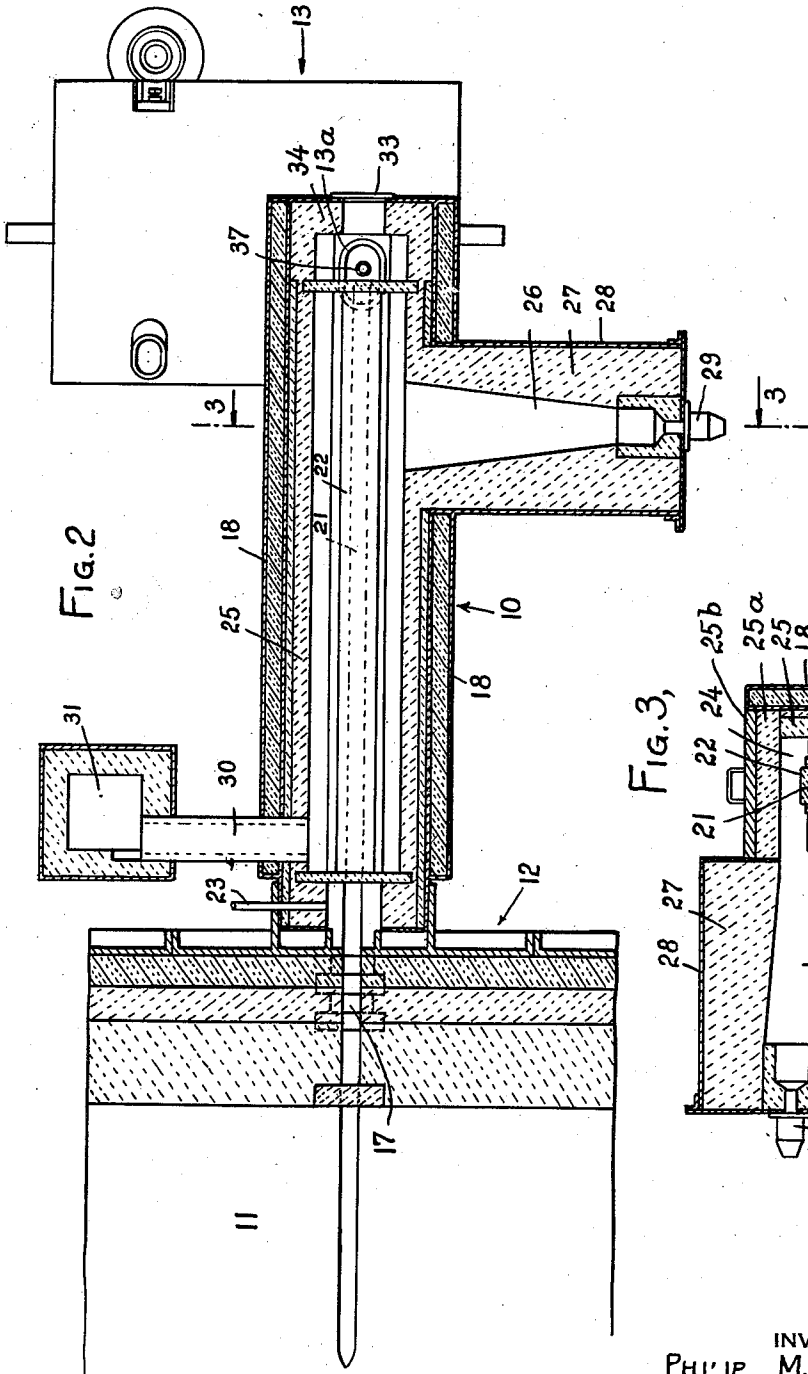


Fig. 2

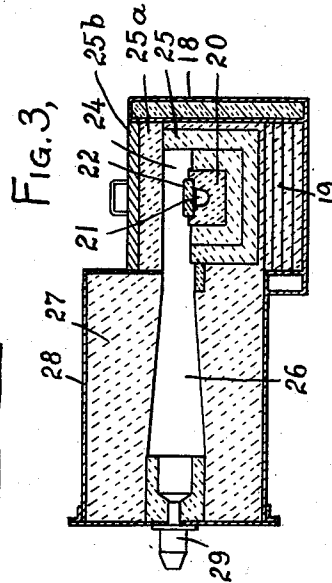


Fig. 3

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2,339,337

FURNACE LAUNDER CONSTRUCTION

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Application March 14, 1942, Serial No. 434,741

11 Claims. (Cl. 266—38)

This invention relates to furnace launder construction, and has for its principal object to provide an improved form of launder heated by combustion gases so as to permit the passage therethrough of a thin, easily frozen stream of molten metal. The invention further provides a launder of improved construction such that the molten metal is maintained out of contact with the combustion gases, and thus contamination of the molten metal by the combustion gases is prevented.

Launders for furnaces quite commonly are simple open troughs through which the molten metal runs from the furnace to the pouring ladle. Such launders are quite satisfactory for ordinary purposes where the stream of metal flowing through the launder is fairly large and not very easily frozen, and where contact between the molten metal in the launder and the atmosphere is not objectionable. Such a launder, however, cannot be used if the molten metal stream is very thin and easily frozen, or if exposure of the molten metal to the air is objectionable.

In United States Patent No. 2,265,284, granted December 9, 1941, on an application of Philip M. Hulme and Robert A. Ghelardi, and assigned to the same assignee as this application, a novel process is described for melting copper in a fuel-fired muffle furnace substantially solely by means of radiant heat. The molten copper produced by this melting process is as free from contaminants as the solid copper charged into the furnace. When electrolytic cathodes are used as the source of solid copper to be melted, the molten copper product is very pure and is substantially oxygen-free. If the substantially oxygen-free molten copper produced in this manner is allowed to flow through an open launder, it rapidly picks up oxygen from the air, so that it is impossible to cast the metal into oxygen-free shapes. The present invention provides a launder constructed so as to exclude air from contact with the molten copper or other metal flowing therethrough, and hence suitable for transferring oxygen-free copper melted as described in the aforementioned patent to the pouring apparatus.

The melting process described in the aforementioned patent is such that it may be carried out continuously. When the melting process is thus carried out, there is a continuously flowing stream of metal from the furnace through the launder to the pouring ladle. This continuous stream of molten metal is, however, very thin and small, even in the case of a furnace having quite large melting capacity. The stream of copper is

so thin that it is easily chilled and frozen, and when this occurs, continuous operation of the furnace is interrupted. The launder provided by the present invention is of such nature that the molten copper or other metal flowing therethrough is kept heated and so is prevented from freezing.

The launder according to the invention comprises an enclosed conduit for carrying the thin stream of molten copper or other metal. A combustion-gas chamber extends substantially the full length of the conduit, and is separated therefrom by a thin, substantially gas-tight wall of heat-conducting refractory material. Means are provided for introducing hot combustion gases into the combustion-gas chamber in contact with the said wall. In this manner the wall may be heated to an elevated temperature above the melting point of the copper or other metal flowing through the conduit, and thereby sufficient radiant heat may be supplied to the flowing metal to maintain it in the molten condition. At the same time, the wall maintains the molten metal out of contact with the combustion gases. If desired, arrangement may be made to introduce a special protective gas atmosphere into the conduit in order to insure against contamination of the molten metal.

A particularly satisfactory form of launder according to the invention comprises a trough of refractory material communicating with the interior of the furnace. A substantially gas-tight cover of heat-conducting refractory material is laid over the trough, and a combustion-gas chamber extending substantially the full length of the trough is provided above the cover. Hot combustion gases are introduced into the combustion-gas chamber, and thus into contact with the cover, at one end of the combustion-gas chamber. Means are provided for withdrawing such gases from the combustion chamber at the other end thereof.

The invention will be better understood from the following description of a specific embodiment, considered in conjunction with the accompanying drawings, in which

Fig. 1 is a longitudinal section through a launder connecting a muffle furnace with a pouring ladle;

Fig. 2 is a horizontal section through the launder shown in Fig. 1, taken substantially along the line 2—2 of Fig. 1; and

Fig. 3 is a cross-section through the combustion chamber and launder, taken substantially along the line 3—3 of Fig. 2.

Referring particularly to Fig. 1, the launder 10 connects the melting chamber 11 of a muffle furnace 12 with a pouring ladle 13. Neither the construction of the furnace 12 nor the construction of the pouring ladle 13 forms any part of the present invention. However, the furnace shown is of the type described and claimed in the co-pending application of Vernon E. MacDonell, Serial No. 434,709, filed March 14, 1942, and the pouring ladle shown is of the type described and claimed in my co-pending application Serial No. 434,742, filed March 14, 1942. The apparatus shown in the drawings is especially useful for carrying out the copper melting process described in the aforementioned Patent No. 2,265,284.

Molten metal, such, for example, as oxygen-free molten copper, is maintained in the melting chamber 11 to a normal level L. The copper may be melted and maintained in the molten state substantially wholly by means of radiant heat radiated from an arch 14 separating the melting chamber 11 from a combustion chamber 15. The molten copper or other metal passes from the melting chamber 11 through a well 16 and a tap hole 17 into the launder.

The launder shown in the drawings comprises a steel supporting structure 18 suitably lined with refractory brickwork 19. A series of trough-shaped refractory brick or tile 20 are supported by the refractory brickwork 19 to provide a trough or conduit 21 for the molten metal flowing from the furnace. The trough 21 receives the molten copper from the tap hole 17, and delivers it to the interior of the pouring ladle 13 through the pipe 13a.

A substantially gas-tight cover 22 is laid over the open top of the trough-shaped tiles to enclose the trough 21. The cover 22 is preferably made of a thin, heat-conducting refractory tile composed, for example, of silicon carbide. The cover 22 advantageously is substantially gas tight so as to protect metal flowing through the trough 21 from contact with any deleterious gases. If desired, a pipe 23 may be provided for introducing a protective gas atmosphere into the trough 21 to insure against contamination of the molten metal. A protective gas composed essentially of carbon monoxide and nitrogen is particularly suitable for protecting molten copper from contamination.

A combustion-gas chamber 24 is provided above the thin refractory trough cover 22, and is defined by refractory brickwork side walls 25 and roof 25a arranged about the cover 22 but in spaced relationship therewith. The combustion-gas chamber extends substantially the full length of the trough 21. The refractory side walls 25 of the combustion-gas chamber may be mounted permanently in place as lining for the steel shell 18, but the refractory brickwork 25a forming the roof of this chamber may be secured to removable steel plates 25b. Such construction facilitates removal of the combustion chamber roof for repairs to or inspection of the launder. Each of the plates 25b may be offset with respect to the refractory 25a attached thereto so as to overlap the refractory attached to the adjacent plate and thus improve the gas-tightness of the joints between adjacent refractory elements 25a and plates 25b.

A combustion chamber 26 (Figs. 2 and 3) is provided near the metal-discharge end of the launder. The combustion chamber is defined by refractory brickwork 27 lining a steel supporting shell 28, and is so arranged that it communicates

with the interior of the combustion-gas chamber 24. An oil burner 29 is mounted so as to face into the combustion chamber 26. An off-take flue 30 (Fig. 2) communicates with the interior of the combustion-gas chamber 24 adjacent the furnace end of the launder, and provides for the withdrawal of combustion gases therefrom to a chimney 31.

In operation of the launder described above, fuel introduced through the burner 29 is burned in the combustion chamber 26. The hot combustion gases thus formed pass into the combustion-gas chamber 24 and into contact with the thin heat-conducting refractory cover 22 over the trough 21. The cover 22 thereby is heated to a temperature above the melting point of the copper (or other metal) flowing through the trough. Consequently, heat is radiated from the inner surface of the cover to the flowing stream of copper to maintain it in the molten condition. Even very thin, easily frozen streams of molten copper may thus be kept flowing continuously without even partially freezing during passage through the launder.

The arrangement for supplying the heat necessary for this purpose by radiation from the trough cover 22 achieves effective heating of the copper by the relatively inexpensive process of burning a fuel, but without permitting the molten copper to be contaminated by the deleterious products of the fuel combustion.

As shown in the drawings, the combustion gases pass through the combustion-gas chamber 24 in a direction countercurrent to the flow of molten copper through the trough 21. The cover 22 over the trough thereby may be heated to its highest temperature adjacent the discharge end of the trough, where the danger that a thin stream of molten copper may freeze is greatest, and where, in the absence of an adequate supply of heat, freezing ordinarily would take place.

The combustion gases, after passing through the combustion chamber 24, pass through the flue 30 and out the stack 31. If desired, these gases may be passed through a waste heat boiler or other heat recuperating means before they are allowed to escape into the atmosphere.

The substantially gas-tight cover 22 over the trough effectively separates the molten copper flowing through the trough 21 from contact with the combustion gases, and thereby protects the copper from contamination by the deleterious combustion products (such as carbon dioxide and water vapor) present in these gases. Moreover, the cover 22 serves to confine any inert or reducing protective gas atmosphere introduced into the trough 21 through the pipe 23 for the purpose of providing additional protection to the molten copper.

In order to permit of observation of copper entering and flowing through the launder, windows or other appropriate observation ports 32 and 33 may be provided. Advantageously one of the windows 32 is located at a point to permit observation of the copper flowing through the tap hole 17 into the launder, and another window 33 is arranged in the end closure 34 at the end of the launder to permit observation of the thin copper stream flowing into the pouring ladle 13.

If it is desired to incorporate alloying ingredients, such as silicon or phosphorus, in the copper as it is withdrawn from the furnace through the launder, a hopper 35 provided with a suitable valve mechanism 36 may be provided adjacent the discharge end of the launder. A slug of phos-

phorus-copper or silicon-copper master alloy, or other alloying material, may then be dropped through a conduit 37 into the copper in the pouring ladle 13 by manual operation of the valve 36 at appropriate time intervals, as, for example, each time a billet or other shape is cast from the ladle 13.

The launder herein described may be so connected to the furnace that the passage for the flow of copper into the launder is fully enclosed and is substantially gas tight, as shown in the drawings. Hence, there is no danger of contaminating gases entering the launder at this point. The discharge end of the launder is closed by the end closure structure 34 in which the observation window 33 is mounted. The bottom of the supporting steel shell 18 at the discharge end of the launder, and the bottom of the corresponding supporting steel shell of the end closure 34, may be curved cylindrically to mate with the cylindrical curvature of the pouring ladle, thus permitting the ladle to tilt back and forth on its axis for pouring without creating any substantial aperture through which air might gain access to the molten copper or other metal. A very small positive pressure of inert or reducing protective gas introduced through the pipe 23 will effectually prevent the entrance of air through whatever slight cracks or open seams may unavoidably be present in the structure or at the junction between launder and pouring ladle. Thus the launder is such that molten substantially oxygen-free copper may be transferred from the melting furnace 12 to the pouring ladle 13 without becoming oxidized or otherwise contaminated.

Although particular reference has been made in the foregoing description to the use of the new launder for transferring molten copper from a melting furnace to a pouring ladle, it is understood that the launder may be used for transferring other molten materials from one point to another.

I claim:

1. A launder for conducting a thin stream of molten metal from a furnace, comprising a trough of refractory material communicating with the interior of the furnace, a substantially gas-tight cover of heat-conducting refractory material over said trough, a combustion-gas chamber immediately above said cover and extending substantially the full length thereof, and means for introducing hot combustion gases into said combustion-gas chamber, whereby the cover over said trough may be heated and thus maintain a thin stream of metal flowing through the trough in the molten condition by means of radiant heat.

2. A launder for conducting a thin stream of molten metal from a furnace, comprising a trough of refractory material communicating with the interior of the furnace, a combustion-gas chamber over said trough and extending substantially the length thereof, a thin substantially gas-tight cover of heat-conducting refractory material over said trough and separating it from said combustion-gas chamber, and means for introducing hot combustion gases into said combustion-gas chamber, whereby said cover may be heated to an elevated temperature above the melting point of the metal flowing through the trough and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition.

3. A launder for conducting a thin stream of molten metal from a furnace, comprising a trough of refractory material communicating with the interior of the furnace, a combustion-gas cham-

ber over said trough and extending substantially the length thereof, a thin substantially gas-tight cover of heat-conducting refractory material over said trough and separating it from said combustion-gas chamber, means for introducing hot combustion gases into said combustion chamber adjacent one end of the launder, and means for withdrawing said combustion gases from said chamber adjacent the other end of the launder, whereby said cover may be heated to an elevated temperature above the melting point of the metal flowing through the trough and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition.

4. A launder for conducting a thin stream of molten metal from a furnace, comprising a trough of refractory material communicating with the interior of the furnace, a combustion-gas chamber over said trough and extending substantially the length thereof, a thin substantially gas-tight cover of heat-conducting refractory material over said trough and separating it from said combustion-gas chamber, means for introducing hot combustion gases into said combustion-gas chamber adjacent the metal-discharge end of the launder, and means for withdrawing the combustion gases from said chamber adjacent the furnace end of the launder, whereby said trough cover may be heated to an elevated temperature above the melting point of the metal by the combustion gases flowing countercurrent to the flow of molten metal through the trough and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition.

5. A launder of the character described comprising an enclosed conduit for carrying a thin stream of molten metal, a combustion-gas chamber extending substantially the length of said conduit, a thin substantially gas-tight wall of heat-conducting refractory material separating said combustion-gas chamber from the interior of said conduit, and means for introducing hot combustion gases into said chamber in contact with said wall, whereby said wall may be heated to an elevated temperature above the melting point of the metal flowing through said conduit and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition while the metal is maintained out of contact with the combustion gases.

6. A launder for conducting a thin stream of molten metal from a furnace, comprising a trough of refractory material communicating with the interior of the furnace, a combustion-gas chamber over said trough and extending substantially the length thereof, a thin substantially gas-tight cover of heat-conducting refractory material over said trough and separating it from said combustion-gas chamber, a combustion chamber communicating with said combustion-gas chamber adjacent one end thereof, a burner for producing hot combustion gases in said combustion chamber, and means adjacent the other end of the combustion-gas chamber for withdrawing combustion gases therefrom after passing from the combustion chamber through said combustion-gas chamber in contact with said trough cover, whereby said cover may be heated to an elevated temperature above the melting point of the metal flowing through the trough and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition.

7. A launder of the character described comprising an enclosed conduit for carrying a thin stream of molten metal, a combustion-gas cham-

ber extending substantially the length of said conduit, a thin substantially gas-tight wall of heat-conducting refractory material separating said combustion-gas chamber from the interior of said conduit, means for introducing a protective gas atmosphere into said conduit, and means for introducing hot combustion gases into said chamber in contact with said wall, whereby said wall may be heated to an elevated temperature above the melting point of the metal flowing through said conduit and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition while the metal is maintained out of contact with the combustion gases.

8. A launder for conducting a thin stream of molten metal from a furnace, comprising a trough of refractory material communicating with the interior of the furnace, a combustion-gas chamber over said trough and extending substantially the length thereof, a thin substantially gas-tight cover of heat-conducting refractory material over said trough and separating it from said combustion-gas chamber, means for introducing a protective gas atmosphere into said trough, and means for introducing hot combustion gases into said combustion-gas chamber, whereby said cover may be heated to an elevated temperature above the melting point of the metal flowing through the trough and may thereby supply sufficient radiant heat to said flowing metal to maintain it in the molten condition.

9. A launder of the character described comprising an enclosed metal-carrying conduit, the under side of said launder adjacent the metal discharge end thereof being curved substantially uniformly and in such manner as to mate with a correspondingly curved tiltable ladle, whereby such ladle may be tilted without thereby creating

any substantial aperture at the juncture with the launder.

10. A launder of the character described comprising an enclosed metal-carrying conduit, the under side of said launder adjacent the discharge end thereof being curved concavely and substantially cylindrically, whereby said launder may be mated with a correspondingly curved tiltable ladle and such ladle may be tilted without thereby creating any substantial aperture at the curved juncture with the launder.

11. A launder for conducting a thin stream of molten metal from a furnace to a tiltable pouring ladle, comprising a trough of refractory material communicating at one end with the interior of the furnace and discharging at the other end into the pouring ladle, a substantially gas-tight cover of heat-conducting refractory material over said trough, a combustion-gas chamber immediately above said cover and extending substantially the full length thereof, and means for introducing hot combustion gases into said combustion-gas chamber, whereby the cover over said trough may be heated and thus maintain a thin stream of metal flowing through the trough in the molten condition by means of radiant heat, while the molten metal itself is maintained out of contact with contaminating combustion and other gases, the underside of said launder adjacent the discharge end being curved substantially uniformly and in such manner as to mate with a correspondingly curved surface of the pouring ladle, whereby the ladle may be tilted without thereby creating at its juncture with the launder any substantial aperture through which contaminating gases could pass in deleterious amounts into contact with the molten metal in the launder.

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