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54 **Control of the temperature distribution of a mould and of cast or moulded parts produced thereby.**

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EP-A- 0 286 977
FR-A- 2 085 409
US-A- 3 506 060
- PATENT ABSTRACTS OF JAPAN, vol. 7, no. 16 (M-187)[1161], 22nd January 1983; & JP-A-57 171 565 (HITACHI KINZOKU K.K.) 22-10-1982**
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Description

This invention relates to a permanent mould, such as a die casting mould and/or an injection mould, and to a process for controlling the temperature distribution in such a mould and in the parts cast or moulded thereby when it is used repetitively.

The life of a die, a permanent mould or a die casting mould and as well as the microstructure and the dimensional stability of a part cast or injected into it are dependent on the temperature distribution of the different points of the casting and mould.

Usually dies are metallic and their cooling is achieved by water or other fluids circulating through cooling tubes or circuits bored inside them.

There are also known systems in which the cooling is controlled by optical (e.g. infrared) pyrometers and realised by external water jets. This is the case, for instance, in US-A-3 506 060, upon which the preamble of claim 1 is based, FR-A-2 085 409 and EP-A-0 286 977. In the method referred in the first two publications, cooling is done on the external side of rotative dies used for centrifugal casting. The third publication considers the direct cooling of the hotter side of the permanent mould, i.e., the side that has been in contact with the metal poured in it.

The systems disclosed in those publications employ water as the cooling fluid. None has the flexibility necessary to search, very quickly, the hotter parts of a die or to search the hotter surfaces of a cast piece, whatever shape it has. EP-A-0 286 977 expressly states that both the temperature detecting carriage and the sprayer carriage are preferably displaceable at a constant speed.

Differently, however, according to the process of the present invention, the search of the hotter surface areas is done very quickly and the cooling of them may be effected with a slow motion of the blowing system or even with this system stopped and pointing to the hotter points during the time necessary to cool them.

The present invention provides a process for controlling the temperature of a permanent mould, comprising scanning areas of the mould by means of at least one optical pyrometer in order to measure the temperatures of those areas, comparing the measured values of said temperatures with desired values, and directing heat carrier fluid streams at the said areas in order to reduce any difference between the measured and desired values, characterised in that the heat carrier fluid is air, the process steps being carried out immediately after the removal of the casting or moulding from the permanent mould.

The use of air has the advantage of avoiding the dispersing of water around the work station.

The present invention provides a process for cooling and/or controlling the temperature distribution of a permanent mould, e.g. a die casting mould, and of a cast or injected part, using optical pyrometry in combination with the localized blowing of air (adjustable flows and adjustable amounts) so that the process may be optimized.

According to the invention, an optical pyrometer or a plurality of optical pyrometers scan at convenient distances the different parts of a permanent mould immediately after the removal of the casting or moulding and measure the temperature of each area thereof and, if necessary, also the temperature of each point of the casting or moulding, e.g. a cluster of cast parts.

The measurements of the optical pyrometer(s) are converted into one or more electrical signals which are fed to an information processing system that treats them according to a predetermined program. Depending on the temperature readings and according to said program, one or more blowing systems are operated so that a controlled flow rate or flow rates of one or more cooling or heating air jets are impinged in controlled amounts against the area or the areas, the temperatures of which are being read or have just been read by the pyrometer(s).

In this way, the temperatures of said areas are controlled.

The present invention provides a system which improves the life of a permanent die casting mould as it avoids its overheating or its excessively heterogeneous heating. On the other hand, this process adjusts the temperature of each area of the permanent die casting mould so that a subsequent casting or injection run may be made and undue heterogeneity, warpings and/or any other defects of the die, caused by its heating, and of the castings, caused by the solidification process, may be avoided. At least, the process according to this invention can also be used whenever the produced castings or the injected parts have to be homogeneously cooled, for instance, when the direct austempering of cast iron after the casting is intended. The inventive process will control effectively the cooling of the cast parts.

The process according to this invention can be used together with the classical systems of temperature control of permanent moulds, including those having channels for the circulation of cooling (or heating and cooling) fluids, in order to reduce deviations in relation to the previewed or desired local temperatures. But the process can also be used alone, replacing the traditional cooling systems.

It has the advantages of being simpler and of acting locally in dependence on the temperature and the real conditions existing at each point and at each time.

The process here disclosed also has the advantage that it can be used not only with metallic moulds, but also for the cooling of ceramic permanent moulds, and moulds made totally or partially of any porous and/or low heat conducting materials, eliminating the excess of heat by the side of the permanent moulds that is directly heated during the pouring or the injection casting, and preventing the absorption of water.

With this system, the opening of cooling channels in the interior of the permanent moulds is no longer necessary and the risk of cracking of the dies and of leakage of cooling liquids are avoided.

It has still the advantage that it can be also used to cool, in a controlled way, the cast pieces, namely when they are poured in dies or made by injection casting.

With the present process, it is possible to homogenize and control the temperature and the cooling of the parts, in order to avoid warping, guarantee predetermined structures, prepare the cast pieces for subsequent heat treatments, or even to accomplish the heat treatments by using an adequately strong cooling rate when the temperatures are convenient for this purpose.

The fluid used is air, including mixtures with lubricants, anti-adherents, thermal insulating materials, and so on. Such additives, besides cooling the permanent moulds, may prepare them for the next pouring or injection casting operation, being deposited on the area against which the stream of fluid is directed.

This process of temperature control can be used in the die casting of cast irons, in the die and injection casting of aluminium and other alloys, and in the injection moulding of polymers and of other materials.

Although designed, in principle, to cool permanent moulds or to cool the pieces poured in dies or injected in permanent moulds, the same process can also be used to heat the permanent moulds (and, in some cases, even the pieces poured or injected in them) when the blowing fluids are conveniently heated.

It is a process that is quite simple, can be automated, and has a very wide application.

For controlling the temperatures of a permanent die casting mould and cast or injected parts, by optical pyrometry in combination with the local blowing of a fluid in dependence on the temperature measured in each area, one or a plurality of optical pyrometers scan (at a certain distance) the surface of a die casting permanent mould, made of a metallic, ceramic composite, coated material, or

any other, with or without cores, and, if necessary, scan also the cast or injected part and, depending on the temperatures read in each area, open or close more or less one or more valves of a blowing system, blowing one or more jets of air as a heat carrier, in controlled amounts, towards the areas that need to be cooled or heated, so that the temperatures become the desired ones, in order to improve the life of the permanent die casting moulds, including eventually cores, and in order also to guarantee good conditions for the subsequent casting or injection operation of the next piece in the same die, or in order also to reach the convenient temperatures in the die-cast or injection-moulded parts, for a subsequent heat treatment (austempering or any other), in order to avoid warping, and also in order to achieve desired microstructures.

Claims

1. A process for controlling the temperature of a permanent mould, comprising scanning areas of the mould by means of at least one optical pyrometer in order to measure the temperatures of those areas, comparing the measured values of the said temperatures with desired values, and directing heat carrier fluid streams at the said areas in order to reduce any difference between the measured and desired values, characterised in that the heat carrier fluid is air, the process steps being carried out immediately after the removal of the casting or moulding from the permanent mould.
2. A process as claimed in claim 1, in which the heat carrier fluid contains an additive, e.g. a lubricant or anti-adherent, which is deposited on the area at which the stream is directed.
3. A process as claimed in claim 1 or 2, further comprising scanning areas of a cast or injection moulded part or cluster of parts by means of at least one optical pyrometer in order to measure the temperatures of those areas immediately after the removal from the mould, comparing the measured values of those temperatures with desired values, and directing heat carrier air streams at those areas in order to reduce any difference.
4. A process as claimed in any preceding claim, in which temperature measurement by optical pyrometry is done in combination with air blowing and the flow rate of the air and the amount of air which is directed towards the said areas are controlled as a function of the local and actual temperatures measured and

as a function of the mould temperature desired for the next pouring or injection.

5. A process as claimed in any preceding claim, in which signals from the optical pyrometer(s) are fed to a processing system which controls one or more blowing systems for directing the heat carrier fluid streams at the said areas. 5
6. A process as claimed in claim 5, in which the blowing systems comprise valves which are closed or opened more or less, as a function of the signals. 10

Patentansprüche 15

1. Verfahren zur Regelung der Temperatur in einer Kokille, das folgende Schritte aufweist: Abtasten von Bereichen der Kokille mit Hilfe mindestens eines optischen Pyrometers, um die Temperaturen dieser Bereiche zu messen, Vergleich der Temperaturmeßwerte mit Sollwerten und Lenken von Wärmeträgerfluidströmen auf die Bereiche, um jede Differenz zwischen den Meßwerten und den Sollwerten zu verringern, dadurch gekennzeichnet, daß das Wärmeträgerfluid Luft ist, wobei die Verfahrensschritte unmittelbar nach der Entnahme des Gußstücks oder Formteils aus der Kokille ausgeführt werden. 20 25 30
2. Verfahren nach Anspruch 1, wobei das Wärmeträgerfluid einen Zusatz enthält, z. B. ein Schmiermittel oder Trennmittel, das auf dem Bereich abgeschieden wird, auf den der Strom gerichtet ist. 35
3. Verfahren nach Anspruch 1 oder 2, das ferner die folgenden Schritte aufweist: Abtasten von Bereichen eines Gußstücks oder Spritzgußteils oder einer Gießtraube von Teilen mit Hilfe mindestens eines optischen Pyrometers, um die Temperaturen dieser Bereiche unmittelbar nach der Entnahme aus der Form zu messen, Vergleich der Temperaturmeßwerte mit Sollwerten und Lenken von Wärmeträgerfluidströmen auf die Bereiche, um jede Differenz zu verringern. 40 45
4. Verfahren nach irgendeinem der vorstehenden Ansprüche, wobei die Temperaturmessung durch optische Pyrometrie in Kombination mit einem Ausblasen mit Luft erfolgt und die Strömungsgeschwindigkeit der Luft sowie die auf die Bereiche gelenkte Luftmenge in Abhängigkeit von den gemessenen lokalen und aktuellen Temperaturen und in Abhängigkeit von der Solltemperatur der Kokille für den nächsten 50 55

Guß oder Spritzguß geregelt werden.

5. Verfahren nach irgendeinem der vorstehenden Ansprüche, wobei Signal vom dem (den) optischen Pyrometer(n) einem Verarbeitungssystem zugeführt werden, das ein oder mehrere Gebläsesysteme steuert, um die Wärmeträgerfluidströme auf die genannten Bereiche zu lenken.
6. Verfahren nach Anspruch 5, wobei die Gebläsesysteme Ventile aufweisen, die in Abhängigkeit von den Signalen mehr oder weniger geöffnet oder geschlossen werden.

Revendications

1. Procédé pour régler la température d'un moule permanent, comprenant le fait de balayer des zones du moule au moyen d'au moins un pyromètre optique afin de mesurer les températures de ces zones, de comparer les valeurs mesurées desdites températures aux valeurs désirées et de diriger des courants de fluide caloporteur sur lesdites zones afin de réduire toute différence entre les valeurs mesurées et les valeurs désirées, caractérisé en ce que le fluide caloporteur est de l'air, les étapes opératoires étant réalisées immédiatement après le retrait de la pièce coulée ou moulée du moule permanent.
2. Procédé selon la revendication 1, dans lequel le fluide caloporteur contient un additif, par exemple un lubrifiant ou un anti-adhérent qui est déposé sur la surface sur laquelle est dirigé le courant.
3. Procédé selon la revendication 1 ou 2, comprenant en outre le fait de balayer des zones d'une pièce coulée ou d'une pièce moulée par injection ou encore d'un groupe de pièces, au moyen d'au moins un pyromètre optique afin de mesurer les températures de ces zones immédiatement après le retrait du moule, de comparer les valeurs mesurées de ces températures aux valeurs désirées et de diriger des courants d'air caloporteur sur ces zones afin de réduire toute différence.
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel la mesure de la température par pyrométrie optique est réalisée en combinaison avec un soufflage d'air, et le débit de l'air, ainsi que la quantité d'air dirigée vers lesdites zones, étant réglés en fonction des températures locales et réelles, mesurées, et en fonction de la température du

moule désirée pour la coulée ou l'injection ultérieure.

5. Procédé selon l'une quelconque des revendications précédentes, dans lequel des signaux provenant du ou des pyromètres optiques sont acheminés à un système de traitement qui règle un ou plusieurs systèmes de soufflage pour diriger les courants de fluide caloporteur sur lesdites zones. 5
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6. Procédé selon la revendication 5, dans lequel les systèmes de soufflage comprennent des vannes qui sont plus ou moins fermées ou ouvertes en fonction des signaux. 15

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