Aug. 23, 1960 J. F. HOBBS ET AL 2,949,652

CONTINUOUS CASTING OF METALS

Filed Feb. 13, 1958

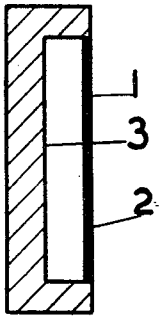

FIG. 1.

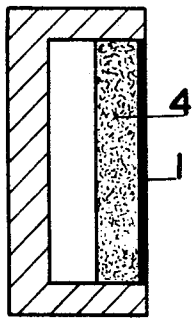

FIG. 2

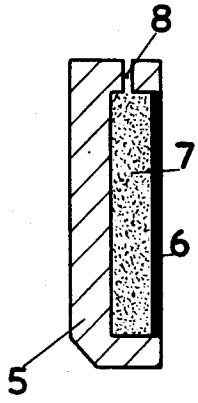

FIG. 3

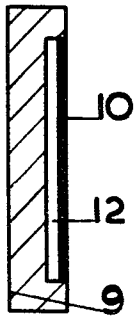

FIG. 4.

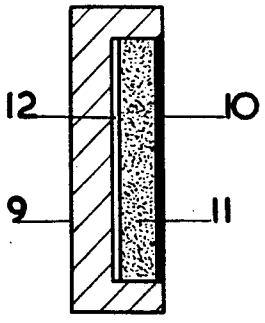

FIG. 5.

INVENTORS

JOHN FRANCIS HOBBS

THOMAS THORLEY

BY Cushman, Darby & Cushman

ATTORNEYS

United States Patent Office 2,949,652
Patented Aug. 23, 1960

2,949,652

CONTINUOUS CASTING OF METALS

John Francis Hobbs, Sutton Coldfield, and Thomas Thorley, Coventry, England, assignors to Imperial Chemical Industries Limited, London, England, a corporation of Great Britain

Filed Feb. 13, 1958, Ser. No. 715,105

Claims priority, application Great Britain Feb. 13, 1957

2 Claims. (Cl. 22—57.2)

This invention is concerned with improved apparatus for the continuous casting of metals and alloys.

In the processes which are in most common use at the present time for the continuous casting (the term "continuous casting" as used hereinafter includes both strictly continuous and semi-continuous processes) of metals and alloys and which employ a water-cooled mould with direct cooling of the emergent casting, the cooling rate within the mould is less than that immediately below it, where water is in direct contact with the casting. Furthermore, at some point in the mould, solidification shrinkage of the casting produces a gap between it and the mould, which not only reduces heat conduction to the mould wall but also, when casting alloys with a considerable freezing range, such, for example, as certain aluminum base alloys, may permit exudation of liquid from the partially solidified metal, forming objectionable "blebbing" on the surface of the final casting.

In our prior British patent, Serial No. 708,632 we have described a process by direct cooling of at least part of the casting within the mould by transmission of liquid coolant through at least part of the mould wall, the said part being formed from a powdered material compacted in such manner that it is sufficiently rigid to perform its function as part of the wall but is permeable to the coolant.

The mould used in this process is open at both ends and the wall thereof adjacent the mould cavity is provided with at least one insert which permits the passage of coolant through it into the mould cavity so as to cool at least a peripheral zone of the casting passing through the mould cavity. Such a mould is hereinafter referred to as "a mould of the type described."

It is desirable in continuous casting processes to introduce a lubricant between the metal and the mould wall to prevent adhesion of the molten or solidifying metal to the wall; the hitherto customary procedure of irregular additions of lubricant to the surface of the pool of molten metal in the mould may lead to inequalities in the rate of heat extraction around the mould periphery, and suggestions have been made for the use of porous inserts, for example of sintered metal, disposed in the mould wall through which the lubricant can be supplied under pressure to the interior of the mould.

Such inserts formed from compacted powdered materials have, however, a somewhat rough surface which causes frictional effects between the said surface and the solidifying casting in its passage over it, resulting in impaired surface quality of the casting and increased mould wear. It is difficult or in some cases impossible to obtain a sufficiently smooth surface on the material from which the inserts are made to avoid such effects.

According to the present invention we provide a mould of the type described in which the insert in the mould wall is made from a wrought metallic material having a smooth finish on the side adjacent the mould cavity and having fine passages to permit flow of coolant or lubricant through it from the side remote from the mould

cavity to the side adjacent the mould cavity. If desired, the said material may be provided with a backing of a compacted powder material also permeable to the mould coolant and/or lubricant.

The said wrought material should have a thermal conductivity exceeding 0.05 c.g.s. units at room temperature. The permeability, for example, for a water-jacketed mould, should be about 45 cubic centimetres/square centimetre/second to water under 5 lbs./sq. in. pressure in the jacket with a mould wall ½ in. thick.

The wrought material may be prepared in a number of ways. For example, it may be prepared by bonding together in any suitable manner, such as by brazing, a plurality of superimposed layers of metal gauze and then submitting the assembly to a rolling operation. By way of further example, it may be prepared by controlled electrodeposition of a suitable metal on a perforated metal plate until the perforations are reduced to very fine apertures. The apertures may be further reduced by an additional operation such as rolling.

The said wrought material may be provided with the requisite smooth finish by any suitable mechanical, chemical, or electrochemical polishing process or combination of two or more such processes.

The powdered material from which the backing is formed may consist of a metal or alloy powder, or a suitable non-metallic substance such for example as graphite. The permeability of the compacted material will be determined in accordance with the nature of the fluid to be passed through it, the rate at which it is required in the mould, and the pressure under which it is to be applied. When heat is required to be transferred from the metal within the mould across the mould wall, of which the backing forms a part, the latter must be of material of adequate thermal conductivity for this purpose.

The wrought metal, when used as a facing, may be secured to the backing by any suitable means, such as a mechanical joint, an adhesive, or a metallic bond, and polishing of the facing may be effected either before or after it is secured to the backing.

The insert may extend through part of or the whole thickness and/or depth of the mould wall and around part or the whole of the internal periphery of the mould. Thus, for example, there may be one insert or series of inserts in the upper half of the mould providing lubricant and a second insert or series of inserts in the lower half of the mould through which coolant is passed into direct contact with the casting. To facilitate operation at the commencement of pouring the section at the top of the mould wall may be of the usual solid construction, and a similar section may also be incorporated at the lower end of the mould.

The mould may be either cylindrical in shape for production of round billets, or rectangular for production of flat slabs or of any other desired cross-section.

The mould may be used in continuous casting processes in which molten metal is introduced via a launder, downspout or other means, and a free molten metal surface is maintained in the mould, or in processes in which molten metal is supplied to the mould from a reservoir superimposed thereon and there is no free metal surface in the mould. In the latter case the longitudinal alignment of the mould may be either vertical or horizontal.

The liquid coolant passing through the mould wall into the mould cavity may under suitable conditions also function as a mould lubricant.

The invention is illustrated, but not limited, by the accompanying diagrammatic drawings in which:

Figure 1 represents a vertical section through a jacketed mould wall;

Figure 2 represents a vertical section through a jacketed mould wall of another construction;

Figure 3 represents a vertical section through a mould wall adapted for the supply of lubricant to the interior of the mould;

Figure 4 represents a vertical section through another construction of mould wall adapted for the supply of lubricant; and

Figure 5 represents a vertical section through a third construction of mould wall adapted for the supply of lubricant.

Referring to Figure 1, an insert 1 of the said wrought metal having a polished surface 2 in accordance with the invention, is secured between the arms of a metal channel section 3 forming an annular jacket which water is circulated under sufficeint pressure to force it through the wall 1 into the interior of the mould.

Referring to Figure 2, the construction and function of the mould are essentially similar to that of Figure 1, except that a backing 4 of sintered powder metal permeable to the coolant in the jacket is secured to the insert 1.

In Figure 3, the mould wall 5 of solid metal has a peripheral recess into which is fitted a composite insert consisting of a polished wrought metal facing 6 secured to a sintered powder metal backing 7. Mould lubricant is supplied under pressure through the entry 8 to an annular passage (not shown) in the top of the mould from which it permeates through the insert and thence into the mould cavity. The cooling means for the mould wall are not shown but may consist of either a water jacket or sprays.

Referring to Figures 4 and 5, the solid metal mould

wall 9 has a peripheral recess into which a sheet of polished wrought metal material 10, either alone (Figure 4) or with a sintered powder material backing 11 (Figure 5) is secured, forming a narrow annular passage through which mould lubricant is circulated under turbulent flow conditions and thence permeates through the insert to the mould cavity. The turbulent flow circulation of the lubricant permits adequate heat transfer from the solidifying metal in the mould across the composite mould wall, which is cooled by means of a water jacket or sprays (not shown).

We claim:

1. An insert for a mold wall of the character described comprising superimposed layers of metallic gauze brazed together and reduced in a rolling operation, said gauze having a smooth finish on the side thereof adapted to be positioned adjacent the mold cavity, and having fine passages therethrough to permit flow of coolant or lubricant through said insert.

2. The insert described in claim 1 in which said insert is provided with a thermally conductive backing of compacted powdered material permeable to the mould coolant or lubricant.

References Cited in the file of this patent

UNITED STATES PATENTS

2,693,624	Corneil	Nov. 9, 1954
2,747,244	Goss	May 29, 1956

FOREIGN PATENTS

634,217	Great Britain	Mar. 15, 1950
708,632	Great Britain	May 5, 1954
532,539	Canada	Nov. 6, 1956