UNITED STATES PATENT OFFICE.

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PROCESS OF LINING FURNACES.

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To all whom it may concern:

Be it known that I, BYRON E. ELDRED, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Processes of Lining Furnaces, of which the following is a specification.

This invention relates to processes of lining furnaces; and it comprises a method of lining and repairing furnaces of the open hearth type and like structures in which a plastic lining material comprising a mixture of tar, pitch or the like combustible carbonaceous binder with a granular refractory material, such as dolomitic lime, is projected across a hot furnace chamber to a point of use by a jet current comprising a protective gas; all as more fully hereinafter set forth and as claimed.

The problem of lining, or of repairing the linings, of hot furnaces without interruption, or with the least possible interruption, of operation is a difficult one; and this is particularly the case with furnaces of the basic open hearth type, cement kilns, etc., wherein the lining is exposed to active erosion or corrosion. The use of tools, and particularly in reaching places across a hearth chamber, is troublesome. Ordinarily these linings are made of some granular or pulverulent material mixed with a suitable binding material, such as tar or pitch, for example, and made into a plastic paste or dough or sticky mass. Where, for example, a tar binder is used, in place the binder of the plastic chars and cokes, forming a temporary bond uniting the material till the permanent bond of the refractory material itself has time to develop. Of course only enough tar is used in the mixture to give plasticity sufficient for application; more would make the lining material too open-textured. But manipulating material of this character in a hot furnace is an operation requiring speed and care since the tar begins to char and burn as soon as the mixture is exposed to heat and comes into contact with the hot gases in the furnace. In patching and repairing furnaces the gas flow is generally shut off and the furnace chamber is then full of hot air so that full opportunity for combustion of the binder is afforded. As stated, but little binder can be used in the plastic in any event; and during application the influence of heat, furnace gases, hot air on the mixture steadily diminishes the amount present, thereby diminishing concomitantly the plasticity of the mix.

In basic open-hearth furnaces, the heat is of course very great and oxidizing conditions prevail while the basic lining is more or less corroded and attacked in normal operation. When bare or thin spots appear, a plastic mixture of tar and basic material is applied to the spot, being tamped on with tools if conditions permit or, and very frequently, the material is simply thrown with a shovel across the furnace to and on the bare spot till enough sticks to cover the spot. Frequently the basic material is dolomitic lime, or limestone, reduced to a granular or pulverulent condition. The same material is used in repairing the linings of basic converters. In place as the heat affects the mixture, the tar at first chars and cokes and then burns away as the heat increases and the basic material develops its own bond.

I have found that I can line or repair furnaces in operation without waiting for cooling off in a simple, easy and ready manner by projecting a mixture of refractory granular material with the required amount of tarry binder by means of a jet comprising products of combustion, which may be taken from the stack of the same furnace or from another source. A little steam may be admixed with the products of combustion, as by using a steam jet to produce the current; but the use of steam alone is inadvisable though steam has some of the same endothermic properties which render products of combustion here valuable. Steam is apt to carry entrained moisture or water and this may expand disruptively in the hot furnace. And the heat of the steam often affects the mixture inconveniently. An air jet is not advisable as a carrier for the plastic mixture since it initiates combustion as soon as the mixture enters the furnace.

A current of products of combustion under pressure may be formed by a jet of steam on the injector principle drawing such products from the stack of a suitable furnace, from a lime kiln, etc. Or the products of combustion may be withdrawn from a suitable source and cooled and compressed to any degree desired by any suitable type of pump. A pump of the type of the well known brake pump is quite suitable. Into a current of such products, or a mixture of

steam and such products, flowing with the necessary velocity, is introduced the mixture of refractory material and binder. This mixture may contain enough binder to make it freely plastic at ordinary temperatures and therefore capable of carriage by the jet. But, as stated, it is better to restrict the proportion of binder and in so doing certain other advantages may be attained. With just enough binder, say around 10 per cent. of ordinary tar, to make the mixture plastic or sticky when hot, the fine powdered lime and tar can be kneaded together hot, the mixture allowed to cool and granulated or powdered. It can now be handled by a cool jet as readily as any other powder, but on projection against the hot wall it resumes its plasticity and sticks where it is applied. The tar and the fine refractory material may be separately conveyed to and mixed in a jet nozzle, but it is generally desirable to use a ready mixed composition of the nature stated. Any suitable type of apparatus may be employed.

The jet of products of combustion under pressure carrying the plastic mixture is directed within the furnace chamber to the point where the lining is to be provided or repaired; the operation in this respect being similar to the use of a pneumatic brush. In passing through the heated furnace chamber, the products of combustion shield the carbonaceous matter of the binder from combustion by excluding hot air and flame gases. They have a further influence in preventing a rise in temperature in that the endothermic action of carbon and carbonaceous material upon the carbon dioxid chemically represses any great increase in heat. The more heat in the furnace penetrates the mixture of gases and plastic material, the more this endothermic action develops and the greater is the tendency to repress heating. These actions are amply sufficient to shield the material during its passage across a furnace chamber of any reasonable dimensions. Operating in this manner the composition of tarry binder and refractory material arrives at its destination in a powdered or plastic but subdivided condition and the force of the jet performs a substantial tamping. By this method it is possible with a restricted amount of tarry binder to make a hard, dense lining or patch saving much time and consequent loss of sensible heat of the furnace without excessive waste of material. The whole furnace chamber may be so lined, or the application of the plastic mixture may be merely to a bare or thin spot. Application of the mixture to a hot converter is in the same manner.

The mixture may be fire-clay and tar, ganister and tar, magnesia and tar, dolomitic limestone and tar etc., or any suitable mixture to suit the requirement of the special use to which the furnace is to be put. For open hearth furnaces previously burnt dolomitic or magnesian lime is generally best. The tar may be any of the usual kinds such as coal tar, wood tar, water gas tar, etc. Asphalt and asphaltic compositions may be used in its lieu. Artificial asphalt made from petroleum residuum is also suitable; and indeed petroleum residuum may be used. Therefore in employing the word tar herein I mean it to be held as generic to the stated binders.

While as stated I regard the process applicable to other materials, I regard it as broadly useful in connection with a mixture of dolomitic lime or limestone and coal tar. Other tars may be employed but coal tar is particularly good. Using dolomitic lime, it is preferably lime which has been burnt at a relatively high temperature. A mixture of such lime with a minimal amount of tar, say 10 per cent. of good coal tar, applied in the stated manner makes a dense, hard, resistant lining or patch on the wall of the furnace.

Gases from lime kilns are better than products of combustion from an ordinary furnace since they carry more carbon dioxid. Carbon dioxid itself may be used but is of course more expensive and difficult to procure. Ordinary products of combustion carrying little free oxygen will suffice well for most purposes. Nitrogen may be used but is not as good as products of combustion since it exercises only a physical shielding action.

The present process may be used for repairing linings of ordinary rotary cement kilns, either with pulverized refractory material such as fire clay or with pulverized clinker. Using powdered clinker, a powdered mixture containing about 10 per cent. of tar may be projected by waste gases from the kiln itself to and on the bare or thin spot. Here it is first held by the tar itself, then by the char and finally by sintering of the fine clinker.

What I claim is:—

1. The process of lining furnaces and repairing furnace linings which comprises making a mixture of fine refractory binding material with a carbonaceous material and conveying such mixture against the wall of a furnace by a jet of gases of such nature as to protect such binder against combustion.

2. The process of lining furnaces and repairing furnace linings which comprises making a mixture of fine refractory material with tar and conveying such mixture against a wall of a furnace by a jet of gases of such nature as to protect such binder against combustion.

3. The process of lining furnaces and repairing furnace linings which comprises making a mixture of dolomitic lime and tar and conveying such mixture against a wall

of a furnace by a jet of gases of such nature as to protect such binder against combustion.

4. The process of lining furnaces and repairing furnace linings which comprises making a mixture of fine refractory material with a carbonaceous material and conveying such mixture against the wall of a furnace by a jet comprising products of combustion.

5. The process of lining furnaces and repairing furnace linings which comprises making a mixture of fine refractory material with tar and conveying such mixture against a wall of a furnace by a jet comprising products of combustion.

6. The process of lining furnaces and repairing furnace linings which comprises making a mixture of dolomitic lime and tar and conveying such mixture against a wall of a furnace by a jet comprising products of combustion.

7. The process of lining basic open hearth furnaces or repairing the linings of such furnaces which comprises making a fine powdered mixture of dolomitic lime with a little carbonaceous binder and projecting such mixture against a hot wall of such furnace by a jet comprising products of combustion.

In testimony whereof, I affix my signature in the presence of two subscribing witnesses.

BYRON E. ELDRED.

Witnesses:
FRED. J. WHELAN,
R. W. EARLE.