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ALUMINUM DIRECT CHILL CASTING MOLD METAL SHUTOFF METHODS

Inventors: John Robert Buster McCallum, Jonathan Quisenberry, Aaron David Sinden, Cameron J. Koentopp, Matthew Walsh

[0001] In direct chill (DC) casting, there are several means for ending the cast. Referring to the figure below, typically, a pin is positioned closed to shut off a flow of metal to the mold so as to not overflow the mold and damage in, a distribution launder is tilted to drain the metal out of the launder so metal does not freeze in the launder, and a cylinder or bottom block stops to prevent molten metal in the mold from casting below the mold water jets, which could lead to an explosion.

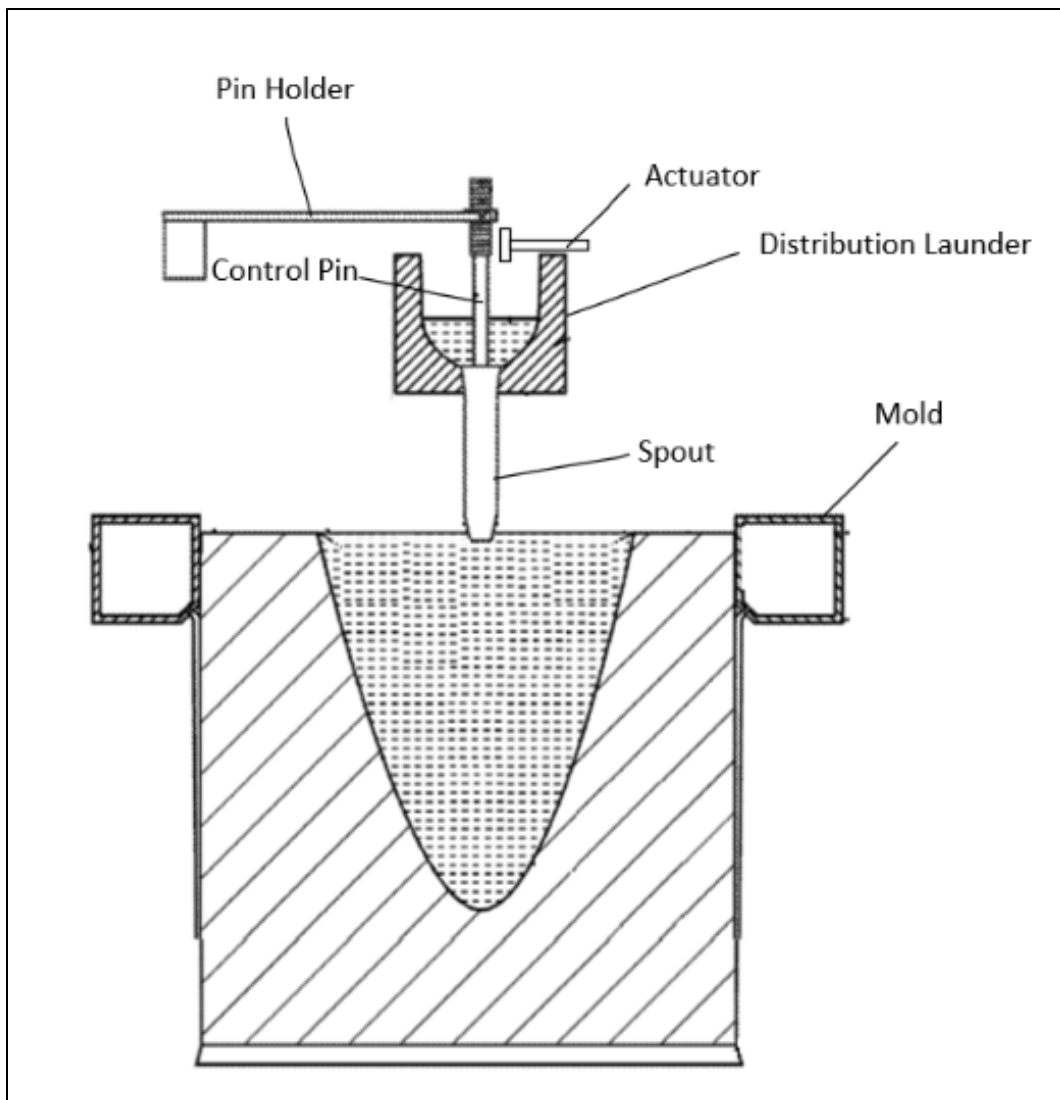


Figure 1

[0002] The ability to shutoff metal flow to the mold may be maintained when there is a power failure with Uninterruptible Power Supply (UPS) backup. In particular, the distribution launder typically includes a hydraulic accumulator to tilt and drain the launder. Some casters automatically trigger tilting and draining of the launder in such situations, which others perform such operations by a manual hand valve.

[0003] In a complete power failure and/or communications failure, collectively referred to as a “power failure” herein, there is variability. Some industry casters stop the cylinder and continue the cast by operators manually operating hand valves. Other casters stop the cylinder and raise the launder by hand valve. However, such existing procedures are dangerous and keep the operator in the line of fire to visually control the cast and prevent an explosion.

[0004] To remove operators from the line of fire, an end cast sequence for complete power failure includes stopping the cylinder and tilting and draining the launder. In order to function and improve reliability of the accumulator, the accumulator needs to be pre-charged with gas, and also charged with hydraulic fluid. Both the charge and pre-charge may be tested during precheck to ensure that the accumulator works when needed. In addition, to minimize and/or prevent unexpected movement of the launder due to the launder raising on power, the sequence includes using a solenoid valve to raise the launder on power failure and an additional solenoid valve, which holds last position, to enable this fail raise on cast start and disables on cast end.

[0005] While this solves the explosion risk and removes the operators from the line of fire, it leaves one issue - molten metal in the launder, which can enter the mold through the unclosed spout, thereby overfilling and damaging the molds and damaging them. In various examples, power failure may result in the ability to close pins. To address the issue of molten metal in the launder, particularly after power failure, described herein are various systems and methods for closing off metal flow.

[0006] Referring back to the above figure, the primary method is the use of at least one actuator, ideally pneumatic, but could be hydraulic or otherwise, which will make contact with the control pin, applying enough force to break the control pin. The actuator may make such contact with the control pin by extending, retracting, or as otherwise desired. The broken control pin will then drop into the spout to close or at least significantly reduce metal flow into the mold. The actuator(s) can

be mounted on the top of distribution launder. In some cases, the actuator may be angled slightly downward, depending on where the bottom of the pin holder is.

[0007] The actuator may have various aspects or features to improve safety and/or reduce or eliminate safety risks. In some examples, the actuator can be a semi-slow movement actuator. Additionally, or alternatively, the actuator may be arranged such that travel creates the only pinch point between the control pin and this device. In some versions, the actuator could have redundant solenoids in series to ensure the system is not falsely activated during a cast (thus aborting the cast), and a fail last position in series to enable during casting and disable at cast end. While typically the control pin is only in the launder during casting and in a position where operators hands generally are not, and with hands free casting, the likelihood of a hand being in an area where pinching could occur may be reduced. The actuator could further be utilized in the event of pin positioner failure and/or the launder break failure, as it may be preferable to freeze metal in the launder than it is to damage molds.

[0008] Additional methods or combinations thereof achieving the same function could be utilized. Non-limiting examples are discussed below:

- a. A spring-loaded (and/or dampened mechanically spring) hammer or some other projectile could be used for breaking the control pin;
- b. A chain could be wrapped around the control pin that retracts on power failure, thereby breaking the control pin;
- c. An actuator to push (or pull) the pin out that captures the control pin within the pin holder to releasing the control pin;
- d. The combo bag, utilized for distributing metal, could be pulled up against the spout exit, stopping or slowing metal. This could be accomplished by:
 - i. Modification to the combo bag holder so it is not rigidly mounted and can then be lifted by pneumatics;
 - ii. clipping on the combo bag itself or potentially the bag jig, which is then pulled up by pneumatics;
- e. A weight could be placed on the pin holder, such that when power is disconnected, the pin holder is driven down;

- f. A weight could be positioned above the arm which then releases on power failure, thereby driving the pin holder down;
- g. A device to push the control pin out of the pin holder from above could be utilized;
- h. Air pressure could be utilized to capture the control pin within a pin holder that is then released;
- i. A yoke that holds the pin holder could drop open on power fail;
- j. A control arm that holds the yoke could be hinged and released to open on power failure;
- k. The pin holder and yoke could be altered to be electro-magnetically coupled to each other, but this would require an electrical connection, modification, and a significant amount of power to endure the forces utilized in the process.
- l. Knife gates could be utilized. Knife gates may be pneumatically driven (could be hydraulic or otherwise, but would not be the ideal choice) actuators that shear the spout underneath the distribution launder, and remain in position to shut off metal flow. This can additionally be applied above the distribution launder to cut the control pin, which would allow the control pin to drop into the bottom of the spout and stop metal flow.

[0009] Various other methods could be utilized.

[0010] The systems and methods described herein may prevent mold damage, which would otherwise result in significant down time and costly repairs or replacement.