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3,454,426

GAS JET CLEANING OF COKE OVEN DOORS AND JAMBS

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FIG. 1.

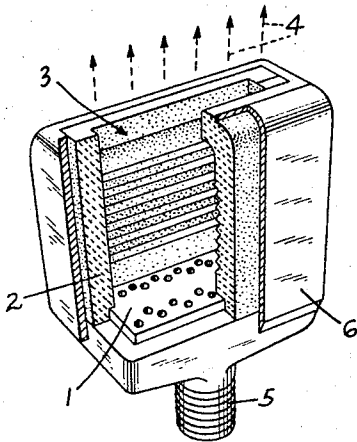


FIG. 2.

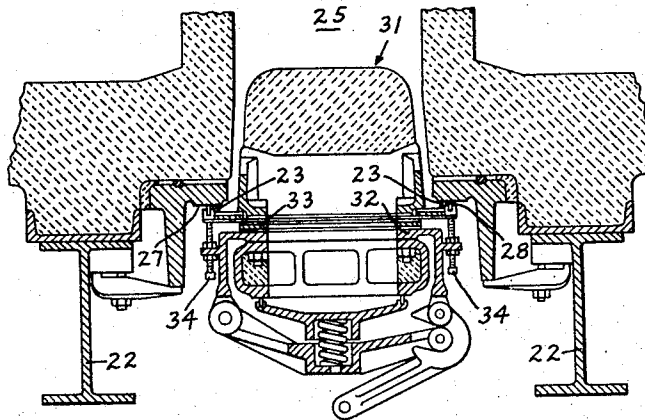


FIG. 5.

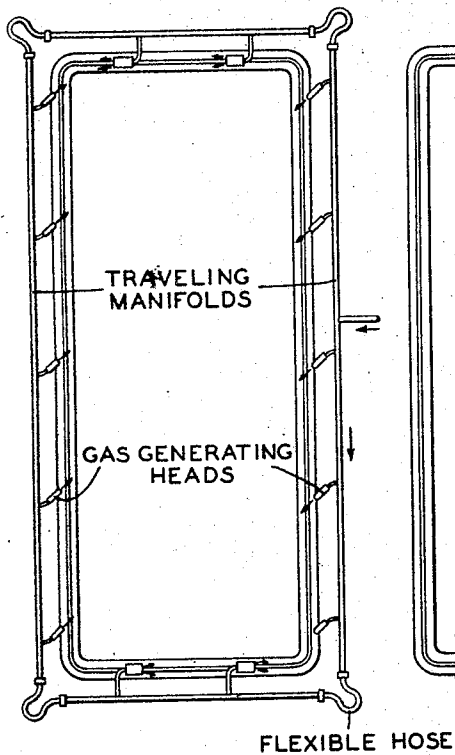


FIG. 3.

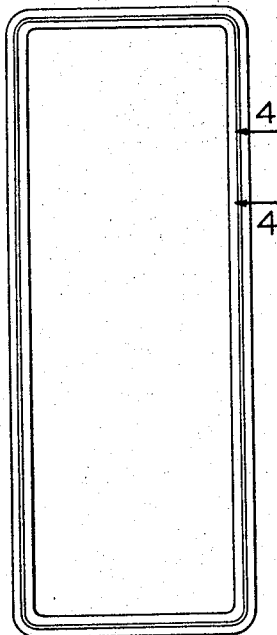
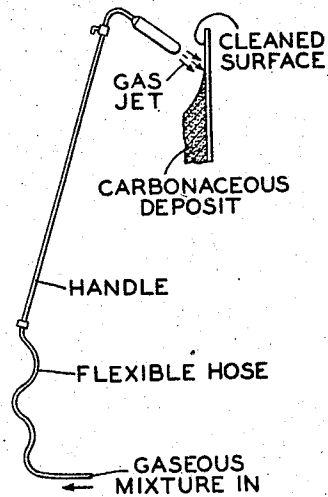


FIG. 4.



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**GAS JET CLEANING OF COKE OVEN
DOORS AND JAMBS**

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5 Claims

ABSTRACT OF THE DISCLOSURE

Method for removing carbonaceous deposits from the sealing surfaces of coke oven doors and door jambs which employs a high velocity, high temperature, shaped gas jet applied at an angle with respect to the sealing surfaces. Exemplary gas velocities are 1000–3000 feet/second, exemplary temperatures are 2500–3500° F.; the shaped jet is preferably in the form of a thin rectangular shape somewhat in the nature of a chisel blade, and the shaped jet is preferably applied to the surface to be cleaned at an angle of about 30–60°

This invention relates to the cleaning of self-sealing coke oven door and door jambs of coke oven batteries; more particularly, this invention relates to a new method of and apparatus for cleaning the sealing surfaces of coke oven doors and door jambs.

Self-sealing doors for coke ovens have a sealing strip extending therearound which presents a knife edge to the machined face of the door jamb for sealing therewith. It is well known that, in order to be effective, the seal made between a self-sealing coke oven door and its jamb must be gas tight and therefore depends upon the sealing surfaces therebetween being initially clean and that, because of the formation of deposits of a pitchy, carbonaceous nature during the coking operation, it is necessary to periodically clean these surfaces.

This cleaning has in the past been performed manually by scraping and chipping the deposits from the sealing surfaces. The cleaning performed in this manner is tedious and arduous work which is not efficiently performed because of the prevailing heat conditions in the vicinity of the coke oven door jambs. Further, this method results in uneconomically long shut-down of the coke oven batteries and additionally the equipment used in scraping and chipping often mars the sealing surfaces.

Various proposals have been made in the past for mechanically effecting the cleaning of the sealing surfaces of coke oven doors and door jambs, such as, the use of mechanical scrapers, rotary steel bristle brushes and burrs. These methods have not proved satisfactory due to wear characteristics on the sealing surfaces and their inability to meet self-cleaning requirements. Other methods proposed for cleaning the self-sealing surfaces of coke oven doors and door jambs have included attempts to burn the deposits off, blow them off with steam and contracting and blowing off the deposits with pressurized air. These methods have proven to be not only cumbersome but also frequently occasion damage to the adjacent brickwork of the oven walls.

It is therefore an object of the present invention to provide a novel method for cleaning the sealing surfaces of self-cleaning coke oven doors and door jambs. Another object of this invention is to provide a novel cleaning apparatus for cleaning the sealing surfaces of self-sealing coke doors and door jambs. A further object of this invention is to provide a cleaning apparatus for cleaning the sealing surfaces of self-sealing coke oven doors and door jambs in combination with a door handling machine which

combination provides for automatic removal of the coke oven door, the cleaning of the sealing surfaces thereof and of the door jamb, and the replacement of the door to seal the end of the coking chamber from which it was removed after pushing of the coke charge in such chamber and before charging of the coking chamber commences.

I have found that by means of a highly concentrated, controllable energy source, tarry carbonaceous deposits formed on the sealing surfaces of self-sealing coke oven doors and door jambs during the coking operation are quickly and efficiently removed both hot and cold doors and door jambs. Briefly, the method of the present invention comprises directing a high velocity, high temperature, shaped jet of gas (primarily products of combustion) at the coke oven doors sealing edge and the adjacent door jambs machined receiving surfaces. The jet of gas is caused to move vertically and/or horizontally by manual or mechanical means until all the undesirable tarry, carbonaceous deposits formed during the coking operation have been removed. Deposits of varying thickness can be removed by the method of the present invention at the rate of approximately four feet per minute. However, the rate of cleaning will of course vary depending upon the mass and velocity of the gas jet employed as well as the thickness of the deposit to be removed. A further advantage of the present invention is that due to the very short period of time during which the metal sealing surface itself may be exposed to hot gases, no detrimental effects occur.

The basic process steps of the present invention comprise:

- (A) Generating a high temperature, high velocity gas jet having a temperature ranging from 2,500° F. to 3,500° F., preferably 3,000° F. and a velocity of 1000 ft./sec. to 3,000 ft./sec., preferably 2,500 ft./sec.
- (B) Shaping the gas into a thin rectangular shape, similar to a thin chisel blade with variations dependent upon the contour of the surface to be cleaned.
- (C) Moving the shaped gas jet across the surface to be cleaned at the rate approximately 4 ft./min., which rate is nominal and may be varied dependent upon mass and velocity of the gas jet. The distance from the gas jet ejector to the surface to be cleaned is nominally from 1 to 2 inches minimum contact with a maximum contact being dependent upon the mass and velocity of the gas jet. Desirably, the gas ejected is at a 45° angle to the surface to be cleaned.

The shaped gas jet employed in the present invention is the combustion product of a gas, such a low pressure coke oven gas and air (air/gas ratio ranging from 9.0/1 to 9.5/1, preferably 9.3/1) prepared by burning the pre-mixed gas and air inside a commercially available burner of the superheat type, such as shown in FIGURE 1 of the drawings capable of producing a superheated blast at a velocity up to 3,000 ft./sec. at temperatures up to 3,500° F. Optionally, the high velocity, high temperature gas may be produced at a location remote from the coke oven batteries and subsequently piped to the cleaning location for eventual use as described above.

For a fuller understanding of the nature of the present invention, reference should be made to the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a vertical section through a superheat burner of the type which may be employed in the present invention in which: 1 is a close-tolerance ceramic structure containing a port pattern from which premixed gas and air burns inside the burner. The combustion proceeds along and in contact with, the surface of preformed insulating lining 2 of refractory material capable of with-

standing more than 3,500° F. This lining is closed in at the nose to form a nozzle or blast opening 3 of appropriate shape. The nozzle or blast opening is preferably a slot 1" wide x 1/8" thick whereby the superheated blast or tongue 4 issuing from the nozzle is desirably chisel shaped. However, depending on the mass of the surface to be cleaned and the temperature and velocity of the jet, other slots having widths up to about 4" or different shapes may be employed. The pipe or hose connection 5 is a standard pipe thread with either male (as shown) or female being employed. The shell 6 is of a material capable of durably and compactly encasing the refractory chamber.

FIGURE 2 is a horizontal section through a conventional self-sealing coke oven door, such as shown for example in U.S. Patent 2,442,348 granted June 1, 1948, wherein: 31 is a refractory plug suitably seated in a metal frame 32 and having a flexible sealing plate 33 suitably secured to the frame 32. The sealing edges 28 (and the carbonaceous material to be removed 23), desirably in the form of knife edges, are positioned about the periphery of sealing plate 32. Spaced adjustable bolts 34 are disposed about the periphery of sealing plate 33 to adjust the pressure of sealing edges 28 on the seating surface 27. The buckstays 22 are disposed at the opposite sides of the battery adjacent the armor at the opposite ends of the heating wall flanking the coking chamber 25.

FIGURE 3 is a diagrammatic elevation of a self-sealing coke oven door as seen from its inner side showing sealing edge 4 (the surface to be cleaned).

FIGURE 4 is a vertical section on line 4—4 of FIGURE 3.

FIGURE 5 is a diagrammatic illustration of the novel cleaning apparatus positioned about the coke oven door of FIGURE 3 for mechanical operation of the cleaning apparatus.

As will be understood, the superheat burner illustrated in FIGURE 1 is merely a typical example of one of the many forms of such burners commercially available.

Likewise, the door constructions illustrated in FIGURES 2 and 3 are typical examples of the self-sealing coke oven doors having a sealing edge which may advantageously be cleaned by the use of the instant improved cleaning method and apparatus.

FIGURE 4 is an illustration of the manual operation of the novel cleaning method of the present invention. A superheat burner, of the type such as shown in FIGURE 1 of the drawings, is attached to a handle, such as a standard pipe handle, which is held in the hands of an operator, gaseous mixture in the appropriate gas/air ratio is fed to the burner through a flexible hose located at the lower end of the handle. The rate of flow of the gaseous mixture to the burner may be regulated by valve means located on the handle. The burners are fired and the shaped jet of high temperature, high velocity gas thus produced is directed at the carbonaceous deposits adhering to the sealing edge of the coke oven door. Desirably the superheat burner employed produces a thin rectangular shaped jet of gas which is directed at the surface to be cleaned at an angle of about 45° whereby a chisel shaped jet striking the surface is effected. The thus shaped gas jet is moved along the sealing edge at the rate of approximately 4 ft./sec. while the distance from the burner to the work surface is maintained at from about 1 to 2 inches. The direction of movement of the cleaning apparatus over the said sealing edge is in such manner that the cleaning action is always exercised in a direction not opposed to that in which gravity acts on the deposits being removed from the sealing surfaces by the shaped gas jet.

Even with a door as high as 15 feet, a user of normal height standing on the bench portion of a coke oven structure a foot below the coke oven floor level, can clean the top portion of the sealing edge of a door with a handle element which is not so long as to be unduly

cumbersome when used in cleaning the bottom and vertical portions of the sealing edge.

A further particularly important feature of the cleaning apparatus of the present invention is its capacity for properly cleaning the corner portions of the sealing edge at which the horizontal and vertical portions of the sealing edge merge into one another and are generally rounded as shown in FIGURE 3 of the drawings. Further, the ease with which the horizontally disposed portion of the sealing edge may be cleaned is especially important, since the bottom portion of the sealing edge is the portion most in need of proper and regular cleaning.

According to another aspect of the present invention there is provided apparatus for mechanically cleaning the sealing surfaces of self-sealing coke oven doors and door frames. This aspect of the present invention may be embodied in coke oven door handling machines operative on the coke or pusher side of the battery, such as the machines shown in U.S. Patents 2,391,214 granted Dec. 18, 1945 and 2,588,060 granted Mar. 4, 1952. Such machines involve a carriage comprising flanged wheels mounted for rotation on axles and arranged to travel on rails positioned along the opposite sides of the battery at the necessary height for the door handling machine hooks to engage the doors of the coking chambers. The wheels are driven from an electric motor to propel the machine along the length of the battery to move it from one chamber to another as necessary in the operation of the battery to remove the doors on the opposite sides of the chamber before pushing coke from each chamber when the coking of the charge therein has reached the end of the coking cycle and to replace the doors before charging an empty chamber. The door handling apparatus involves a door head frame mounted for turning movement through a 90° arc on pivot pins suitably journaled in supporting members secured to the carriage. The door head frame carries pivoted hooks and associated bearing members adapted to engage the latch mechanism of the door and effect compression of the door springs to permit actuation of the latch mechanism to release the door. The door is then supported by the door head frame which through linkage mechanism swings the door in an upward and outward direction away from the door opening. The door is thus moved so that it is positioned clear of the side of the coke oven battery including the buckstays and other supporting structure. The door head frame is then actuated to rotate it through a 90° arc.

When replacing the door, the movement is just the opposite of that hereinabove described for removing the door; that is to say, the door after having been cleaned by the door cleaner is first swung through a 90° arc by the pivotal movement of the door head frame to return the door to a position in front of the coking chamber. The door is thereafter moved to seat the sealing edges on the sealing surfaces of the door jamb.

A plurality of the gas jet cleaning means of the present invention may be mounted on the main carriage of the door handling machine in any suitable manner whereby such door handling means and said gas jet cleaning means being so constructed and arranged that a door removed from an oven by said handling means may be brought into sealing-surface cleaning relationship with said gas jet cleaning means for cleaning thereby.

It will be appreciated that FIGURE 5 is merely given to show the relationship of the sealing edge and cleaning means in sealing-surface cleaning relationship. Further, it will be appreciated that the upper and lower horizontally extending sealing surfaces of the door are cleaned solely by the upper and lower horizontally placed gas jets respectively likewise the vertical sealing surfaces are cleaned solely by the gas jets placed for vertical movement. The gas jets are all connected to a suitable fuel supply by means of flexible hose and to suitable guiding and power means whereby the desired movement is obtained.

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Thus it is apparent that my apparatus is readily adaptable for automatic operation by the addition of an appropriate arrangement of guiding means and power means hence, the cleaning operation may be performed either manually or mechanically without interfering with the pushing schedule or damage to the metal sealing surfaces or adjacent brickwork as a result of long exposure to the hot gases.

I claim:

1. A method for removing tarry, carbonaceous deposits adhering to the sealing surfaces of coke oven doors and their cooperating door jambs which comprises: generating a high velocity, high temperature gas jet having a velocity of from about 1000 feet/second to about 3000 feet/second and a temperature of about 2500° F. to about 3500° F., shaping the jet into a relatively thin, flat elongated form and applying the thus generated high velocity, high temperature gas jet to the aforesaid surfaces to be cleaned at an angle thereby removing said tarry, carbonaceous deposits from said sealing surfaces.

2. The method as described in claim 1 wherein said high velocity, high temperature gas jet has a velocity of about 2300 to about 2800 feet/second and a temperature of about 2800° F. to about 3200° F.

3. The method of claim 1 wherein said gas jet is in the form of a thin rectangular shape having a forward edge directed at the surface to be cleaned at an angle of about 30° to 60° C.

4. The method as described in claim 3 wherein said shaped gas jet is formed in a burner having a blast opening

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of from about 1/8 inch to 1/2 inch thick and from about 1 to about 4 inches wide.

5. A method for removing deposits from the surfaces of coke oven doors and door jambs which comprises:

- (a) directing a plurality of inter-connected gas jets at an angle against the surface to be cleaned,
- (b) simultaneously moving said plurality of jets with respect to said surface,
- (c) each of said jets comprising a high velocity, high temperature gas jet having a velocity of from about 1000 feet/second to about 3000 feet/second, a temperature of from about 2500° F. to about 3500° F., and a relatively thin, flat elongated shape,
- (d) thereby removing said deposits from said surfaces.

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