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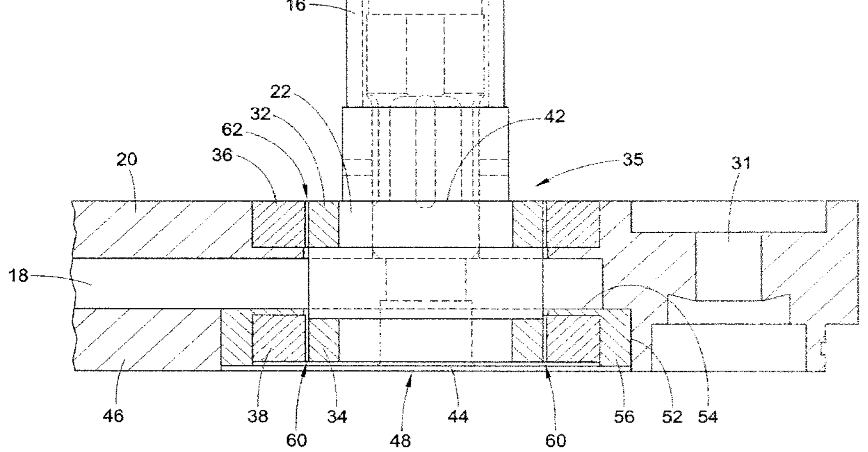
FIG. 7



(57) Abstract: A molten metal pump assembly (10) and method to fill complex molds with molten metal, such as aluminum. The pump assembly includes an elongated shaft (16) connecting a motor (14) to an impeller (22). The impeller is housed within a chamber (18) of a base member such that rotation of the impeller draws molten metal into the chamber at an inlet (48) and forces molten aluminum through an outlet (50). A first bearing (36) is adapted to support the rotation of the impeller at a first radial edge (32) and a second bearing (38) is adapted to support the rotation of the impeller at a second radial edge. A bypass gap (60) is interposed between the second bearing and the second radial edge. Molten metal leaks through the bypass gap at a predetermined rate to manipulate a flow rate and a head pressure of the molten metal such that precise control of the flow rate is achieved.

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AMENDED CLAIMS
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CLAIMS:

1. A molten metal pump assembly to fill a mold with molten metal, the pump assembly comprising:

an elongated shaft connecting a motor to an impeller, the impeller being housed within a chamber of a base member such that rotation of the impeller draws molten metal into the chamber at an inlet and forces molten metal through an outlet of the chamber, the impeller including a first radial edge spaced from a second radial edge such that the first radial edge is proximate the elongated shaft; and

a bearing assembly surrounding the impeller within the chamber, the bearing assembly including:

a first bearing adapted to support the rotation of the impeller at the first radial edge;

a second bearing adapted to support the rotation of the impeller at the second radial edge; and

at least one bypass gap interposed between a portion of one of the first and second bearings and the associated first and second radial edges, the bypass gap being operative to manipulate a flow rate and a head pressure of the molten metal.

2. The molten metal pump in accordance with claim 1, wherein molten metal leaks from the chamber through the bypass gap at a predetermined rate as the impeller is rotated.

3. The molten metal pump in accordance with claim 1, wherein the base member includes a first side and an opposite second side such that the bypass gap is between the second bearing and second radial edge.

4. The molten metal pump in accordance with claim 1, wherein the base member is adapted to support the impeller, elongated shaft and the motor such that a second

peripheral circumference of the impeller is adjacent to the second radial edge and is generally aligned with a bottom portion of the base member.

5. The molten metal pump in accordance with claim 1, wherein the impeller includes a first peripheral circumference and a second peripheral circumference such that the elongated shaft is generally perpendicular to the first peripheral circumference of the impeller.

6. The molten metal pump in accordance with claim 5, wherein the inlet is located at the first peripheral circumference, the inlet includes a plurality of apertures adapted to communicate molten metal to the chamber.

7. The molten metal pump in accordance with claim 6, wherein said apparatus comprises a plurality of bores extending from said first peripheral circumference to a side wall of the impeller.

8. The molten metal pump in accordance with claim 1, wherein the bypass gap is adapted to reduce a head pressure of the associated molten metal at the outlet as the rotational rate of the impeller is increased.

9. A molten metal pump assembly to fill molds with molten metal, the pump assembly comprising:

an elongated shaft connecting a motor to an impeller, the impeller is housed within a chamber of a base member such that rotation of the impeller draws molten metal into the chamber at an inlet and forces molten metal through an outlet of the chamber, the impeller including a first radial edge adjacent to a first peripheral circumference spaced from a second radial edge adjacent to a second peripheral circumference such that the elongated shaft is rigidly attached to the first peripheral circumference; and

a bearing assembly surrounding the impeller within the chamber, the bearing assembly including:

a first bearing adapted to support the rotation of the impeller at the first radial edge;

a second bearing adapted to support the rotation of the impeller at the second radial edge; and

at least one bypass gap is provided at the second peripheral circumference to communicate between the chamber and an atmosphere, the bypass gap is operative to control a flow rate and head pressure of the molten metal.

10. The molten metal pump in accordance with claim 9, wherein the bypass gap extends about a portion of the second peripheral circumference.

11. The molten metal pump in accordance with claim 9, wherein the bypass gap extends around the entire periphery of the impeller.

12. The molten metal pump in accordance with claim 9, wherein the bypass gap includes a plurality of apertures extending through the second peripheral circumference for communication between the chamber and an exterior atmosphere of the base member.

13. The molten metal pump in accordance with claim 9, wherein molten metal leaks from the chamber through the bypass gap at a predetermined rate as the impeller is rotated.

14. The molten metal pump in accordance with claim 9, wherein the bypass gap is adapted to reduce a head pressure of the associated molten metal as the a flow rate of molten metal is increased through the outlet.

15. The molten metal pump in accordance with claim 9, wherein the bypass gap is adapted to reduce a head pressure of the associated molten metal at the outlet as the rotational rate of the impeller is increased.

16. The molten metal pump in accordance with claim 9, wherein the bypass gap is operative to tune the pump assembly such that molten metal is statically held at approximately 1.5 feet of head above a metal line or between 850 to 1000 rotations per minute of the impeller.

17. A method of filling a mold with molten metal, the method comprising:
rotating an impeller within a chamber;
transferring molten metal through the impeller into the chamber;
leaking a predetermined portion of molten metal through at least one bypass gap from the chamber to an exterior environment for tuning a head pressure relative to a rotational speed of the impeller; and
filling an associated mold with the molten metal.

18. The method of filling a mold with molten metal according to claim 17, further comprises adjusting the rotational speed of the impeller while the associated mold is filled with molten metal.

19. The method of filling a mold with molten metal according to claim 17, further comprising controlling a head pressure and flow rate of molten metal according to a programmable mold fill profile while the associated mold is filled with the molten metal.

20. The method of filling a mold with molten metal according to claim 17, wherein the bypass gap is located between the chamber and the impeller.

21. A method of filling a mold with molten metal, the method comprising:
rotating an impeller within a chamber;

transferring molten metal through the impeller into the chamber;

leaking a portion of molten metal through at least one bypass gap within the chamber or downstream thereof to an exterior environment; and

filling an associated mold with the molten metal.

22. A system to deliver molten metal to at least one mold, the system comprising at least one furnace having a mechanical pump disposed therein, and a controller to control impeller RPM according to a programmable fill profile of the associated mold.

23. A system to deliver molten metal to at least one mold, the system comprising:

at least one furnace; and

a pump assembly within said at least one furnace to deliver the molten metal to the at least one mold associated with the pump assembly, the pump assembly comprising:

a shaft;

an impeller coupled to the shaft and configured to direct the molten metal to the at least one mold; and

a controller to adjust the rotational speed of the impeller according to a programmable fill profile for obtaining a desired flow rate or pressure of the molten metal while delivering the molten metal to the at least one mold.

24. The system of claim 23, wherein the programmable fill profile is associated with a geometry of the at least one mold.

25. A method of filling a vessel with molten metal, the method comprising:

transferring the molten metal to a furnace;

rotating an impeller within the furnace to direct a flow of the molten metal to the vessel;

adjusting the rotational speed of the impeller according to a programmable fill profile to obtain a desired flow rate or pressure of the molten metal; and

delivering the molten metal to the vessel.

26. The method of claim 25, wherein the vessel is a mold, and wherein the programmable fill profile is associated with a geometric volume of the mold.

27. The method of claim 25, wherein the adjusting the rotational speed of the impeller is based at least in part on a measured pressure of the molten metal.

28. A pump assembly to deliver molten metal from a molten metal bath to a vessel, the pump assembly comprising:

a shaft;

an impeller coupled to the shaft and configured to direct the molten metal to a riser for delivery to said vessel; and

the pump being configured to selectively statically position the molten metal within said riser above said bath of molten metal.

29. A pump assembly to deliver molten metal to a vessel, the pump assembly comprising:

a shaft;

an impeller coupled to the shaft and configured to direct the molten metal toward the vessel;

wherein a volumetric flow rate and a head pressure relationship of said pump results in an increased number of rotations of said impeller per minute yielding a reduction in the head pressure and an increase in said volumetric flow rate; and

a controller to control the rotational speed of the impeller according to a programmable fill profile for obtaining a desired flow rate or pressure of the molten metal while delivering the molten metal to the vessel.

30. The pump assembly of claim 29, wherein the programmable fill profile is associated with a geometry of the vessel.