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(54) **A molten metal dispensing apparatus.**

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A molten metal dispensing apparatus

This invention relates to an apparatus for dispensing molten metal into a mold or the like. It includes a molten metal storage container, and a pouring passage extending upwardly from the bottom of the storage container and having an outlet in a position above the highest level of molten metal in the storage container. Compressed gas is introduced into a closed hollow space in the storage container to apply pressure to molten metal therein to discharge it through the outlet of the pouring passage.

A dispensing system of this type as further defined in the precharacterising part of claim 1 is described in the DE—A—2624435. Another known system as described in DE—A—2433060 employs air as a gas for compressing molten metal. When it is desired to discontinue dispensation of molten metal, the compressed air in the storage container is released into the atmosphere. If it is desired to dispense molten metal again, it is necessary to introduce a fresh supply of compressed air into the storage container. If fresh air is introduced into the storage container whenever it is desired to dispense molten metal, however, the storage container always remains filled with a gas containing a large quantity of oxygen. This gas oxidizes the molten metal contacting it, and disadvantageously brings about generation of a large quantity of slag, and the loss of effective constituents from molten metal. The apparatus is, therefore, unsuitable for use in the dispensation of easily oxidizable molten metal, or molten metal containing an easily oxidizable constituent, though it can relatively easily and accurately control the amount to be dispensed. Attempts have, therefore, been made to introduce compressed argon or other inert gas into the storage container in order to prevent such oxidation. However, such an inert gas is expensive, and disadvantageously increases the cost of operation, as it requires a large quantity of such gas.

In view of the aforesaid disadvantages, it is an object of this invention to provide a molten metal dispensing apparatus which can be operated with compressed air without any oxidation of molten metal.

This object is achieved in accordance with the present invention as defined in claim 1 by a molten metal dispensing apparatus including a molten metal storage container and a pouring passage extending upwardly from the bottom of said container to a point above the highest level of molten metal in said container, and adapted for dispensing molten metal through said pouring passage when compressed air is introduced into a closed hollow space above said molten metal in said container to apply pressure to said molten metal, a high pressure tank in which said compressed air is stored before it is introduced into said storage container, a low pressure tank into which said compressed air is

recovered from said storage container, and a compressor for compressing said air from said low pressure tank and returning it into said high pressure tank, whereby a substantially constant negative pressure is maintained in said low pressure tank, and that a pressure regulator is connected between a suction valve and the low pressure tank, said suction valve being vented to the atmosphere or open air.

The invention will now be described by way of example with reference to the drawing.

Referring to the enclosed figure, there is schematically shown a dispensing system embodying this invention. The system comprises a storage container 1 lined with refractories. The storage container 1 defines a storage chamber 2 for storing molten metal 6 therein, and is provided with a pouring passage 3 extending upwardly from the bottom of the storage chamber 2 and having an outlet 31 at a point above the highest level 7 of molten metal 6, and a receiving passage 4 extending upwardly from the bottom of the storage chamber 2 and having an inlet 41 at a higher level than the outlet 31 of the pouring passage 3. Molten metal is received through the receiving passage 4, and stored in the storage chamber 2. The top opening of the storage chamber 2 is closed by a cover 5 in a gastight manner, so that a closed hollow space may be formed above the molten metal in the storage chamber 2. A gas feed line 21 and an exhaust line 22 extend through the cover 5 into the storage chamber 2.

The gas feed line 21 is connected to a high pressure gas tank 8, in which compressed gas is stored, through a device 9 for controlling the pressure of the gas to be introduced into the storage chamber 2. The exhaust line 22 is connected through an exhaust valve 10 to a low pressure gas tank 11 into which exhaust gas is collected. The low pressure gas tank 11 has an outlet connected to the inlet of a gas compressor 15 through a primary cooler 12, a drain separator 13 and a filter 14. The gas compressor 15 has an outlet connected to the high pressure gas tank 8 through a secondary cooler 16. A pressure regulator 17 is provided for detecting the pressure of the gas in the high pressure gas tank 8, and maintaining it at a predetermined level of say, 3.5 kg/cm² by causing the operation of the compressor 15 to be stopped if the gas pressure exceeds the predetermined level, while causing it to be started again if the gas pressure has dropped below the predetermined level. A suction valve 19 is connected to the low pressure gas tank 11 for drawing air thereinto. A pressure regulator 18 is connected between the suction valve 19 and the low pressure gas tank 11 for detecting the pressure of the gas in the tank 11 and maintaining it at a substantially equal negative pressure of, say, -0.3 kg/cm² by causing the valve

19 to open if the gas pressure in the tank 11 has dropped below the aforesaid level, while causing it to be closed if the gas pressure exceeds the aforesaid level.

In preparation for the pouring operation, the compressor 15 is started for drawing air from the low pressure gas tank 11, and compressing it, so that the compressed air may be stored in the high pressure gas tank 8. The pressure regulator 9 and the exhaust valve 10 remain closed. Until the pressure of the gas in the high pressure gas tank 8 reaches a predetermined level of, say, 3.5 kg/cm², the compressor 15 continues in operation, and draws air from the low pressure gas tank 11. Therefore, a gradual reduction takes place in the quantity and pressure of the air in the tank 11. If the pressure of the air in the tank 11 drops below a predetermined level of, say -0.3 kg/cm², the pressure regulator 18 causes the suction valve 19 to open, and draw a fresh supply of air into the tank 11. The compressor 15 stops its operation when the high pressure gas tank 8 has been filled with air to the extent that its pressure reaches a predetermined level of, say, 3.5 kg/cm² whereupon the apparatus is ready for the dispensing operation. The pressure of the air in the low pressure gas tank 11 is maintained at a predetermined negative pressure of -0.3 kg/cm².

In the operation of the apparatus for dispensing molten metal, the pressure regulator 9 is controlled to introduce compressed air from the high pressure gas tank 8 into the closed storage chamber 2 through the feed line 21 for raising the pressure of the gas in the storage chamber 2, whereby pressure is applied to the molten metal 6. The level 7 of the molten metal in the storage chamber 2 is lowered, and the levels of the molten metal in the pouring passage 3 and the receiving passage 4 are raised correspondingly. If the molten metal in the pouring passage 3 reaches its outlet 31, it is forced out therethrough into a mold not shown, or the like. As long as the pouring of molten metal continues, the pressure regulator 9 continues to introduce compressed air into the storage chamber 2 to maintain therein the pressure required for forcing molten metal out of the pouring passage 3.

When it is desired to discontinue the pouring operation, the pressure regulator 9 is actuated in such a manner as to interrupt the supply of compressed air from the high pressure gas tank 8, and the exhaust valve 10 is opened. The high pressure air in the storage chamber 2 is drawn into the low pressure gas tank 11 in which a negative pressure is maintained, and reduces its pressure. The air in the storage chamber 2 ceases to apply pressure to the molten metal 6 therein, and its level 7 rises, while the level of the molten metal in the pouring passage 3 drops below its outlet 31, whereby the pouring operation is terminated. Upon termination of the pouring operation, the exhaust valve 10 is

closed again, so that the apparatus may be ready for another cycle of pouring operation.

As compressed air is supplied from the high pressure gas tank 8 into the storage chamber 2 for the pouring operation, the resulting reduction in the quantity and pressure of the air in the tank 8 causes the compressor 15 to be started. The air recovered from the storage chamber 2 into the low pressure gas tank 11 is compressed and recycled into the high pressure gas tank 8.

The aforesaid sequences of operation are repeated for dispensing molten metal, and discontinuing any such dispensation. The quantity of the molten metal to be dispensed can be controlled by the pressure regulator 9 which controls the duration of pressure application into the storage chamber 2.

According to the system of this invention, the compressed gas supplied from the high pressure gas tank 8 into the storage chamber 2 is never released into the open atmosphere, but is recovered into the low pressure gas tank 11, so that it may be compressed by the compressor 15 again, and recycled into the high pressure gas tank 8. In other words, the gas is circulated along a closed loop. The closed loop circulation of the gas provides a number of advantages. Oxygen, which is present in a large quantity in the air during the initial stage of operation, is gradually reduced by reacting with molten metal in the storage container 1 during its recirculation in the closed loop. Accordingly, the oxidation of the molten metal 6 in the storage container 1 can be effectively prevented.

Should there develop any deficiency in the quantity of the gas in the closed loop due to leakage, however, the pressure of the gas in the low pressure gas tank 11 drops below a predetermined level. The pressure regulator 18 detects any such pressure drop in the tank 11, and causes the suction valve 19 to open to draw air therethrough to supply a satisfactory amount of additional air into the tank 11. There is virtually no fear of molten metal oxidation, since the amount of any such additional air is very small, and does not bring about any appreciable increase in the quantity of oxygen in the closed loop.

The primary cooler 12 provided on the inlet side of the compressor 15 cools the gas from the low pressure gas tank 11 before its transfer into the compressor 15 to thereby protect the compressor 15 against overheating, since the gas recovered from the storage container 1 remains hot due to the high temperature of the molten metal therein. The secondary cooler 16 provided on the outlet side of the compressor 15 cools the gas heated during its compression. The drain separator 13 and the filter 14, which are provided on the inlet side of the compressor 15, remove moisture and dust, respectively, from the gas to be supplied from the low pressure gas tank 11 to the com-

pressor 15 to protect the compressor 15 against damage by any such moisture or dust.

Claims

1. A molten metal dispensing apparatus including a molten metal storage container (1) and a pouring passage (3) extending upwardly from the bottom of said container (1) to a point above the highest level (7) of molten metal (6) in said container (1), and adapted for dispensing molten metal through said pouring passage (3) when compressed air is introduced into a closed hollow space above said molten metal in said container (1) to apply pressure to said molten metal (6), a high pressure tank (8) in which said compressed air is stored before it is introduced into said storage container (1), low pressure tank (11) into which said compressed air is recovered from said storage container (1) and a compressor (15) for compressing said air from said low pressure tank (11) and returning it into said high pressure tank (8), characterized by the fact that a substantially constant negative pressure is maintained in said low pressure tank (11), and that a pressure regulator (18) is connected between a suction valve (19) and the low pressure tank (11), said suction valve being vented to the atmosphere or open air.

2. A molten metal dispensing apparatus as claimed in claim 1, wherein said compressor (15) is operated in such a manner as to maintain a substantially constant positive pressure in said high pressure gas tank (8).

Revendications

1. Appareil de distribution de métal en fusion comprenant un récipient d'emmagasinage de métal en fusion (1), ainsi qu'un passage de coulée (3) montant à partir du fond de ce récipient (1) jusqu'à un point situé au-dessus du niveau le plus élevé (7) du métal en fusion (6) contenu dans ce dernier, cet appareil étant conçu pour distribuer le métal en fusion via ce passage de coulée (3) lorsque de l'air comprimé est introduit dans un espace vide enfermé défini dans le récipient (11) au-dessus du métal en fusion (6) afin d'appliquer une pression à ce dernier, un réservoir sous haute pression (8) dans lequel l'air comprimé est emmagasiné avant son introduction dans le récipient d'emmagasinage (1), un réservoir sous basse

pression (11) dans lequel est récupéré l'air comprimé provenant du récipient d'emmagasinage (1), ainsi qu'un compresseur (15) destiné à comprimer l'air provenant du réservoir sous basse pression (11) et à le recycler dans le réservoir sous haute pression (8), caractérisé en ce qu'une pression négative pratiquement constante est maintenue dans le réservoir sous basse pression (11), tandis qu'un régulateur de pression (18) est relié entre ce dernier et un clapet d'aspiration (19), lequel est mis en communication avec l'atmosphère ou l'air libre.

2. Appareil de distribution de métal en fusion suivant la revendication 1, caractérisé en ce que le compresseur (15) fonctionne de telle sorte qu'une pression positive pratiquement constante soit maintenue dans le réservoir de gaz sous haute pression (8).

Patentansprüche

1. Vorrichtung zum Abgeben von Metallmengen mit einem Behälter (1) für die Metallschmelze und einem Ausgusskanal (3) welcher sich vom Boden des Behälters (1) bis zu einem über dem Höchsteniveau (7) der Metallschmelze (6) im Behälter (1) gelegenen Punkt erstreckt und dazu bestimmt ist, Metallschmelze durch diesen Ausgusskanal (3) abzugeben wenn Druckluft in einen geschlossenen Hohlraum über der Metallschmelze im Behälter (1) eingelassen wird, um Druck auf die Metallschmelze auszuüben, einem Hochdruckgefäß (8) in welchem die Druckluft vor dem Einlassen in den Behälter (1) aufbewahrt wird, einem Niederdruckgefäß (11) in welchem die Druckluft aus dem Behälter (1) wiedergewonnen wird und einem Kompressor (15) um die Luft aus dem Niederdruckgefäß (11) zu komprimieren und in das Hochdruckgefäß (8) zurückzubefördern, dadurch gekennzeichnet, dass ein substantieller, konstanter, negativer Druck im Niederdruckgefäß (11) aufrechterhalten wird und dass ein Druckregler (18) zwischen einem Saugventil (19) und dem Niederdruckgefäß (11) eingebaut ist, wobei das Saugventil zur Atmosphäre oder Aussenluft hin entlüftet wird.

2. Vorrichtung zum Abgeben von Metallmengen gemäss Anspruch 1, dadurch gekennzeichnet, dass der Kompressor (15) so betrieben wird, dass ein substantieller, konstanter, positiver Druck im Hochdruckgefäß aufrechterhalten wird.

