May 15, 1956 F. L. BURKETT 2,745,153

APPARATUS FOR DISPENSING SHOTS OF MOLTEN METAL

Filed Feb. 2, 1955

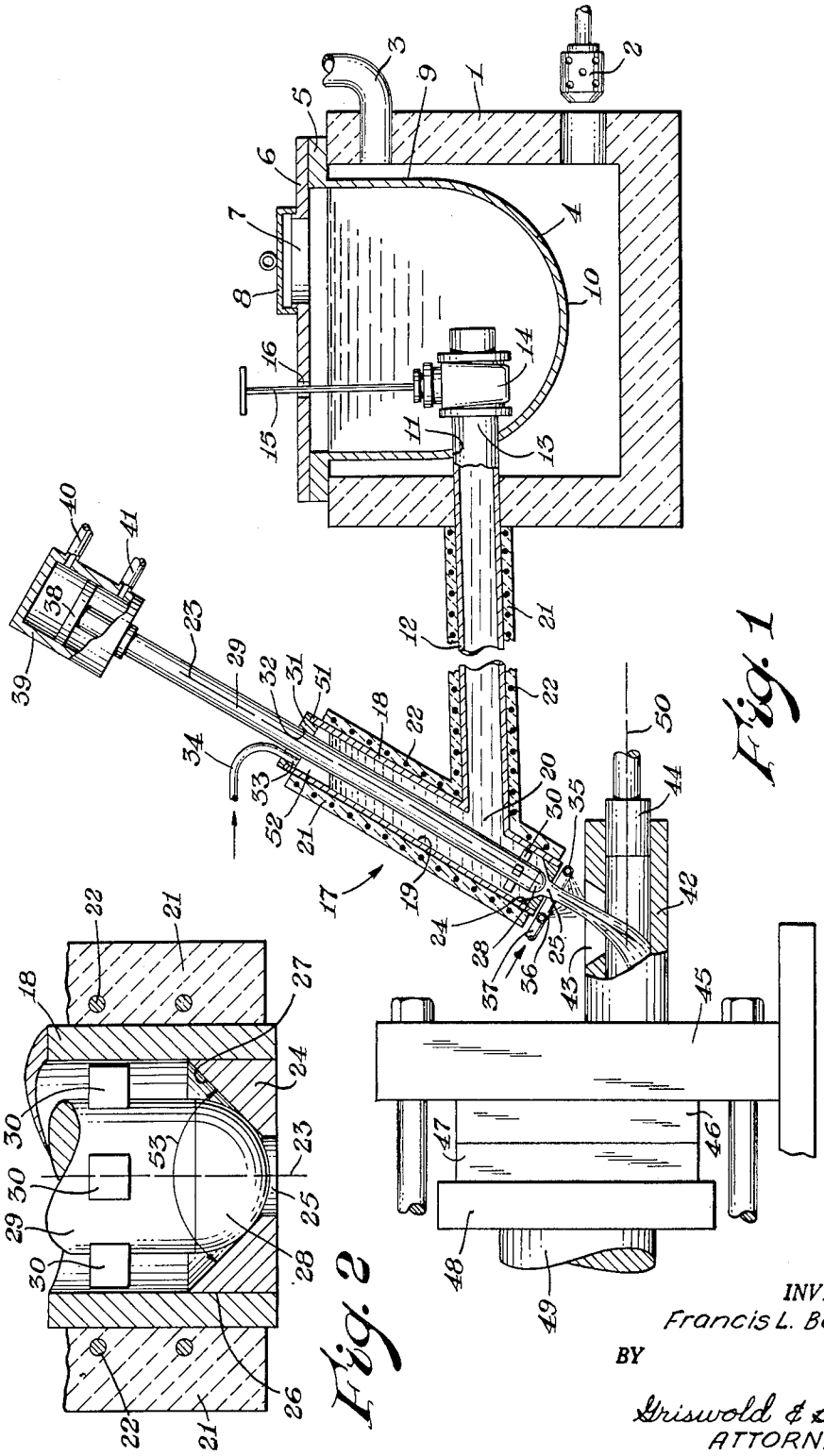


Fig. 1

Fig. 2

INVENTOR.
Francis L. Burkett
BY
Griswold & Burdick
ATTORNEYS

United States Patent Office 2,745,153 Patented May 15, 1956

2,745,153

APPARATUS FOR DISPENSING SHOTS OF MOLTEN METAL

Francis L. Burkett, Breckenridge, Mich., assignor to The Dow Chemical Company, Midland, Mich., a corporation of Delaware

Application February 2, 1955, Serial No. 485,642

3 Claims. (Cl. 22—79)

The invention relates to an apparatus for dispensing slugs or charges of molten metal to a casting device. It more particularly concerns an improved apparatus for dispensing a succession of equal size charges of a molten readily oxidizable metal, such as magnesium alloy, from a supply thereof to a die casting machine.

It is an object of the invention to provide an improved apparatus of the character above indicated including a pipe for conveying by gravity flow molten readily oxidizable metal from a source thereof, such as a melting pot, to a dispensing valve from which a succession of shots of metal is delivered by opening and closing the valve. A feature of the invention is that the valve arrangement permits precise control of the volume of each shot, by providing an abrupt cut off of flow at the termination of each shot so that dripping and dribbling are obviated. A further feature of the invention is that the outlet from the valve is designed to overcome the adverse effects of the propensity of the molten metal to be attacked by the atmosphere forming a dross which tends to adhere to solid surfaces exposed to the air and in contact with the molten metal. Other objects and advantages of the invention will appear as the description of the invention proceeds.

The invention will be readily understood from a reading of the following specification and reference to the accompanying drawing.

In the said drawing:

Fig. 1 is a side elevation largely in section showing a preferred embodiment of the apparatus as it delivers a shot of molten metal to the shot cylinder of a die casting machine.

Fig. 2 is an enlarged view largely in section of a portion of the dispensing valve of Fig. 1.

Referring to the drawing, there is shown a furnace setting 1 provided with a heating burner 2 and flue 3. Shown in the furnace setting is a melting pot 4 or metal supply vessel having a rim 5 which rests upon the setting. The melting pot is preferably provided with a cover 6 having a charging opening 7 which may be closed with a removable cover 8. The side wall 9 of the pot near the bottom 10 is provided with an opening 11 through which passes the outlet pipe 12 the outside of which is welded or otherwise sealed to the wall 9 of the pot around the opening 11. The end 13 of the pipe in the pot preferably is provided with an emergency shut off valve 14 by which the inflow of molten metal from the pot into the pipe can be prevented when desired. The valve 14 is controlled by a valve stem 15 which extends upwardly from the valve through an opening 16 in the cover.

Pipe 12 extends through the furnace setting close to the point of delivery of the molten metal from the pot and is given a slight slope (e. g. from 1° to 10° from the horizontal either way) so as to permit any gas bubbles formed in or entering the pipe to escape by travelling to one end or the other. As shown in the drawing, the pipe slopes slightly upwardly toward the pot. The pipe lies below the top of the pot so that molten metal will pass

through it under the force of gravity. At the delivery end of the pipe is affixed by shot dispensing valve assembly, indicated generally by numeral 17, on which the novel features of the invention largely depend. As shown valve assembly 17 comprises a body portion 18 having a cylindrical bore 19 on the side of which is an inlet port 20 which communicates with the bore of pipe 12 so that there is an unobstructed passageway for molten metal from the melting pot to the cylindrical bore 19 when valve 14 is open. Both the valve body 18 and pipe 12 are lagged with thermal insulation 21 and provided with heating means, such as the electrical resistance heating element 22, by which the valve assembly and pipe may be kept at a suitable operating temperature.

The long axis of the cylindrical bore 19 is indicated by numeral 23, and in the lower end of the bore 19 and in line with axis 23 is a valve seat 24 in the form of an annulus having a central opening 25. The outer periphery 26 of the annulus is welded or otherwise sealed to the valve body 18. The upper side 27 of the annulus 24 is beveled, and slopes downwardly and inwardly toward opening 25, the bevel giving the top side of the annulus the form of a conical recess. The thickness of the valve seat at the opening 25 does not exceed about 0.25 inch. Communication between the bore 19 and the opening 25 is under the control of a valve 28 which is hemispherically shaped and is secured to or made an integral part of the valve stem 29. The valve stem 29 comprises a cylindrical member, such as a rod, which is centrally disposed and arranged for longitudinal movement in the bore of the valve body. Near the lower end of and around the valve stem 29 are affixed spacer members 30 which maintain the lower end of the valve stem substantially centrally disposed in the valve body allowing while valve 14 is open a suitable amount of clearance (e. g. 0.03 inch). The upper end of the valve stem extends above the valve body through the bushing 31 the central opening 32 of which preferably is somewhat larger in diameter (e. g. as much as 0.04 inch larger) than the valve stem. The bushing 31 maintains the upper portion of the valve stem substantially centrally disposed in the valve body. In the bushing is a port 33 to which is connected a pipe line 34 from a supply of a protective or inert gas not shown. Encircling the space just below the opening 25 is a ring of pipe 35. Around the inside of the ring is bored a series of openings 36 for distributing an inert gas around the space below opening 25. The ring of pipe 36 is connected by pipe 37 to a source of protective or inert gas (not shown).

At the upper end of the valve stem 29 is attached a piston 38 operating in a cylinder 39 for imparting longitudinal movement to the valve stem 29 whereby valve 28 either may be applied to or lifted from the valve seat 24 so as to close or open respectively the pathway from the bore 19 to the opening 25. Hydraulic lines 40 and 41, respectively, connected to opposite ends of cylinder 39 and to a source of hydraulic fluid, not shown, may be used to actuate piston 38 as desired.

A portion of a die casting machine with which the foregoing apparatus may be used in shown in Fig. 1 in operative relation to the shot dispensing valve 17. The portion shown of the die casting machine is conventional and consists of a generally horizontal shot cylinder 42 having a charge receiving opening 43. This is placed below the opening 25 of the valve assembly 17 in a position such that the line of the axis 23 of the bore of the valve assembly passes centrally through the middle of the opening 43. A piston 44 is reciprocally operable in the shot cylinder 42 to force the shot of molten metal delivered thereto into the cavity of a mold or die. In the usual arrangement of casting apparatus of this kind, the shot cylinder 42 is mounted on a fixed platen 45 which

carries one-half 46 of the die or mold. The other half 47 of the die or mold is mounted on a movable platen 48 by which the two die halves are brought and held together for casting and separated for the removal of the casting from the dies. The movable platen is actuated by the ram 49. To avoid splashing of the molten metal delivered by the valve assembly into the shot cylinder the axis 23 of the bore of the valve assembly is placed in the same plane as the long axis 50 of the shot cylinder 42 and tilted in the direction of travel of the shot through the shot cylinder into the dies. The amount of tilt is quite critical. In practice, it is found that the axis 23 of the bore of the valve assembly should make an angle with the long axis 50 of the shot cylinder of between 45° and 76°.

The apparatus described is particularly suitable for dispensing shots of molten magnesium and the magnesium-base alloys (i. e. alloys of magnesium in which the magnesium content exceeds 80 per cent by weight), as in die casting these metals, and the operation of the apparatus will be described in connection with dispensing shots of these metals to the die casting machine shown.

In starting, valve 14 is closed and the metal to be cast is brought to casting temperature in the melting pot 4. The pipe 12 and valve assembly 17 are brought to a similar temperature by energizing heating element 22. Opening 25 is closed by setting the valve 28 on valve seat 24 by actuating piston 38 so as to move the valve stem 29 downwardly. Protective gas is introduced into the valve body through pipe 34 and inert gas is supplied to the ring of pipe 35 before opening valve 14, and, when the pipe 12 and valve body 17 are brought to operating temperature, that is, a temperature about the same as that of the molten metal, valve 14 is opened thereby allowing molten metal from the pot 4 to flow by gravity into the valve body and fill it to the same level as that of the molten metal in the pot. The valve body 17 is made long enough so that its upper end 51 extends above the level of the molten metal in the melting pot. The distance between the bottom of bushing 31 and the top of the molten metal in the valve body should be at least as much as the length of movement of the valve stem 29 in opening valve 28. In this way, there is left a gas filled space 52 in the valve body below the bushing 31 at all times and molten metal is not carried by the valve stem up to the bushing on reciprocating the valve stem. With the valve body thus filled with molten metal to the same level as that in the melting pot, the apparatus is ready to be used for dispensing a succession of shots to the die casting machine.

Shots of molten metal are released in succession by actuating piston 38, the size of each shot being determined by the length of time the valve 28 is held off the seat 24 during a shot. With a 7/8 inch opening (i. e. 25) below the valve and with a metal head over it of about 18 inches a shot weighing 3½ pounds of magnesium alloy can be discharged in two seconds, a one pound shot in about 0.8 second, using valve lifts of from 5/8 inch to 1.25 inches.

With the apparatus, the molten metal discharges from the opening 25 under the force of gravity on opening the valve in a smooth solid cylindrical stream, the flow of which is brought to an abrupt end without dripping or dribbling on closing the valve. The amount of metal discharged between opening and closing the valve is subjected to precise control because of the absence of dripping or dribbling and the fact that the spherical surface of the valve makes a narrow line of contact with the beveled surface of the valve seat permitting a moderate pressure on the valve stem to effect a shut off without interference from dross. For example, a push applied to the valve stem 29 of the order of 100 to 400 pounds

using a hemispherical valve having a diameter of one inch and seating upon a conically beveled seat the included angle 53 of which is at least 20° but not more than 120° produces a complete seal without any tendency for the valve to be seized by the seat. Because of the very small area of the surfaces of the valve parts below the shut off, when the valve is seated, and the small area of contact between the valve and its seat, these surfaces remain quite clean in spite of the propensity of molten magnesium alloy to form, in the presence of air, a dross which tends to cling to all the solid metal surfaces over which the metal flows. By employing a protective gas in the space in the valve body above the molten metal therein below the bushing, the use of a stuffing box around the valve stem is obviated along with the difficulties a stuffing box entails. The central opening 32 of the bushing 31 being somewhat larger than the diameter of the valve stem 29 permits passage through the space between the valve stem and the annular guide of protective gas. In this way, atmospheric contamination of the molten metal within the valve body is prevented without interfering with the movement of the stem in operating the valve 28 and long trouble-free operation is had.

Any gas released from the molten metal in pipe 12 escapes by travelling to either end of the pipe depending on which way it is made to slope and cannot enter the shot of molten metal released by the valve. In the event it is desired to shut down the valve assembly and pipe 12, valve 14 may be closed and the molten metal in the valve assembly drained out by lifting valve 28 off its seat.

I claim:

1. An apparatus for dispensing shots of molten readily oxidizable metal comprising in combination with a melting pot adapted to contain a quantity of the molten metal to be dispensed shotwise of a sloping pipe leading from the pot under the force of gravity to the discharge end, a valve assembly on the discharge end of the pipe remote from the melting pot for controlling the release of molten metal from the pipe, said valve comprising a body member having an axial bore from end to end and a port in the side intermediate the ends of the bore and communicating with the discharge end of the pipe, the upper end of the bore of said body member being above the working level of the molten metal in the pot, a valve seat in the lower end of the bore of the body, said seat comprising an annulus the inner periphery of which is cylindrical and the upper face of which slopes downwardly from the outer to the inner periphery as a conical recess having an included angle of between 20° and 120°, a valve stem extending into the valve body through the upper end thereof, a valve of hemispherical form on the lower end of the valve stem adapted to be urged by the stem onto the upper surface of the valve seat to close the passageway through the said annulus, the length of said passageway through the opening in the annulus being not over one-quarter inch, and the distance between the top of the said axial bore and the working level of the molten metal being at least as much as the valve stem travel in opening the valve.

2. An apparatus according to claim 1 in which a shut off valve is provided on the end of the pipe inside the melting pot.

3. An apparatus according to claim 2 in which heating means are provided for the pipe and valve assembly.

References Cited in the file of this patent

UNITED STATES PATENTS

1,321,300	Gathmann	Nov. 11, 1919
2,477,838	Toleik	Aug. 2, 1949
2,678,480	Lapin	May 18, 1954