Feb. 1, 1966 P. E. DEMPSEY 3,231,948

METHOD AND APPARATUS FOR LINING A HOT TOP

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FIG. 1.

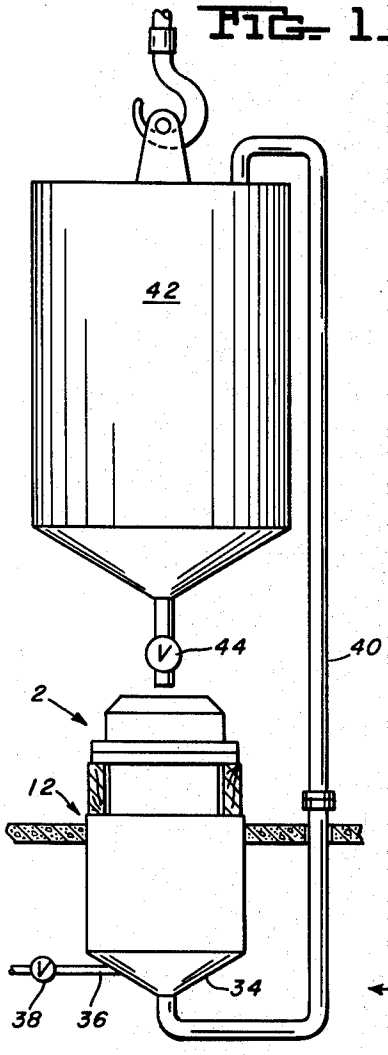
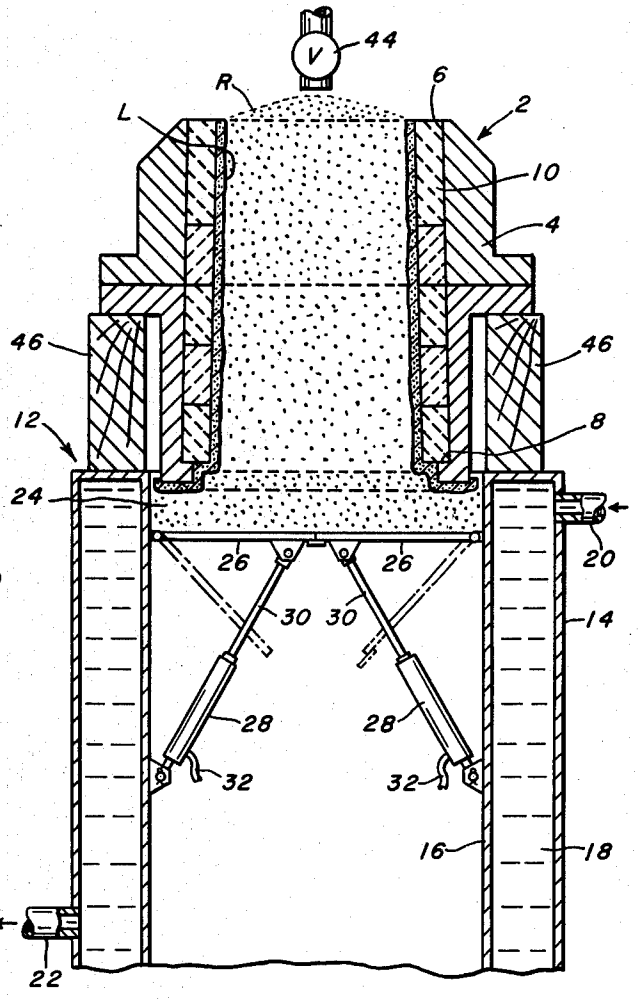


FIG. 2.



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METHOD AND APPARATUS FOR LINING A HOT TOP

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This invention relates to a method and apparatus for lining a hot top and more particularly to applying a protective lining to the inner surfaces of a semi-permanent hot top such as shown in Peterson Patent No. 2,678,481 dated May 18, 1954. Such hot tops include a cast iron casing having a semi-permanent lining. This lining may be first quality fire brick, a monolithic lining of a refractory of the same quality as the fire brick, an insulating fire brick or a castable insulating material. When using an insulating material it is quite common to provide a higher refractory lining thereover. The above described linings are used a number of times. On top of this semi-permanent lining it is necessary to provide a veneer of refractory material to protect the semi-permanent lining from deterioration due to the great heat of the molten steel and from other damage. This veneer, which may be a moldable mortar which is troughed or otherwise applied to the inner surface of the semi-permanent lining, is provided for each use of the hot top. Other types of veneer used are pre-stressed fire boards made of fire clay, paper or exothermic material which are fastened to the inner surface of the lining. In addition to this veneer lining most of these hot tops utilize a single use refractory bottom ring which is secured to the bottom of the wire casing by wire clips. This bottom ring protects the lower edges of the casing from the molten metal.

Before the hot tops can be re-used they must be cooled down to permit patching of the semi-permanent lining, if such is necessary, to provide a new protective veneer lining and install a bottom ring. This is an expensive and time consuming operation. Normally at least six hours is necessary. It is also necessary to dry the veneer lining. Because of the time that the hot tops are out of use a large supply of spare hot tops must be provided. Also the bottom ring sometimes falls into the mold or hangs partially into it, thereby causing severe defects in the steel. Difficulty is also often encountered in stripping the hot top from the mold and ingot. Also the residual heat in the hot top is wasted since the mold must be cooled down before being prepared for reuse.

It is therefore an object of my invention to provide a method of applying a protective veneer lining to the inner surface of the semi-permanent lining of a hot top in which the residual heat in the hot top casing is utilized.

Another object is to provide such a method which is simple and requires a shorter time than previous methods.

Another object is to provide such a method which eliminates the need of the separate bottom ring.

A still further object is to provide apparatus which is especially adapted for carrying out the method of my invention.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a view of the apparatus of my invention; and

FIGURE 2 is an enlarged sectional view of a portion of the apparatus of FIGURE 1.

Referring more particularly to the drawings, reference numeral 2 indicates the hot top of the semi-permanent type. The hot top 2 includes a cast iron casing 4 having a generally vertical opening 6 therethrough and a ledge 8 adjacent the bottom thereof. A lining 10 of refractory

blocks is provided for the opening 6 and rests on the ledge 8. The blocks 10 are preferably of the porous or insulating type. A support 12 is provided for the hot top 2 and includes an outer wall 14 and an inner wall 16 providing a water chamber 18. Cooling water is delivered to the chamber 18 through a pipe 20 and discharged through a pipe 22. A vertical hole 24 is provided in the support 12 and is of such dimensions that it can receive the bottom of the hot top 2. A pair of closure members 26 are hinged to the inner wall 16 a short distance below the top of the opening 24. Air cylinders 28 are pivotally mounted on the wall 16 and are provided with piston rods 30, the outer ends of which are connected to the closure members 26. Air under pressure is introduced to the bottom of the cylinders 28 through flexible conduit 32. When air is so introduced the closure members 26 are moved to their operative position shown in full lines to close the opening 24 and when the air is released the closure members 26 assume their inoperative position shown in broken lines in FIGURE 2. A hopper 34 closes the bottom of hole 24. High pressure air is delivered into the hopper 34 through a conduit 36 having a valve 38 therein. A conduit 40 leads from the bottom of hopper 34 to the top of a hopper 42. A granular refractory R is received in the hopper 42 and is preferably shell molding sand of a standard type, this being sand which is coated with a thermal setting binder such as formaldehyde, urea, resin or similar material. Flow of the refractory R from the hopper 42 is controlled by a valve 44.

In carrying out the method of my invention, a hot top 2 which has been recently stripped so that its temperature is between approximately 600° and 1300° F. is positioned on the support 12 by means of wooden blocks 46 so that the lower part of the hot top is within the hole 24. The hopper 42 is then positioned above the opening in the hot top by means of a crane or other handling device. Air is delivered to the bottom of cylinders 28 to raise the closure members 26 to operative position after which the valve 44 is opened to permit the refractory R to fill the hole 24 above the closure members 26 and to fill the opening in the hot top 2. The valve 44 is then closed and the sand allowed to dwell in contact with the heated inner surfaces of the hot top for a sufficient time to permit thermal setting thereof to produce the required thickness of protective lining L. The time required to produce any desired thickness of lining L is dependent upon the time the surface of the hot top is in contact with the sand. It has been found that a ⅜ inch thick lining can be produced in about 60 seconds dwell time in a hot top at a temperature of 600° F. The same thickness can be produced in approximately 15 seconds in a hot top at a temperature of about 1300° F. When a thicker lining is desired the dwell time is increased. It will be noted that the lining L is formed on the bottom of the metal casing 4 and hence takes the place of the separate bottom ring which is ordinarily used. After the desired thickness of lining is obtained air is exhausted from the cylinders 28 to permit the closure members 26 to move to the inoperative position shown in broken lines in FIGURE 2, thus permitting the excess sand to drop downwardly into the hole 24 and hopper 34. The closure members are then returned to their operative position and the valve 38 opened to permit air at approximately 100 lb. pressure to enter the hopper 34 and force the sand upwardly through conduit 40 into the storage hopper 42. The hopper 42 is then removed and the hot top is ready for immediate use.

If desired, the valve 44 may be solenoid operated and can be automatically opened for the time necessary to pass sufficient shell molding sand to fill the hot top opening after which it automatically closes. Control of air

to the cylinders **28** can also be automatically controlled so as to move the closure members **26** to inoperative position after the sand has remained in the hot top for the time necessary to obtain the desired thickness of lining L. The valve **38** can also be made to operate automatically in timed relationship with the opening and closing of the closure members **26**. It will also be understood that the hopper **34** may be omitted and the sand permitted to fall into any suitable receptacle.

If the hot top has cooled below the desired temperature it can be heated in any conventional manner to the desired temperature, either on the support **12** or at a separate heating station.

If desired, a conventional steel wiper strip can be used with the finished hot top by placing the ring on top of the ingot mold and allowing it to slide into the mold by movement of the hot top into the mold.

While one embodiment of my invention has been shown and described it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. The method of lining hot tops having a generally vertical opening therethrough which comprises providing a heated hot top having a temperature between approximately 600° and 1300° F. on a support, closing the bottom of its vertical opening, then filling the said opening with a granular refractory and a binder therefor, permitting the granular refractory to remain in said opening until a portion thereof adheres to the wall thereof, then opening the bottom of said opening to permit the remainder of said refractory and binder to be removed from said opening, then transporting the removed refractory and binder to a second heated hot top, and then lining the second hot top utilizing the removed refractory and binder.

2. The method of lining hot tops having a generally vertical opening therethrough with a refractory lining therein which comprises providing a heated hot top on a support having a temperature substantially less than the temperature of said hot top, said support having a vertical hole therein of such dimension as to receive the bottom of said hot top, placing a closure in the said vertical hole below the bottom of said hot top, then filling the opening and hole above said closure with a granular refractory and a binder therefor, permitting the granular refractory to remain in said opening and hole until a portion thereof adheres to the wall of said opening and the bottom of said hot top, then removing the closure to permit the remainder of said refractory and binder to be removed, then transporting the removed refractory and binder to a second heated hot top, and then lining the second hot top utilizing the removed refractory and binder.

3. The method of lining hot tops according to claim **2** in which the temperature of said hot top is between appoximately 600° and 1300° F., and the granular refractory is sand with a thermally setting bonding material thereon.

4. The method of lining hot tops according to claim **3** in which the sand remains in said opening and hole a period of time which is dependent upon the temperature of said hot top and the thickness of lining desired, the time being increased as the thickness of lining desired is increased and the time being decreased as the temperature of the hot top increases.

5. Apparatus for lining a generally vertical opening in a hot top with a granular refractory comprising a support having a generally vertical hole therein of such dimensions as to receive the bottom of said hot top, means for supporting said hot top on said support with the bottom thereof in said hole, means for cooling the wall of said hole, a pair of closure members pivotally mounted within said hole below the top thereof, means for moving said closure members between an operative position where they close said hole and an inoperative position where the hole is open, a hopper closing the bottom of said hole, means for delivering air under pressure into said hopper, a storage hopper for a granular refractory and a binder therefor, means for delivering granular refractory and binder from said storage hopper into said vertical opening when the closure members are in operative position, and means for delivering the granular refractory from said first named hopper to said storage hopper.

6. Apparatus for lining a generally vertical opening in a hot top with a granular refractory comprising a support having a generally vertical hole therein of such dimensions as to receive the bottom of said hot top, means for supporting said hot top on said support with the bottom thereof in said hole, closure means mounted within said hole below the top thereof, means for moving said closure means from an operative position where the hole is closed to an inoperative position where the hole is open, means for cooling the wall of said hole above said closure means, means for substantially filling said opening when the said hole is closed with a granular refractory and a binder therefor, and means for removing the excess refractory from said hole and opening.

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