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[54] **APPARATUS AND METHOD FOR CASTING COMPOSITE CAST ROLLS**

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[51] **Int. Cl.** **B22d 7/02**

[58] **Field of Search** 249/109, 105, 108; 164/363, 94, 95, 96, 91, 92, 93, 99

[56] **References Cited**

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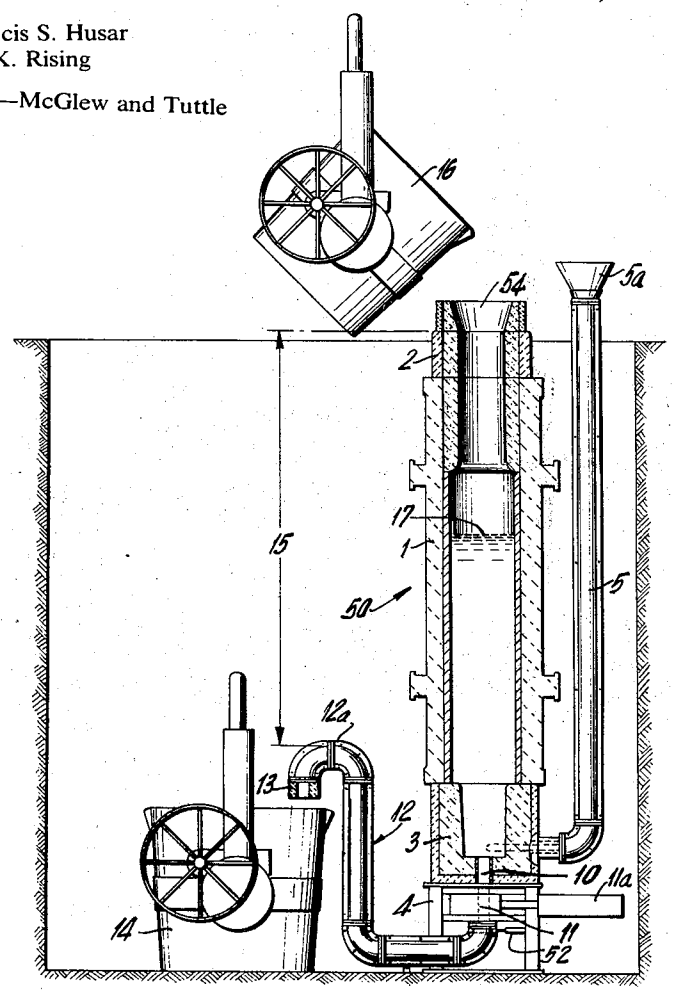
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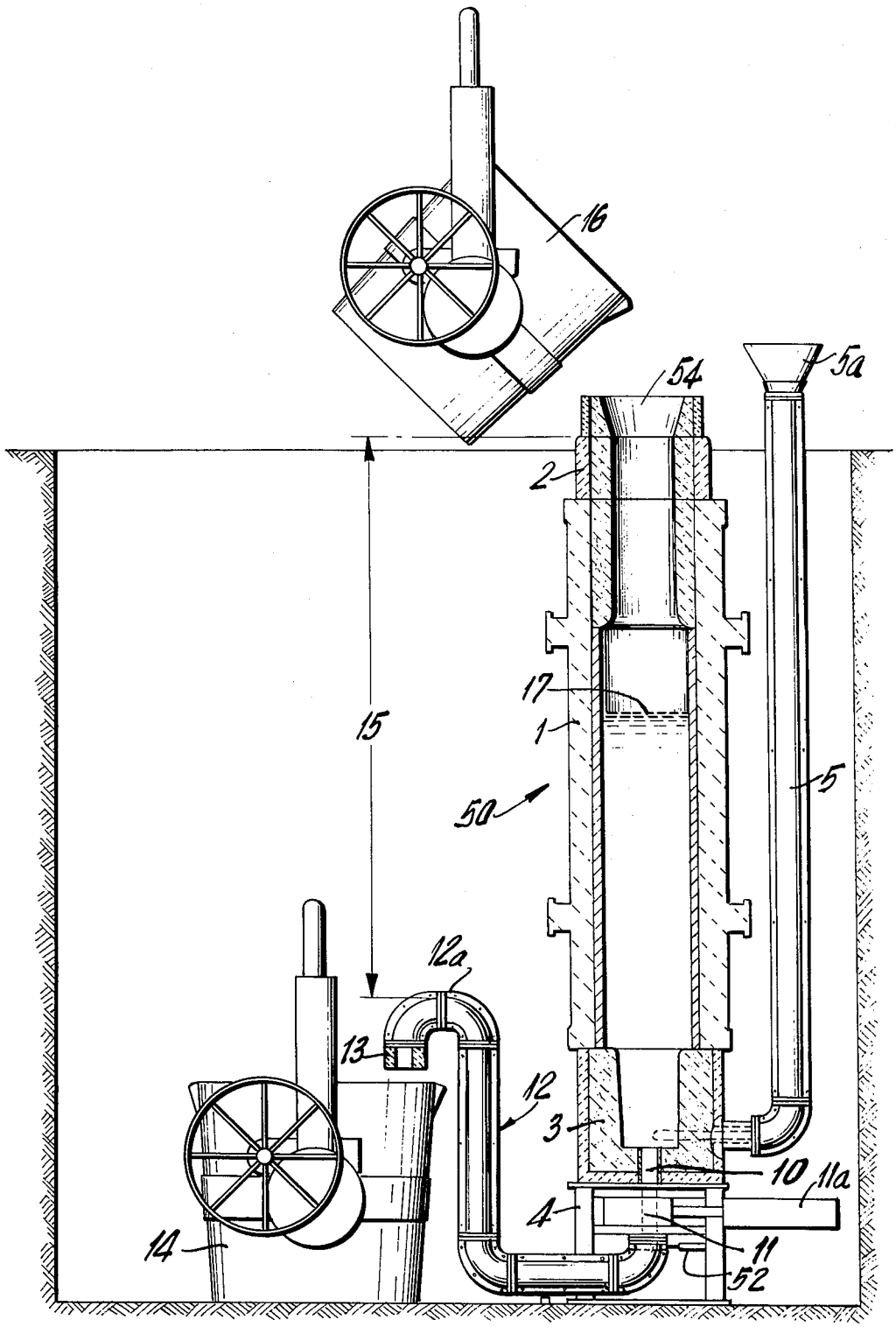
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[57] **ABSTRACT**

A device for casting composite cast rolls includes a vertically elongated mold having a top opening and a filling funnel connected into a tangential bottom inflow passage for the shell material and a bottom valve for closing a bottom discharge. The shell material is directed into the mold through the filling funnel and bottom inflow passage to flow upwardly in the mold to the level of the top of the shell portion of the article to be cast, after the bottom valve is closed to close off the discharge. The shell material is permitted to harden to a certain thickness and the bottom discharge valve is opened to drain the shell material and the core material is poured into the mold from the top opening. During the pouring of the core material, means in the form of a siphon are provided for controlling the outflow rate of the material through the bottom discharge. The siphon comprises a connecting conduit connected to the bottom discharge and having an upwardly extending bend which is made up of a plurality of interfitted parts so that the height thereof may be varied. The top of the syphon bend is arranged at a predetermined distance from the top of the mold, and the outlet for the syphon is controlled so as to regulate the amount of material which is directed out through the discharge during the pouring of the core material.

4 Claims, 1 Drawing Figure




16
54
5a
2
17
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15
5
50
12a
13
12
3
10
11a
4
11
52
14

APPARATUS AND METHOD FOR CASTING COMPOSITE CAST ROLLS

FIELD AND BACKGROUND OF THE INVENTION

This invention relates in general to the construction of casting molds and to a method of operating such molds and, in particular, to a new and useful composite roll casting apparatus and to a method of forming a composite roll.

DESCRIPTION OF THE PRIOR ART

It is known to provide a casting mold construction which includes a lower box forming the mold for the lower roll neck, a permanent mold for the roll above the lower roll neck and a top mold part over the permanent mold which is provided for forming the upper roll neck. The mold is connected by a pouring tube or funnel having a top funnel opening above the top of the mold and leading downwardly into a tangential inflow passage in the lower box which is provided for the lower roll neck. The bottom of the box is also provided with a discharge passage having a slide valve therein which may be regulated for opening and closing the discharge. The discharge is opened after the solidification of a predetermined thickness of the shell material in the mold in order to drain the central portion of the shell material into a ladle by flow through the bottom discharge. Thereafter, the core material is filled in through the funnel pipe. An advantage of such a construction is that a high quality shell material in excess will remain completely separated from the core material poured in after the outer shell material solidifies. With such an arrangement, the quality of the outer shell is not reduced by any mixing in the contact zone between the material, and the shell material may be collected separately, and immediately re-used without special treatment except for reheating. In addition, the slide valve used in such an arrangement permits unhindered draining of the shell material as well as a subsequent trouble-free closing of the mold.

However, experience has shown that while casting extremely large, long and thick rolls, for example, for plate rolling, difficulties arise in the process insofar as the draining of the shell material which is in excess of the required shell thickness and the filling of the core material takes a relatively long time so that in some cases, the cohesion between the shell and the core is not sufficiently ensured. An acceleration of the draining and filling, for example, by enlarging the openings in the slide valve, is not possible for reasons of the pouring technique since there is too large a flowing mass and also for reasons of operational economy. Another drawback is the fact that due to the length of the roll and the collecting ladle placed therebelow, the constructional height of the device becomes excessive.

Up to the present time, in such cases, it was necessary to use an overflow casting method in which the shell material in excess is expelled from the casting mold upwardly by the core material filled in at the bottom through the funnel pipe. This method is disadvantageous because a relatively large quantity of core material must be passed through the mold before the desired composition of the core material is obtained by mixing with the shell material. Nevertheless, it is necessary to proceed in such a manner, for example, in the casting of rolls with a high percentage of chromium, where the chromium must be largely removed from the core material.

It is also known to cast composite rolls in a mold in which the lower box is provided with a plug closure actuated by a plug bar extending through the entire mold. In this case, after the solidification of the desired shell, the portion of the shell material which is not solidified is drained downwardly by opening the plug closure and the soft core material is filled in from above onto the automatically sinking shell material. The drained shell material does not flow freely into the ladle, however, but into a bucket placed below the lower box which, after removal of the plug bar, seals the mold from below. In this method, it is a disadvantage that the drained shell material solidifies and cannot be used again without special treatment. In addition, for various reasons, the operation with a plug bar is very disadvantageous.

SUMMARY OF THE INVENTION

The present invention eliminates the drawbacks of the known devices and methods and provides a method and apparatus suitable even for the casting of rolls of extreme dimensions, particularly rolls for plate rolling. For solving the problem, the invention provides an apparatus and method in which the shell material which remains liquid after a certain thickness has formed is drained through a slide valve located in a bottom discharge passage at the bottom of the mold and passes into a foundry ladle. With the inventive arrangement, the slide valve is connected to a syphon having an outlet with a variable cross-section so that the discharge rate may be varied therethrough. The syphon has the effect that with the slide valve opened at the bottom discharge of the mold, the outflow velocity of the shell material is kept constant by selecting appropriate outflow cross-sections and syphon size so that in the interior of the mold, the metal level sinks slowly and uniformly without turbulence.

With the inventive apparatus and method, the draining of the shell material in excess is avoided and, in accordance with the invention, the core material is continuously poured from above through a top opening in the mold directly on the sinking surface of the shell material, so that nearly no mixing at all takes place in the contact zone between the two materials. With such an arrangement, the drained shell material is recovered in a liquid state in the ladle placed below the syphon, and of particular advantage, is the fact that the height of the ladle no longer affects the constructional height of the mold.

In a further development of the invention, the height of the syphon is adapted to the length of the rolls or the height of the casting mold. For this purpose, the syphon is made up of a plurality of interconnectable elements which are interchangeable so that elements of various lengths may be selected to fix the distance between the top of the casting mold and the top of the syphon tube. In this manner, rolls of any length may be cast in an apparatus which may be adjusted to maintain constant pressure conditions during the draining of the shell material and the inflowing of the core material. In a preferred arrangement, an additional slide valve is provided after the first slide valve to ensure that the mold can be closed after the draining of the shell material. With an additional slide valve, it is assured that the mold may be closed even in the case of failures due to high ferrostatic pressures (the height of the mold may,

for example, be 10 m) or perhaps to a solidification of the material in the mobile parts of the first valve.

Accordingly, it is an object of the invention to provide an improved casting apparatus which includes a vertically elongated mold for casting composite articles which includes a top opening and a core material filling opening at the bottom thereof which connects to a filling funnel and which also includes a bottom discharge passage having a controllable valve therein which is connected through a syphon having an upwardly extending bend portion which discharges into a ladle and which preferably has an output discharge opening of a selectable size for controlling the rate of withdrawal of the shell material after the outer portion thereof has solidified and for facilitating the infilling of the core material from the top of the mold onto the surface of the withdrawing shell material.

A further object of the invention is to provide a method of casting composite articles, such as rolls, using a vertically elongated mold having a top opening and a bottom inflow passage and a bottom discharge passage regulatable by a valve which comprises directing the core material into the mold through the bottom inflow passage to fill the mold to a desired level and thereafter permitting the core material to solidify around its periphery, opening the bottom discharge to drain the unsolidified core material through the bottom and while regulating the outflow rate of the unsolidified shell material directing the core material onto the surface of the receiving shell material to gradually fill the mold inside the solidified shell with the core material as the shell material which is unsolidified is withdrawn.

A further object of the invention is to provide an apparatus for casting composite articles which is simple in design, rugged in construction and economical to manufacture.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and specific objects attained by its uses, reference should be had to the accompanying drawing and descriptive matter in which there is illustrated a preferred embodiment of the invention.

In the Drawing:

The only FIGURE of the drawing is a diagrammatic vertical sectional view of a composite roll casting apparatus constructed in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing in particular, the invention embodied therein, comprises a casting apparatus for casting composite rolls, generally designated **50**, which includes a vertically elongated permanent mold portion **1**, a top portion **2** for molding the upper roll neck and a bottom portion **3** for forming the lower roll neck which is mounted on a drain support **4**. A funnel filling pipe **5** has a top funnel portion **5a** above the top of the open mold and it connects into a tangential filling passage adjacent the bottom of the lower portion **3**. Directly on the bottom of lower portion **3**, there is provided a drain brick **10** forming a discharge passage which is lined with refractory material. The discharge passage is provided with a continuation in which there is a slide valve **11**, which is also lined with refractory material, and which is actuated by a fluid pressure operated piston and cylinder combination **11***a*.

In accordance with a feature of the invention, when the slide valve **11** is opened to open the discharge passage **10**, means are provided to control the outflow of the shell material and, in the embodiment shown, this comprises a syphon, generally designated **12**, which includes an upper bend portion **12***a* having a discharge side which terminates in an outflow passage **13** of a refractory brick material which has a preselected cross-section depending upon the size of the roll to be cast. The discharge passage **13** provides a simply connectable means for regulating the discharge opening, but the whole syphon **12** may, of course, be selected with a reduced cross-section or a cross-section sized in accordance with the desired flow conditions. A feature of the syphon construction is that it may be made up of a plurality of interconnected parts which are interchangeable and which may be of a length such that a preselected distance **15** is maintained between the top of the bend portion **12***a* and the top of the casting mold. When the mold is changed in size, the distance **15** may be changed by changing the length of the interconnectable parts of the syphon **12**.

It is preferable to provide an additional slide valve **52** which is located in the discharge passage downstream of slide valve **11** and provides an auxiliary valve for operation to close the bottom of the mold in the event that the operation of slide valve **11** becomes difficult, and this is done after the draining of the shell material.

A foundry ladle **14** is placed below the discharge **13** of syphon **12** for collecting the shell material which is drained from the mold after the outer portion thereof solidifies in the mold. A pouring ladle **16** is shown above the open top **54** of the mold, and it may be tilted to continuously pour the core material into the top **54**.

In accordance with the method for the invention, the shell material is first delivered into the interior of the casting mold through the bottom inlet passage by pouring a quantity thereof into filling funnel **55**. The shell material is permitted to flow upwardly into the top of the mold to the distance of the termination of the outer shell layer and the outer shell layer is permitted to solidify. The inner portion of the shell material, while still liquid, is drained from the casting mold by opening the discharge valve **11** and the outflow rate is regulated by the syphon **12** in order to ensure an even and uniform withdrawal. During this time, the core material is poured from ladle **16** onto the top of the receiving surface of the shell material, and the core material is continuously filled in from above on the sinking surface **17** while the shell material is directed through syphon **12**. During this time, the contact surface **17** between the two materials remains completely quiet.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. An apparatus for casting composite rolls comprising a vertically elongated mold having an open top for the inpouring of core material and a lower inflow passage for shell material, a shell material filling funnel connected to said inflow passage for the delivery of shell material thereto, means defining a bottom discharge passage at the bottom of said mold having a reg-

ular closure valve therein, and a syphon connected to said discharge passage having an upwardly extending portion with a bend therein, the downwardly extending discharge leg having a discharge opening therethrough, the top of said syphon being at a predetermined distance from the top of said mold whereby to regulate the outflow rate of the shell material.

2. An apparatus for casting composite rolls, according to claim **1**, wherein said syphon is made up of a plurality of interconnectable parts which are exchangeable with parts of distinct sizes in order to regulate the top of the syphon in respect to the top of the casting roll.

3. Apparatus for casting composite rolls, according to claim **1**, including an additional slide valve in said discharge passage for regulating the flow therethrough.

4. An apparatus for casting composite rolls, according to claim **1**, wherein said syphon includes a discharge opening on the downwardly extending discharge end thereof having an interchangeable orifice.

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