

April 26, 1960

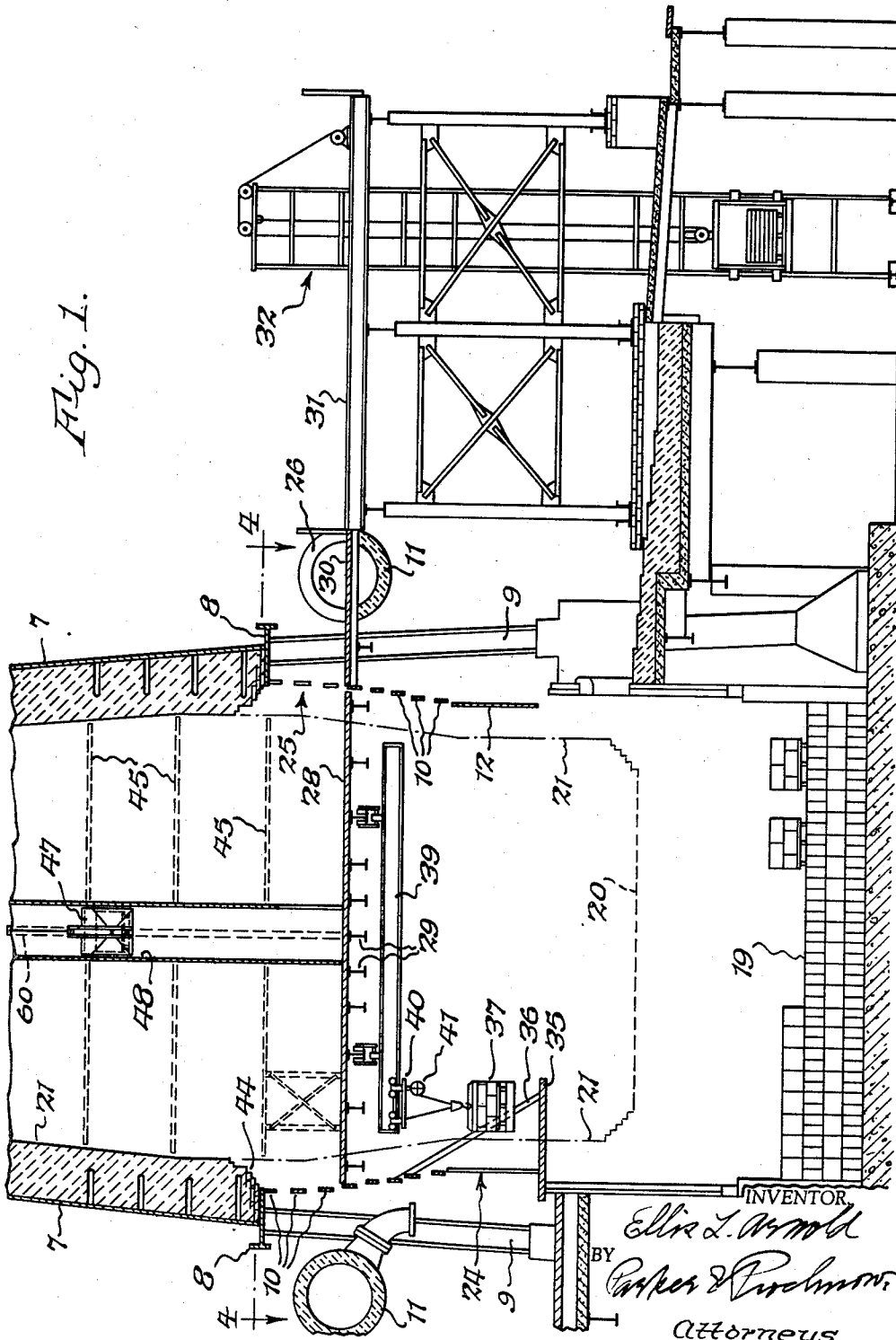
E. L. ARNOLD  
METHOD OF LINING FURNACES

2,933,918

Filed June 18, 1958

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Fig. 1.



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Fig. 3.

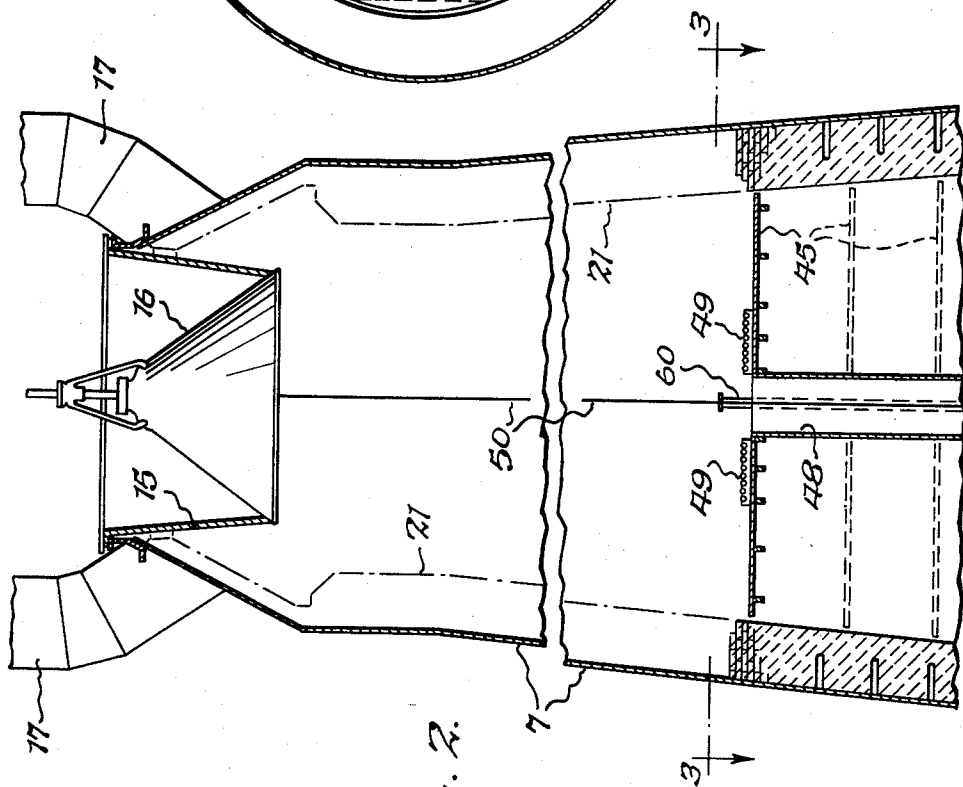
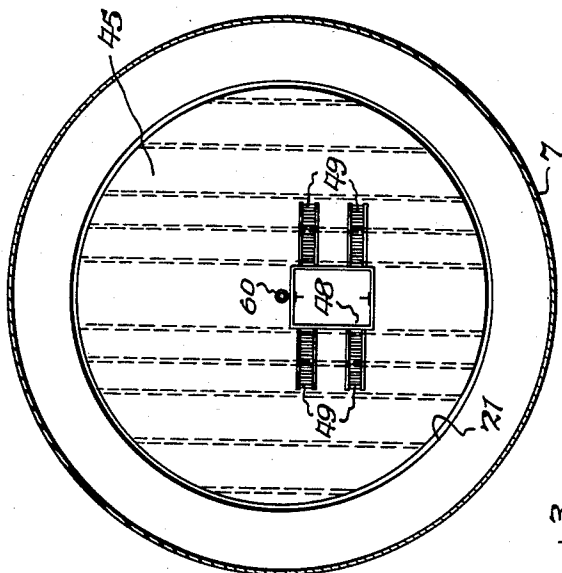


Fig. 2.

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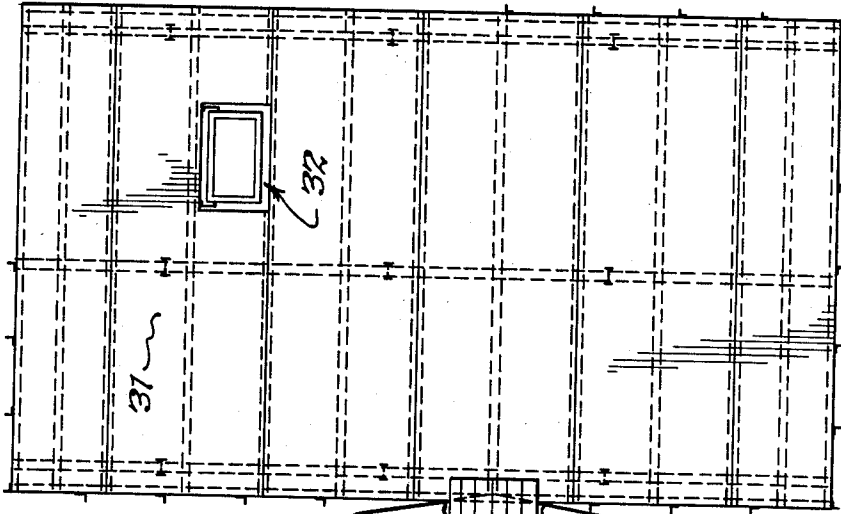
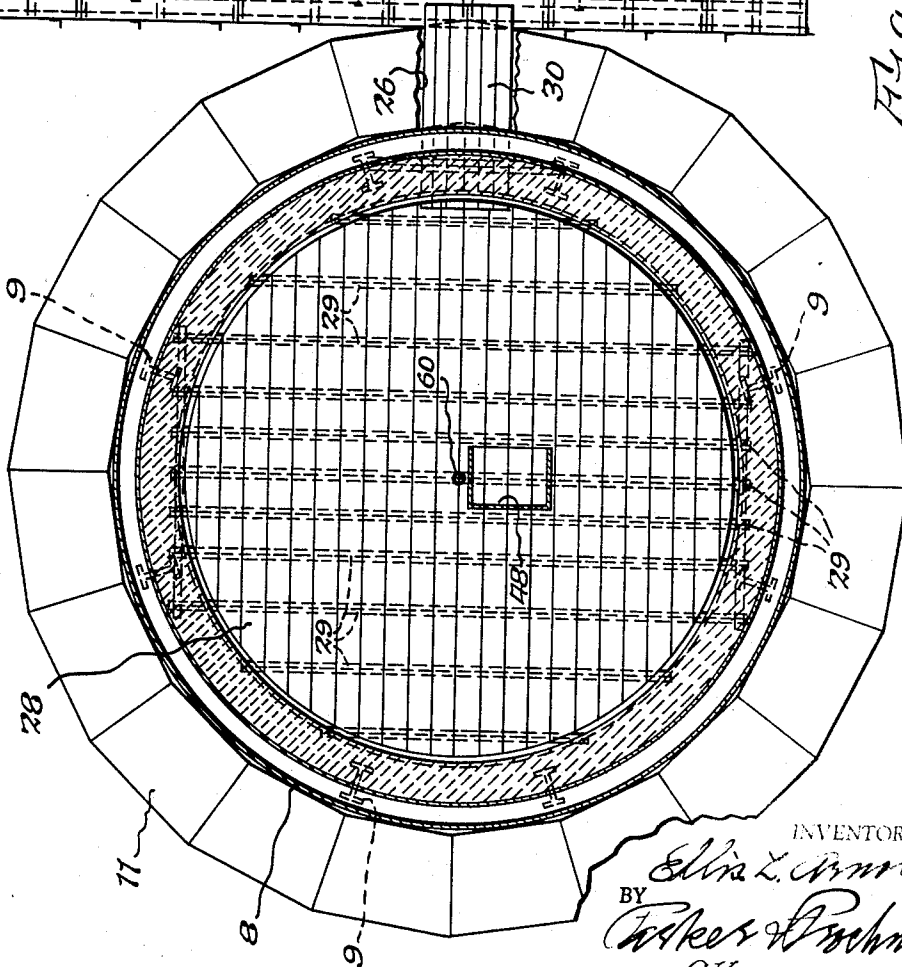


Fig. 3.



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2,933,918

## METHOD OF LINING FURNACES

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Application June 18, 1958, Serial No. 742,889

5 Claims. (Cl. 72—14)

This invention relates to methods of lining metallurgical furnaces such as blast furnaces in such a manner that the lining operation will be effected in the minimum of time.

Modern blast furnaces are very large and consequently very expensive to construct. In order that a mill may get the maximum use out of a furnace and reduce the time during which it is laid up for lining or relining, it is necessary that the lining operation be effected with a maximum of speed, efficiency and accuracy.

It is also very important in connection with the lining of furnaces that the bricks or blocks used in the lining be handled with the utmost care since any defects in the lining, such for example as a broken corner or chipped edge of one of the blocks, would result in rapid deterioration of the lining.

It is consequently one of the objects of this invention to provide a method of lining a metallurgical furnace so that the operation of lining the furnace may be carried on simultaneously in the upper portion and in the lower portion of the furnace and in such a manner to incur the minimum of risk of damaging any of the lining bricks or blocks.

A furnace object is to provide a method of lining a furnace which includes the handling of the bricks or blocks in such a manner as to reduce the possibility of damage as much as possible as well as reducing the time required for handling the bricks or blocks.

In the accompanying drawings, Fig. 1 is a central sectional elevation of the lower portion of a blast furnace with the lining partly in place therein in accordance with my improved method.

Fig. 2 is a fragmentary sectional elevation of the upper part of the furnace immediately above that shown in Fig. 1.

Fig. 3 is a horizontal sectional view thereof on line 3—3, Fig. 2.

Fig. 4 is a sectional plan view thereof on line 4—4, Fig. 1, and showing in the plan a portion of the structure used in lining the furnace.

In the drawings I have shown by way of example one type of furnace in connection with which my improved method may be employed, but it is not intended to limit this invention for use with the furnace shown since it will be obvious that my invention may be used in connection with other furnaces. This structure includes a metal shell 7 extending about the upper portion of the furnace and mounted on an annular frame member or mantle 8 which is suitably supported by means of supporting columns 9. The metal or frame portion of the furnace also includes a series of bosh bands 10 of circular shape which are imbedded in the lining of the furnace. The furnace also includes the usual bustle pipe 11 through which air is introduced into the lower portion of the furnace. The lower portion of the furnace has an annular steel wall 12. The upper portion of the furnace is provided with the usual inlet hopper or bell 15 closed by means of another bell or conical closing member 16

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that can be lowered to permit material from the hopper to drop into the furnace. The furnace is also provided with the usual gas discharge passages or oftakes 17 to receive products of combustion and other gases which are then discharged from the furnace.

The lining of the furnace includes the usual floor or base 19 which is shown partly completed, and which when completed extends approximately to the broken line 20 in Fig. 1, and the lower portion of the lining of the furnace wall rests on this floor and extends upwardly therefrom as indicated at 21 by the broken lines shown in Figs. 1 and 2.

At the start of the lining operation, or of relining the furnace after the old lining has been removed therefrom, an opening 24 is provided through which workmen and lining material may enter for working on the floor or base and on the lower part of the lining. Another opening 25 is provided to let the workmen and material enter for lining the upper portion of the furnace. This is most readily done when a furnace is to be relined by means of metal cutting torches which may cut out a portion of the annular wall 12 and another entrance 25 is formed by cutting through some of the upper bosh bands 10 of the furnace. This opening 25 is preferably formed immediately below the mantle 8. In order to gain entrance below the mantle, it is generally necessary to remove a portion of the bustle pipe as shown at 26.

One of the first operations in preparation for the actual lining of the furnace is to provide within the furnace at the level of the upper entrance 25 a deck 28 which is preferably mounted on beams 29, the ends of which may be secured, for example by welding, to some of the bosh bands of the furnace. This deck is left in position in the furnace during the lining operation and serves as a support for an elevator and a hoist for use both in lining the upper and the lower portions of the furnace. This deck is connected by means of a platform or gangway 30 with a platform 31 mounted on a suitable structure on the exterior of the furnace, and a hoist or elevator 32 is provided for transporting material from the ground level to the platform 31.

At the entrance 24 to the lower portion of the furnace, an elevator platform 35 is suitably mounted within the furnace, that shown being partly suspended by rods or cables 36, the upper ends of which may be welded or otherwise secured to some of the bosh bands. This elevator platform is arranged at such elevation that lining material may be readily deposited on the same, for example by means of a lift truck. The platform may be provided with gravity rollers or other anti-friction means, not shown, for facilitating the movement of the pallets to the inner end of the platform from which the pallets are removed by means of a pallet hoist including a cage 37. This cage is open at the bottom thereof so that it may be lowered over the pallet and the bricks supported thereon and secured to the pallet. The cage 37 consequently may be easily connected with a pallet and protects the bricks against damage.

This hoist is suspended from a track beam 39 preferably in the form of an "I" beam which is mounted by means of trolleys on some of the supporting beams 29 for the deck 28 so that the track beam may move back and forth underneath the deck by means of the trolleys which operate on the "I" beams 29 supporting the deck 28. The track beam 39 supports a carriage 40 on which the cage 37 is supported by a suitable cable suspended from the carriage 40. The cable connects with a winding drum 41 of any suitable construction, preferably driven by power to raise and lower the cage 37.

In order to incur the minimum or risk of damage to the bricks or blocks used in the lining, they are preferably positioned on pallets at the factory, and preferably

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the bricks are arranged in groups which are protected by cardboard and banding. In this way the bricks or blocks are subjected to the minimum of handling which might damage the same and such handling would add expense to the lining operation. The pallets supporting the bricks are loaded on railroad cars or trucks at the plant where they are made, and at the furnace which is being lined the pallets are raised by means of a lift truck and deposited on the elevator platform 35. The pallet may then be hoisted by means of the hoist mechanism mounted on the carriage 40 and may be raised off of the elevator platform and positioned to any part of the furnace floor or wall lining where the brick are required. By means of the track beam and the carriage 40, the pallets may be positioned in any portion of the lower part of the furnace where they may be required and the bricks are then removed from the pallet by the bricklayer. By handling the bricks in this manner there is the minimum of risk of damage to the bricks since there is very little chance of damage to the bricks while supported on the pallets. This method of handling the bricks also reduces the time required in laying the bricks.

During the operation of lining the upper part of the furnace, other bricks also on pallets are raised by means of the elevator 32 to the platform 31. The pallet on which the bricks are mounted may then be placed on a ramp which may include roller units along which the pallet of bricks is moved along the platform 31 and the gangway 30 to the deck 28. While the lining for the lower part of the furnace is being constructed, the lining for the upper part is also begun by laying brick on the mantle 8, and preferably a corbel construction 44 is employed at the beginning of the lining of the upper part of the furnace.

After the lining bricks have been positioned on the mantle to a height which can be conveniently reached by bricklayers standing on the deck 28, scaffolding of any usual or suitable type is erected on the deck on which platforms 45 are successively supported. The pallets are supplied to the platform 45 by means of an elevator 47 arranged within an elevator shaft 48. The elevator shaft is provided with openings wherever necessary to permit pallets and brick mounted thereon to be placed on the elevator 47, and suitable openings are provided in the elevator shaft through which the pallets are removed from the elevator for placing them into convenient positions for bricklayers working on one or other of the platforms 45. Suitable roller platforms 49 or other friction reducing means may be employed wherever desired to facilitate moving the pallets to the desired locations on the platforms. The elevator 47 is preferably supported on a cable 50 mounted in the upper portion of the furnace for lifting the elevator to any desired level.

60 represents a pipe forming a center post positioned accurately in the vertical center of the furnace. This pipe is used to facilitate positioning the lining in correct relation to other parts of the furnace and the elevator and the scaffolding is positioned to be clear of this post.

When the lining of the upper portion of the furnace has been completed, the scaffolding and platforms supported by the deck 28 are removed. The deck and the supporting beams 29 are also removed when the lining of the lower portion of the furnace has been finished to a height at which further lining would be interfered with by the track beam 39 and the deck 28, whereupon these parts are removed. The portions of the bosh bands which have been removed to provide the entrance 25 are then again welded in place and the work of lining the remaining portion of the furnace is carried on from below so that the lining covers the mantle and the corbel.

By means of the method described, the lining of a furnace can be very expeditiously carried out and the breakage of bricks is also greatly reduced. Since the bricks must be made of various shapes to fit the various parts of

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the furnace, the breakage of some bricks of special shapes may cause considerable delay in completing the lining, which in turn increases the idle or lay-up time of the furnace.

It will be understood that various changes in the details, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art, within the principle and scope of the invention, as expressed in the appended claims.

I claim:

1. A method of lining a blast furnace having a shell and an annular mantle mounted on the shell of the furnace at a substantial distance from the lower end thereof, said method including the steps of cutting an opening in the furnace shell below said mantle to admit lining material, mounting a deck within the furnace substantially on the level of the bottom of said opening, providing a platform on the exterior of said furnace substantially on the level of the bottom of said opening, erecting a scaffold and an elevator on said deck to receive lining material approximately at the level of said deck and discharging the lining material on said scaffold, and providing an entrance for lining material in said furnace shell below said deck, and applying lining to said furnace simultaneously above and below said mantle.

2. A method according to claim 1 and including the steps of closing said opening after completing the lining of the portion of the blast furnace above said mantle, and then completing the construction of the lining from below up to said mantle.

3. A method according to claim 1 and including the steps of removing from said furnace said elevator and said deck after completing the lining of said furnace above said mantle, then closing said first mentioned opening and completing the lining of said furnace to and around said mantle from below said mantle.

4. A method of lining a blast furnace having an annular mantle mounted on the shell of the furnace at a substantial distance from the bottom thereof, said method including the steps of first positioning bricks belonging to a certain portion of the lining on a pallet, cutting an opening in the shell of the furnace below said mantle, mounting a deck within said furnace substantially on the level of the bottom of said opening, passing pallets with the brick arranged thereon through said opening onto said deck and moving the pallets to the position of the furnace in which the brick are to be installed, and removing the brick from the pallet in immediate vicinity of the portion of the furnace in which the brick on such pallet are to be installed, providing a second entrance in the furnace below said deck, passing other pallets containing brick through said second entrance into the interior of the lower portion of the furnace, and hoisting said other pallets containing the brick to the part of the lower portion of the furnace in which said bricks are to be installed, whereby the brick on any pallet is maintained in its original position on such pallet until removed therefrom in immediate vicinity of the portion of the furnace in which the bricks are to be installed.

5. A method according to claim 4 and including the steps of mounting scaffolding and supporting platforms on said deck at different elevations, elevating the pallets containing the brick to a platform, and moving the pallets on said platforms to the portion of the furnace in which the bricks are to be installed.

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