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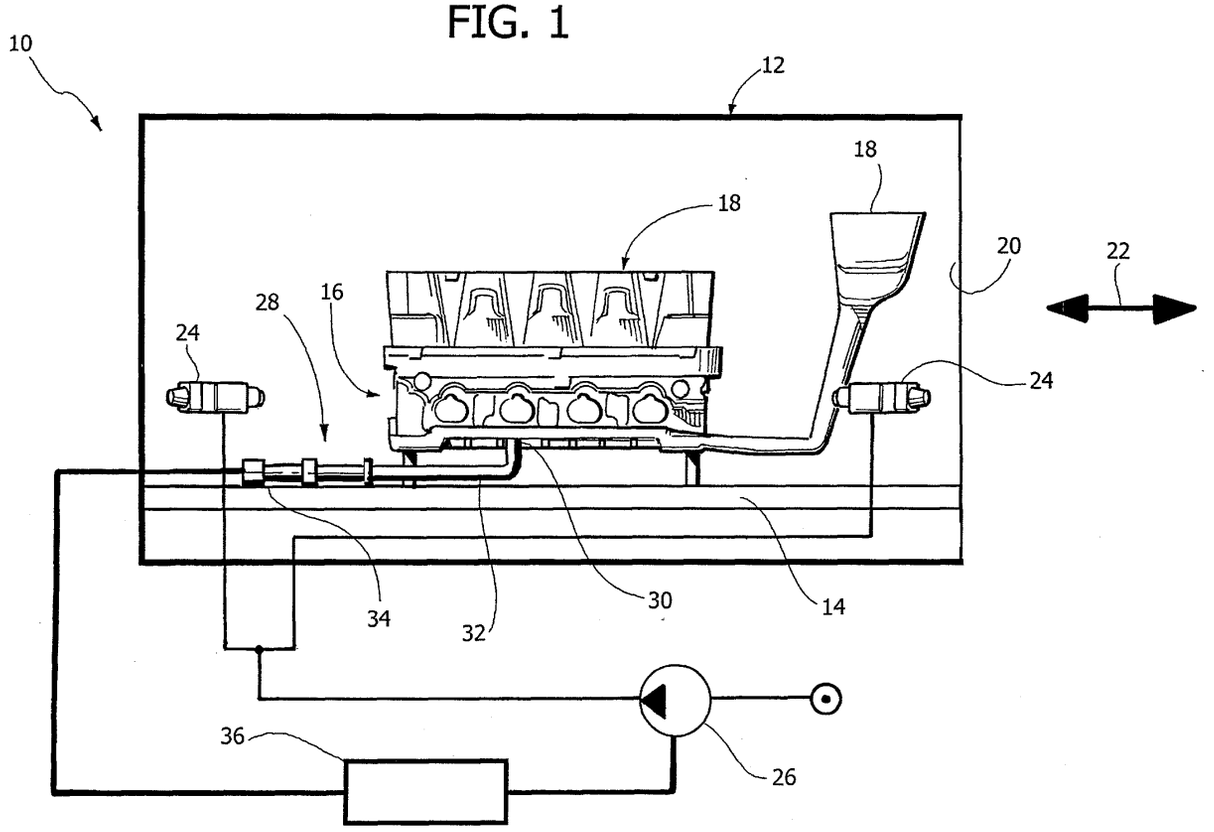
(54) Method and apparatus for cooling foundry castings

(57) A method and apparatus for cooling foundry castings, characterised in that it comprises the steps of:

- forming a cooling fog by nebulising a flow of water,
- exposing a substantial part of the external surface of the casting (16) to said cooling fog,
- measuring the temperature of the casting (16), and
- interrupting the exposure of the casting (16) to the cooling fog when the measured temperature drops below the predetermined threshold.

FIG. 1



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Description

[0001] The present invention relates to a method and apparatus for cooling foundry castings.

[0002] The invention was developed in particular for installations for the production of aluminium castings, by gravity or low pressure die-casting. However, the invention is not limited to this sector of use and can be used in all technical sectors in which there is a need to rapidly cool foundry castings.

[0003] In the case of castings of aluminium or similar light alloys, the casting comes out of the mould at temperatures in the order of 500°C. To be capable of being handled for the operations subsequent to die-cast (flogging, etc.), the temperature of the casting must drop to values in the order of 120-150°C or lower.

[0004] Cooling the castings in ambient air requires an extremely long time. The cooling time depends on the weight of the casting and of the sand cores contained therein. In the case of a cylinder head, the cooling time in ambient air is in the order of hours.

[0005] Installations where castings are cooled in ambient air require large accumulations areas in which the pieces are laid for cooling. This solution is not very practicable because it uses a large surface of the installation as an accumulation storage location for the pieces undergoing cooling and due to the problems that originate from the handling of the pieces in the cooling area.

[0006] Cooling installations are known in which the pieces to be cooled are made to pass through a forced air tunnel. In a forced air cooling tunnel, the temperature of the pieces drops to the desired value in about 20 minutes. The problem of forced air cooling tunnels consists in that the flow of cooling air contains polluting vapours which must be abated before the air is discharged into the atmosphere and this requires highly powerful and costly air extraction and treatment facilities, also in consideration of the high flow rate of air required to cool the castings.

[0007] On the other hand, the use of water to cool foundry castings would have the drawback of causing stresses and warping in the pieces. Moreover, the cooling water would wet the sand contained in the castings, making difficult the subsequent step of flogging the castings.

[0008] The object of the present invention is to provide a method and an apparatus for cooling foundry castings which allows to overcome said drawbacks.

[0009] According to the present invention, said object is achieved by a method and by an apparatus having the characteristics set out in the claims.

[0010] The characteristics and advantages of the present invention shall become readily apparent in the course of the detailed description which follows, given purely by way of non-limiting example, with reference to the attached drawings in which:

- Figure 1 is a lateral schematic view of an apparatus for cooling foundry castings according to the present invention and
- Figure 2 is a plan schematic view of the apparatus of Figure 1.

[0011] With reference to the figures, the reference 10 designates an apparatus for cooling foundry castings. The apparatus 10 can be installed in an installation for the production of aluminium castings by, by gravity or low pressure die-casting. The cooling apparatus 10 receives the foundry castings at the output of the mould and cools them down to a temperature whereat the castings can be subjected to the subsequent operations, such as flogging, etc.

[0012] The apparatus comprises a cooling chamber 12 within which is provided a support base 14 able to support a foundry casting 16. The figures show, by way of example, a casting constituted by a head for an internal combustion engine of a vehicle. Naturally, it is understood that the method and the apparatus according to the present invention can be used for cooling castings of any type and material. The foundry casting 16 which is subjected to the cooling operation is further provided with the riser and with the pouring channels 18 and contains the cores of sand agglomerated with resins which are used to form channels, seats and cavities of various types in the structure of the castings.

[0013] In the example illustrated in the figures, the cooling chamber 12 has the shape of a parallelepiped with rectangular base and is provided with at least one opening for the introduction and the extraction of the casting 16. In the illustrated example, the cooling chamber 12 lacks one of the two vertical walls with smaller sides in order to form an opening 20 contained in a vertical plane which allows the introduction and extraction of the casting along a horizontal direction indicated by the double arrow 22. The casting 16 is preferably introduced and extracted by means of an automatic manipulator device (not shown) constituted for example by an anthropomorphic robot.

[0014] Alternatively, the cooling chamber 12 could be constructed in the form of a tunnel with a motorised conveyor which extends through the cooling chamber and which transports the castings through the chamber. Said conveyor could be capable of being operated in steps to maintain the casting in stationary position during the cooling time and to carry the cooled casting outside the cooling chamber at the completion of the cooling step.

[0015] The cooling chamber 12 contains means able to create a cooling fog formed by a suspension of very fine water droplets. Preferably, the means for generating the cooling fog comprise a plurality of nebuliser guns 24 fed by a jet of water under pressure produced by a pump 26, preferably electrically or pneumatically operated. When the nebuliser guns 24 are fed by a flow of water under pressure, produce a fog formed by very fine water droplets in suspension in the air which fills the internal volume of the cooling chamber 12 surround the foundry

casting 16 and its riser 18. The cooling fog is not projected onto the external surface of the casting but forms a substantially static cloud which surrounds the casting to be cooled. In contact with the casting at high temperature, the cooling fog vaporises, removing the heat of vaporisation of the water from the piece. The fog comes in contact with the surface of the piece in uniform fashion, without producing sudden local cooling which could generate stresses or warping in the structure of the piece.

[0016] The cooling chamber 12 is provided with a temperature measuring device 28 able to measure the temperature of the casting 16 housed within the cooling chamber 12. The temperature measuring device 28 comprises a sensitive element 30 (Figure 1) which is placed in contact with a point of the casting 16 and is maintained in contact with the piece 16 throughout the cooling step.

[0017] The sensitive element 30 of the temperature measuring device 28 can be a thermocouple. To enhance the accuracy of the temperature measurement, the sensitive element 30 is placed in contact with a wall of a cavity of the casting 16 open inferiorly. In this way, the sensitive element 30 is substantially sheltered from the action of the cooling fog. The sensitive element 30 must remain in contact with the casting 16. To obtain this, the sensitive element can be positioned at the end of a lever 32 articulated to the base 14 and provided with a counterweight 34 which tends to maintain the sensitive element 30 in contact with the wall of the lower cavity of the casting 16.

[0018] The temperature measuring device 28 provides an electric signal, indicative of the temperature of the casting 16. This signal is received by a control unit 36 which compares the measured temperature with a predetermined threshold temperature. The control unit 36 is provided to interrupt the feeding of the pump 26 when the measured temperature drops below the reference threshold. For example, the feeding of the pump 26, and hence the generation of fog in the cooling chamber 12, can be interrupted when the measured temperature drops below about 130-140°C.

[0019] When a hot casting 16 is introduced into the cooling chamber 12, the temperature measuring device 28 measures its temperature by means of the sensitive element 30. When the measured temperature exceeds a reference chamber, the pump 26, which generates the cooling fog, is started. The production of the fog continues until the measured temperature drops below the reference threshold. Interrupting the production of fog according to the measured temperature of the casting 16 allows to prevent the fog from being deposited on the piece, wetting the sand. Assurance is thereby provided that the castings exiting the cooling chamber 12 are perfectly dry. Therefore, even if the cooling operation is performed in the presence of water, the subsequent step of flogging the pieces is not compromised in any way.

[0020] The cooling system according to the present invention is extremely efficient. Within a few minutes (4-6 minutes) the temperature of a casting with a weight, including the cores, in the order of 40-50 kg is reduced from about 500°C to about 130-140°C.

[0021] As an alternative to the illustrated solution which entails the activation and deactivation of the pump which generates the cooling fog, a solution can be obtained in which the fog is produced in continuous fashion and the casting is moved outside the operating range of the cooling fog when the temperature measured of the casting drops below the predetermined threshold.

Claims

1. A method for cooling foundry castings, **characterised in that** it comprises the steps of:

   - forming a cooling fog by nebulising a flow of water,
   - exposing a substantial part of the external surface of the casting (16) to said cooling fog,
   - measuring the temperature of the casting (16), and
   - interrupting the exposure of the casting (16) to the cooling fog when the measured temperature drops below the predetermined threshold.

2. Method as claimed in claim 1, **characterised in that** the cooling fog is formed within a cooling chamber (12) surrounding the casting (16).

3. Method as claimed in claim 1, **characterised in that** the formation of the cooling fog is interrupted when the measured temperature of the casting (16) drops below said predetermined threshold.

4. Method as claimed in claim 1, **characterised in that** the casting (16) is moved outside the range of operation of the cooling fog when the measured temperature drops below said predetermined threshold.

5. Method as claimed in claim 1, **characterised in that** the temperature of the casting (16) is measured by bringing a sensitive element (30) in contact with a surface of the casting (16) at least partially sheltered from the action of said cooling fog.

6. An apparatus for cooling foundry castings, **characterised in that** it comprises:

   - means (24) for producing a cooling fog by nebulising a flow of water,
   - means (28) for measuring the temperature of a foundry casting (16) whilst a substantial part of the external surface thereof is exposed to the action of said cooling fog, and

- control means (36) for interrupting the exposure of the casting (16) to the action of said cooling fog when the measured temperature drops below the predetermined threshold.

7. Method as claimed in claim 6, **characterised in that** it comprises a cooling chamber (12) containing at least one nebulising gun (24).

8. An apparatus as claimed in claim 6, **characterised in that** said means (28) for measuring the temperature of the casting (16) comprise a sensitive element (30) which in use is placed in contact with a surface of the casting (16) at least partially sheltered from the action of the cooling fog.

9. An apparatus as claimed in claim 6, **characterised in that** said control means (36) are able to interrupt the feeding of the water flow to said means for forming the cooling fog.

10. An apparatus as claimed in claim 6, **characterised in that** said control means (36) are able to move the casting (16) outside the range of action of said cooling fog.

FIG. 1

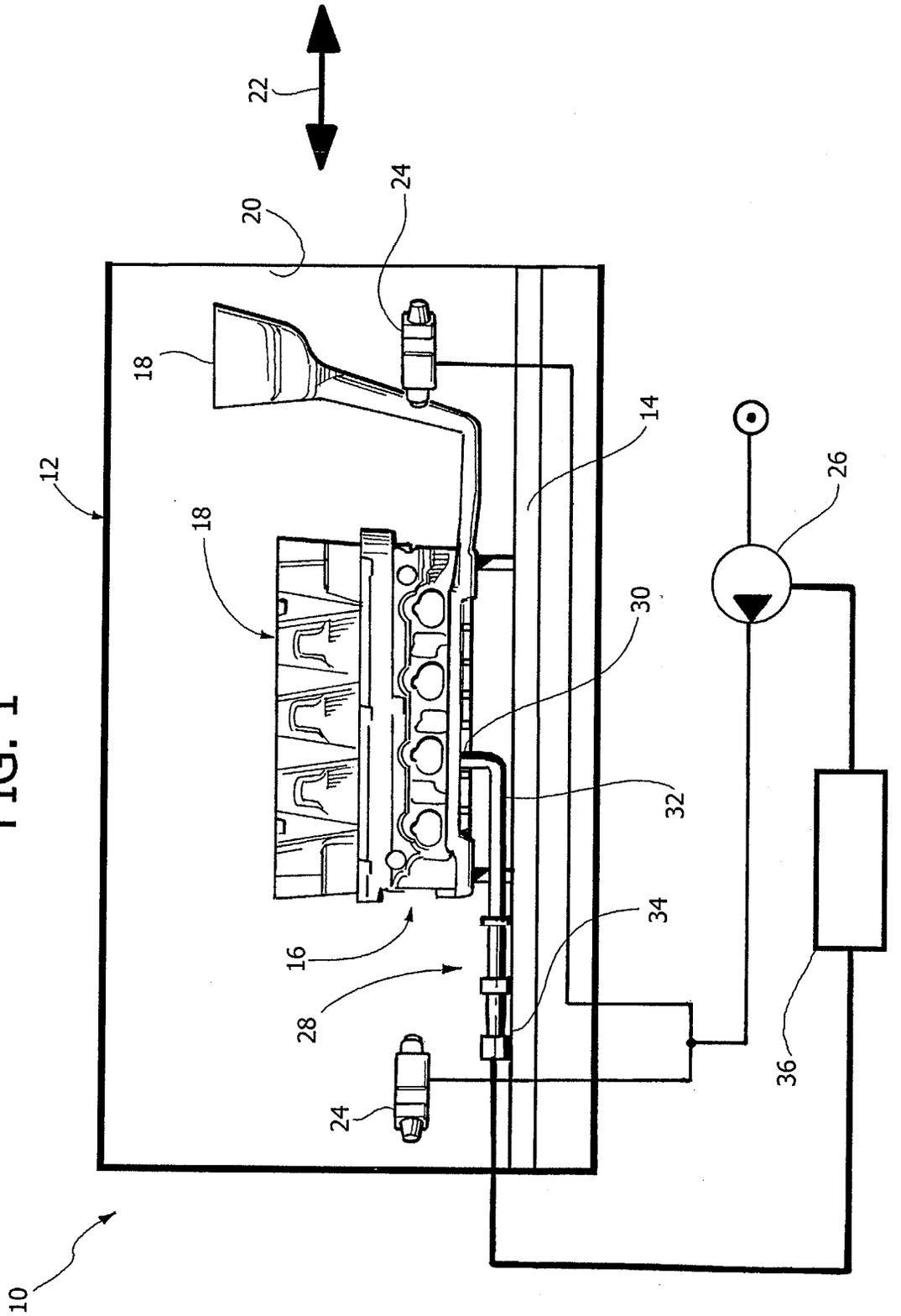
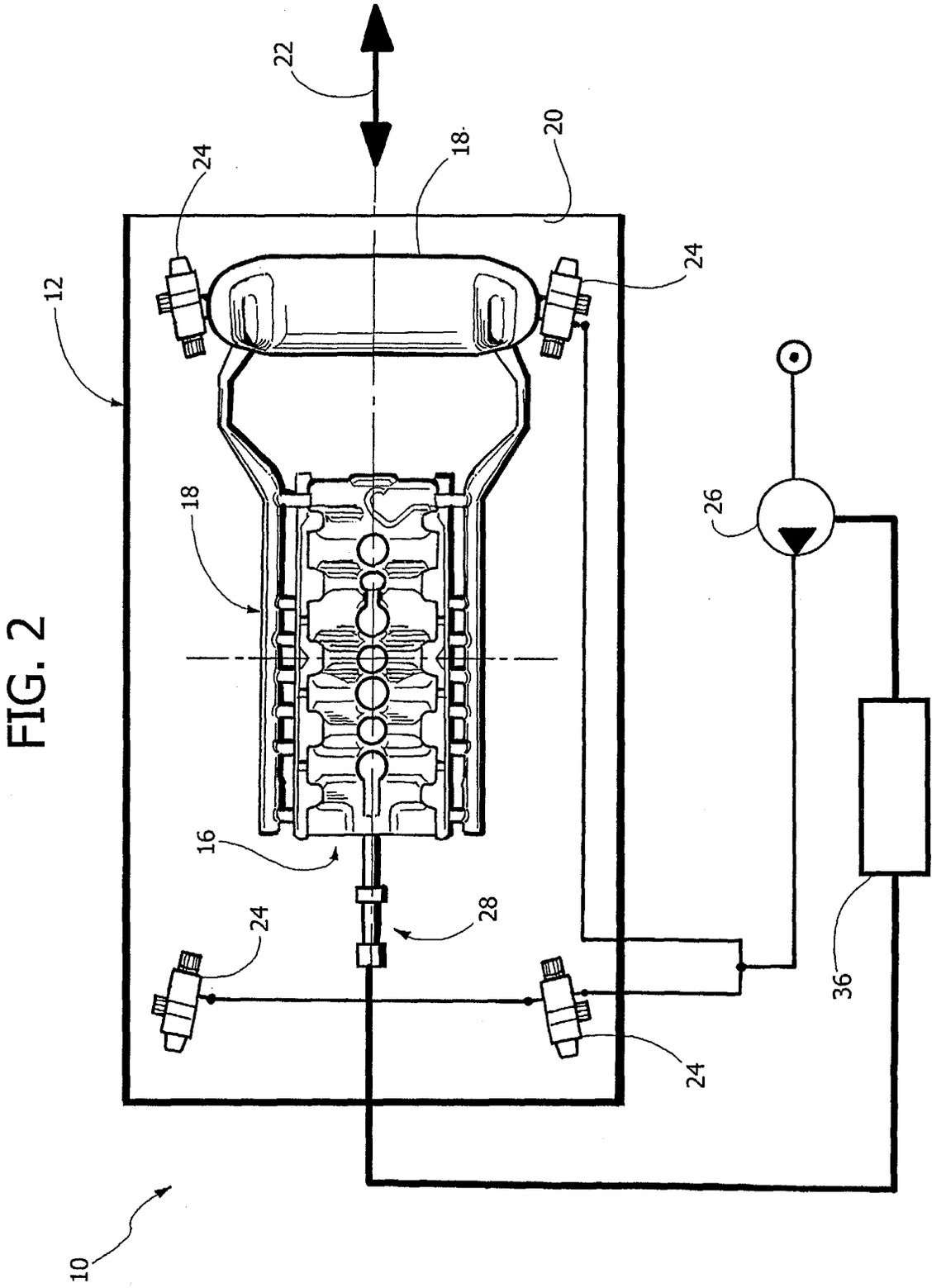


FIG. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5218

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	11 November 2004	Hodiamont, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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