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VACUUM OPERATED LIQUID DISPENSING MEANS

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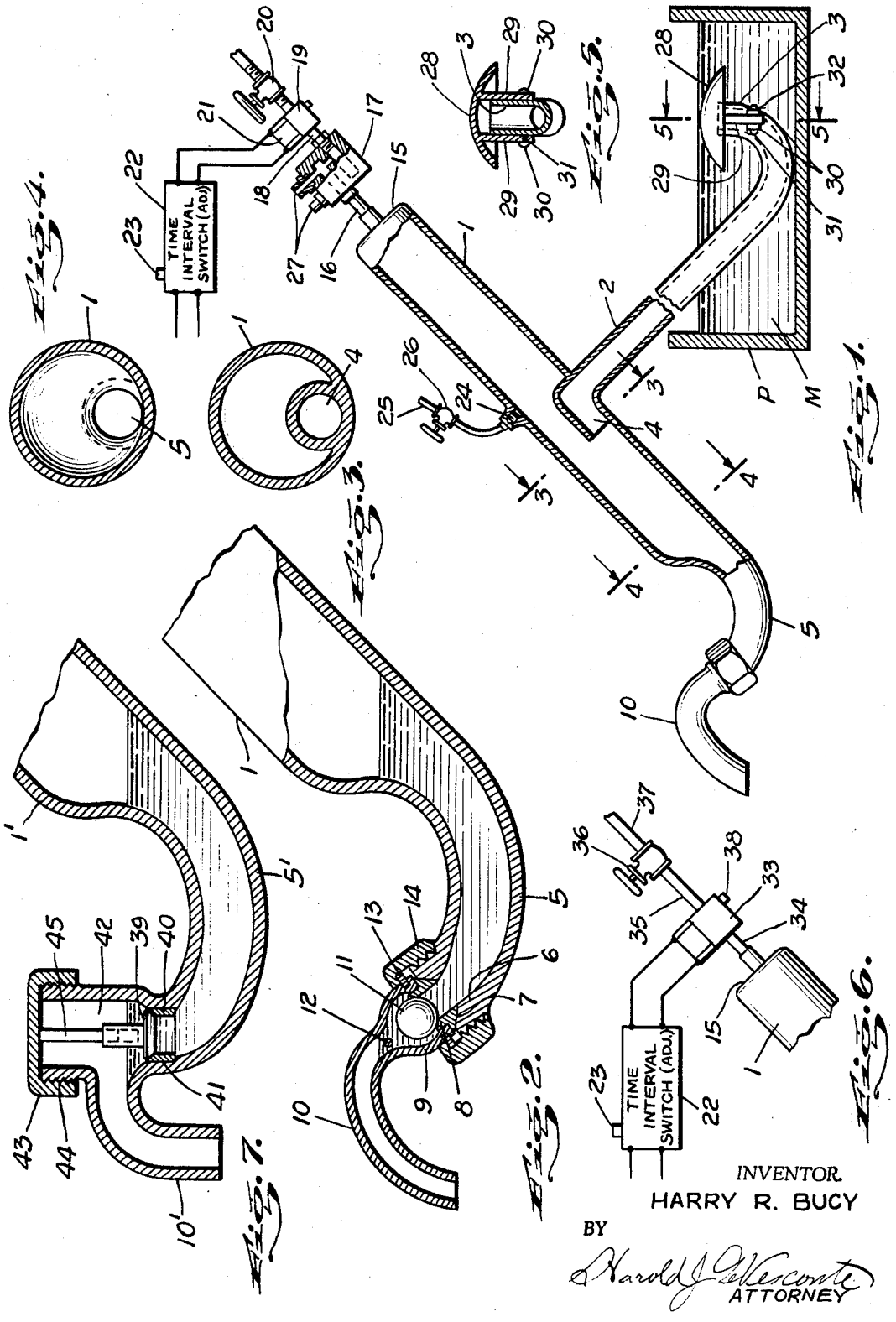

Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 7.

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VACUUM OPERATED LIQUID DISPENSING MEANS

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ABSTRACT OF THE DISCLOSURE

A device for dispensing molten metal in predetermined amounts comprising a closed elongated hollow body member having an intake member which includes an intake orifice submerged in the molten metal supply and a delivery orifice communicating with the interior of the said member at a point above the level of the supply. The body member includes a gooseneck delivery spout normally closed by a check valve means disposed below the level of the body of molten metal retained by the gooseneck spout. A vacuum producing means is connected to the interior of the member above the delivery end of the intake conduit and a time interval switch means controls the time interval to which the interior of the member is subjected to vacuum. Additionally, means is provided for optional supply of a non-oxidizing atmosphere to the interior of the member when it is not subjected to vacuum.

This invention relates to handling means for molten metals or other liquid substances in predetermined increments or quantities by control means disposed remote from the liquid being handled and while the illustrated embodiment of the invention is shown as employed for use in dispensing molten, non-ferrous metal, the principles of the invention can equally well be employed for dispensing other liquid substances where the prevailing conditions afford opportunity for advantageous use of the invention.

The principal object of the invention is to provide a means for dispensing liquids in predetermined increments or quantities from a container by the use of vacuum to lift the substance from the container to a point from which it may flow by gravity to the point to which it is to be delivered.

Another object of the invention is to provide a vacuum responsive means for delivering predetermined increments or quantities of molten metals and alloys from a body of the molten material to a mold.

Still another object of the invention is to provide a means for delivery of predetermined quantities of molten metals and alloys from a body of the molten material and in which the intake orifice of the device is so situated that neither dross floating on the surface of the body of molten metal nor "fallout" materials on the bottom of the container of the molten material will be drawn into and thence be delivered by the device.

A still further object of the invention is to provide a device of the foregoing character which is constructed and arranged to reduce contact of the molten material with the air whereby oxidation of the molten material is reduced to a minimum.

Still another object of the invention is to provide a device of the above character which is simple in construction and is capable of being readily installed and removed from any intended point of use.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts, and in the construction, combination and arrangement of parts described, by way of example, in the following specification of certain presently preferred embodiments of the invention, reference being had to the accompanying drawings

which form a part of said specification and in which drawings:

FIG. 1 is a side elevational view, partly in section, of a device constituting a first embodiment of the invention,

FIG. 2 is an enlarged sectional view of the delivery check valve end portion of the first embodiment of the invention,

FIGS. 3 and 4 are transverse sectional views taken on the lines 3—3 and 4—4, respectively, of FIG. 1,

FIG. 5 is a fragmentary sectional view taken on the line 5—5 of FIG. 1,

FIG. 6 is a fragmentary side elevational view of an alternative control means for the device, and

FIG. 7 is a fragmentary, medial, longitudinal view showing an alternative form of discharge check valve means.

Referring first to FIGS. 1–5, the first embodiment of the invention includes a hollow, cylindrical, body member **1** formed of suitable material, e.g., cast iron and disposed at an approximately 45° angle. Extending at right angles from about the midlength of the under side of the body **1** is an integrally formed intake tube **2** extending from the intake port **2'** of the device and then which extends into the pot P or other container containing the molten metal M, said inlet tube terminating in an upwardly extending intake orifice portion **3** which is disposed below the level of the molten metal. Within the body **1**, the intake portion **2** includes a downwardly directed hood portion **4**.

The lower end of the body **1** merges into a gooseneck delivery spout means, effective to maintain a predetermined level of the liquid being dispensed and which comprises a reduced diameter, upwardly curved, hollow, neck portion **5** which terminates in an externally threaded end **6**. The end of the threaded portion **6** is provided with a frusto-conical seat **7** engaged by the meeting end of a valve seat bushing **8** seated in the end **9** of an upwardly and thence downwardly curved gooseneck spout **10** at a level which is slightly below the portion of the spout which determines the retained liquid level. The end **9** is slightly bulged outwardly to accommodate a check valve ball **11** which is removably retained in said spout end **9** by said valve seat bushing and is adapted to be seated on the inner end of the valve seat bushing member **8**. Additionally, the spout member **10** is provided with suitable means, e.g., an integrally cast cross member **12**, to retain the valve ball in proximity to its seat on the valve seat bushing member **8**. The outer surface of the spout end **9** is provided with a groove containing a snap ring **13** which forms a retaining shoulder for a nut element **14** adapted to engage the threads on the end **6** of the body member to secure the spout member to the body member in the desired rotative position. It will be noted on reference to FIG. 2 that the check valve means above described is preferably, but not necessarily, disposed at a level such that the ball is submerged in the fluid, the fluid level being determined by the highest portion in the spout.

The upper end of the body member **1** is provided with an integrally formed end wall **15** including an air entrance and exit port which is engaged by a nipple **16** connecting the interior of the body member **1** to a jet pump device **17** such as heretofore employed in the evacuation of pressure die casting mold cavities and shown for example in my prior Patent 3,108,339 granted Oct. 8, 1963. The nipple **18** connects the air inlet end of the jet pump device with a normally closed solenoid valve **19** which, in turn, is connected to a source of compressed air with an interposed manually adjustable valve **20**. The operating solenoid **21** of the valve **19** is connected to a suitable source of electrical energy through a time interval switch **22** having a push button **23** by

which the action thereof is initiated. The switch **22** and valve **19** are standard articles of commerce and need not be further described except to say that the switch is of the type which, upon actuation by the push button, closes and allows current to flow therethrough to the valve for a predetermined period of time, which time period or interval may be from an interval of a fraction of a second to several seconds according to the adjustment of the switch, and then the switch opens until it is again actuated by the starting button **23**. The jet pump device is, of course, at all times open to atmosphere through the exhaust jet nozzles **27** thereof and when the valve **19** is closed air will enter through the nozzles **27** into the interior of the body **1**.

Additionally, the body **1** may be provided with a threaded orifice or port **24** which may be connected by conduit means **25** through an interposed adjusting valve **26** with a source of supply of an inert gas such as argon or nitrogen. Where the device is used for handling molten metals which readily oxidize, a small supply of heavy non-oxidizing gas may be constantly supplied to the lower end of the interior of the body **1** to resist the oxidizing tendency of the metal. When the device is used for metals or other substances in which this precaution is unnecessary, the orifice may be plugged or the supply of heavy gas merely shut off by the valve **26**.

Having reference particularly to FIGS. 1 and 2 and assuming that the discharge spout is disposed over a mold or other receptacle for the molten material, e.g., the receiving cavity of a die casting machine shot cylinder, the push button **23** is actuated to open the valve **19** for a timed interval and thereby cause the jet pump device to evacuate the body **1** to an extent sufficient to cause the delivery through the inlet tube **2** of a predetermined quantity of the molten material which, as it is delivered to the upper end of the tube **2** will flow down to the lower end **5** of the body **1**, the hood **4** serving to prevent the spattering of incoming metal against the opposite wall of the body **1** with probable entry of droplets thereof into the jet pump means. Upon cessation of the flow of air through the jet pump, air will enter the upper end of the body **1** allowing the molten materials still in the tube **2** to flow back into the pot P to the level of the material in the pot and since the material which has been added that which is already in the portion **5**, the check ball **11** will be unseated and the metal will flow out of the delivery end **10** to the point of use until it reaches the level of the highest point within the delivery tube **10**. It should be mentioned at this point that the volume of metal retained in the gooseneck should be so substantial that under normal operating conditions, the heat thereof maintained by the added increments thereto will maintain the body of metal in a fluid condition and will also make an air tight seal for the check valve.

In alloy or other non-ferrous casting operations, and particularly those operations in which the molten material is transferred by ladle from the mass of molten metal to the machine or to the mold, care has always been required to prevent the ladling of the oxidized metal (dross) floating on the top of the body of molten metal or to prevent picking up the portions of the molten material which separate out and collect on the bottom of the mass of molten metal which, as in the case of dross, form defective castings.

Recurring now to FIG. 1, it will be noted that the inlet end **3** of the tube **2** is directed upwardly and terminates in an intake orifice disposed below the top level of the molten material. Associated with the inlet end is a detachably mounted, shallow, dome-like hood **28** of greater diameter than the inlet orifice end and disposed thereover with the lower edge concentrically spaced with respect to the inlet end **3** and disposed with the said lower edge well below the upper end of the inlet end **3**, preferably, a distance which is somewhat greater than the thickness to which dross will be allowed to accumulate on the top of the metal and with the under surface of said hood spaced well above the inlet end **3**. Any practicable mounting means may be employed. In the illustrated embodiment, the hood **28** includes a pair of rigid, parallel, depending leg elements **29, 29** which extend downwardly in close proximity to the opposite sides of the upwardly extending portion of the inlet end **3**, each of said leg elements passing between a complementary pair of ear elements **30, 30** projecting outwardly from the sides of the inlet end and at least one of said legs and the pair of ear elements associated therewith having complementary holes extending therethrough for reception of a removable pin **31** which may be secured by any suitable means as, for example, a cotter pin **32**. The height of the dome is such as to be at least substantially submerged in the molten metal at all times and the diameter of the hood is such as will result in a relatively slow movement of the metal toward the inlet end incident to the presence of vacuum in the body **1** and out from under the hood when the vacuum is released and the molten material returns by gravity down the tube **2** into the pot. Since the lower edge of the hood is below the level at which dross will accumulate, and since the upper end of the inlet tube is well above the bottom of the pot, only uncontaminated molten metal will be supplied through the body **1** to the point of use.

When the device is initially placed in operation, there will, of course, be a small quantity of air trapped under the hood **28** but the first one or two operations of the device will draw the trapped air into the body **1** and discharge it through the evacuating means and thereafter, the under side of the hood will be filled with the molten material as will the inlet tube **2** to the level of the metal in the pot P.

While during use, the transfer of heat through the tube **2** to the body **1** as well as the heat of the body of molten metal contained at the lower end of the body **1** and the constant change of metal therein is usually sufficient to keep the metal from congealing therein in such instances in which the heat loss exceeds the gain by increments of molten metal as by small increments or time lapse between succeeding operations, heat may be applied to the section **5** by any suitable means sufficient to keep the metal trapped therein constantly in a molten condition. It will be understood that the before starting operation of the device, the gooseneck portion thereof would first be preheated to its operating temperature.

While the material for the body **1** and associated parts has been described as being of cast iron, it will be appreciated that where the nature of the molten material requires other materials, such other materials may be used within the scope of disclosure of the invention and the invention further contemplates the possibility that cast iron or other basic material may be employed with a suitable resistant coating for the liquid material to be handled.

Referring next to FIG. 6, a modification of the vacuum means is shown in which the valve **19** and jet pump **17** are replaced by a solenoid operated spring biased three-way valve **33** having the port thereof connected by a nipple **34** to the end member **15'** of the body **1**, a second port connected by a nipple **35** to a valve **36** connecting said nipple to a line **37** leading to a source of vacuum and a third port **38** which is open to atmosphere. The spring bias of the valve **33** is such as normally maintains the port **38** connected with the port to which the nipple **34** is connected so that atmospheric pressure normally exists within the upper end of the body member **1**. Suitable valve devices of this character are available on the open market. Upon actuation of the switch **22** by the push button **23** thereof, the solenoid of the valve **33** operates to connect the ports connected to the nipple **35** and the source of vacuum with the nipple **34** and the interior of the body **1** thus producing vacuum within the body member **1** and the resultant introduction of molten metal into

said body. The valve **33**, like the valve **19** is an article of commerce readily available on the open market. The operation of the device is exactly the same as previously described.

Referring finally to FIG. 7, there is shown an alternative form of discharge check valve means in which the body member **1'** and the gooseneck delivery spout means comprising the reduced diameter delivery end **5'** and the delivery spout **10'** are formed as an integral casting and in which a poppet type valve member **39** normally seated on a removable valve seat **40** is employed in place of the ball check valve **11** and disposed below the liquid level established by the delivery spout means. The portion **5'** terminates at the valve seat portion **40** in a counterbored portion **41** disposed concentrically with an upper opening **42** which is closed by a threaded cap **43** engaging the external threads on a neck portion **44** concentrically disposed above the valve seat member and said cap carrying a depending rod **45** on which the valve **39** is slidably guided, the extent to which the valve **39** may be displaced being limited by engagement of the bottom of the hole in the valve **39** in which the rod **45** is received with the end of the rod **45**, removal of the cap **43** permitting access for removal and replacement of the valve and valve seat when and if required.

The operation of this modified form of the device is exactly the same as the first described form. Upon introduction of added metal to the interior of the body **1** and cessation of the application of vacuum therein, the metal will then unseat the valve and flow out of the delivery spout **10'** until it reaches the level of the upper portion of the interior of the delivery spout. In both forms of the invention, the valve seat is located below this level so that the application of vacuum within the body **1** causes air pressure within the delivery spout to operate on the molten metal which is on top of the valve member and hold it sealed against the entry of air past the valve.

Each disclosed embodiment has its advantages. The first embodiment has the advantage of some degree of rotative adjustment of the spout to accommodate installation in relation to points of supply and discharge as well as the capacity for interchangeability of spouts of different size or other characteristics, e.g., the level of the retained liquid. The second embodiment, of course, has the advantage of simplicity of construction at the expense of the advantages of the first described embodiment.

Thus there has been provided a means for dispensing liquid materials and substances in predetermined quantities by remotely controlled means and while the invention will probably find its greatest use for the purpose indicated, it will be appreciated that its usefulness is not necessarily limited to that particular field of endeavor and that the principles of the invention may be employed for dispensing liquid materials in predetermined quantities under any condition in which remote control is desirable either for convenience or for the purposes of health and safety. With these considerations in mind, it will be understood that the invention is not to be deemed to be limited to the precise details of construction and operation thus disclosed by way of example and it will be understood that the invention includes as well all such changes and modifications in the parts and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. A pump means for intermittent delivery of predetermined quantities of molten metal from a supply container, said pump comprising an enclosed hollow body having a portion of the interior thereof disposed above a horizontal plane defining the top surface of the molten metal in the container and said body also having discharge port means communicating with the interior of said body and including a gooseneck delivery spout at the lower end of said body having a configuration which is effective to maintain a predetermined level and a substantial quantity of molten metal therein, an intake port disposed above the plane of said predetermined level of molten metal established by said delivery spout and connected by conduit means to a receiving orifice submerged in the molten metal in the container, means associated with said intake port effective to direct molten metal emerging from said intake port toward the body of molten metal maintained by said discharge spout, an air port also disposed above said predetermined level of molten metal and through which air may flow into and out of said hollow body and normally open to establish atmospheric pressure in said body, a check valve means seated in said delivery spout below said predetermined level operative to oppose fluid flow therethrough into said body, an evacuating means connected to said air port and operative to effect a predetermined degree of evacuation to the interior of said body for a predetermined time interval, and means for rendering said evacuating means operative in said time interval to exert an evacuation of such magnitude as will result in the transfer of a predetermined quantity of molten metal from the container through said conduit means to said hollow body and resultant delivery by displacement of a corresponding quantity of molten metal through said delivery spout upon termination of said evacuation; the retention of said quantity of molten metal in said body below said predetermined level serving in part at least to maintain said body at a temperature sufficient to maintain the metal in a molten condition.

2. A molten metal pump means as claimed in claim **1** in which said evacuating means includes a jet pump device having a discharge passage connecting said air port with atmosphere, a jet pump nozzle disposed in said discharge passage and directed therein in a direction away from said air port, a normally closed valve interposed between said nozzle and a source of compressed air and control means for opening said valve for predetermined time intervals.

3. A molten metal pump means as claimed in claim **1** in which said delivery spout is mounted on said hollow body and secured thereto by means permitting lateral adjustment of the distal end of said spout means relative to a vertical plane containing the medial longitudinal line of said body.

4. A molten metal pump means as claimed in claim **1** in which said evacuating means includes a three-way valve having a common port connected to said air port, a second port connected to a source of vacuum, and a third port open to atmosphere, means normally maintaining said common and third ports connected and control means operable to disconnect said third port from said common port and simultaneously connect said common port to said second port for a predetermined time interval.

5. A molten metal pump means as claimed in claim **1** in which said check valve means comprises a ball normally seated by gravity on a seat which is inclined with respect to the horizontal.

6. A molten metal pump means as claimed in claim **1** in which said check valve means comprises a poppet valve element and guiding means therefor.

7. A molten metal pump means as claimed in claim **1** in which said body is provided with a port through which a non-oxidizing or other inert gas may be fed to the interior of said body.

8. A molten metal pump means as claimed in claim **1** in which the means for determining the time interval of evacuation of said hollow body comprises a time interval determining switch and a valve controlled thereby.

9. A pump means for delivering a predetermined quantity of molten metal from a container of molten metal to a molding means, said pump means comprising an enclosed hollow body formed of a metal having a higher melting point than that of the metal to be delivered, said body having port means communicating with the interior thereof including a gooseneck delivery spout at the lower end of said body including a portion disposed to maintain a predetermined level of molten metal at said lower end, an intake port disposed above the plane of said pre-

determined level and a substantial quantity of molten metal in said body established by said delivery spout, integrally formed metal conduit means extending between said intake port and an intake orifice submerged in the molten metal in the container, means associated with said intake port effective to direct molten metal emergency from said intake port toward said delivery spout and an air port also disposed above the level of molten metal in said body maintained by said gooseneck delivery spout; said air port being normally open to establish atmospheric pressure in said body, a check valve means in said delivery spout operative to oppose fluid flow therethrough into said body, and evacuating means connected to said air port operative to effect a degree of evacuation in said body of such magnitude for such predetermined time interval as will effect the transfer of a predetermined quantity of molten metal through said conduit means from the container to said hollow body and the consequent displacement and delivery of a corresponding quantity of molten metal through said delivery spout upon termination of said evacuation; the retained portion of molten metal in said body serving, at least in part, to maintain said body at a temperature sufficient to maintain the metal at said lower end thereof in molten condition.

10. A molten metal pump means as claimed in claim **9** in which said evacuating means includes a jet pump device having a discharge passage connecting said air port with atmosphere, a jet pump nozzle disposed in said discharge passage and directed therein in a direction away from said air port, a normally closed valve interposed between said nozzle and a source of compressed air, and control means for opening said valve for a predetermined time interval.

11. A molten metal pump means as claimed in claim **9** in which said delivery spout is detachably mounted on said body by means permitting lateral adjustment of the distal end of said spout relative to a vertical plane containing the medial longitudinal line of said body.

12. A molten metal pump means as claimed in claim **9** in which said evacuating means includes a three-way valve having a common port connected to said air port, a second port open to atmosphere, and a third port connected to a source of vacuum, said valve normally maintaining said common and second ports in communication with one another, and control means operable to disconnect said second port and simultaneously connect said third port and said common port for a predetermined time interval.

13. A molten metal pump means as claimed in claim **9** in which the metal of said intake conduit means and said body is sufficiently heavy to act as a heat transfer means to contribute to the maintenance of the metal retained in said gooseneck spout in a molten condition by conduction of the heat from the container of the molten metal.

14. A molten metal pump as claimed in claim **9** in which said intake conduit means terminates in an upwardly directed intake orifice disposed below the level of the molten metal in the container and in which said intake end carries shield means effective to prevent the entry of floating dross from entering said intake orifice.

15. A molten metal pump means as claimed in claim **1** in which said intake port terminates within said hollow body in a portion thereof directed toward said delivery spout.

16. A molten metal pump means as claimed in claim **9** in which said intake port terminates within said hollow body in a portion directed toward said delivery spout.

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