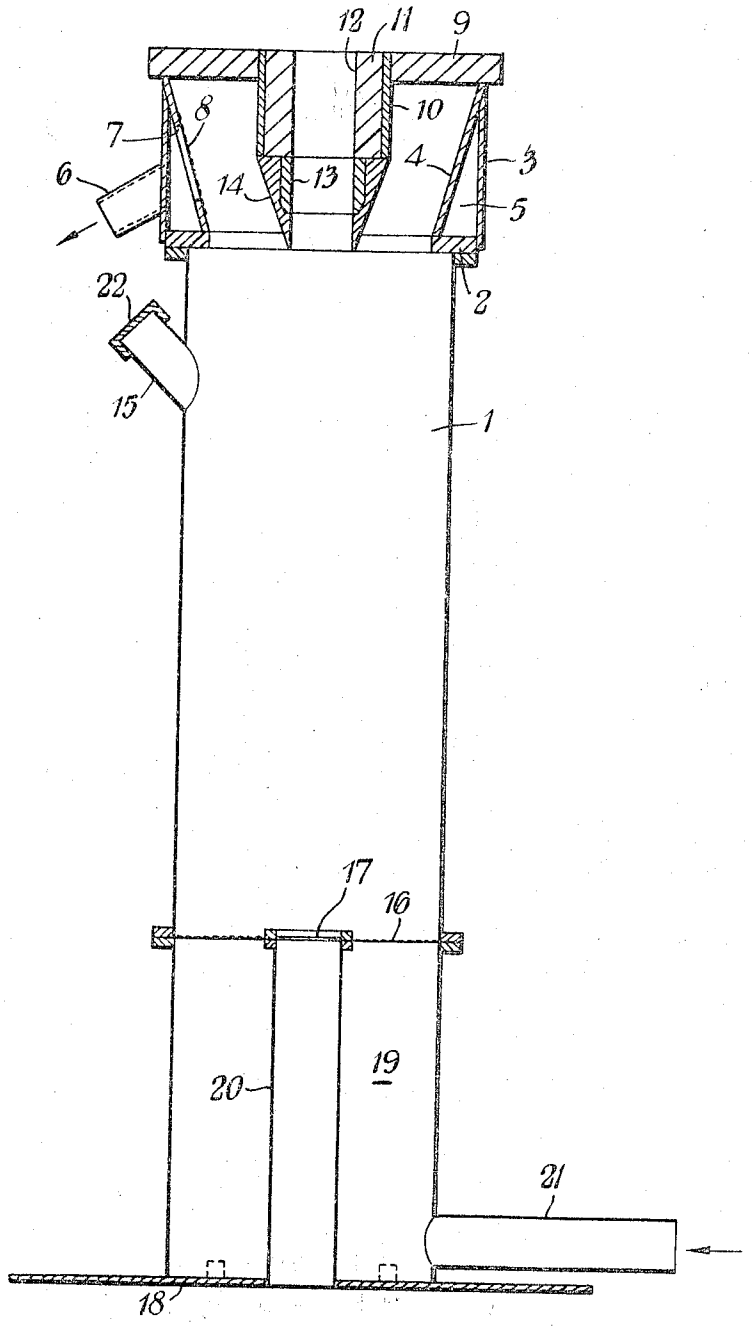
June 13, 1967 P. AYERS 3,324,932

METHOD FOR CONTINUOUSLY CASTING MATERIALS

Filed July 15, 1963



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United States Patent Office

3,324,932

Patented June 13, 1967

3,324,932
METHOD FOR CONTINUOUSLY CASTING MATERIALS

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Filed July 15, 1963, Ser. No. 294,886
Claims priority, application Great Britain, July 17, 1962, 27,416/62
2 Claims. (Cl. 164—89)

This invention relates to improvements in a method of and apparatus for continuously casting materials particularly, but not exclusively, metals.

A continuously cast metal billet is usually made by pouring molten metal into a water cooled die, the solidified metal being continuously withdrawn from the die. Further cooling is obtained by directing jets of water at the emerging metal. The rate at which casting can proceed is often governed by the rate at which heat can be withdrawn from the metal. The effectiveness of the jets of cooling water however is limited because an insulating film of vapour tends to form around the hot cast metal preventing good thermal contact with the cooling liquid. The rate at which heat is extracted from the cast metal is further limited because the greater part of the water impinging on the hot cast metal does not remain in the vicinity of the metal but tends to be deflected away again.

It is an object of the present invention to provide an improved method of and apparatus for continuously casting materials whereby the disadvantages referred to above shall be materially reduced.

According to one feature of the present invention, a method of continuously casting materials comprises feeding the material in fluid form to a die and exposing the material emerging from the die to a bed of particles fluidised by a cooling liquid.

According to another feature of the present invention, apparatus for continuously casting materials comprises a die to which the material is to be fed in fluid form, a chamber adapted to receieve a bed of particles and an inlet to the chamber for cooling liquid to fluidise the bed, the die opening into the chamber.

The preferred cooling liquid is water because of its desirable thermal properties. It has a high latent heat of vaporisation, a high thermal conductivity and a high specific heat. However, if water cannot be used for any reason, e.g. a corrosive effect on the hot material, then other liquids such as oils can be used although the cooling rates are less than can be obtained with water.

The particles of the bed can be of almost any solid material and have a preferred size range of between 0.5 mm. to 5 mm. Particles smaller than 0.5 mm. generally are not effective in breaking up the vapour film which tends to form round the hot material, whilst particles greater than 5 mm. require high liquid flow rates to become fluidised and then give poor quality fluidisation. Particles of high density are preferred since, with their greater kinetic energy, they can more easily disrupt the vapour film.

One embodiment of the invention will now be described by way of example, reference being made to the accompanying drawing which is a longitudinal sectional view of an apparatus for continuously casting a metal such as aluminium or an aluminium alloy.

The apparatus of this example comprises a cylindrical vertically extending chamber 1. The chamber supports at its upper end an annular metal plate 2 to the outer periphery of which is secured in a liquid-tight manner an upstanding cylindrical wall 3. Between the upper edge of the cylindrical wall 3 and the inner periphery of the plate 2 is connected an inverted frusto-conical metal wall 4 defining with the plate 2 and the wall 3 an annular water outlet chamber 5 which communicates with a water outlet pipe 6 and which also communicates with the interior of the chamber 1 through one or more apertures 7 in the wall 4, each aperture 7 being covered with a gauze or mesh material 8. The top of the wall 3 supports an annular lid 9 of heat insulating material such as, for example, Sindanyo, and centrally of the lid 9 there is supported a downwardly depending mould. The mould comprises a metal sheath 10 lined with a heat insulating material 11 such as, for example, Maronite, the lining 11 defining a part of the length of a passage 12 which continues through a Maronite insert 13 within an inverted frusto-conical metal member 14. The insert 13 extends for only part of the axial length of the member 14 so that the latter also defines a part of the length of the passage 12. The passage 12 is of a cross-section throughout its length corresponding to that to be imparted to the metal to be cast and is defined initially by the Maronite lining 11, the insert 13 and finally by the metal member 14.

As is explained hereafter, the whole of the outer surface of the metal member 14 is exposed to a cooling medium which extracts heat therefrom, but only that portion of internal surface which defines the outlet end of the passage 12 contacts the molten metal and acts as a die which extracts heat from the molten metal.

A charging port 15 for solid particles opens into the chamber 1 towards the upper end thereof and a screen 16 extends across the chamber 1 towards the lower end thereof, this screen being composed of a gauze, a mesh material or a perforated metal plate. The chamber 1 which contains the solid particles provides a "thermophore" which is a captive bed of divided solids. Centrally of the screen 16 is an opening defined by a rubber gasket 17 dimensioned to permit the passage therethrough of the cast metal in a substantially liquid-tight manner. The lower end of the chamber 1 is closed by a base plate 18 which defines with the screen 16 a plenum chamber 19 through which extends a tube 20 which opens at its lower end through the base plate 10 and opens at its upper end to the gasket 17 such that the cast metal can pass through the gasket 17, the tube 20 and the base plate 18. A water inlet pipe 21 opens to the plenum chamber 19.

In the operation of the apparatus described, a length of metal cast to the appropriate shape is arranged to extend from the passage 12 through the chamber 1 and through the gasket 17. The chamber 1 is filled through the charging port 15 with particles of a suitable material and dimension, e.g. 1 mm. lead shot, the charging port then being closed by means of a cap 22. Water at ambient temperature is then fed to the plenum chamber 19 through the inlet pipe 21 at a rate sufficient to fluidise the material in the chamber 1, the water flowing through the screen 16 upwardly through the chamber 1 and out through the one or more apertures 7 to the outlet pipe 6. It will be appreciated that the gauze or mesh material 8 and the screen 16 are such that they prevent the passage of the particles therethrough.

Molten metal is fed to the passage 12 and passes with the initially cast bar downwardly through the fluidised cooling bed and out through the gasket 17 and tube 20. The metal member 14 is in heat-transfer relationship with the fluidised bed so that the metal emerging from the lower end thereof into the fluidised bed has been cooled sufficiently, at least on its surface, to retain the shape it has acquired at the outlet end of the metal member 14, the cast metal thereafter being confined by the fluidised bed and being rapidly cooled by the fluidised bed.

It will be appreciated that the method and apparatus described above has the advantage over existing techniques of cooling by water jets in that an increased rate of cooling is achieved allowing for higher casting speeds

and requiring less cooling to be effected by the die so that the length of the latter can be significantly reduced with the result that there is less friction between the walls of the die and the newly cast metal and a superior cast product is obtained. Additionally, the fluidised bed supports the casting as it emerges from the die.

Although, in the above description, the metal is cast downwardly under gravity into the fluidised bed, it is possible to cast the metal upwardly into the bed against the effect of gravity.

It will be appreciated that by controlling the density of the fluidised bed, a large degree of hydrosatic balance can be achieved between the bed and the metal emerging from the die.

The following is an example of casting aluminium rod in accordance with the invention.

A rod of aluminium 1½ inches in diameter was made by casting downwardly from a die into a bath of fluidised lead shot 1 mm. in diameter. The shot was fluidised by water at ambient temperature flowing at a rate of 100 gal./hr./ft.^{2}. The speed at which the casting was made was 12 inches/minute and the depth of the die available for heat extraction from the metal was ⅜ inch.

I claim:

1. A method of continuously casting materials which comprises feeding the material in fluid form to a die and cooling the shaped material emerging from the die by exposure to a thermophore consisting of a bed of particles fluidised by a cooling liquid, and cooling said die by contact with the fluidised bed.

2. A method of continuously casting materials which comprises feeding the material in fluid form to a die and cooling the shaped material emerging from the die by exposure to a thermophore consisting of a bed of particles fluidised by a cooling liquid and cooling said die by contact of the outlet end thereof with the fluidised bed.

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