An automatic ladling system for a cold-chamber, low pressure type die casting machine and permanent molding machines including a housing which is adapted to be submerged in a reservoir of molten cast metal, and a dual piston pumping mechanism structured for synchronous actuation and located in the submerged housing, the first pumping device serving to pump a quantity of molten cast metal into the submerged housing, while the second pumping device is structured to pump molten cast metal from the housing through a gooseneck to the shot sleeve at the die cast injection chamber of a cold-chamber machine or directly into the casting mold in the case of low pressure or permanent molding.

4 Claims, 2 Drawing Figures
AUTOMATIC DOLDING SYSTEM FOR DELIVERING MOLTEN METAL FROM FURNACE TO DIE CASTING MACHINE

BACKGROUND OF THE INVENTION

This invention relates in general to an automatic ladling system for a low pressure die casting machine, or the cold-chamber pressure casting machine or for permanent mold casting. More specifically, this invention relates to structural means adapted to ensure that predetermined quantities of molten metal are consistently and uniformly delivered to the die cavities of a die casting machine. In this respect, this invention is based on a structural arrangement of multiple pumping devices to satisfy the requirement of consistency in the amount of molten metal to be delivered to the die cavity.

A die casting machine of the type upon which this invention is based is usually comprised of a horizontally arranged base, having a holding furnace for molten metal, means adapted to pump molten metal submersed in the holding furnace, and a "gooseneck" having a passage therein which provides communication between the pumping means and the sleeve adjacent the die cast cavity.

The die arrangement conventionally includes a vertically or horizontally positioned die support, a plurality of spaced rods secured to one side of the die support, on which is mounted for reciprocal movement a movable die support member. In addition, a cover die is mounted on the rod side of the stationary die support and an ejector die is mounted on the movable support on the side facing the cover die. The movable die is adapted to move toward the stationary die by way of hydraulic means in a reciprocal manner, thus enabling the cover and ejector dies to be opened and closed pursuant to the die casting cycle.

Formerly, in the operation of cold chamber die casting machines, the "shot" of molten metal was manually delivered from the melting chamber to the shot sleeve at the end of the injection cylinder and at the entrance to the die cavity for the subsequent die casting process. In view of the inefficiency, poor product results, and dangers which this manual system generated, semiautomatic and fully automatic means were conceived and brought forth in the art for handling this system of delivering the molten metal to the sleeve of the die casting machine for injection into the die cavity. At a still later phase, more fully automatic machines were advanced, and in particular, the more modern automatic die casting machines utilize structural means for automatically metering the amount of molten metal to be delivered to the shot sleeve of the injection cylinder near the die cavity.

However, the die casting machines with automatic metering means have not had the requisite efficiency and effectiveness for delivering an exact predetermined constant quantity of molten metal to the sleeve. For one matter, most of the structural approaches have been centered about use of automatic dipper mechanism, vacuum or air or gas pressure displacement means adapted to deliver to the shot sleeve an amount of molten metal greater than required by the capacity of the die cavity runner and biscuit. As a consequence of such overcompensation, excessive amounts of molten metal would be delivered to the die cast cavity, resulting in an undesirable situation, such as excessive large biscuit, as an excessive amount or insufficient amount of molten metal in the die cavity is not conducive to effective and efficient die casting. Furthermore, a single pump means often used to deliver molten metal to the shot sleeve is often unable to deliver the exact and constant amount of molten metal required in the die cavity. This latter problem arises from the fact that usually the shot-cylinder pump utilizes gravity flow or other inherent pressure sources to fill the shot cylinder due to the varying metal temperature. In particular, the gravity and pressure of the molten metal itself is used to fill the shot cylinder and, frequently, this combined gravity and force is not sufficient or substantial enough to fill the shot cylinder completely. Thus, very often the pressure or other means used to fill the shot cylinder will not perform sufficiently or properly to fill the primary and only pump, thereby making it impossible for the pump to deliver to the shot sleeve the predetermined amount of molten metal as called for by the pump capacity.

SUMMARY

In view of the foregoing problems as existent in the art of die casting machines, it is an object of this invention to provide an automatic ladling system which is fully effective in delivering predetermined and consistent quantities of molten metal to the sleeve of the die cavity;

A further object of this invention is to provide an improved ladling system for a die casting machine and other casting methods which require precise metered amounts of molten metal for each cycle;

It is also an object of this invention to provide an automatic ladling system for a die casting machine which is efficient in the usage of molten metal;

It is further the object of this invention to provide an automatic ladling system which substantially eliminates the oxidation of molten metal, due to the nature of the reservoir oxides and inclusion are floated and only clean metal is displaced to the shot sleeve or die cavity;

Still another object of the subject invention is to provide a comparatively safe automatic ladling system for a die casting machine;

Yet another object of the subject invention is to provide a more productive automatic ladling system for a die casting machine.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of the subject invention will become apparent from the following description of the invention taken together with the accompanying drawings, in which:

FIG. 1 is a side elevational view of the die casting machine incorporating the subject invention, partly in cross section, showing the pressure chamber situated in the holding furnace housing; and

FIG. 2 is an elevational view, partly in section, of the structure illustrated in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

This invention involves an automatic ladling system for a die casting machine and, in this regard, there is a horizontally disposed holding furnace having an exterior housing of some suitable refractory material, and securely disposed in the molten metal held in this holding furnace is a pressure chamber having a two cylinder pumping structure contained within said pressure chamber. This pumping structure is adapted to pump the molten metal from the holding furnace into the pressure chamber and thence to a passageway located in a gooseneck connected to the shot sleeve adjacent to the die cast cavity. Communicating with the sleeve is the end of a hydraulic injection cylinder used as the final pressure means for injecting the molten metal into the die cast cavity from the sleeve.

Referring to the drawings, in which there is shown a specific embodiment of the subject invention, and referring particularly to FIG. 1, a holding furnace or molten metal reservoir 10 of substantially horizontal disposition is shown. The holding furnace 10 contains molten metal at a level generally indicated by reference numeral 12, and includes heating means (not shown) for maintaining the metal in a molten state. The walls of the holding furnace 10 are formed of refractory material which is capable of withstanding high temperatures over relatively long periods of time.

Fitted securely in the holding furnace 10 is a multichambered housing 14 having vertical spaced apart sidewalls 16 and 18, which functions to draw molten metal from the holding furnace 10 for pumping the molten metal to the die cavities. Connected to the bottom of the sidewall 16 and communicating with the interior of housing 14 is a gooseneck 20, hav-
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ing an internal passageway 22. The upper end of the
goose neck 20 is connected to a spout 24 which communicates
with a sleeve 25 at the entrance of the die cavity (not shown).
Within the housing 14 are two vertically disposed cylinders 26
and 28, which define an immediately disposed chamber 30.
Both cylinder 26 and 28 have wall linings made of graphite or
other suitable refractory material for retaining the molten
metal in its heated state. Disposed within each of the cylinders
26 and 28 are pistons 32 and 34, respectively, which are
adapted to reciprocate predetermined distances therein.

Cylinder 28 is typically of a larger diameter than cylinder
26. Consequently, the volume of molten metal which can be
pumped by cylinder 28 is greater than the volume of molten
metal which can be pumped by cylinder 26.

Extending from the upper portions of pistons 32 and 34 are
vertically disposed rods 36 and 38, respectively, which are fix-
edly secured to the pistons for integral movement therewith.
Rods 36 and 38 are, in turn, fixedly secured at their upper
ends to a horizontally disposed cross brace member 40. More
particularly, the rod 36 is secured to one end of the cross
brace 40 by a conventional locking method, while rod 38 is
secured to the opposite end by a similar conventional locking.

Suitably fastened to the cross brace 40 is vertically disposed
piston rod 42 of a fluid motor 44. The fluid motor 44 is suit-
edly secured in such a fashion that, upon actuation thereof, the
piston rod 42 can move the cross brace 40 relative to the
furnace 10.

It will be readily apparent from the foregoing description that
whenever the fluid motor 44 is actuated to move the
piston rod 42 downwardly, cross brace 40 will be caused to
move downwardly and consequently, the rods 36 and 38 will
travel downwardly to the same vertical extent, simultaneously
effecting downward movement of the pistons 32 and 34 in
cylinders 26 and 28, respectively. It can be seen that the
pistons in each cylinder will travel downwardly simultaneously
and to the same vertical extent, resulting in the same relative
displacement in each cylinder 26 and 28.

Centrally disposed between the cylinders 26 and 28 in the
housing 14 there is a chamber 50. Communicating between
the lower end of the cylinder 28 and the upper portion of
chamber 50 is a generally vertically disposed passageway 52.
Additionally, the cylinder 28 is provided with an inlet port 56
leading from the interior of the furnace 10 through the vertical
wall 16 of the housing 14 directly to the inside of cylinder 28.

An inlet port 58 is provided to establish communication
between the central chamber 50 and the interior of the
cylinder 26.

The goose neck 20 is provided with an internal passageway
22 which provides communication between an outlet port 60
of the cylinder 26 and the inlet of the spout 24. Spout 24 may
be heated electrically, for example, to insure a smooth flow of
molten metal therethrough. The spout 24 leads directly to the
sleeve 25 of a die cavity of a die casting machine.

In operation, molten metal from holding furnace 10 is
drawn into chamber 14 through inlet port 56 by the partial
vacuum effect created upon the withdrawal of piston 34. Sub-
sequently, when hydraulic plunger 38 is lowered, molten
metal will be forced from cylinder 28 through the passageway 52
and thence into central chamber 50. On the following stroke,
the raised piston 32 into the cylinder 26 causes the mol-
ten metal in central chamber 50 to flow through inlet port 58
and into cylinder 26. When piston 32 is lowered after mol-
ten metal enters the cylinder 26, the inlet port 58 is closed by
the piston 32 and the molten metal will be forced from
cylinder 26 upward through passageway 22 of the goose neck
20 to the spout 24 and thence into the associated die cavity.

The structural relationship of having cylinder 28 larger than
cylinder 26 ensures that the interior of the cylinder 28, and
thus, the central chamber 50 will always have more molten
metal than the capacity of cylinder 26, which injects the mol-
ten metal into the die cavity. This will ensure that cylinder 26
is always full to capacity or maintain a constant metal level 12
to inject a constant amount of molten metal into the asso-
ciated die cavity. Thus, the die cavity will always be filled
with a consistent exact amount of molten metal during each
duty cycle, regardless of metal level 12 in furnace 10.

It can thus be seen by the structural arrangement of the dual
pumping arrangement in the housing 14 that the cylinder 26
will always be filled completely because the molten metal
drawn into the cylinder 26 will be received from the quiescent
reservoir of molten metal in the central chamber 50. Any ex-
cess metal displaced by the piston 34 into the chamber 50 is
overflowed off by overflow grooves 66, thus maintaining a
constant metal level in the reservoir chamber 50.

It will be understood that the main body portion of the hous-
ing 14 is preferably formed of a suitable ceramic refractory
material wherein the internal walls of the cylinders 26 and 28
are provided with sleeves of wear resistant material to provide
the necessary sealing fit with the external walls of the pistons
32 and 34, respectively.

According to the provisions of the patent statutes, I have ex-
plained the principles and mode of my invention and have illu-
minated and described what I now consider to represent its
best embodiment. However, I desire to have it understood
that, within the scope of the appended claims, the invention
may be practiced otherwise than as specifically illustrated and
described.

What I claim is:

1. A system for delivering molten metal from a molten metal
furnace to a casting machine comprising:
a housing mounted within said furnace and adapted to be
at least partially submerged below the normal level of the
molten metal in the furnace, said housing comprising ad-
jacent first, second, and third chambers;
said first chamber having a larger volume than said third
chamber;
first inlet means in said housing disposed to be beneath
the normal level of the molten metal in said furnace and
providing communication between the molten metal and
said first chamber;
closed passageway means between and extending from the
lower portion of said first chamber to the upper portion of
said second chamber and providing communication
between said first and second chambers, said passageway
means having a substantially smaller volume than said
first chamber;
second inlet means in said third chamber disposed to be
beneath the level of said passageway outlet into said
second chamber and providing communication between
said second and third chambers;
outlet means in said housing providing communication
between said third chamber and the casting machine;
and pumping means in said first and third chambers, said
pumping means being adapted to move vertically with
simultaneous reciprocal movement and the same vertical
displacement;
whereby molten metal can be pumped through said first
and third chambers with each downward stroke of said pumping
means, and said second chamber can be constantly main-
tained at full capacity with molten metal, and thereby effec-
tively delivering molten metal from the furnace to the casting
machine.
2. The invention defined in claim 1 wherein said passageway
outlet is disposed to be above the normal level of the molten
metal in the furnace.
3. The invention defined in claim 1 wherein said pumping
means consists of a piston in the first and second chambers.
4. The invention defined in claim 3 wherein said pumping
means includes a pressure fluid motor for effecting simultane-
ous reciprocal movement of the pistons.