Title (en)

Method for controlling the pouring movement of a ladle

Title (de)

Verfahren zur Steuerung einer Ausgießbewegung eines Gießlöffels

Title (fr)

Procédé de commande d'un mouvement de versement d'une poche

Publication

EP 2072161 A1 20090624 (DE)

Application

EP 08171100 A 20081209

Priority

DE 102007047926 A 20071217

Abstract (en)

The method for controlling a pouring movement of a spoon (18) for pouring a molten material (12) e.g. molten metal into a casting mold (14) e.g. cast, comprises predetermining a mold-specific casting characteristic (A) with respect to a volume of the molten product in the mold via a time course and storage of the casting characteristic, determining a spoon-specific pouring characteristic as function of a volume of the molten product from the spoon over the inclination of the spoon and storage of the pouring characteristic, and automatically generating the progress of the pouring movement. The method for controlling a pouring movement of a spoon (18) for pouring a molten material (12) e.g. molten metal into a casting mold (14) e.g. cast, comprises predetermining a mold-specific casting characteristic (A) with respect to a volume of the molten product in the mold via a time course and storage of the casting characteristic, determining a spoon-specific pouring characteristic as function of a volume of the molten product from the spoon over the inclination of the spoon and storage of the pouring characteristic, and automatically generating the progress of the pouring movement, where the volume of the molten product is determined on the basis of the casting characteristic at each time, and is equated to an optimal volume of the molten product, so that an optimal inclination is regulated to each time via the pouring characteristic. The casting characteristic is simulated as function of the volume of the molten product over the time course by simulation software or manually simulated. The pouring characteristic is empirically determined as a function of the pouring volume of the molten-product over the spoon inclination, where a full-filled spoon is gradually inclined in an automatic calibration procedure until completely emptying the spoon. During the tilting motion, the filled quantity is measured by an electronic balance and the measured value is transferred to a controller (32), in which the measured values are recorded and are created under the knowledge of the specific density of the molten product. The pouring characteristic is analytically calculated as a function of the pouring volume of the molten-product over the spoon inclination that is accumulated volume, under the knowledge of spoon geometry such as three-dimensional-model and under a condition of a horizontally lying molten-product reflector. After a change of spoon geometry, the pouring characteristic is determined according to the new spoon geometry. The mold is moved from an inclined initial position into a vertical end position, where the progress of the movement of the mold in a characteristic for the tilting motion (mold characteristic) is determined and stored as function of the mold position over a time course. The mold characteristic is determined by a simulation method and with external control by recording the mold movement using a coupled position detector (34) during a casting process. The pouring movement of the spoon and the movement of the mold are controlled by the same control. The casting characteristic and the mold characteristic lie in a common time axis. The mold position on the basis of the casting characteristic at each time during the casting process from the mold characteristic and the spoon inclination on the basis of the optimal casting volume over the pouring characteristic are determined so that an automatic control of the inclination of the spoon and the mold takes place. The mold is controlled by an independent controller. The actual position of the mold is detected by the position detector and is transferred to the control of the spoon, where a casting-melt volume is obtained from the casting characteristic at each time and is determined via the associated pouring-melt volume by the pouring characteristic of the associated spoon position. The tracking of the pouring movement of the spoon takes place by a kinematic transformation, where the actual position of the mold is considered and a tool center point is adjusted in such a way that a curvature of the spoon is moved over a charging hole of the mold. Intermediate values are interpolated between discretely measured characteristic values and are provided by controlling the casting machine at a drive of the mold and/or a spoon drive, so that it results a continuous movement. An off-line program generation is carried out, where a movement program for controlling the automation equipment is produced over an algorithm from information of the casting characteristic, pouring characteristic and optionally mold characteristic. An on-line movement generation is carried out, where the position of the spoon and/or the mold is continuously determined via a time course from the given characteristic data and/or characteristic tables and is immediately adjusted by controlling the automation equipment as casting machine.

Abstract (de)

Die Erfindung bezieht sich auf ein Verfahren zur Steuerung einer Ausgießbewegung eines Gießlöffels zum Ausgießen eines Schmelzgutes wie Metallschmelze in eine Gießform wie Kokille, wobei eine gießformspezifische Eingießkennlinie (A) in Abhängigkeit eines in die Gießform (14) eingegossenen Schmelzgutvolumens (12) über dem Zeitverlauf vorgegeben und gespeichert wird. Damit die Ausgießbewegung vollständig automatisiert, geplant und gesteuert werden kann und um die Rüstzeiten nach einem Wechsel der Gießlöffelgeometrie zu verkürzen werden folgende Verfahrensschritte vorgeschlagen: - Ermittlung einer gießlöffelspezifischen Ausgießkennlinie (B) als Funktion eines aus dem Gießlöffel (14) ausgegossenen Schmelzgutvolumens (12) über der Neigung (G) des Gießlöffels (14) und Speichern der zumindest einen Ausgießkennlinie (B), - automatische Generierung des zeitlichen Verlaufs der Ausgießbewegung, wobei auf der Grundlage der Eingießkennlinie (A) zu jedem Zeitpunkt das notwendige Eingießschmelzgutvolumen bestimmt wird, welches einem optimalen Ausgießschmelzgutvolumen gleichgesetzt wird, dem über die Ausgießkennlinie (B) eine optimale Neigung (G) zu jedem Zeitpunkt zugeordnet ist.

IPC 8 full level

B22D 37/00 (2006.01); **B22D 39/02** (2006.01)

CPC (source: EP)

B22D 37/00 (2013.01); **B22D 39/026** (2013.01)

Citation (applicant)

- DE 102006034044 A1 20080131 - ABB PATENT GMBH [DE]
- WO 8504607 A1 19851024 - MEZGER AG MASCHF GIESSEREI [CH]

Citation (search report)

- [A] DE 3223803 A1 19830120 - FISCHER AG GEORG [CH]
- [A] JP H1058120 A 19980303 - HITACHI METALS LTD
- [A] JP H07227668 A 19950829 - HITACHI METALS LTD
- [A] DE 102004026062 A1 20041230 - ROBOTEC ENGINEERING GMBH [DE]
- [A] US 4084631 A 19780418 - KUNZMANN KONRAD
- [A] JP S6216869 A 19870126 - SHIN MEIWA IND CO LTD
- [AP] WO 2008011978 A1 20080131 - ABB PATENT GMBH [DE], et al

- [A] KENICHI YANO ET AL: "Adaptive Feedforward Control of Automatic Pouring Robot Considering Influence of the Accumulating Disturbance", CONTROL APPLICATIONS, 2006 IEEE INTERNATIONAL CONFERENCE ON, IEEE, PI, 1 October 2006 (2006-10-01), pages 2820 - 2825, XP031011615, ISBN: 978-0-7803-9795-8

Cited by

CN111957938A; CN114210961A; CN114799137A; CN110465223A; CN113165175A

Designated contracting state (EPC)

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR

Designated extension state (EPC)

AL BA MK RS

DOCDB simple family (publication)

EP 2072161 A1 20090624; **EP 2072161 B1 20110921**; AT E525154 T1 20111015; DE 102007047926 A1 20090618; PL 2072161 T3 20120131

DOCDB simple family (application)

EP 08171100 A 20081209; AT 08171100 T 20081209; DE 102007047926 A 20071217; PL 08171100 T 20081209