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APPARATUS FOR PLUGGING AND REPAIRING TAPHOLES IN METALLURGICAL FURNACES

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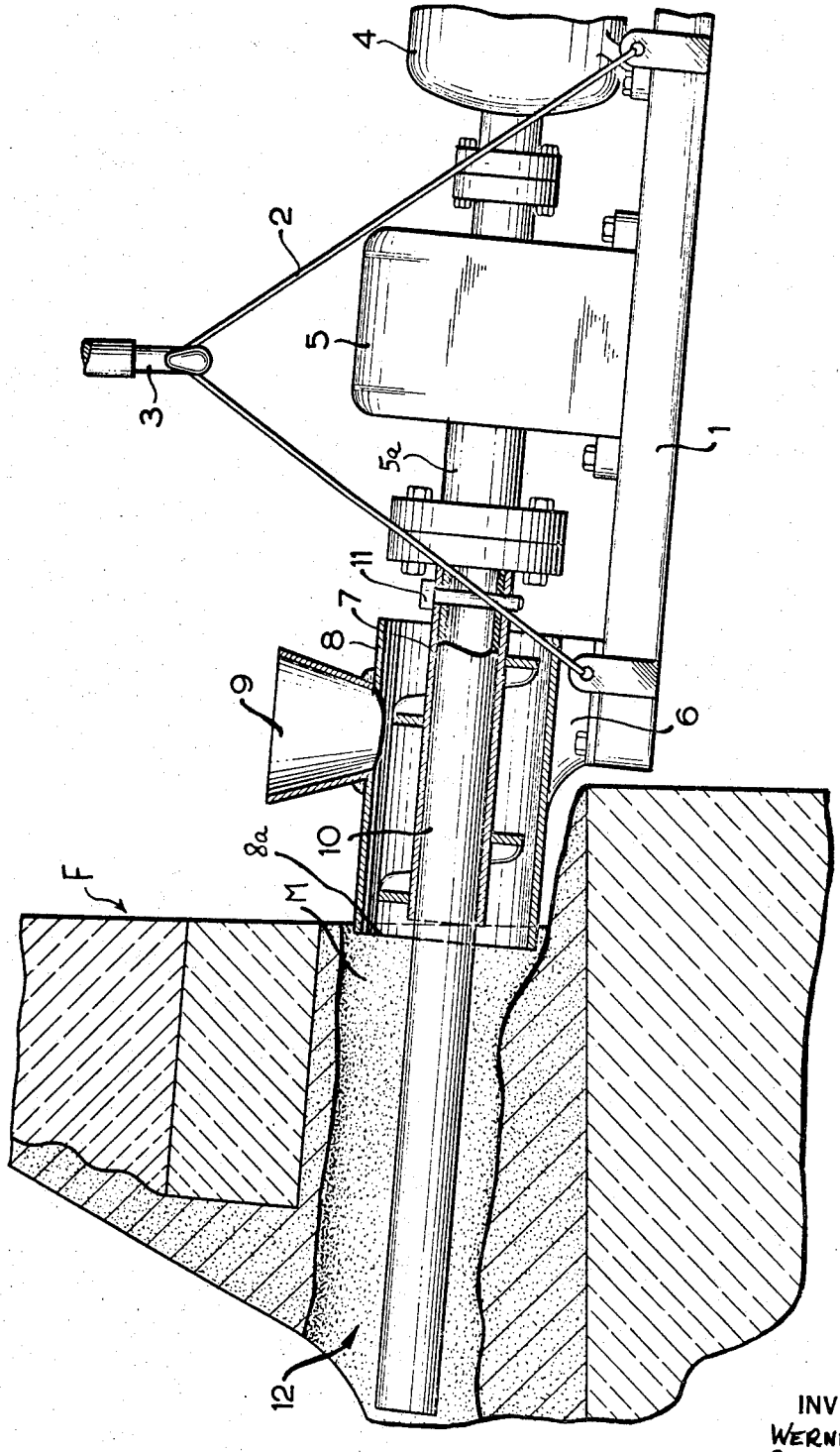

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APPARATUS FOR PLUGGING AND REPAIRING TAPHOLES IN METALLURGICAL FURNACES

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Int. Cl. C21b 7/12
U.S. Cl. 266—42 6 Claims

ABSTRACT OF THE DISCLOSURE

Tapholes of open-hearth furnaces are plugged and repaired by admitting into their outer ends a mass of heat-resistant hardenable plastic material which is fed around a tapping pipe and is compacted radially by causing the pipe to rotate and to simultaneously wobble in the taphole. Axial compression or condensation of plastic material is effected by a feed screw which supports the tapping pipe and can be detached therefrom upon completion of the material admitting step. During introduction of plastic material from the outside, the inner end of the taphole is closed by a plug of hardened plastic material which is introduced from the interior of the furnace.

The feed screw is driven by a motor through the intermediary of a transmission and is mounted on a platform which is transported by a crane.

CROSS REFERENCES TO RELATED APPLICATIONS

This is a division of application Ser. No. 674,615, filed Oct. 11, 1967.

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus for plugging or closing and repairing tapholes in metallurgical furnaces, particularly in hot Siemens-Martin and other open-hearth furnaces.

Economical plugging of tapholes in metallurgical furnaces is of utmost importance, particularly in furnaces for the production of deep-drawing and special deep-drawing steels. Such plugging of tapholes is often accompanied by a restoration or repair of the area around the taphole because streams of outflowing molten metal and slag cause considerable wear at the tapping side of a furnace. Time spent for plugging and repair is deducted from the time during which the furnace is in operation so that the output depends considerably on the quality and speed of plugging and repair. The stability of furnace material around the taphole determines the degree of separation of molten metal and slag in the last stage of a tapping operation. If the slag is allowed to escape prematurely, the action of iron oxydul and certain other ingredients of molten slag will cause oxidation of a certain amount of molten alloy which adversely affects the quality of molten metal and prevents its utilization in the manufacture of certain products.

In accordance with one of several known proposals, heat-resistant material is introduced into a taphole and is tamped in place by hand. Such procedure is very slow, its quality is dependent on the skill and carefulness of workmen, and it can be carried out only when the furnace is cold.

It is also known to repair the tapping sides of large metallurgical furnaces by employing a simple iron pipe and by feeding the plugging compound through the pipe

from the interior of the furnace. This proposal is disclosed in German DAS 1,220,874, which also mentions a suitable plastic material for use in repair of the area around a tap hole. The material is liquefied to such an extent that it flows freely toward the damaged area if the pipe is held in sufficiently inclined position. This method of repairing tapholes is impractical in Siemens-Martin furnaces because the dimensions of an open-hearth furnace and the position of the taphole therein do not permit the use of a pipe which is inclined sufficiently to cause plastic material to flow toward the tapping side. Moreover, the pipe is destroyed if the repair work is carried out in a hot furnace.

Similar drawbacks are inherent in a further proposal which is disclosed in German DAS No. 1,160,475 and is intended to facilitate the repair of areas around the tapholes of Siemens-Martin furnaces and similar open-hearth furnaces wherein the taphole is not accessible from above. This publication proposes introducing through the charging door or through another opening a plate which is placed against the inner end of the taphole. A pipe is introduced into the taphole from outside and the space around the pipe is filled with a suitable plastic mass which is tamped against the plate. The latter is destroyed if the repair work is carried out prior to substantial cooling of the furnace. The mass is intended to fill only that area which is adjacent to the inner end of the taphole.

The available art also includes German Pat. No. 572,208 which suggests the use of two screw conveyors to feed a plastic mass into the taphole of a blast furnace. This proposal is unsatisfactory in connection with Siemens-Martin furnaces, particularly for repair of hot Siemens-Martin furnaces, because such furnaces are provided with tapping pipes which are fitted into tapholes and because the feed screws disclosed in the patent cannot supply a mass having a preferably granular consistency which is best suited for repair work in a Siemens-Martin furnace.

SUMMARY OF THE INVENTION

It is an object of our invention to provide a novel and improved apparatus for plugging and repair of tapholes in open-hearth furnaces which need not be cooled prior to introduction of a pipe into the taphole.

A concomitant object of the invention is to provide an apparatus which can tamp the plastic mass in the taphole simultaneously with admission of such mass so that the tamping operation does not consume extra time.

Briefly outlined, the apparatus of our invention comprises means for introducing a tapping pipe into the taphole in such a way that the pipe is received therein with clearance, imparting to the thus inserted tapping pipe a rotary movement, simultaneously introducing into the taphole a fire-resistant hardenable plastic mass to embed the pipe in the mass and to fill the hole around the pipe, and terminating the rotary movement of the tapping pipe. In accordance with another feature of our invention, the tapping pipe is caused to perform a radial movement during rotation so that it tamps the plastic mass in response to its rotation. The plastic mass is introduced from the outer end of the taphole in the axial direction of the pipe, and the pipe is preferably inclined downwardly and outwardly and a portion thereof extends from the taphole.

The admission of plastic mass is preferably effected by resorting to a hollow feed screw operating in the cylinder of a conveyor and receiving the outer portion of the tapping pipe. The pipe is eccentric with reference to the feed screw and wobbles to perform the aforementioned radial tamping movements. When the area around the pipe is filled with plastic mass, the feed screw is detached from the pipe so that the latter can remain in the plugged and repaired tap hole.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of a specific embodiment with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

The single figure of the drawing is a partly elevational and partly vertical sectional view of an apparatus which embodies one form of our invention, further showing a portion of an open-hearth metallurigcal furnace having a taphole which is to be plugged and repaired.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The drawing illustrates an apparatus which can be used in plugging and repair of a taphole **12** provided in an open-hearth furnace, preferably a Siemens-Martin furnace. This apparatus comprises a main support in the form of a platform **1** suspended on cables **2** which are connected to the hook **3** of a crane or the like so that the entire apparatus can be moved toward or away from the outer end of the taphole **12**. The platform **1** supports a conveyor having a horizontal or nearly horizontal cylinder **8** whose left-hand open end constitutes an outlet and can be moved close to or into the outer end of the taphole **12**. The feed of the conveyor includes a hollow rotary feed screw **7** which is received in the cylinder **8** with some clearance and whose bore accommodates the right-hand portion of a tapping pipe **10**. The latter extends with clearance into the taphole **12**. The drive for rotating the tapping pipe **10** is constituted by the drive for the feed screw **7**. This drive includes an electric motor **4** which is mounted on the platform **1** and a variable-speed transmission **5** which receives motion from the motor and has an output member **5***a* releasably connected with the tapping pipe **10** by a substantially diametrically extending connecting bolt **11** or the like. The output member **5***a* is rigid with the feed screw **7** and the latter accommodates the right-hand portion of the pipe **10** in such a way that the pipe is eccentrically received therein and wobbles when the motor **4** drives the transmission **5**. Such wobbling causes the left-hand portion of the pipe **10** to perform radial movements and to tamp the plastic mass which issues from the outlet **8***a* of the cylinder **8** in response to rotation of the feed screw **7**. The cylinder **8** receives plastic material through a hopper **9**.

The operation is as follows:

The taphole **12** can be plugged and repaired without requiring any cooling of the furnace F. The crane is manipulated to move the platform **1** close to the outer end of the taphole **12** so that the outlet **8***a* of the cylinder **8** is adjacent to the outer end of the taphole. The pipe **10** is releasably secured to the output member **5***a* by the bolt **11** and is received in the feed screw **7** with sufficient clearance and eccentrically so that it wobbles in response to rotation of the feed screw. The hopper **9** admits hardenable plastic heat-resistant material M into the cylinder **8** and the motor **4** is started to drive the transmission **5** whereby the feed screw **7** forces plastic material M into the taphole and fills it all around the left-hand portion of the pipe **10**. Thus, the pipe is embedded in plastic mass M and simultaneously produces a very satisfactory radial tamping action. Axial tamping or compacting is effected by the screw **7**.

Prior to or at the start of admission of plastic mass M through the outer end of the taphole **12**, the operators introduce through the furnace F a small amount of the same plastic mass (not shown) which is fed into the inner end of the taphole **12** and hardens immediately due to high temperature in the furnace whereby the thus hardened mass forms a plug or stopper for the material M which is being fed by the screw **7**.

When the tapehole **12** is filled all around the pipe **10**, the motor **4** is arrested and the bolt **11** is withdrawn so that the platform **1** can be moved away from the taphole whereas the pipe **10** remains embedded in tamped plastic material M. The pipe **10** is thereupon burned away.

It was found that the improved apparatus enables the operators to plug and repair tapholes with a high degree of uniformity and with little loss in time so that the plugging and repair work do not materially affect the output of the furnace. Furthermore, the quality of repair work is very satisfactory because the plastic mass M admitted by cylinder **8** is tamped in two directions, namely, radially by the wobbling pipe **10** and axially by the feed screw **7**. The plastic mass M consists of tar dolomite or tar-bonded magnesite.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of our contribution to the art.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. Apparatus for plugging and repairing tapholes in metallurgical furnaces, particularly in open-hearth furnaces wherein the taphole receives a tapping pipe embedded in a mass of fire-resistant hardenable plastic material, comprising conveyor means having an outlet adapted to be placed adjacent to the outer end of a taphole and comprising elongated rotary feed means for admitting plastic material into the taphole through said outlet; and drive means for supporting the tapping pipe centrally within said elongated rotary feed means in a position in which the pipe extends into the taphole from outside and receives rotary motion during admission of plastic material.

2. Apparatus as defined in claim **1**, wherein said drive means includes a rotary output member which is operatively connected with said feed and with the tapping pipe.

3. Apparatus as defined in claim **2**, further comprising connector means releasably securing said output member to the tapping pipe.

4. Apparatus as defined in claim **2**, wherein the tapping pipe is eccentric with reference to said output member so that it moves radially and tamps the plastic material in the taphole in response to rotation with said output member.

5. Apparatus as defined in claim **4**, wherein said feed includes a hollow screw and said tapping pipe has a portion extending into said screw during admission of plastic material.

6. Apparatus as defined in claim **5**, wherein said conveyor further comprises a cylinder surrounding said screw and having an open discharge end constituting said outlet.

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