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TUNDISH NOZZLE CONSTRUCTION

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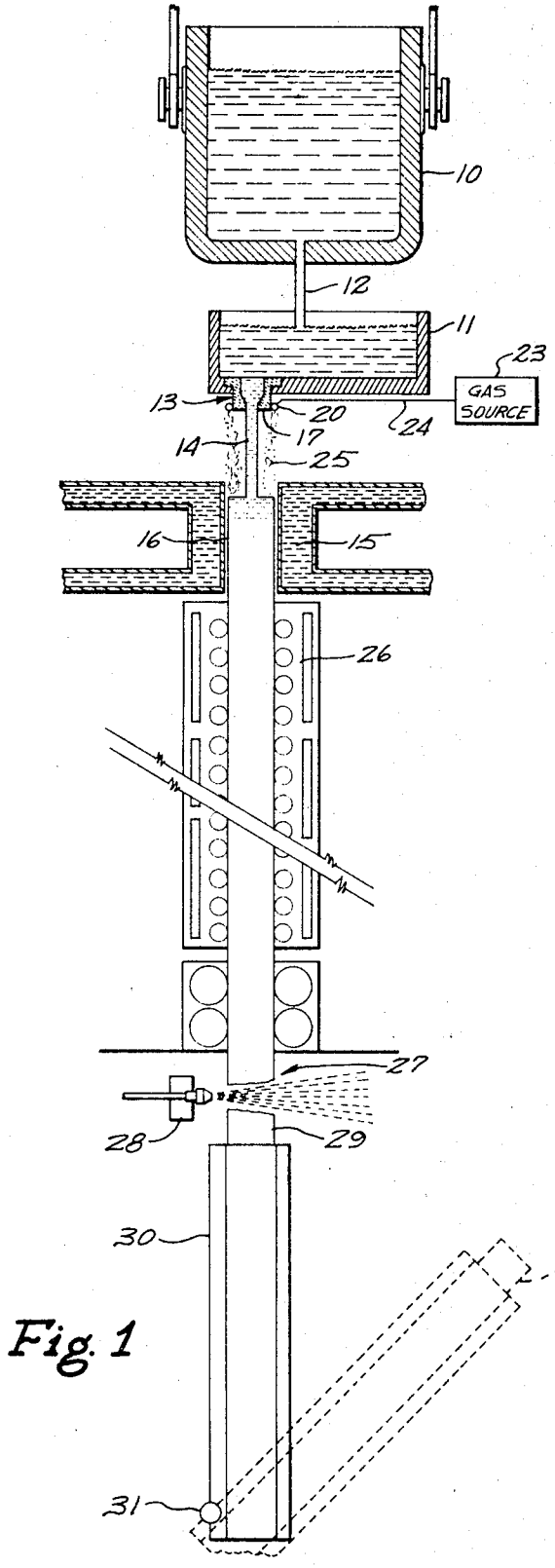


Fig. 1

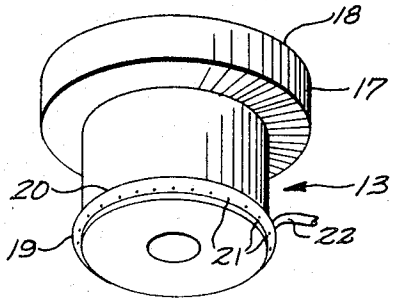


Fig. 2

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TUNDISH NOZZLE CONSTRUCTION

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ABSTRACT OF THE DISCLOSURE

A nozzle for use in tundish ladles consisting of a cylindrical shell of refractory, the lower extremity thereof having concentrically secured thereto a tubular conduit having a plurality of apertures for the ejection of inert gas.

The commercial use of processes for the continuous casting of steel seems destined to take an increasingly important position in contemporary steelmaking. Its many advantages in terms of cost, labor, and simplicity of practice make it very attractive to a highly automated industry.

Continuous casting is generally defined as the making of a casting many times the length of the mold in which it is produced. Molten steel is poured into an open bottom mold of the desired product shape. The steel is cooled in the mold just enough to harden the exterior surface of the casting, which forms a shell or container to hold the balance of the liquid metal. The partially solidified casting is then continuously withdrawn from the bottom of the mold, where it is further cooled by water sprays until all the metal is solidified.

Preparing liquid metal for pouring and handling hot bars presents no serious problems. The secret of success and wherein the problems arise is in handling the metal from the time it is poured from the ladle until it leaves the mold.

The tundish plays an important role in this process. It provides a means for controlling the rate of flow by regulating the metal level in it. Also, here is where provisions must be made for holding back slag since if any goes through into the mold it eventually will cause sticking.

The particular problem with which the present invention is concerned, is in the continuous casting of steel where a deoxidizer, particularly aluminum, is added to the molten batch. As the stream of steel containing aluminum flows to the mold, from the tundish nozzle, spinels are formed. These spinels appear as large icicles which seriously interfere with the stream of metal.

Accordingly, it is an object of the present invention to provide a means for preventing the formation of spinels in aluminum containing molten steel in the continuous casting process.

Another object of the invention is to provide an improved tundish nozzle construction for use in the process of the invention.

Other objects of the invention will, in part, be apparent hereinafter.

In order to more fully understand the nature and scope of the present invention, reference should be had to the following detailed description and drawings, in which:

FIG. 1 is a schematic diagram of a portion of a continuous casting operation, employing the concepts of the present invention; and

FIG. 2 is a perspective view of a tundish nozzle according to the present invention.

Briefly, according to one embodiment of the present invention, steel is continuously cast by pouring a prepared molten steel into a transfer ladle. In the ladle, a deoxidizer (i.e., aluminum) is intermixed with the steel. The steel is then transferred to a tundish and is finally passed in a uniform stream from the tundish through a tundish

nozzle to a mold. As the metal stream exits from the tundish nozzle, a surrounding curtain of inert gas is applied thereto between the tundish and the mold to prevent the formation of spinels in the steel.

The curtain of gas is applied through a circular tubular conduit disposed about the lower extremity of the tundish nozzle. The conduit contains a plurality of apertures opening toward the metal stream. The conduit also contains means connecting it to a source of inert gas. Suitable inert gases for use herein are carbon dioxide, nitrogen, helium and argon.

The term spinel refers to a group of minerals which crystallize in the cubic systems, and which have the formula $RO \cdot R_2O_3$. The RO may consist of one or more of the bivalent oxides MgO, FeO, MnO, or ZnO. The R_2O_3 may consist of one or more of the trivalent oxides; Al_2O_3, Cr_2O_3, or Fe_2O_3. The usual and most troublesome spinel formed when employing an aluminum deoxidizer is $FeO \cdot Al_2O_3$. However, various spinels may form using other deoxidizers.

Referring to the drawings, in FIG. 1, a ladle of steel **10** is placed above a tundish **11** in such a position to continuously discharge a stream of molten metal **12** to the tundish, and at such a rate as to maintain a substantially even bath depth in the tundish. A nozzle **13**, according to this invention, opens from the bottom of the tundish, and is so positioned that its bottom orifice discharges a stream **14** of substantially constant volume and cross sectional dimension into the mold cavity **15** wherein a shaping and skin formation is caused to form the steel strip **16**.

As is shown more clearly in FIG. 2, the nozzle **13** consists of a cylindrical shell **17** of refractory material. The shell has an upper extremity **18** and a lower extremity **19**. A tubular i.e., donut shaped conduit **20** is concentrically secured to the lower extremity of the shell. The conduit may be fabricated of any material capable of withstanding the temperatures prevalent in the area employed. The conduit may be secured to the nozzle by any method known to those skilled in the art. The tubular conduit contains a plurality of apertures **21** opening in the direction of the lower extremity **19**, of the shell. At least one aperture **22** therein, is adapted for interconnection of the conduit with an inert gas source. As in FIG. **1**, the gas source is indicated generally at **23** and is connected to the conduit by means of a pipe **24**.

The dimensions for the tundish and nozzle vary, depending upon the installation in which they are used. The shape of the nozzle is also variable, depending upon the desire of a user. It can be generally inverted bell shaped with an orifice opening through the small end of the bell. It can be a truncated, cone shape with the exit orifice formed through the smaller end of the cone.

Referring again to FIG. 1, as the stream **14** passes between the bottom orifice of the tundish nozzle and the mold cavity **15**, a curtain of inert gas **25** completely envelopes the stream so as to prevent the formation of spinels as hereinbefore described.

The strip **16** passes downwardly between rollers **26** until it eventually is entirely solidified, at which point it is cut into lengths, as at **27**, whereat we have schematically indicated an oxyacetelene burner **28** cutting off lengths of steel **29** in the container **30**. The container **30** is pivoted about pin **31**. As soon as a length of steel **27** has been cut, the container rotates, as shown in dotted lines to a substantially horizontal position and the cut billet or length of steel **27** is discharged onto, for example, a conveyor system for movement to additional treatment stages, storage, etc. (not shown).

Having thus described the invention in detail and with sufficient particularity as to enable those skilled in the art to practice it, what is desired to have protected by Letters Patent is set forth in the following claims.

I claim:

1. A nozzle, suitable for use in tundish ladles consisting essentially of a cylindrical shell of refractory material defining a nozzle opening, said shell having an upper extremity and a lower extremity, the lower extremity having concentrically secured thereabout and in contiguous contact therewith a tubular conduit having a plurality of apertures therein opening in planes parallel to the nozzle opening and in the direction of the lower extremity of the nozzle and at least one aperture therein adapted for interconnection with an inert gas source.

2. The nozzle of claim 1 in which said conduit is generally donut shaped.

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