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[54] **COUPLING MEANS FOR CONNECTING MOLTEN METAL TRANSPORTING LINES**
5 Claims, 2 Drawing Figs.

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[51] **Int. Cl.** **F16k 1/00**
[50] **Field of Search** 137/565, 563; 222/318, 385; 285/261, 9; 251/144, 319

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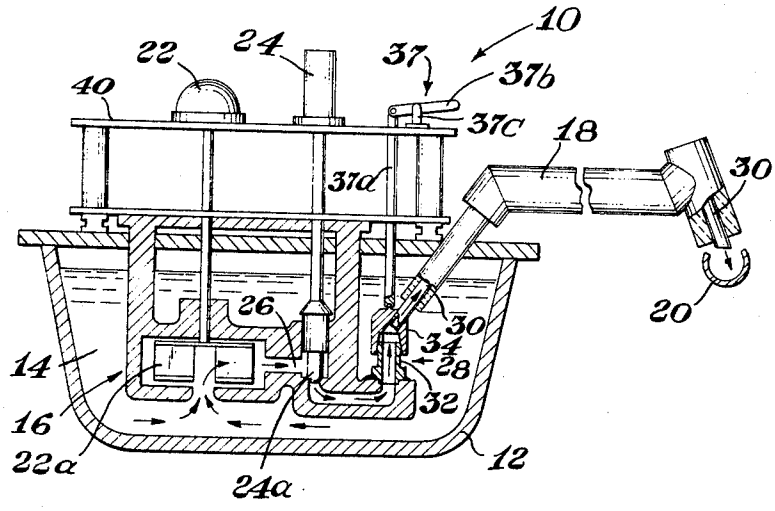
ABSTRACT: Coupling means particularly useful in a metal diecasting apparatus for connecting the metal-conducting passageway in the pumping and metering assembly to the metal-conducting passageway in the delivery line. The male half of the coupling comprises a stud fitting having a ball-shaped head portion and a lengthwise axial bore in communication with the outlet end of the pumping and metering assembly passageway. A female half of the coupling is defined by a bell-shaped fitting having a central lengthwise bore in communication with the inlet end of the delivery line passageway. A lower portion of the bore defines a frustoconical cavity having tapered sidewalls adapted to wedgingly engage the ball-shaped head portion of the stud fitting to provide an essentially liquidtight joint.



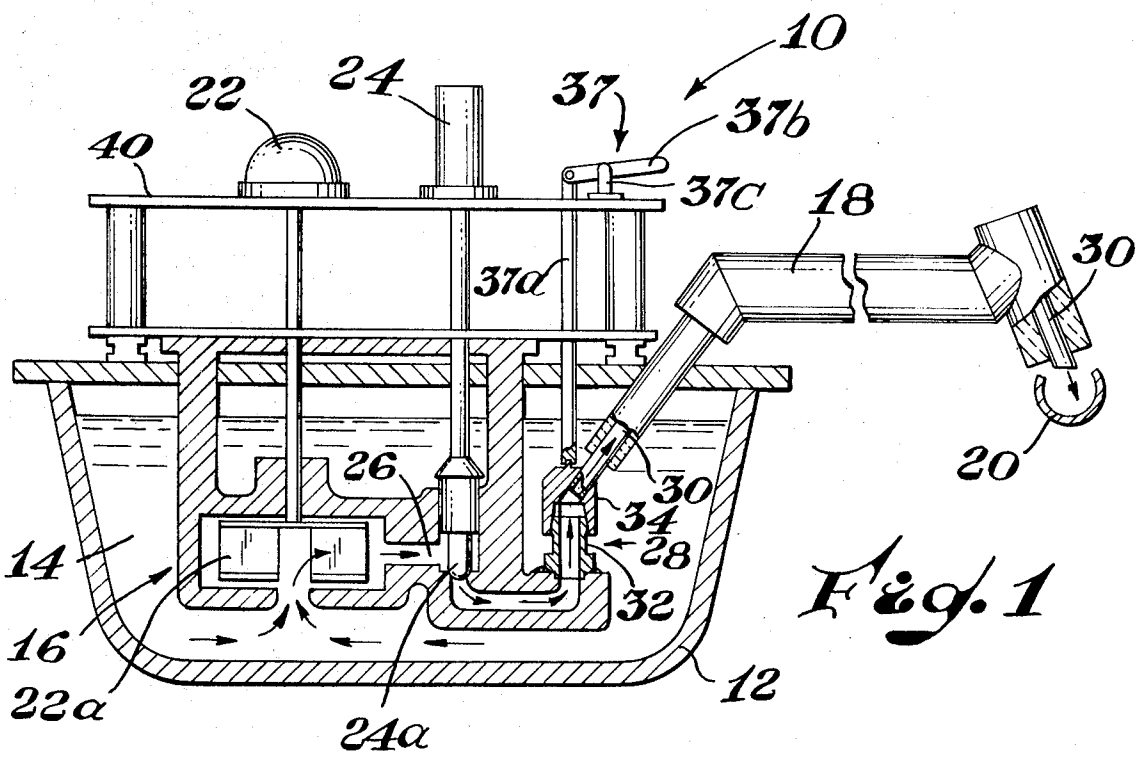


Fig. 1

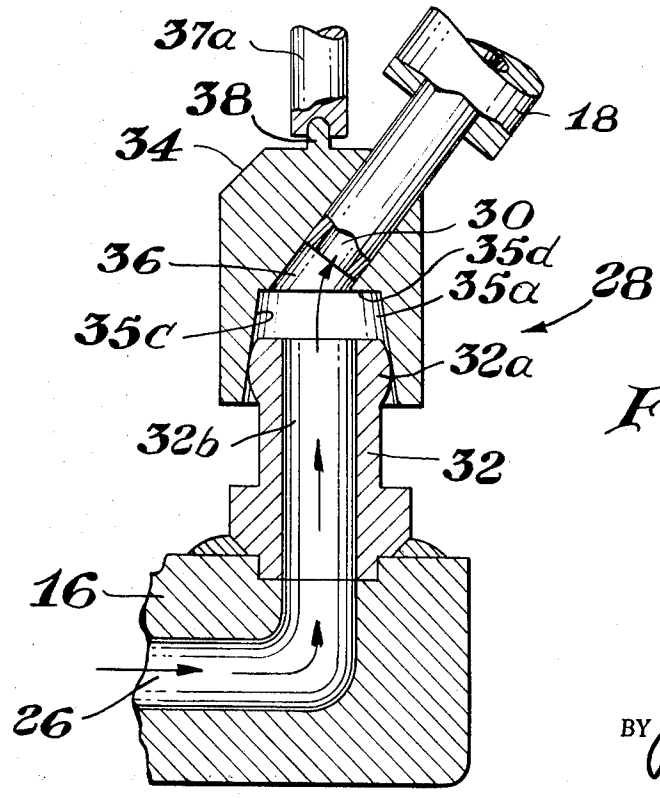


Fig. 2

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COUPLING MEANS FOR CONNECTING MOLTEN METAL TRANSPORTING LINES

BACKGROUND OF THE INVENTION

The invention relates broadly to handling of molten metal. More specifically, the invention is directed to an improved coupling means for transferring molten metal from a pumping and metering assembly to a delivery line in a diecasting apparatus.

In a typical diecasting apparatus the molten metal to be die-cast is contained in a suitable vessel, such as a crucible or melting pot. The molten metal is transferred to a diecasting machine through a pumping and metering assembly and a delivery line or transfer pipe coupled to the assembly. Molten metal is drawn into a pump intake chamber which houses the impeller unit of a centrifugal pump. The impeller unit drives the metal through a passageway containing a metering valve. The valve meters a predetermined quantity of the metal, which passes through the coupling and directly into a passageway in the delivery line. From the delivery line the metal is ejected through a nozzle portion at the outlet end of the line and into the shotwell of a diecasting machine.

One of the more common diecasting metals is a magnesium-based alloy which, in a molten state, is readily oxidizable by atmospheric oxygen. It is essential therefore in die-casting magnesium-based metals, to maintain the delivery line substantially completely full of the liquid metal during the casting operation. Any interruption of metal flow into the delivery line will produce open spaces in the metal stream in the delivery line passageway, which cause suction of air into the passageway through the nozzle portion. This resulting in surface oxidation of the metal remaining in the delivery line passageway and creates oxide "slugs" which plug the passageway in a relatively short time.

In the presently available die-casting apparatus a principal cause of interrupted metal flow in the delivery line is the coupling means which joins the pumping and metering assembly to the delivery line. In a common type of coupling used for this purpose the male half of the coupling is a fitting having a central bore therethrough and a head portion with generally tapered sidewalls. The male fitting is mounted on the pumping and metering assembly at the outlet end of the metal-conducting passageway in the assembly. The female half of the coupling is a generally bell-shaped fitting having a central frustoconical bore section, the fitting being mounted integral with the inlet end of the metal-conducting passageway in the delivery line. In coupling the delivery line to the pumping and metering assembly, the frustoconical bore section of the female fitting fits over and wedgingly engages the tapered sidewalls of the head portion of the male fitting.

The prior coupling means has been generally unsatisfactory with regard to maintaining the passageway in the delivery line full of metal during the casting operation. For example, the delivery line, which usually comprises several feet of an insulation-covered pipe, exerts a substantial downward pull at the nozzle or discharge end of the pipe, due to the weight of the line. The downward pull of the line thus has a tendency to tip or cant the female fitting at the inlet end of the line such that the conical bore section of the fitting gets out of alignment with the tapered head portion of the male fitting. When the female fitting is canted in this manner the coupling "seal" is broken and the liquid metal in the delivery line will leak between the coupling fittings and back into the melting pot. The usual procedure, in attempting to prevent the coupling from leaking, is to hammer the female fitting down into the male fitting. Forcing the coupling fittings together in this manner exerts considerable strain on the pumping and metering assembly housing and frequently results in cracking the housing. A further disadvantage of the prior coupling is that it is not flexible enough to permit up and down adjustment of the nozzle end of the delivery line without breaking the coupling "seal." This is particularly undesirable in that it is frequently necessary to vary the distance of the delivery line nozzle from the shotwell in order to deliver metal into the shotwell under optimum conditions for producing castings.

Other means for coupling the pumping and metering assembly to the delivery line have included use of railroad unions or a coupling similar to that described above, but with a ring-seal fitted into the bore section of the female fitting. Railroad unions have the general disadvantage of being difficult to disconnect, particularly under the surface of a molten metal bath. Additionally, the unions are not flexible enough to allow for nozzle adjustment of the delivery line. The ring-seal type of coupling has the same general drawbacks as the first-mentioned coupling means described above, since the structure of both couplings is essentially the same.

SUMMARY OF THE INVENTION

A broad object of the invention is a coupling means which provides an essentially liquidtight connection between lines for transporting molten metal.

A more specific object is to provide a coupling for joining the pumping and metering assembly to the delivery line in a metal diecasting apparatus which provides a better liquid metal "seal" than the prior couplings.

Another object is to provide a coupling of the character described which permits more flexibility in adjusting the delivery line of a diecasting apparatus.

Still another object is to provide a coupling as described which permits the delivery line in the diecasting apparatus to be easily and readily disconnected from the pumping and metering assembly to facilitate cleaning of the delivery line.

Broadly stated, the invention provides an improved coupling means for effecting transfer of molten metal from a pumping and metering assembly to a delivery line. A male half of the coupling defines a stud fitting having a ball-shaped head portion and a lengthwise axial bore extending therethrough. The stud fitting is upstandingly affixed to the pumping and metering assembly, such that the lower end of the fitting bore is in direct communication with the outlet end of metal conducting passageway in the assembly. The opposite or female half of the coupling defines a generally bell-shaped fitting with a central bore extending generally lengthwise through the fitting. The bore in the female fitting includes a lower bore section adapted to sealingly engage the head portion of the stud fitting. An upper bore section obliquely intersects the lower bore section and is directly joined to the inlet end of a metal-conducting passageway in the delivery line. In a preferred application the coupling means of this invention is employed in a metal diecasting apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front elevation view, partly schematic and partly in section, of a conventional diecasting apparatus which includes the coupling means of this invention.

FIG. **2** is an enlarged detailed view, mostly in section, of the coupling means illustrated in FIG. **1**.

The drawing illustrates only one of numerous embodiments within the scope of the invention, the form shown being selected for convenient illustration and clear demonstration of the principles involved.

DESCRIPTION OF A PREFERRED EMBODIMENT

In the drawing, referring particularly to FIG. **1**, there is illustrated a portion of a conventional diecasting apparatus of the type employed in diecasting of a magnesium-based alloy. The diecasting apparatus **10** includes a crucible or melting pot **12** for containing the molten metal **14** to be die-cast. A pumping and metering assembly, as generally designated by numeral **16**, provides means for transferring the molten metal **14** from the crucible **12** to a delivery line **18**. From delivery line **18** the metal is injected into the shotwell **20** of a diecasting machine (not shown). Pumping and metering assembly **16** comprises basically a centrifugal pump unit **22** and a metering valve unit **24**. The lower portion of assembly **16**, which is suspended in

the metal melt **14**, includes a metal-conducting passageway **26**. The metal inlet end of passageway **26** is defined by a chamber which houses an impeller unit **22***a* of the pump **22**. A piston-type metering valve **24***a* is positioned in passageway **26** downstream from the impeller unit **22***a*. Valve **24***a* is operated by a suitable electrical control (not shown) to meter a predetermined amount of the metal **14** through passageway **26** into the delivery line **18**. As indicated by the flow direction arrows in FIGS. **1** and **2**, the metal **14** is transferred from the pumping and metering assembly **16** into the delivery line **18** through a coupling means **28**, which connects the passageway **26** in assembly **16** with a metal-conducting passageway **30** in delivery line **18**.

Coupling means **28** is more specifically illustrated in the enlarged detail view of FIG. **2**. As shown in FIG. **2**, the male half of coupling **28** comprises a stud fitting **32** having a ball-shaped head portion **32***a* and an axial bore **32***b*, which extends lengthwise through the fitting. Stud fitting **32** is upstandingly affixed to the pumping and metering assembly **16** such that the lower end of bore **32***b* is directly joined to the outlet end of passageway **26** in assembly **16**. An upper or female half of coupling **28** defines a generally bell-shaped fitting **34** with a central bore extending substantially lengthwise through the fitting. The bore in fitting **34** comprises a lower bore section **35***a* and an upper bore section **36**. Lower bore section **35***a* defines a frustoconical cavity having tapered sidewalls **35***c*, which are adapted to wedgingly engage the perimeter of the ball-shaped head portion **32***a* of stud fitting **32**. The lower end of upper bore section **36** communicates with the lower bore section **35***a* by forming an oblique intersection with a transverse upper wall **35***d* of the lower bore section. Preferably, the bore section **36** intersects bore section **35***a* at an angle of about 45° such that the bore section **36** will extend generally diagonally through the upper part of fitting **34**. The metal-conducting passageway **30** of delivery line **18** fits into the upper portion of upper bore section **36** and the outer wall of the passageway is secured to the fitting **34** to thereby directly join bore section **36** with the (metal) inlet end of passageway **30**.

As will be apparent from the foregoing description and the accompanying drawing, the coupling means **28** provides an excellent connection for the transfer of the molten metal **14** from the pumping and metering assembly **16** to the delivery line **18**. Referring to FIG. **2**, it will be seen that the tapered sidewalls **35***c* of bore section **35***a* provide a substantially snug "wedging-type fit" of fitting **34** on the perimeter of the ball-shaped head portion **32***a* of stud fitting **32**. The snug fit thus obtained provides a good liquidtight "seal" which prevents the molten metal **14** in passageway **30** of delivery line **18** from leaking between the coupling fittings and back into the crucible **12**. Another advantage of the coupling **28** is the "swivel-type" joint it provides, which permits substantially unlimited flexibility of delivery line **18**, as regards either up or down or lateral adjustment of the delivery line. The coupling has another particularly desireable feature which is not found in the prior coupling means. With a swivel-type joint the coupling may be readily disconnected when it is desired to remove plugging solids from the passageway **30** in delivery line **18**.

In the preferred embodiment illustrated in FIGS. **1** and **2**, coupling **28** includes a holddown means **37** for urging the bell-shaped fitting **34** downwardly against stud fitting **32**. Holddown means **37** is defined generally by an upstanding bar or rod **37***a*. The lower end of rod **37***a* has a recess therein adapted to engage an integral knob member **38** formed at the apex of bell-shaped fitting **34**. The upper end of rod **37***a* is connected to one end of lever **37***b*, which is pivotally mounted in a yoke member **37***c* carried on an upper deck plate **40** of the diecasting apparatus. As will be apparent from the drawing, lever **37***b* may be moved upwardly to force fitting **34** downwardly against stud fitting **32** to assure good "sealing" contact between the fittings. Conversely, the lever may be moved downwardly to disengage rod **37***a* from fitting **34** when it is desired to disconnect the coupling **28** for cleaning purposes, replacement of parts, or the like. The frustoconical configuration of lower bore section **35***a* and the ball-shaped configuration of head portion **32***a* make it possible to obtain satisfactory sealing contact of fitting **34** with fitting **32** without the use of holddown rod **37***a*. In the practice of the invention, however, a holddown means is preferred to assure that the coupling joint will be leakproof. It will be understood that any mechanical structure within the skill of the art may be used to provide a holddown means of the type described.

In a typical operation of the diecasting apparatus **10**, a general procedure for casting of the molten metal **14** in crucible **12** is as follows. A series of "test" shots are made to completely fill the passageway **26** in pumping and metering assembly **16** and passageway **30** in delivery line **18**. Once the passageways are full of metal, electrical controls are employed to set the pump **22** on idle speed and to open the metering valve **24***a*. The speed of pump **22** is then increased to the point where the impeller **22***a* is continuously withdrawing metal from the crucible and filling the passageway **26** in the assembly **16** and passageway **30** in delivery line **18**. After a preset period, valve **24***a* automatically closes to meter a given amount of metal into the delivery line **18** through passageway **26** and coupling **28**. From delivery line **18** the premeasured amount of metal is injected into a die-assembly (not shown) to make the casting. Timer controls operating in conjunction with pump **22** and metering valve **24** open and close the die assembly according to an established sequence.

The importance of having a good liquidtight connection between the pumping and meter in assembly **16** in delivery line **18**, as provided by the coupling **28**, is readily apparent. For example, once metering value **24***a* closes off passageway **26** during the metering sequence, the only way to hold the desired level of metal in delivery line **18**, is to have a connection between passageways **26** and **30** which will not permit the metal to drain back into the crucible.

Although the coupling means of this invention has particular utility in a diecasting apparatus of the type used to cast light metals, such as alloys of magnesium, aluminum or zinc, it is not intended that the invention be limited to this precise concept. It is contemplated, for example, that the present coupling means may be used in any type of system requiring a leakproof, flexible, readily disconnectable coupling to join sections of conduit used to transport liquids from one point to another.

I claim:

1. In a pumping and metering assembly for transferring molten metal to a delivery line, an improved means for coupling the pumping and metering assembly to the delivery line, the coupling means comprising:

a stud fitting having a ball-shaped head portion and a lengthwise axial bore extending therethrough, the stud fitting being upstandingly affixed to the pumping and metering assembly such that the lower end of the fitting bore is in direct communication with the outlet end of a metal-conducting passageway in said pumping and metering assembly;

a generally bell-shaped fitting having a central bore extending substantially lengthwise through the fitting, the bore including a lower bore section adapted to sealingly engage the head portion of the stud fitting and an upper bore section obliquely intersecting the lower bore section and being directly joined to the inlet end of a metal-conducting passageway in said delivery line.

2. The coupling means of claim **1** wherein the lower bore section of the bell fitting defines a frustoconical cavity having tapered sidewalls adapted to wedgingly engage the perimeter of the ball-shaped head portion of the stud fitting.

3. The coupling means of claim **1** wherein the upper bore section defines a cylindrical cavity, the lower end of which intersects with an upper transverse wall of the lower bore section at an angle of about 45°.

4. In a metal die casting apparatus including a pumping and metering assembly for transferring molten metal to a delivery

line, an improved means for coupling the pumping and metering assembly to the delivery line, the coupling means comprising:

a stud fitting having a ball-shaped head portion and a lengthwise axial bore extending therethrough, the stud fitting being upstandingly affixed to the pumping and metering assembly such that the lower end of the fitting bore is in direct communication with the outlet end of a metal-conducting passageway in said pumping and metering assembly;

a generally bell-shaped fitting having an integral knob member at the apex of the fitting, the fitting including a central bore extending substantially lengthwise through the fitting, the bore including a lower bore section adapted to sealingly engage the head portion of the stud fitting and an upper bore section obliquely intersecting the lower bore section and being directly joined to the inlet end of a metal conducting passageway in said delivery line;

holddown means adapted to engage the knob member of the bell-shaped fitting and to urge said fitting downwardly against the stud fitting to thereby provide sealing contact between the lower bore section of the bell fitting and the head portion of the stud fitting.

5. The die-casting apparatus of claim 4 in which the holddown means is defined by an upstanding rod having a recess in the lower end thereof adapted to engage the knob member of the bell fitting and the upper end of the rod being adapted for engagement with a lever member carried on the diecasting apparatus and adapted for effecting up and down movement of the rod.