

[54] **SPLASH ARRESTER HAVING PACT MEMBER SUPPORTED IN HOUSING**

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[58] Field of Search222/547, 567, 575, DIG. 1, 222/DIG. 23; 239/428.5, 590; 164/135, 337, 281; 249/206

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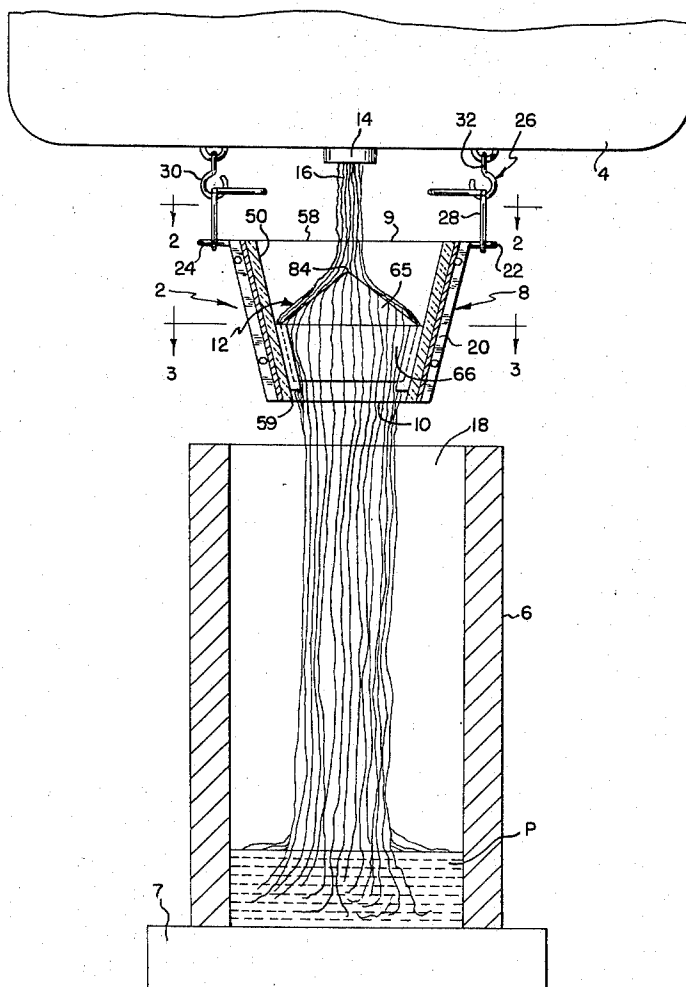
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[57]

ABSTRACT

A splash arrester apparatus adapted for use in pouring molten metal into a mold including an open ended housing of refractory material adapted to encompass a stream of molten metal being poured into the mold. An impact member is supported by the housing being adapted to change the direction of flow of the molten metal as it passes through the housing. The impact member and housing define passageway means so constructed and arranged to change the shape of the entering molten metal stream into ribbon-like shaped streams to reduce the force of the molten metal striking the pool of metal contained in the mold.

14 Claims, 3 Drawing Figures



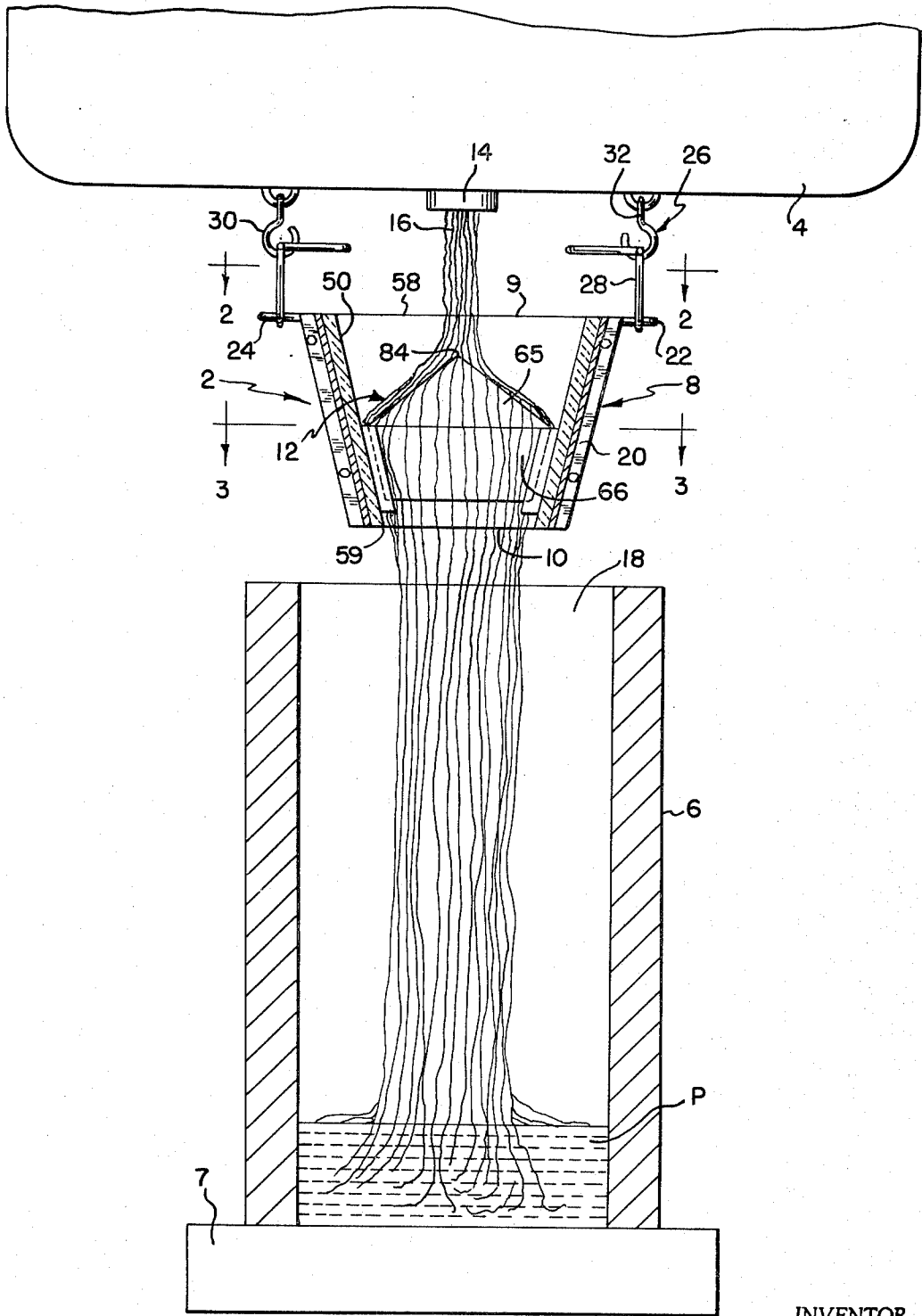


FIG. 1

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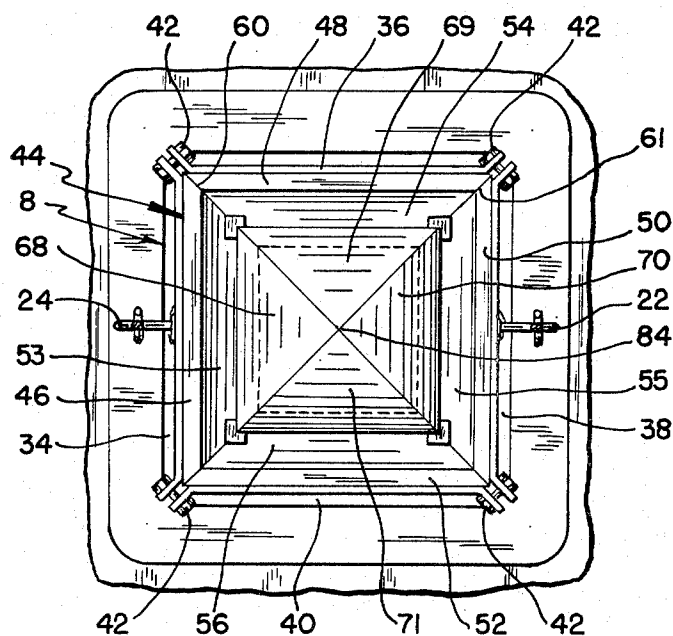


FIG. 2

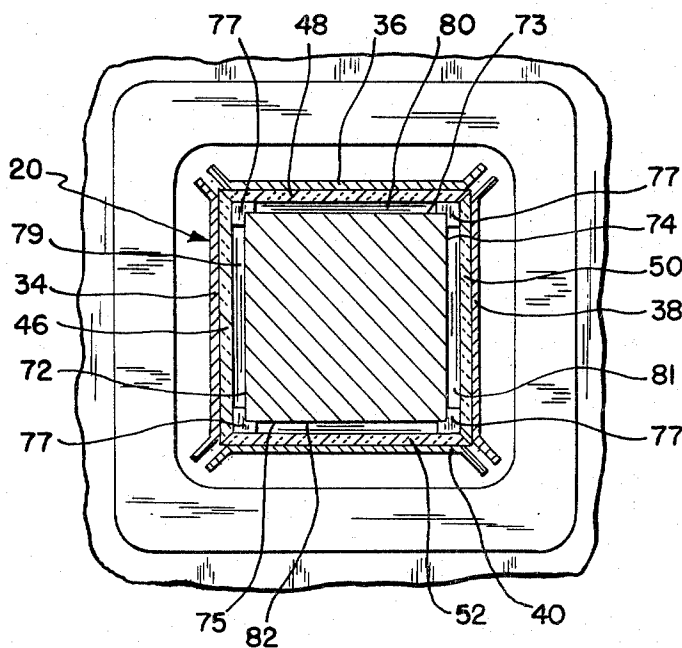


FIG. 3

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SPLASH ARRESTER HAVING PACT MEMBER SUPPORTED IN HOUSING

This application is a continuation-in-part of the copending application of Robert A. Saxer, Ser. No. 16,766, filed Mar. 5, 1970.

BACKGROUND OF THE INVENTION

This invention relates to the pouring and/or casting of metal, such as iron and steel, and more particularly relates to an improved apparatus and method for pouring and/or casting of ingots to eliminate or minimize defects in a finished product thereof.

As stated in the co-pending application, the aforementioned defects are present in many forms, such as scabs and cracks, which are formed in numerous ways. For example, scabs may occur as a result of the splashing of the molten metal onto the mold walls as the molten metal is poured into the mold. Scabs may also occur as a result of a surge of the molten metal above the general level of the molten metal in the mold. These surges are a result of waves formed by teeming streams of molten metal striking the pool of molten metal within the mold. Scabs may also occur as a result of air bubbles formed by the trapping of air by the teeming stream, which air is carried some distance under the surface of the molten pool. As the trapped air surges upwardly it tends to force the liquid metal ahead of it above the general level of the pool of molten metal thereby generating a wave. As the wave strikes the mold walls, a thin layer of metal will solidify above the general level of the molten pool. As the level of the molten pool rises in the mold, this thin layer is covered often resulting in an imperfect weld between this layer and the main body of the ingot. As the ingot cools, the stresses created by the normal contraction of the metal during the cooling process are frequently sufficient to cause rupturing in the area of the weld thus formed.

Understandably, the height of the generated waves has a direct bearing on the number and size of the aforementioned defects. Of course, larger waves will be formed as a result of the air bubbles being driven deeper into the molten pool. In the case of a larger wave, the molten metal will be deposited higher on the mold wall above the general level of the pool, and thus, the metal so deposited has more time to cool and become oxidized before being covered by the molten metal in the pool.

In addition, the teeming stream upon striking the molten metal in the pool tends to force the metal ahead of it to the bottom of the mold and then across the bottom of the mold onto the walls thereof. The velocity and mass of the currents formed within the pool are often sufficient to cause certain areas of the mold walls to be welded to the body of the ingot. During the cooling of the ingot or casting, stresses are created at these areas which often result in a crack in the body of the ingot.

Heretofore, devices known as tundishes have been used to reduce the force of the teeming stream as it strikes the standing pool of molten metal in an ingot. Although these devices did serve to improve somewhat on the aforementioned conditions, they have not proven to be entirely satisfactory. These tundishes have been provided with multiple or single nozzles. Often, the nozzle size is too large to sufficiently reduce the force of the teeming stream. When the nozzle size was

reduced sufficiently to minimize such force, too many nozzles were required to keep up with the rate of flow of molten metal into the tundish. The use of numerous small nozzles frequently resulted in the weakening of the refractory lining and also caused congealing of metal within the nozzles. It is extremely important that the discharge of molten metal from the tundish keep up with the molten metal entering the tundish to avoid too frequent manipulation of the ladle stopper. Such frequent manipulation results in fouling or plugging of the stopper-nozzle arrangement and at times results in loosening of the stopper head from the stopper rod causing uncontrolled flow of molten metal from a ladle.

SUMMARY OF THE INVENTION

The present invention contemplates providing a splash arrester device for use in pouring molten metal into an ingot mold. The device comprises a hollow housing of refractory material being open unrestrictedly at the top and bottom being adapted to encompass a stream of molten metal as it flows from a ladle and to discharge it through the bottom of the housing into the mold. An impact member is mounted within the housing between the top and bottom thereof. The impact member coacts with the housing to form passageways through which the molten metal flows for discharge in ribbon-like streams from the housing. The impact member is of a substantially pyramidal shape having an apex adjacent the vertical center of the housing and a base cooperating with the housing to form the passageways. The housing includes walls which diverge upwardly and outwardly from the bottom, and the impact member includes a portion thereof shaped complementary to the slope of the walls for supporting the impact member by gravity in its position within the housing. The volume of the impact member above its base is at least equal to 7 per cent of the volume enclosed by the walls of the housing between the base and a horizontal plane extending through the apex of the impact member. The slope of the pyramidal portion is between 30° and 70° with respect to a plane extending horizontally through the apex thereof. The housing is of a generally polygonal configuration, in top plan, including a frame and a lining of refractory material carried by the frame. The lining includes a plurality of slab members secured in end-to-end relation defining a passageway between the open top and bottom thereof. The passageways have a combined transverse cross-sectional area equal to or greater than the cross-sectional area of the orifice of the ladle nozzle discharging the molten metal into the apparatus. In addition, the passageways are of a rectangular configuration, in cross-section, having their lengthwise dimension equal to approximately three or more times greater than the widthwise dimension thereof.

As can be seen, the aforementioned structural arrangement provides an apparatus which is capable of substantially reducing the force of a molten metal stream upon striking a pool of molten metal contained in an ingot mold. Further, such an arrangement enables the molten metal to flow through the apparatus at a sufficiently rapid speed to prevent solidification of the metal within the passageways thereof. Still further, the apparatus effectively reshapes the form of the molten metal stream into ribbon-like streams having a

thickness sufficient to minimize splashing and the penetration of the molten metal entering the standing pool of molten metal within the mold thereby effectively reducing the size and incidence of cracks or scabs in the finished ingot product.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional, side elevation view of the splash arrester apparatus of the present invention shown in position above an ingot mold;

FIG. 2 is a fragmentary, cross-sectional view taken along the line 2—2 of FIG. 1; and

FIG. 3 is a fragmentary, cross-sectional view taken along the line 3—3 of FIG. 1.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

The splash arrester apparatus of the present invention is illustrated in FIG. 1, generally at 2, being adapted for use in teeming of molten metal, such as steel, iron or the like, from a ladle 4 into an ingot mold 6 which is mounted in a conventional manner on a support base 7.

In the form of the invention shown, the apparatus includes a hollow housing 8 being open adjacent the upper end 9 and lower end 10 being adapted to be supported beneath the ladle 4. An impact member 12 is shown mounted within the housing 8 being disposed in aligned relation with the nozzle 14 of the ladle 4. By this arrangement, the molten metal in the teeming stream 16 being discharged through the nozzle 14 will enter the open end of the housing and impinge upon the impact member 12, and then be directed by the housing and impact member through the apparatus for discharge from the lower end into the cavity 18 of the mold 6.

As shown, the housing 8 comprises an inverted-truncated body which may be of any suitable cross-sectional configuration, but preferably is generally rectangular or square, and of a symmetrical design. The housing 8 may include an outer frame 20 including outwardly projecting rods or pintles 22 and 24 adapted for supporting the housing beneath the ladle 4. The rods 22 and 24 may be connected to the frame 20 in any suitable manner, such as by welding or the like, being adapted for mounting on a suitable support assembly 26 carried adjacent the underside of the ladle 4. As shown, the support assembly 26 may include a hanger member 28 adapted to supportingly engage the rods 22 and 24. The hanger member 28 may be detachably connected to hooks 30 and 32 secured to the underside of the ladle 4 to thus suspend the housing 8 in generally fixed position beneath the ladle 4.

As shown in FIG. 2, the frame 20 includes generally flat side plates 34, 36, 38 and 40 which may be connected to one another at their adjacent ends in any suitable manner, such as by bolts 42 or the like. Further, the frame 20 supports a liner 44 of refractory material to insulate the frame 20 from the molten metal during the pouring process. The liner 44 includes a plurality of generally flat slab-like members 46, 48, 50 and 52 having interior surfaces 53, 54, 55 and 56, respectively, which are supported in inclined relation by the frame 20 being inclined downwardly and inwardly toward one another and adapted to support the impact

member 12 in spaced relation therebetween. As all the slab-like members are shown as being identical in configuration, only one, such as 48, will be described in detail herein.

The slab-like member 48 may be of any suitable configuration, but as shown, is preferably generally wedge-shaped including generally parallel upper and lower edges 58 and 59 (FIG. 1), respectively, and inclined side edges 60 and 61. Preferably, the side edges 60 and 61 are inclined or tapered toward one another from the upper edge 58 to the lower edge 59 so that the slab-like member 48 is narrower adjacent the lower edge. In addition, each of the respective side edges 60 and 61 may be beveled, such as at an angle of 45 degrees, to enable tight seating engagement of the side edge of one slab-like member, such as 48, with the confronting side edge of an adjacent slab-like member, such as 46. By this arrangement, the respective slab-like members will be wedged together to prevent sliding movement downwardly with respect to the frame 20 when in the installed position. As shown, the liner 44 may terminate adjacent the lower edge of the frame 20, but it is understood that it may project downwardly beyond the frame, if desired.

The impact member 12 preferably includes a baffle-like upper portion 65 and an inverted truncated lower portion or base 66 which is adapted for seating engagement with the liner 44. As shown in FIG. 1, the upper portion may be of a generally pyramid-like configuration. Referring now to FIG. 2, the upper portion may include generally smooth deflecting surfaces 68, 69, 70 and 71 which are adapted to deflect the molten metal outwardly toward the interior surfaces 53, 54, 55 and 56, respectively, of the liner 44. Preferably, the respective deflecting surfaces are inclined downwardly and outwardly, such as at an angle of approximately 30° to 70° with respect to the horizontal, terminating in the lower portion 66 (FIG. 1). Preferably, the slope of the deflecting surfaces is substantially steep to enhance the rapid transfer of molten metal therealong and prevent solidification of the same within the housing 8.

Referring now to FIGS. 2 and 3, the lower portion or base 66 is defined by generally flat side walls 72, 73, 74 and 75 which have a reverse inclination with respect to the deflecting surfaces of the upper portion 65 being inclined generally downwardly and inwardly toward one another in a direction toward the lower end 10 of the housing 8. Further, the impact member 12 may be supported in spaced relation with respect to the surrounding liner 44 by means of insulating spacers 77. The spacers 77 support the respective side walls 72, 73, 74 and 75 in generally parallel relation with respect to the confronting surfaces 53, 54, 55 and 56 of the liner 44 to define generally elongated passageways 79, 80, 81 and 82 therebetween, respectively, to provide a path for the flow of molten metal through the housing 8.

The passageways 79, 80, 81 and 82 are preferably rectangular in transverse cross-section having their lengthwise dimension equal to approximately three or more times greater than the widthwise dimension to permit the stream of molten metal flowing therethrough to occupy a cross-sectional area greater than the cross-sectional area of the orifice of the ladle nozzle while at the same time sufficiently narrow whereby the stream velocity and penetration into the

standing pool of molten metal in the mold is minimized. In addition, this arrangement obviates the need for separate discharge nozzles and results in the molten metal being discharged uniformly in ribbon-like streams having substantially less impact force than the teeming stream 16. Preferably, the upper portion 65 of the impact member 12 is positioned a sufficient distance interiorly of the frame 20 to prevent the molten metal from splashing over the upper marginal edge, such as at 58, of the liner 44. Preferably, the volume occupied by the upper pyramidal portion 65 of the impact member 12 is equal to 7% or more of the interior volume of the housing 8 defined by the portion of the respective liner side surfaces above the upper extremity of the passageways 79, 80, 81 and 82 and a plane extending generally horizontally through the apex, such as at 84, of the upper portion 65 (FIG. 1).

The spacer members 77 are also made of a refractory material and may be mounted within the housing in any suitable manner. In the form shown, each of the spacer members is generally L-shaped in cross-section (FIG. 3) being adapted to engage the lower portion 66 of the impact member adjacent the juncture of the side walls 72, 73, 74 and 75. Preferably, the spacer members are held in position solely by the force of the wedging action of the impact member 12 with the housing 8. Spacer members of varying thickness may be provided to vary the width of the passageways 79, 80, 81 and 82 to selectively control the thickness of the ribbon-like streams of molten metal being discharged from the apparatus. In addition, this arrangement also enables the respective spacer members to be readily and easily removed and replaced for maintenance purposes, when necessary.

I claim:

1. A splash arrester apparatus for use in pouring molten metal from a ladle into a mold, comprising:

a hollow housing of refractory material,
said housing being unrestrictedly open at the top and adapted to encompass a stream of molten metal being poured from said ladle,

said housing including walls diverging upwardly and outwardly from the bottom,

an impact member disposed within the housing and including walls which are shaped complementary to the slope of the walls of the housing,

spacing members interposed between the housing and impact member and operating to hold the walls of the impact member away from the walls of the housing and to form passageways through which the molten metal flows for discharge from said housing into said mold.

2. An apparatus in accordance with claim 1, wherein said impact member includes an upper portion which is a portion being substantially pyramidal in shape having an apex adjacent the vertical center of said housing and a base cooperating with said housing to form said passageways.

3. An apparatus in accordance with claim 2, wherein said impact member has a volume above its base equal to or greater than 7 percent of the volume enclosed by said walls of said housing between said base and a horizontal plane extending through said apex of said impact member.

4. An apparatus in accordance with claim 2, wherein

the slope of said pyramidal portion is between 30° and 70° with respect to a plane extending horizontally through the apex thereof.

5. An apparatus in accordance with claim 1, wherein said housing is of a generally polygonal configuration, in top plan, including a frame, and

a lining of refractory material carried by said frame.

6. An apparatus in accordance with claim 5, wherein said lining includes a plurality of slab members secured in end-to-end relation defining a passageway between the open top and bottom ends of said housing.

7. An apparatus in accordance with claim 1, wherein said passageways have a combined transverse cross-sectional area equal to or greater than the cross-sectional area of the orifice of said ladle nozzle discharging molten metal into said apparatus.

8. An apparatus in accordance with claim 1, wherein said passageways are of a generally rectangular configuration, in cross-section, having their lengthwise dimension equal to approximately three or more times greater than the widthwise dimension thereof.

9. An apparatus in accordance with claim 1, including

hanger means operably connected to said housing being adapted to support said housing in stationary overlying relation with respect to said mold.

10. A splash arrester apparatus for use in pouring molten metal from a ladle to a mold or the like, comprising,

a hollow housing having a liner of refractory insulating material and being unrestrictedly open at its top and bottom to encompass a stream of molten metal poured from said ladle,

said housing being of a generally inverted-truncated, in side elevation, construction defined by a plurality of side walls which extend divergently upwardly and outwardly from said open bottom,

attachment means for detachably mounting said housing immediately below said ladle and above said mold,

an impact member disposed interiorly of and supported by gravity within said housing,

said impact member including a baffle-like upper portion made integral with and extending centrally upwardly from a base,

said upper portion including a plurality of smooth deflecting surfaces which are inclined upwardly and inwardly generally opposite to the inclination of the side walls of said housing adapted to deflect molten metal downwardly and outwardly toward the confronting interior surfaces of said housing,

said base being of a generally inverted, truncated configuration having a plurality of side walls inclined complementary with respect to and for seating engagement with the confronting interior surfaces of the side walls of said housing,

spacer means disposed between said housing and said impact member for holding the respective side walls of the base of said impact member in spaced, generally parallel relation with respect to the confronting interior surfaces of the side walls of said

housing to define a plurality of polygonal passageways therebetween, and each of said passageways having a lengthwise dimension greater than the widthwise dimension so as to enable molten metal to be discharged in a plurality of ribbon-like streams into said mold.

11. An apparatus in accordance with claim 10, wherein

the base of said impact member is polygonal in transverse cross section having the same number of sides as that of the sides of said housing so as to define a plurality of passageways corresponding in number to that of the number of sides of said housing, and

said passageways having their lengthwise dimension equal to approximately three or more times greater than the widthwise dimension thereof.

12. An apparatus in accordance with claim 10, wherein

the upper portion of said impact member is of a pyramidal shape defining an apex remote from said base and spaced axially inwardly of the open top of said housing, and

the number of deflecting surfaces on said upper por-

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tion corresponding to the number of side walls of said base and said housing.

13. An apparatus in accordance with claim 12, wherein

the volume occupied by the upper pyramidal portion of the impact member is equal to at least 7 per cent or more of the interior volume of the housing defined by the volume within the side walls of the housing above the distal ends of said passageways and a plane extending generally horizontally through the apex of said upper pyramidal portion thereof.

14. An apparatus in accordance with claim 10, including

a plurality of projections extending laterally outwardly from said housing adjacent the open top thereof,

hook members depending downwardly from the underside of said ladle, and

hanger members removably connected at one end to said projections and at the other end to said hook members for detachably mounting said device immediately below said ladle and above said mold.

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