March 10, 1970 K. BROCK 3,499,587

ADJUSTABLE POURING NOZZLE FOR A LADLE OR TUNDISH

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FIG.1

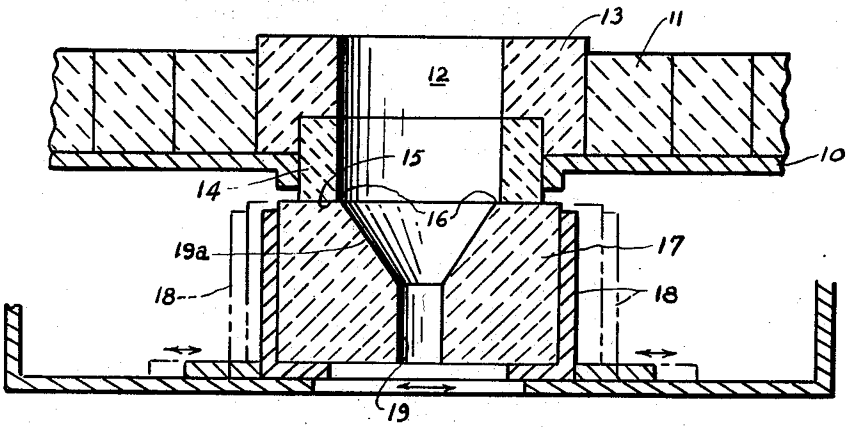


FIG.2

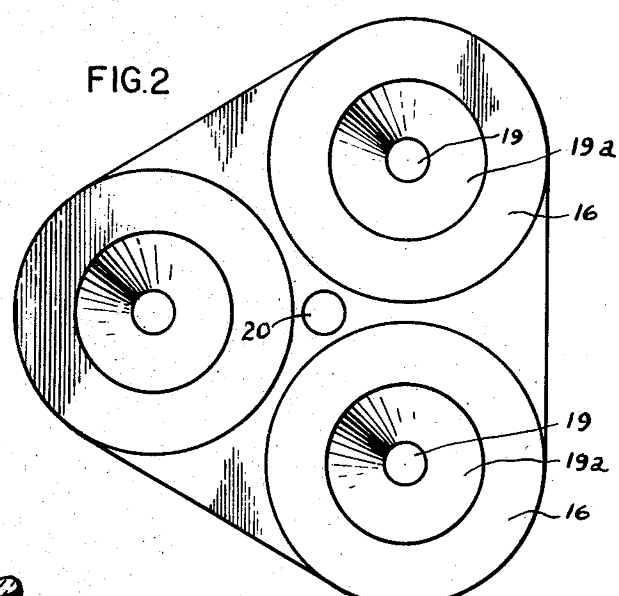
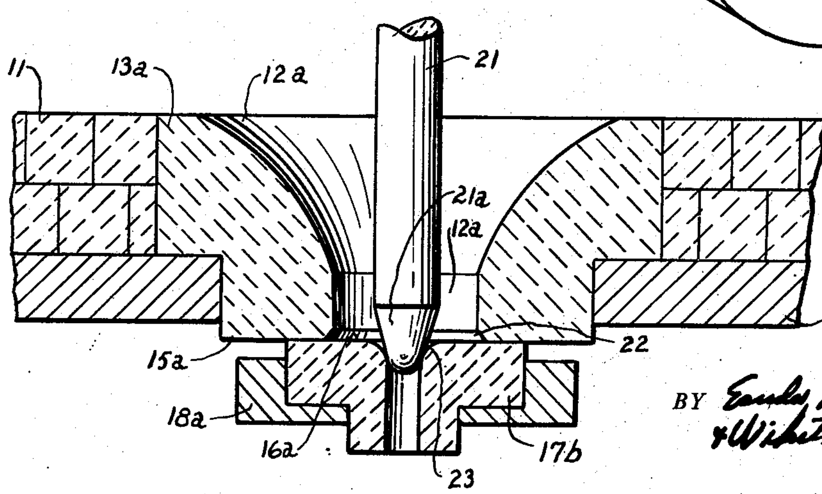


FIG.3



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ADJUSTABLE POURING NOZZLE FOR A LADLE OR TUNDISH

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U.S. Cl. 222—526 6 Claims

ABSTRACT OF THE DISCLOSURE

This is an adjustable nozzle for directing a stream of molten metal from a ladle or tundish which has a discharge orifice with a flat face surface around the discharge end of the orifice. The nozzle is provided by a block having a flat end surface abutting, and slidable across, the flat face surface around the orifice. A hole through the block with one end opening through the flat end surface of the block has a smaller diameter than the orifice so that the block may be shifted to alternative lateral positions relative to the orifice, while maintaining the hole in fluid flow communication with the orifice, for adjusting the position of the outflow from the exit end of the hole.

The present invention is an adjustable pouring nozzle for directing a stream of molten metal from the discharge orifice of a ladle or tundish.

The speed and quality of casting are vitally affected by the alignment of the stream of molten metal poured into the mold cavity from the ladle or tundish which supplies the metal to the mold. This is particularly true in continuous casting in which the speed of casting is determined by the cooling rate of the mold and by the uniformity with which the periphery of metal in the mold is cooled.

The alignment of the stream from the ladle or tundish with the mold cavity has customarily been accomplished by shifting the position of the ladle or tundish relative to the mold cavity and/or by shifting the position of the mold. This is an awkward and time consuming procedure. Moreover, it is difficult to make an accurate adjustment by having to move these bulky and heavy parts.

It is an object of the present invention to provide a nozzle that is movable relative to the discharge orifice of a ladle or tundish for aligning the outpouring stream of molten metal with the mold cavity without having to shift the position of the ladle or tundish and/or of the mold. Thus, the alignment is made more easily and quickly, and more accurately, than with apparatus which requires shifting the ladle or tundish and/or the mold.

Another object is to provide a nozzle arrangement in which alternative nozzle openings are adapted to be shifted into fluid flow communication with the discharge orifice as means for replacing worn nozzle openings or substituting a nozzle opening of a different size or configuration.

A further object is to provide an adjustable nozzle in accordance with the invention that is adapted to be stopped with a conventional form of stopper rod.

In accordance with the invention, a ladle or tundish has a flat face surface around its discharge orifice. The nozzle is formed by a block movably mounted for a flat end surface of the block to be slidable across, and in abutting relation with, the flat face surface, and one end of a hole through the block opens through the flat end surface. The discharge orifice is made to have a longer diameter than the hole through the block; thus, the block is adapted to be shifted to a variety of lateral positions relative to the orifice, while maintaining the hole in fluid flow communication with the orifice, for shifting and adjusting the position of the stream of molten metal from the other, exit, end of the hole. It would also be possible to utilize the block as a stopper by having the area of the end surface large enough to include a blank portion larger than the diameter of the exit end of discharge orifice so that the block could be shifted to move the blank over the exit of the orifice to stopper it. The stoppering may also be accomplished with a conventional form of stopper rod having an end adapted to be received in, and stopper, the upper end of the hole through the block.

In another embodiment of the invention the block may be provided with several holes to be moved alternatively into fluid flow communication with the discharge orifice. Thus, when a hole became worn, the block could be shifted to move a substitute hole into place; or the several holes could be of different sizes and/or configurations which could be substituted for each other as means for adjusting the pouring rate, or the nature of the stream being poured. For example, depending on the properties of the metal being poured, it is sometimes advantageous to have the hole oval in cross section as a means of reducing turbulence in the stream.

The discharge orifice of the ladle or tundish customarily has a liner, or hole brick, in it and the lower edge of the orifice defined by the liner is advantageously provided with a replaceable insert defining the edge, and the outward face of this insert is flat to form the flat face surface which the flat end surface of the nozzle block abuts and slides across. This insert may thus be replaced when it is worn, thereby saving the trouble and expense of having to replace the entire orifice liner. In the preferred form of the invention the outward end of the orifice liner, or the insert therein, which forms the flat face for the nozzle brick, projects from the ladle or tundish to provide a clear bearing surface for the nozzle block.

Illustrative embodiments of the nozzle of this invention are described below with reference to the accompanying drawings in which:

FIG. 1 is a vertical section through the discharge orifice of a ladle or tundish, and through a nozzle therefor in accordance with this invention;

FIG. 2 is a plan view of another embodiment of a nozzle brick of this invention, showing three alternative nozzle holes through it; and

FIG. 3 is a vertical section through another form of a discharge orifice of a ladle or tundish, and through another embodiment of the nozzle brick, showing a stopper rod in stoppering position.

Referring to FIG. 1, the bottom **10** of a ladle or tundish, having a lining **11**, has a discharge orifice **12** defined by a liner, or hole brick, **13**. The bottom, exit, end of the liner **13** is defined by an insert **14** which has the same diameter as the orifice **12** and which can be readily replaced when it becomes worn. The outer face **15** of the insert **14** is flat around the orifice and forms a bearing surface which the upper flat end **16** of a nozzle block **17** is pressed against to form a seal.

The nozzle block **17** is carried in a holder **18** which is mounted to be moved laterally by mechanism known in the art. The block **17** is moved laterally by the holder **18** for sliding the flat end **16** of the block relatively across the face **15** of insert **14** and the holder **18** may be adapted to move the block laterally in one, or several, directions and is adapted to press the block **17** against the face **15** with sufficient pressure to maintain sealing contact therewith.

The block **17** has a hole **19** therethrough, with the upper end of the hole opening through the flat end **16** to be in fluid flow communication with the discharge orifice **12**.

The other, lower, end of the hole **19** opens through another side of the block **17**—the bottom in the embodiment shown. In the embodiment illustrated, the hole **19** has an enlarged funnel portion **19***a* at its upper end. The orifice **12** and the hole **19** are formed with the diameter of the orifice much larger than the smallest diameter of the hole **19**. Thus, the block **17** may be shifted laterally relative to the axis of the orifice **12** an amount approximately equal to half the difference between the diameters of the orifice **12** and hole **19** for maintaining the orifice and hole in fluid flow communication, so as to shift the block, and the stream of metal emerging from the hole **19**, to align the emerging stream with a mold cavity below.

FIG. 2 shows a nozzle block **17***a* which has three holes **19** arranged in a circle around a center **20**. The several holes **19** may be the same diameter, to provide substitutes for one of the others when it becomes worn, or may be different diameters and/or configurations for alternative positioning in order to change the pouring speed or the effect of the pouring. In this embodiment the nozzle block **17***a* may be mounted to rotate about the center **20** spaced from the axis of the discharge orifice **12** so that by rotating the block **17***a* successive holes **19** can be brought into fluid flow communication with the discharge orifice **12**.

The embodiment shown in FIG. 3 illustrates the employment of a stopper rod **21** for stoppering the hole **19** in nozzle block **17***b*. This embodiment also serves to illustrate some additional useful features in the general structure.

In this embodiment the upper portion **12***a* of the discharge orifice **12** as defined by the orifice liner **13***a* is funnel shaped to minimize surface wear, and also to permit angular arrangement of the stopper rod **21** relative to the hole **19**—for example, when the nozzle brick **17***b* is shifted (by movement of the holder **18***a* for the brick **19**) to shift the hole **19** to one side of the discharge orifice **12***a*. The lower end of the liner **13***a* projects down, through an appropriate aperture in the bottom **10** of a ladle or tundish, below the bottom **10**, and its bottom surface provides the flat face **15***a* which is engaged by the flat end **16***a* of the nozzle block **17***b*. The bottom edge **22** of liner **13***a* at the bottom, exit, end of the discharge orifice **12** is rounded, as shown, to avoid wear at that edge due to the sliding movement of the flat end **16***a* of the block **17***b* across the flat face **15***a* on the bottom end of the liner **13***a*.

The upper end edge **23** around the upper end of the hole **19** through the block **17***b* is rounded, as is the bottom end **21***a* of the stopper rod **21** so that the end **21***a* is received in the upper end of the hole **19** at various angles from straight up and down. Thus, the stopper rod **21** can be applied to stopper the hole **19** even when the block **17** is in a position with its hole **19** adjacent one edge of the orifice **12***a*.

Also, as shown in FIG. 3, a bottom portion of the block **17***b* extends down through the holder **18***a* as means to provide a longer nozzle hole **19** for more accurate direction of a stream of molten metal flowing out through the hole **19**.

What is claimed is:

1. An adjustable pouring nozzle for directing a stream of molten metal from a ladle or tundish which has a discharge orifice with a flat face surface around the discharge end of the orifice, said nozzle comprising a block having a flat end surface abutting said face surface and being mounted for relative sliding movement of its flat end surface across said face surface, said block having a hole therethrough with one end of the hole opening through the flat end surface of the block and the other end of the hole opening through a different side of the block, and said hole having a smaller diameter than said discharge orifice whereby the hole through the block will be in fluid flow communication with the orifice in various alternative lateral positions of the block relative to the discharge orifice so as to be able to adjust the position of an outflow of molten metal from the ladle or tundish by shifting the position of the block.

2. The nozzle of claim **1** in which said block has more than one of said holes therethrough and is movable for alternatively placing said holes in fluid flow communication with the orifice.

3. The nozzle of claim **2** in which the ends of said holes opening through the flat end surface of the block are arranged in a circle about a center and in which the block is mounted to rotate about said center for selectively moving the holes into fluid flow communication with the orifice.

4. The nozzle of claim **1** in which an annular lower edge defining the discharge end of the orifice projects below the bottom of the ladle or tundish, said face surface around the discharge end of the orifice being the outward face of said edge.

5. The nozzle of claim **4** in which said annular lower edge at the discharge end of the orifice is a replaceable insert set into the wall of the orifice.

6. The nozzle of claim **1** in combination with a stopper rod having an end adapted to be received in the upper end of the hole through the block for stopping the hole, the edge of the upper end of the hole and said end of the stopper rod being rounded for said end of the stopper rod to be received in stopping position in the upper end of the hole from various angles relative to the axis of the hole.

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