

Jan. 31, 1956

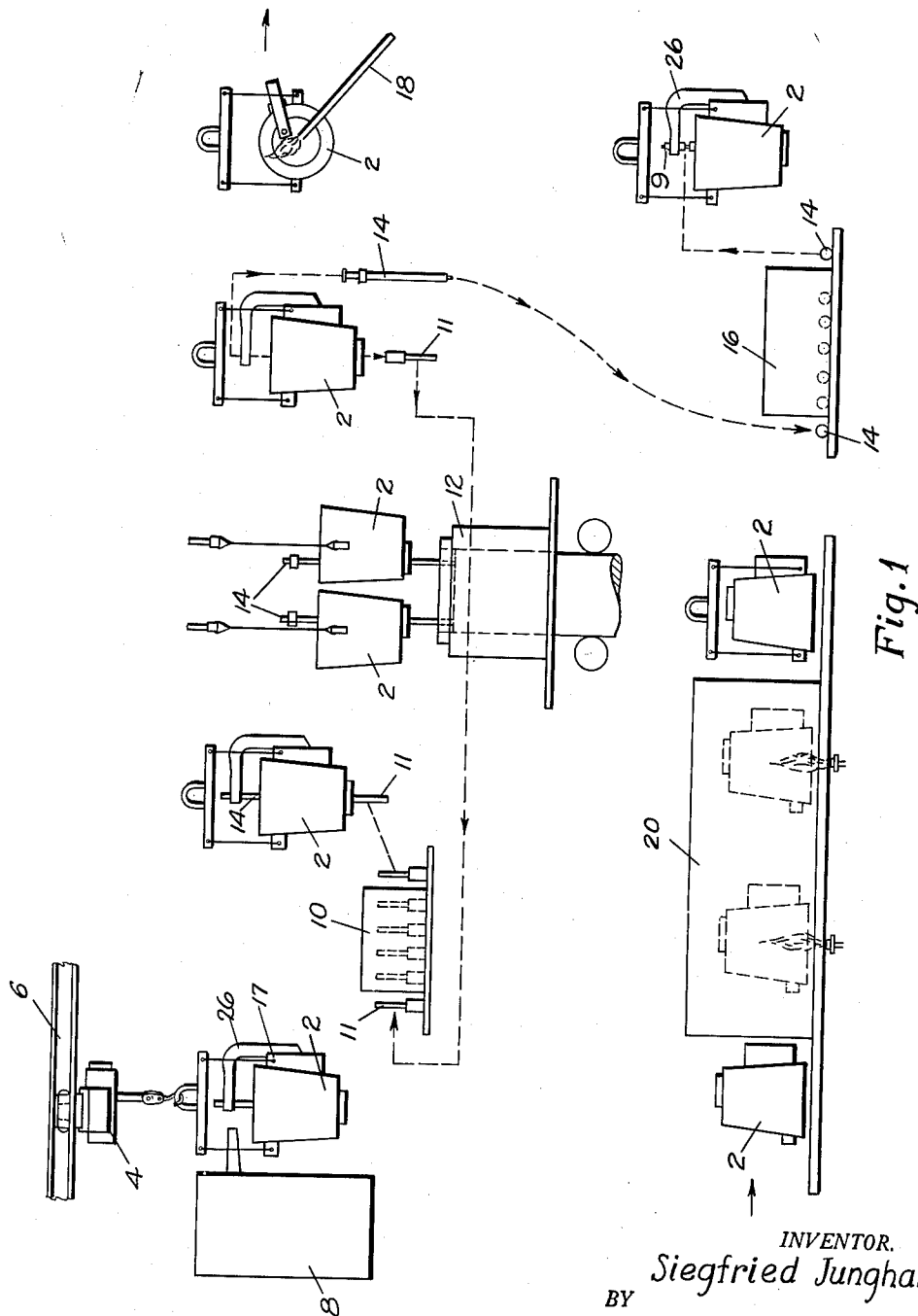
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2,732,601

METHOD OF CONTINUOUS CASTING

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Fig. 2

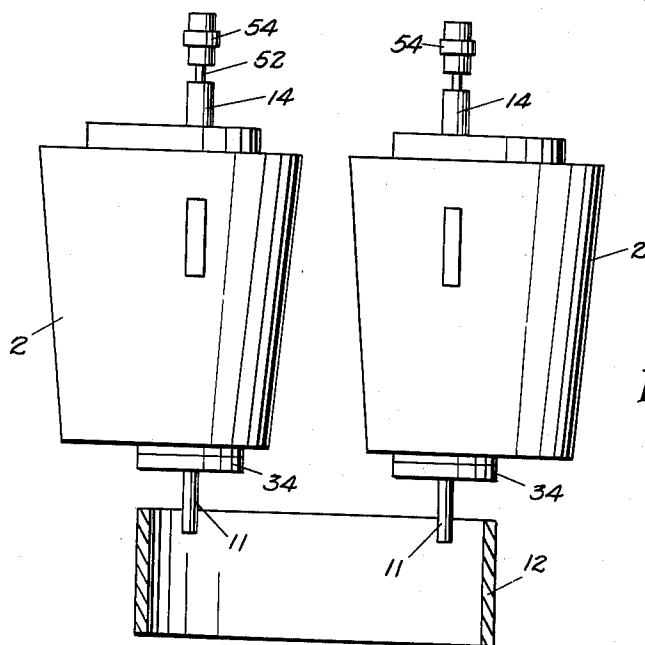
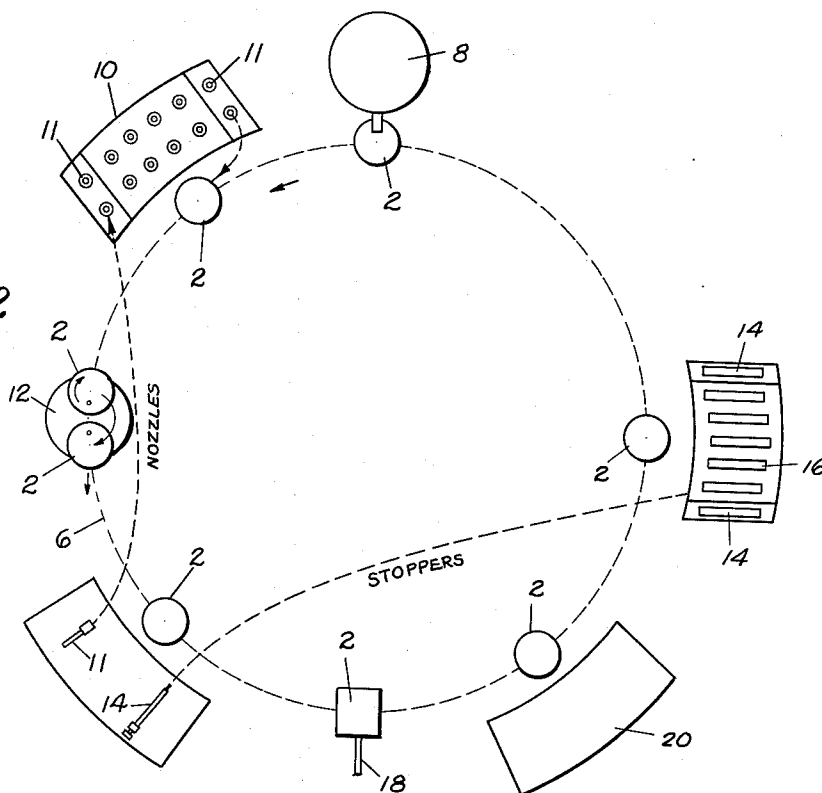


Fig. 3

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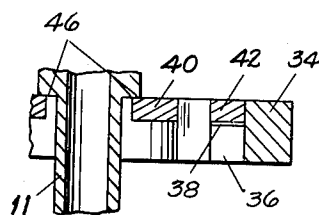
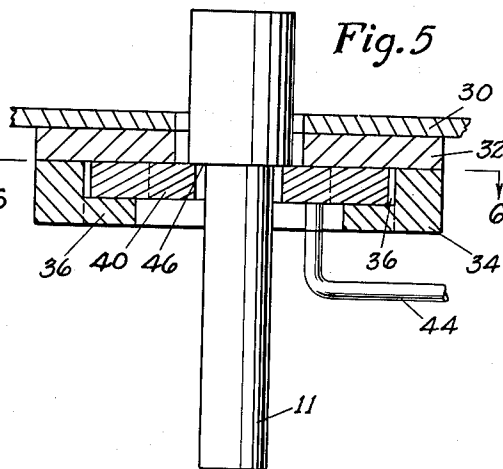
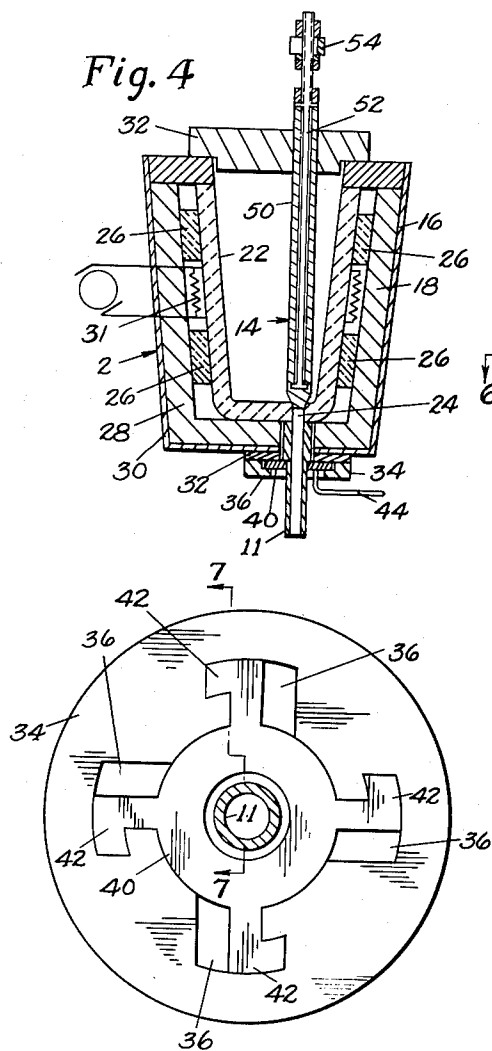
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METHOD OF CONTINUOUS CASTING

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2 Claims. (Cl. 22—200.1)

This invention relates to the continuous casting of high melting point materials, such as steel. In particular, the invention is directed to the process for giving a constant, uninterrupted supply of metal to a continuous casting mold.

The continuous casting of low melting point metals is well known, and apparatus for the casting of metals such as copper, brass, and the various light metals have been kept in reliable operation for weeks and months. However, neither an apparatus nor a method has been successfully used heretofore over a long period of time in the casting of high melting point materials such as steel. The difficulty lies in that the molten steel rapidly ruins the pouring spouts and nozzles, a part of which is caused by the rapid oxidation of the metal. This oxidation results in so-called burrs made of a form of slag forming in the nozzles and obstructs the uniform flow of metal into the mold. Such interruption in the steady flow of metal into a continuous casting mold affects the quality of the casting and produces an inferior product.

An object of the instant invention is to produce a method by which a steady flow of molten metal can be fed from a melting furnace to a continuous casting mold. A further object of the invention is supplying the mold with predetermined quantities of molten metal at a time rate which insures a steady flow of molten metal into the mold.

In general, these and other objects of the invention are accomplished by employing a number of ladles, each of which is of a size to hold a quantity of molten metal which can be taken from the furnace to the mold and poured before it oxidizes or loses sufficient heat so as to form slag, burrs, or other obstructions to the flow of the molten metal into the mold. Thus the molten metal must be transferred from the furnace and poured in the mold within a predetermined time. Furthermore, each ladle is so designed that as one ladle is pouring metal in a mold it can be shifted in position so that a second ladle can be put in place over the mold and pouring started therefrom before, or immediately upon, the first ladle becomes empty. Each ladle contains a predetermined quantity of molten metal, and the rate of delivery of ladles to the mold is pre-established. Furthermore, a cyclic path is established between the furnace and the mold, along which are stations for repairing and replacing the plugs or stopper rods, and the outlet nozzles, as well as stations for reconditioning the ladles themselves. By this method, a supply of ladles in good operating condition is always available for conveying the molten metal from the furnace to the mold, and no interruption due to apparatus failure, slag plugged nozzles, and the like, takes place in the continuous pouring of the metal in the mold.

The means by which the objects of the invention are obtained are described more fully in connection with the accompanying drawings, in which:

Figure 1 is a diagrammatical view illustrating in elevation the steps employed in the method of the invention;

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Figure 2 is a diagrammatical view in plan illustrating the cyclic arrangement of the apparatus;

Figure 3 is a front elevational view of two ladles in place above a continuous mold;

Figure 4 is a vertical cross sectional view through a ladle;

Figure 5 is an enlarged view of a detail of Figure 4;

Figure 6 is a cross sectional view on the line 6—6, Figure 5; and

Figure 7 is a cross sectional view on the line 7—7, Figure 6.

In Figures 1 and 2, a plurality of ladles 2 are carried by a hoist 4 around a circular path as represented by the overhead track 6. The respective ladles first receive molten metal from furnace 8, and then go to a nozzle conditioning, repair and preheat station 10, where a fresh discharge nozzle 11 is placed on the ladle. It is important that the nozzle be preheated and retain as much heat as possible until the metal is poured, as the formation of slag or burrs in the nozzle is thus minimized. Next, the ladle is moved to a position above continuous mold 12 where it is lowered, and the plug or stopper 14 pulled to permit the metal to be discharged into the mold. While this is taking place, the ladle is gyrated by being rotated about its vertical axis, note Figure 2, and also moved across the mold to make room for a second following ladle which is brought into position over mold 12 before the first ladle is empty.

When emptied, ladle 2 travels to the next station, where stopper 14 and nozzle 11 are both removed. The holding and operating mechanism for stopper 14 is of conventional design and forms no part of this invention. Nozzle 11 is separately returned to the nozzle conditioning station 10, while stopper 14 is advanced to a stopper repair and preheat station 16.

Ladle 2 then passes to the burner 18, at which point the ladle is tilted and has the slag burned away. It then proceeds to ladle preheater 20, where it remains until needed to receive a new load of molten metal. When taken from preheater 20, the ladle is first fitted with a stopper 14 at station 16, and then taken immediately to furnace 8 to repeat the cycle.

As particularly shown in Figures 3 and 4, the nozzle 11 is offset from the center of the ladle, and indeed is located as near to the bottom edge of the ladle as is possible. Thus, when two ladles are positioned over the mold 12, both nozzles must extend into the mold. When the right hand ladle in Figure 3 is emptied and removed, the left hand ladle while still pouring metal, is rotated on its vertical axis and gyrated so that its nozzle is brought adjacent the opposite wall of the mold 12, and into the vacated position of the preceding ladle. The next following ladle of molten metal can then be brought over the mold.

Detailed construction of ladle 2 is illustrated in Figures 4 and 5. Crucible 22 has a bottom discharge port 24, this port being located as close as possible to the inner vertical wall of the crucible. Spacing and centering blocks 26 separate crucible 22 from insulation 28, the whole being housed in a metal bucket 30. An insulated lid 30 is also provided. Additional heating of the molten metal in crucible 22 can be effected by an electrical heating element 31, located between the crucible and insulation 28.

In the bottom of ladle 2, an opening is formed in alignment with port 24. Surrounding the opening in jacket 30 and secured thereto is a plate 32 having a central aperture therein, and to which is fastened a cylindrical member 34 having an inner diameter defining an opening of greater extent than the opening in jacket 30 and plate 32. The inner wall of cylinder 34 is formed

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with bayonet joint sockets 36, the bottoms 38 of which are inclined so as to give an upward camming action. A collar plate 40 having bayonet lugs 42 is inserted through the opening in cylinder 34, the lugs 42 passing into sockets 36, and on being rotated is secured in sockets 36, lugs 42 being cammed upwardly. A handle 44 is joined to plate 40 to facilitate this operation. Nozzle 11 has a shoulder 46 which seats on plate 40. Thus plate 40, removed from the ladle, is put on nozzle 11, and then both the nozzle and plate lifted into cylinder 32, and rotated to lock plate 40 into position with the top of the nozzle in tight contact with the bottom of crucible 22.

Stopper 14 consists of a rod 50 of high heat resisting material having its bottom end shaped to seat firmly on port 24. A re-enforcing tie rod 52 extends within and outwardly of the upper end of rod 50, and to which are attached fittings 54 for pulling the stopper 14.

The described apparatus makes possible the continuous casting of metals having a high melting point. The quantity of molten metal held in ladle 2 is correlated with the time necessary to transport the metal from furnace 8 into mold 12 so that the ladle is emptied before oxidation or slag formation can obstruct the pouring into the mold. If too great a quantity of metal is carried to the mold, it will chill before there is time for the metal to run into the mold, and if too little metal is carried there will be difficulty in maintaining a constant rate of pouring for successive ladles into the mold. The preheating and reconditioning operations further insure the reliability of the pouring operation.

Having described the means by which the objects of the invention are obtained, I claim:

1. A method for the continuous casting of a high melting metal such as steel comprising filling a first ladle having an off-center stopper therein with molten metal, then attaching a preferably preheated pouring nozzle to said first ladle, positioning said first ladle above a mold, opening said stopper and pouring metal in said mold while simultaneously turning said first ladle 180 degrees while moving the first ladle and nozzle from one side of the

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mold to the other to alter its position above said mold and provide clearance for a second ladle above the mold, said metal being transported to the mold and poured before said metal is cooled below casting temperature and before the useful life of the ladle is destroyed by the molten metal therein, positioning a second similar ladle above said mold and discharging its content into the mold immediately upon the exhaustion of said first ladle, and recycling said first and second ladles in a similar manner.

2. A method as in claim 1, further comprising transporting said first ladle when empty away from said mold, removing said nozzle and said stopper, respectively, reconditioning said first ladle, and then installing a stopper in said ladle.

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