

[54] **PRESSURIZED TILTABLE TUNDISH CONSTRUCTION**

[75] Inventor: **Richard E. Lyman**, Country Club Hills, Ill.

[73] Assignee: **United States Steel Corporation**, Pittsburgh, Pa.

[22] Filed: **Sept. 10, 1971**

[21] Appl. No.: **179,403**

[52] U.S. Cl..... **222/166, 164/281, 222/396**

[51] Int. Cl..... **B22d 11/10**

[58] Field of Search..... 164/281, 283, 276, 164/279, 278, 337, 259, 82, 87, 66, 155; 222/166, 396

[56] **References Cited**

UNITED STATES PATENTS

2,659,948 11/1953 Properzi..... 164/278

3,299,481 1/1967 Brotzmann..... 164/82
3,368,273 2/1968 Maltsev et al. 164/283 X
3,467,284 9/1969 Koncsics et al..... 222/166

FOREIGN PATENTS OR APPLICATIONS

4,679 2/1889 Great Britain..... 164/283

Primary Examiner—Robert D. Baldwin

Attorney—Ralph H. Dougherty

[57] **ABSTRACT**

A tundish formed as a fully enclosed refractory-lined vessel for feeding molten metal to a continuous-casting machine. Particularly useful with inclined-mold casting machines. The vessel is mounted to tilt and has a nozzle in the bottom and a funnel in the top. The vessel is pressurized through a dynamic pressure regulator which controls the effective head at the nozzle.

4 Claims, 3 Drawing Figures

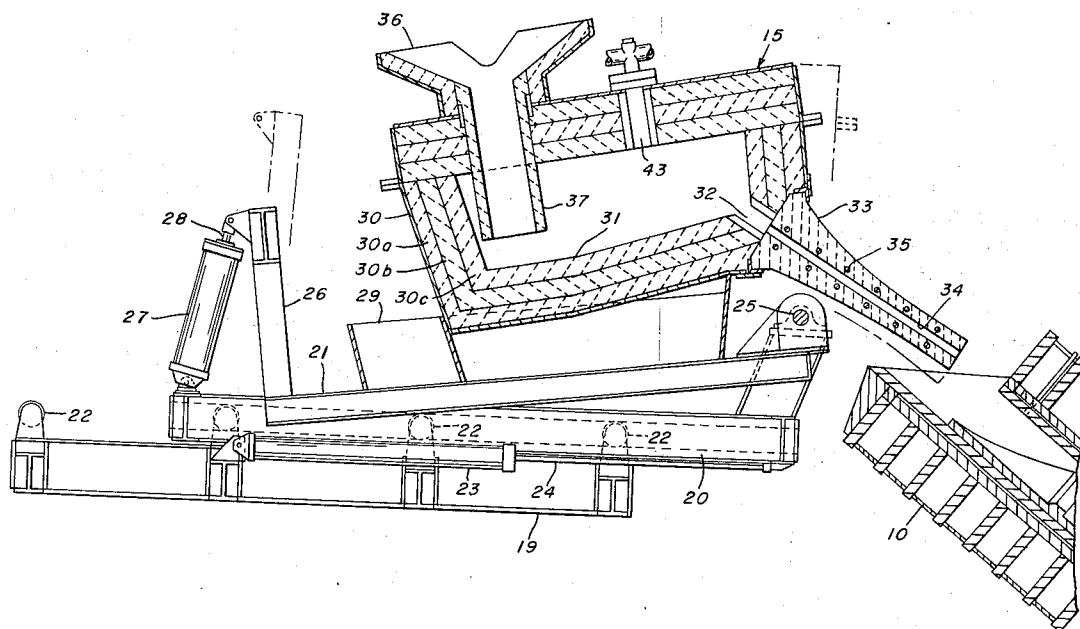


FIG. 1.

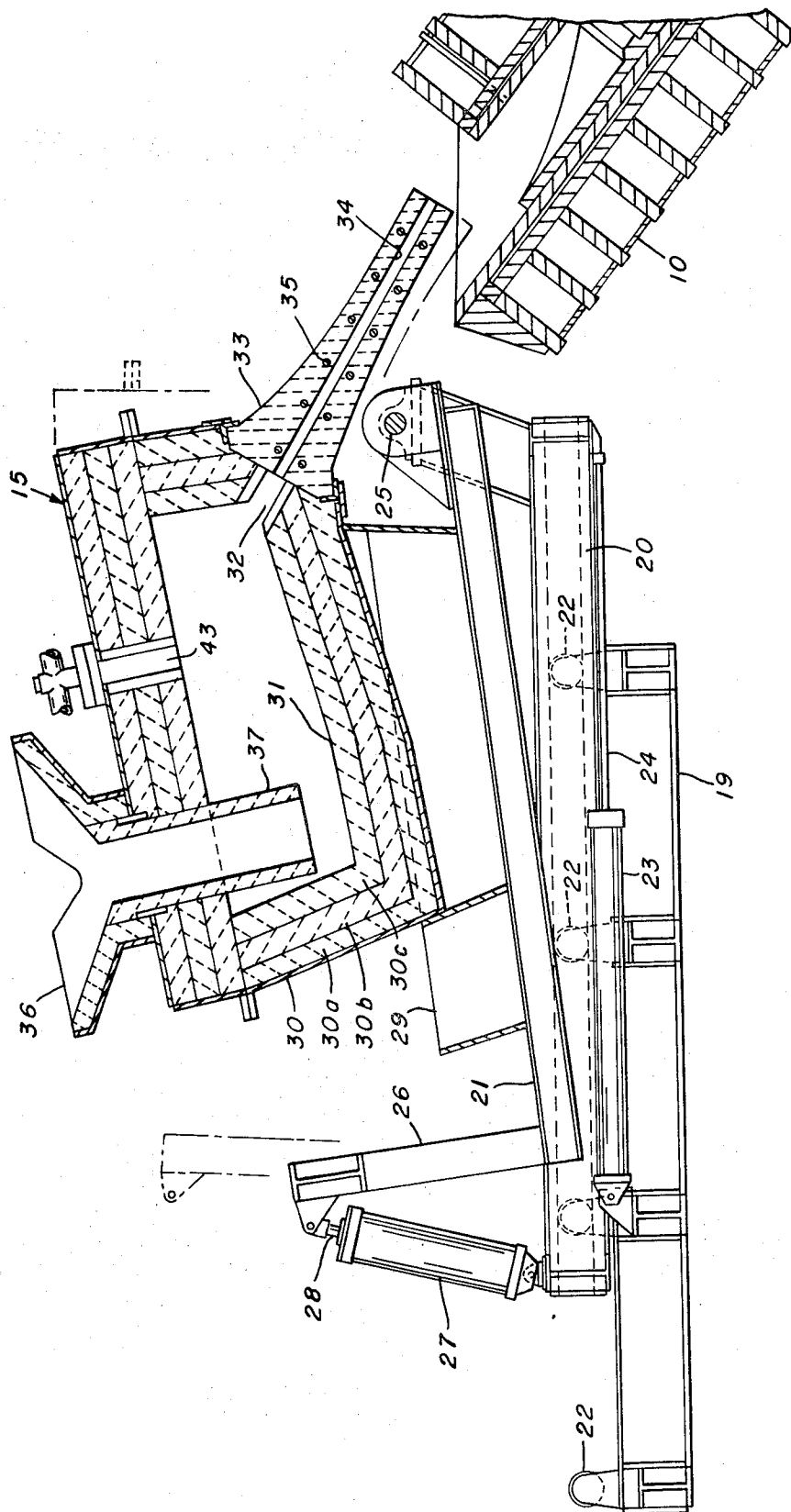


FIG. 2.

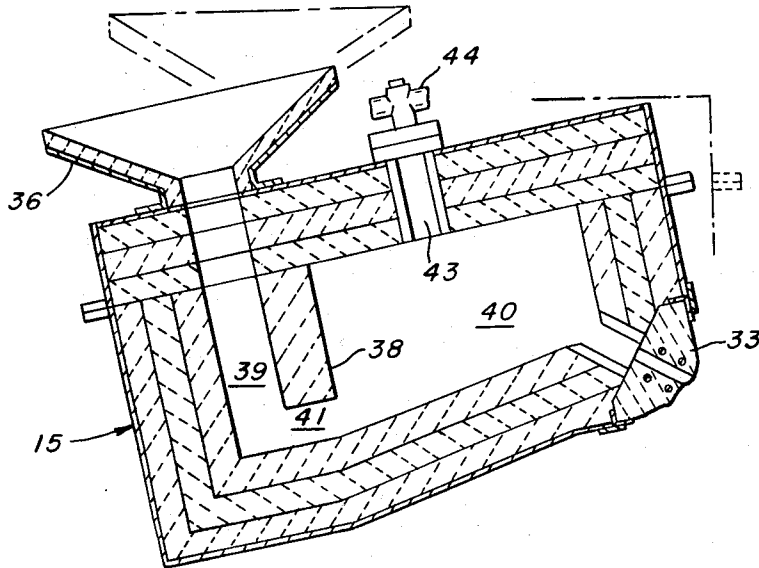
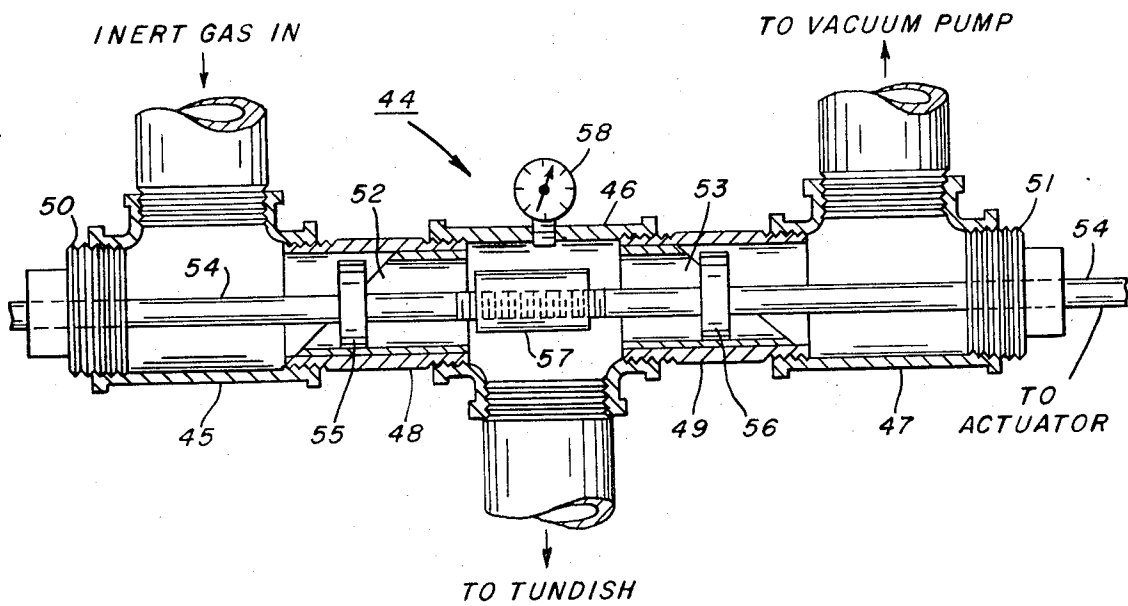


FIG. 3.



PRESSURIZED TILTABLE TUNDISH CONSTRUCTION

This invention relates to an improved tundish construction for feeding molten metal to a continuous-casting machine.

Although my invention is not thus limited, my tundish is particularly useful for feeding molten metal to any type casting machine, including a machine having a non-vertical mold, one example of which is shown in Rossi U.S. Pat. No. 3,391,725. It is especially useful in those machines in which it is important to distribute the molten metal uniformly across the width of the mold as it is fed. It is important to control the rate of feeding in such machines. Provision also should be made for shutting off the flow of metal from the tundish very quickly. My invention effectively achieves these objectives, when applied to an inclined mold casting machine, but it is apparent I may apply the same principles to feeding other types of casting machines such as belt-type casters.

An object of my invention is to provide an improved tundish construction and feeding method which assure both that molten metal is distributed uniformly across the width of a casting machine, and that the feed rate can be controlled.

A further object is to provide a tundish which enables the flow of molten metal from the tundish to be shut off quickly without causing the metal to freeze at the pouring nozzle nor to drip or spray into the casting cavity and form solid hangers.

A further object is to provide an improved tilting tundish which is equipped with a dynamic pressure regulator for controlling the pouring rate.

In the drawings:

FIG. 1 is a vertical sectional view of my improved tundish installed on an inclined-mold casting machine; and

FIG. 2 is a vertical sectional view of an alternative tundish.

FIG. 3 is a vertical sectional view on a larger scale of my dynamic pressure regulator.

FIG. 1 shows diagrammatically the feed end portion of an inclined mold casting machine which includes a water-cooled open-ended mold 10 which slopes downwardly from the feed end at an angle illustrated as about 20° from horizontal. Molten metal is fed from a tundish 15 into the open upper end of the mold. Machines of this type apart from my novel tundish are known, as shown for example in the aforementioned Rossi patent; hence no more detailed description is deemed necessary.

In accordance with my invention, the tundish 15 has a fixed horizontal base 19, a carriage 20 mounted for movement along the base, and a tilting frame 21 mounted on the carriage, preferably of structural steel members. The base has rollers 22 on which the carriage rides. A hydraulic cylinder 23 is attached to the base and contains a reciprocable piston and piston rod 24 attached to the carriage for propelling the latter. One end of frame 21 is pivotal about axle 25, which axle is connected through a bearing block to carriage 20. The opposite end of the frame carries an upright post 26. Another hydraulic cylinder 27 is pivoted to the carriage 20 and contains a reciprocable piston and piston rod 28 pivoted to the upper portion of the post for tilting the frame. The frame carries a base 29 on which I mount the tundish 15 itself.

Tundish 15 has the form of a fully enclosed vessel and includes a steel shell 30 and a refractory lining 31. I prefer to make up the lining of a layer 31a of ordinary fire clay brick next to shell 30, an intermediate layer 31b of low-density insulating refractory such as bubbled alumina, and an innermost working layer 31c of high magnesia or high alumina content. The shell 30 and lining 31 have outlet openings 32 which lead to a nozzle block 33 at the lower edge of the tundish adjacent the casting machine. The nozzle block has a multiplicity of discharge passages 34 across its width aligned with the opening of mold 10, and its tip fits partially into this opening. Alternatively, the tundish may be provided with a plurality of nozzles, each having one or more discharge passages. The nozzle block can also contain a plurality of electric heating elements 35 above and below its passages 34. I mount a funnel 36 in the top wall of the tundish remote from the nozzle. The funnel includes a downcomer 37 which extends a substantial distance within the tundish. I shape the bottom wall of the tundish to provide a greater depth at the end adjacent the funnel than at the other end adjacent the nozzle. This provides a liquid-metal seal for the interior of the tundish.

Alternatively, as shown in FIG. 2, I employ a baffle 38 depending from the top wall of the tundish to divide the tundish into a riser section 39 and a vacuum receiver section 40 connected by passageway 41. This provides the same liquid-metal seal as the arrangement of FIG. 1.

The top wall of the tundish also has a port 43 in which I removably mount a dynamic pressure regulator 44. As FIG. 3 shows, this pressure regulator includes three tees 45, 46 and 47, a nipple 48 connecting two arms of tees 45 and 46, a nipple 49 connecting two arms of tees 46 and 47, and plugs 50 and 51 closing the outer arms of tees 45 and 47. The leg of tee 46 communicates with port 43 of the tundish. I connect the leg of tee 45 to a source of inert gas (usually argon) under pressure, and the leg of tee 47 preferably to a vacuum pump, although it may simply discharge to the atmosphere. Nipples 48 and 49 contain variable opening valve sleeves 52 and 53 respectively. An operating stem 54 extends through the assemblage of tees and nipples and out the plugs 50 and 51 at each end of the assemblage. The stem carries valve discs 55 and 56 within the sleeves 52 and 53 respectively. The mid-portion of the stem includes an adjusting sleeve 57 for varying the relative position of the two discs. I connect one end of the stem to a suitable actuator (not shown). The central tee 46 carries a pressure gage 58 located between the two discs.

According to my feeding method, I start with the piston rod 28 retracted in its cylinder 27 and frame 21 and tundish 15 tilted away from the casting machine, as shown in solid lines in FIG. 1. I preheat the inside of the tundish, preferably to a temperature of about 2,700° to 3,000° F. Conveniently I use the burner and follow the procedure described and claimed in my U.S. Pat. No. 3,480,376 in preheating. I may either remove the pressure regulator 44 and insert the preheating burner through port 43, or I may permanently install the burner in the port and connect the regulator through the sight opening of the burner. I pour molten metal into the tundish through the funnel 36 to a level just below the outlet 32. The lower end of the downcomer 37 (FIG. 1) or baffle 38 (FIG. 2) thus is submerged in

3

the pool of metal. Next I project piston rod 28 and thus tilt frame 21 and tundish 15 toward the casting machine. Molten metal feeds through the discharge passages 34 to the mold 10. The heating elements 35 assure that no metal freezes in these passages. Since the passages are spread across the width of nozzle 33, they assure that the metal is distributed uniformly across the width of the mold. I remove the nozzle after each cast for the necessary maintenance.

As the tundish feeds metal to the casting machine, I pour additional metal through the funnel 36 to replace that which discharges, keeping the lower end of the downcomer 37 submerged, thus retaining the pressure seal. The dynamic pressure regulator 44 acts to maintain the desired effective head acting on the metal in the tundish irrespective of the level of molten metal therein. Its action is analogous to that of a voltage divider in an electric circuit. A varying portion of gas which enters tee 45 acts to pressurize the tundish, while the remainder discharges through tee 47. The relative position of stem 54 determines the pressure applied to the tundish. When the stem moves toward the left, the area of the opening through valve sleeve 52 increases, while the area of the opening through valve sleeve 53 diminishes. Thus more gas is admitted to the regulator and there is more resistance to its escape, whereby the pressure applied to the tundish rises. The reverse action takes place when the stem moves toward the right. When a steady state condition is reached in the tundish, gas flow is direct from the pressure source to the vacuum receiver. I may simply observe the pressure as indicated on gage 58 and manually adjust the stem position, or I may include suitable automatic mechanism. Whenever a drastic change in the feed rate is needed for the casting machine to operate properly, I can effect such change very quickly by moving the stem in the appropriate direction. Whenever I wish to stop feeding metal to the casting machine, I can operate cylinder 27 to tilt the tundish away from the machine.

From the foregoing description it is seen that my invention affords a simple tundish construction which assures complete control of feeding metal to a continu-

4

ous-casting machine. The metal is uniformly distributed across the width of the machine as it is fed. The tundish effectively prevents the metal from freezing around its outlet.

I claim:

1. A tundish construction comprising:

a base,
rollers journaled on said base,
a carriage mounted for horizontal movement on said rollers,
a tilting frame mounted on said carriage for pivotal movement on a horizontal axis,
tilting means connected to said frame and to said carriage for pivoting said frame about said horizontal axis,
an enclosed, gas-tight refractory-lined vessel seated in said frame,
a nozzle mounted in the bottom wall of said vessel and having at least one discharge passage,
a downcomer carried by the top wall of said vessel remote from said nozzle for introducing molten metal to the vessel and adapted to have its lower end submerged in a pool of molten metal to effect a gas-tight seal between the interior of said vessel and the exterior of said vessel,
a source of inert gas under pressure, and
a dynamic pressure regulator communicating with said source and the interior of said vessel for pressurizing said vessel and controlling the pressure therein.

2. A tundish construction as defined in claim 1 in which said nozzle is located at a lower edge of said vessel, is inclined downwardly from said edge, and has a nozzle tip adapted to be received within an inclined continuous casting mold.

3. A tundish construction as defined in claim 1 in which said nozzle has a multiplicity of discharge passages across its width.

4. A tundish construction as defined in claim 1 in which the tundish has a greater depth at the end remote from said nozzle than at the end near said nozzle.

* * * * *

45

50

55

60

65