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METHOD AND APPARATUS FOR MEASURING THE TEMPERATURE OF COKE OVEN WALLS

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FIG. 1

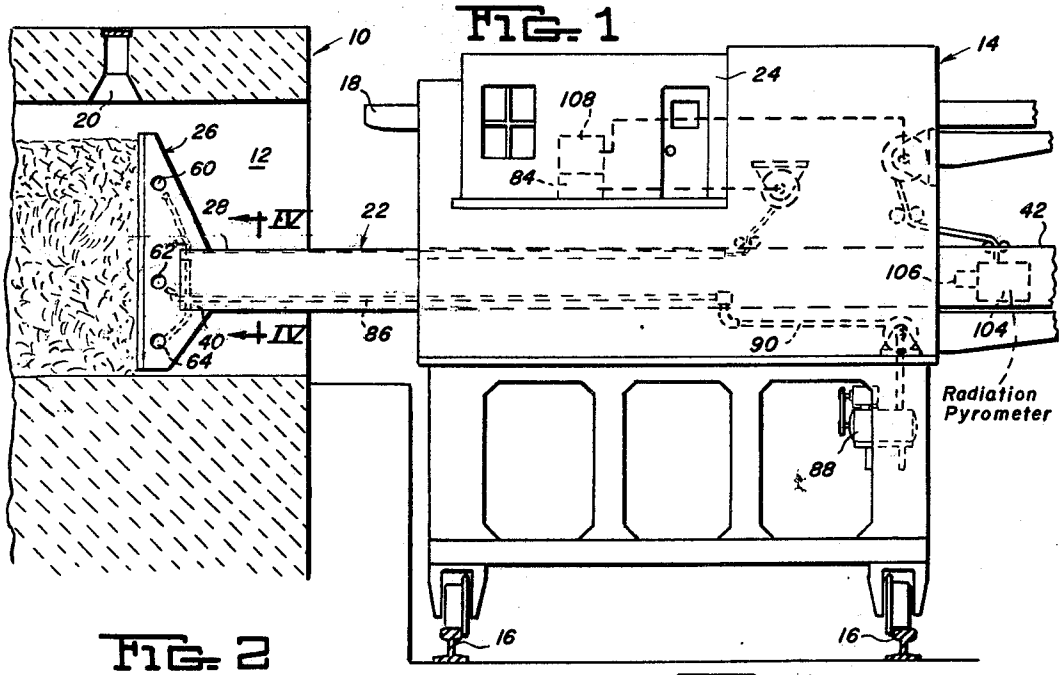


FIG. 2

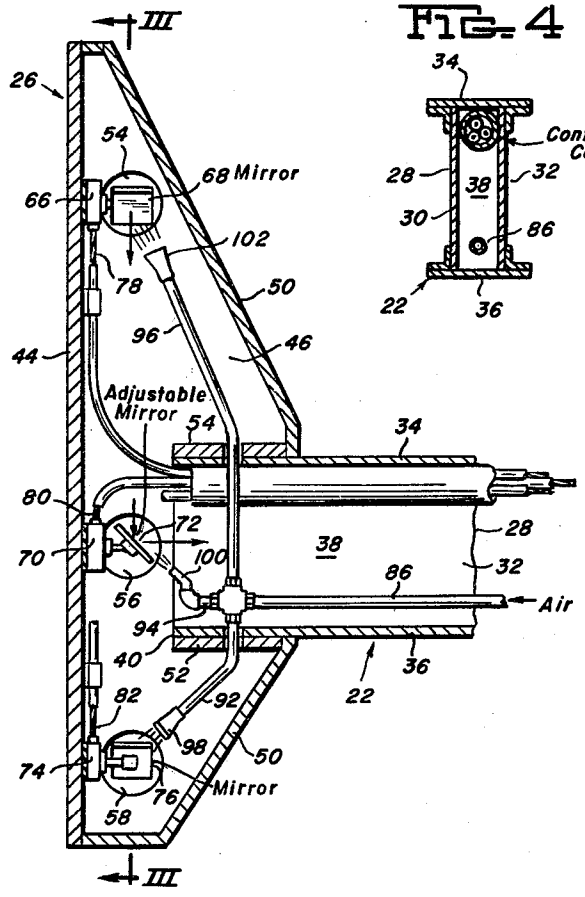
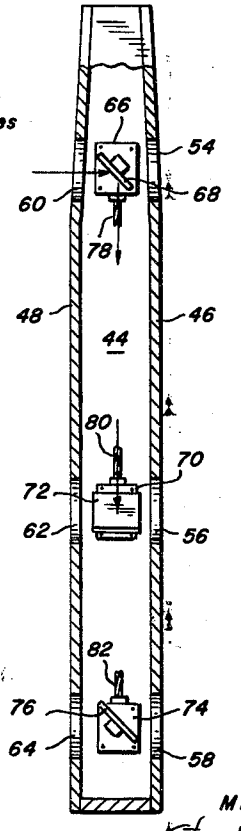


FIG. 4

FIG. 3



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METHOD AND APPARATUS FOR MEASURING THE TEMPERATURE OF COKE OVEN WALLS

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ABSTRACT OF THE DISCLOSURE

The pusher ram has a plurality of openings or windows in the sidewalls and a plurality of reflective surfaces inside the pusher ram. A radiation pyrometer is positioned inside the hollow horizontal arm of the pusher ram adjacent the end portion that does not enter the coke oven and has its sensing head focused on one of the reflective surfaces. The other reflective surfaces are arranged to reflect the radiant energy emitted by the coke oven wall onto the intermediate reflective surface and the intermediate reflective surface in turn reflects the radiant energy along an unobstructed path through the horizontal arm to the radiation pyrometer positioned outside of the coke oven. Suitable means are provided to adjust the reflective surfaces so that the temperature of one or both of the coke oven walls may be measured at different elevations as the coke is being removed from the coke oven by the pusher ram.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a method and apparatus for measuring the temperature of the coke oven walls as the coke is being removed from the coke oven and more particularly to a method and apparatus for measuring the temperature of the coke oven walls with a radiation pyrometer positioned externally of the coke oven.

Description of the prior art

Presently the temperature of coke ovens is determined from flue temperature measurements, manually made with optical pyrometers that view the base of the flue through the inspection openings. The measurement of the flue base temperature can not provide a vertical temperature profile of the coke oven walls. In many cases the temperatures of the base of the flue are rapidly taken without the care necessary for reliable control. With the present trend toward increased coking rates and higher coking temperatures this practice is inadequate and at times dangerous to the safety of the coke oven brick work. There is a need for a reliable means of measuring and monitoring the temperatures of the coke oven walls so that procedures can be initiated to clean the nozzles and make proper adjustments in the temperature of the flues for optimum coke oven operation.

Attempts have been made in the past to measure the temperature of the coke as it moves through the coke guide when it is pushed out of the coke oven. This technique has not proven entirely satisfactory because the radiation pyrometer is sited on the rapidly cooling coke as it emerges from the oven and the temperatures measured do not provide an accurate temperature profile of the coke oven walls.

SUMMARY OF THE INVENTION

The present invention comprises a method and apparatus for measuring the temperature of the coke oven walls by reflecting the radiant energy emitted by the coke oven walls to a radiation pyrometer positioned outside of the coke oven. The pusher ram has a plurality of windows in the side walls through which the radiant energy from the coke oven walls enters the inner portion of the ram. The radiant energy is reflected by reflective surfaces within the ram through the horizontal arm of the pusher ram to a radiation pyrometer positioned on a portion of the horizontal arm that does not enter the coke oven. The radiation pyrometer translates the radiant energy emitted by the coke oven walls to temperature and the temperature profile of the coke oven walls is determined as the pusher ram pushes the incandescent coke out of the coke oven. Means are provided to keep the reflective surfaces clean and cool during the temperature determination. Other means are provided to remotely control the position of the reflective surfaces so that the reflective surfaces may be focused on either of the coke oven walls to selectively determine the temperature of either of the walls and obtain a temperature profile of the entire coke oven at preselected elevations.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a fragmentary view in section of the pusher side of a coke oven with the pusher ram extending from a track mounted pusher machine into a coke oven.

FIGURE 2 is an enlarged view in vertical section of the pusher ram head illustrating the openings in the sidewalls and the reflective surfaces positioned within the ram head.

FIGURE 3 is a view in vertical section taken along the lines 3—3 of FIGURE 2.

FIGURE 4 is a view in section of the horizontal arm taken along the line 4—4 of FIGURE 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and particularly FIGURE 1 there is illustrated the pusher side of a coke oven battery generally designated by the numeral **10** having an elongated horizontal coking chamber **12**. A pusher machine generally designated by the numeral **14** is mounted on tracks **16** adjacent the pusher side of the coke oven battery. The machine **14** includes apparatus for removing the coke oven doors (not shown), a leveling bar **18** operable to level the piles of coal charged into the coke oven through the charging holes **20**, and a pusher ram generally designated by the numeral **22** that is arranged to push the incandescent coke out of the coke oven **12**, as illustrated in FIGURE 1.

The pusher machine **14** has a cab portion **24** in which the operator actuates the drive mechanisms to remove the coke oven door and reciprocate both the leveling bar **18** and pusher ram **22**. The pusher ram **22** is suitably supported on roller means and is provided with drive means to reciprocally move the pusher ram **22** within the coke ovens **12** and includes a ram head generally designated by the numeral **26** connected to a horizontal arm or girder generally designated by the numeral **28**. The horizontal arm **28** has a box-like configuration with a pair of spaced vertical side walls **30** and **32** suitably secured to upper and lower walls **34** and **36** that provides an unobstructed longitudinal passageway **38** extending throughout the length of the horizontal arm **22**. The horizontal arm **22** has a front end portion **40** and a rear end portion **42** and is arranged on the pusher machine so that the rear end portion **42** does not enter the coke oven **12** during the pushing cycle.

The pusher ram head **26** has a front wall **44**, a pair of spaced sidewalls **46** and **48** and an angularly extending rear wall **50**. The horizontal arm end portion **40** is positioned in an opening in the ram head rear wall **50** and is

secured to the inturned flange portions 52 to form a unitary structure. The ram head sidewall 46 has spaced apertures or windows 54, 56 and 58 therein and the other sidewall 48 has corresponding windows or openings 60, 62 and 64 that are aligned with the openings 54, 56 and 58 in the opposite sidewall 46. A top mirror supporting device 66 is secured to the ram head front wall adjacent the openings 54 and 60 and adjustably supports a mirror 68 thereon. An intermediate mirror supporting device 70 is secured to the ram head front wall 44 and adjustably supports a mirror 72 thereon. Similarly, a lower mirror supporting device 74 is secured to the ram front wall 44 and adjustably supports a lower mirror 76.

Control devices for adjusting the relative position of the mirrors 68, 72 and 76 are contained within the supporting devices 66, 70 and 74 and may be any conventional adjusting device as, for example, gearing or chain and sprocket mechanisms or the like. The adjusting mechanisms within the devices 66, 70 and 74 are connected by means of flexible control cables 78, 80 and 82 to a remote control station 84 within the cab 24. The control cables extend through the horizontal arm 22 to the cab 24 so that the operator within the cab 24 may adjust and focus the mirrors 68, 72 and 76 on the respective coke oven walls through the openings 54, 56 and 58 in ram head sidewall 46 or through openings 60, 62 and 64 in ram head sidewall 48.

A conduit 86 is positioned within the horizontal arm 22 and is connected at one end to a source of gas 88 on the pusher machine 14 and includes a flexible portion 90 to permit the reciprocal movement of the horizontal arm 22. The opposite end of conduit 86 opposite the horizontal front arm portion 40 is connected to branch conduits 92, 94 and 96 that have nozzle portions 98, 100 and 102 directed toward the mirrors 76, 72 and 68. Either air or an inert gas is conveyed through the conduit 86 to the nozzles 98, 100 and 102 that direct the air or gas across the reflective surfaces of the mirrors 68, 72 and 76 to both cool the mirrors and to keep the mirrors clean.

A two-color radiation pyrometer 104 is secured within the arm 22 adjacent the end portion 42 and has its sensing head 106 focused along the unobstructed longitudinal passageway 38 in the horizontal arm 22. The two-color radiation pyrometer is connected to a computer recorder 108 within the cab 24 where the temperature measured by the two-color radiation pyrometer is recorded continuously during the pushing operation.

The three mirror arrangement within the ram head 26 provides an arrangement whereby the temperature at preselected elevations along either of the coke oven walls may be measured. The sensing head 106 of radiation pyrometer 104 is focused on the intermediate mirror 72. The mirror 72 can, in turn, be adjusted to reflect the radiant energy from either of the coke oven walls through the windows 56 or 62 into the radiation pyrometer sensing head 106. For example, the mirror may be positioned vertically and at a 45° angle facing the window 62 to reflect the radiant energy from the coke oven wall opposite the window 62 to the sensing head 106 of the radiation pyrometer 104. The mirror 72 may be rotated about its vertical axis at an angle of 45° and facing the window 56 so that the radiant energy emited by the coke oven wall through window 56 is reflected to the radiation pyrometer sensing head 106 through the unobstructed passageway 38.

The intermediate mirror 72 may also be positioned at a suitable horizontal angular position to reflect the radiant energy reflected by either the upper or lower mirrors 68 or 76 to the radiation pyrometer sensing head 106. For example, the upper mirror 68 may be adjusted to reflect the radiant energy from the coke oven wall adjacent the window 60 in ram head side wall 48 onto the reflective surface of mirror 72. Mirror 72 is so adjusted that the reflective surface is focused both on mirror 68 and on the sensing head 106 so that the radiant energy emitted from the coke oven wall adjacent the window 60 is first reflected by mirror 68 onto mirror 72 and from mirror 72 onto the radiation pyrometer sensing head. Similarly, the intermediate mirror 72 may be focused to reflect the radiant energy reflected from the lower mirror 76. Lower mirror 76 may also be adjusted to reflect radiant energy through either window 58 or 64 onto the intermediate mirror 72.

The mirrors 68, 72 and 76 may be fabricated from any suitable polished metallic surfaces as, for example, chrome reflective surfaces. Silvered glass mirrors, although subject to oxidation after extended use, may also be used.

Although a two-color radiation pyrometer as manufactured and sold by Milletron, Inc., Irwin, Pa., and described and illustrated in Milletron Bulletin #31565 is preferred, any suitable pyrometer that will measure the radiation of a surface and translate the radiation to a temperature may be used.

By means of the mirror position adjusting device 84 it is possible to either record the temperature of one of the coke oven walls at a preselected elevation during the push, or to selectively measure the temperature at various elevations of either of the coke oven walls as the ram head 26 discharges the coke from the oven.

According to the provisions of the patent statutes, the principle, preferred construction and mode of operation of this invention have been explained and what is now considered to represent its best embodiment has been illustrated and described.

I claim:

1. A method for measuring the temperature of a coke oven wall comprising,
   - inserting a pusher ram into a coke oven chamber and displacing a charge of incandescent coke with said ram to exposed the coke oven wall to the side portions of the ram head,
   - focusing a reflective surface within the ram head of said pusher ram on a coke oven wall at a preselected elevation from the base of said coke oven,
   - focusing a radiation pyrometer positioned externally of said coke oven on said reflective surface, and
   - determining the temperature of said coke oven wall from the radiant energy emitted by said coke oven wall and reflected by said reflective surface to said radiation pyrometer.

2. A method for measuring the temperature of a coke oven wall as set forth in claim 1 which includes,
   - focusing a second reflective surface within said ram head on said coke oven wall at a second preselected elevation from the base of said coke oven,
   - focusing said first reflective surface on said second reflective surface so that the radiant energy emitted by said wall onto said second reflective surface is reflected onto said first reflective surface,
   - focusing a radiation pyrometer positioned externally of said coke oven on said first reflective surface, and
   - determining the temperature of said coke oven wall at said second preselected elevation from the radiant energy emitted by said wall at said second preselected elevation and reflected by said reflective surfaces to said radiation pyrometer.

3. A method for measuring the temperature of a coke oven wall as set forth in claim 2 which includes,
   - focusing a third reflective surface within said ram head on said coke oven wall at a third preselected elevation from the base of said coke oven,
   - focusing said first reflective surface on said third reflective surface so that the radiant energy emitted by said wall at said third preselected elevation onto said third reflective surface is reflected onto said first reflective surface,
   - focusing a radiation pyrometer positioned externally of said coke oven on said first reflective surface, and
   - determining the temperature of said coke oven at said third preselected elevation from the radiant energy

emitted by said coke oven wall at said third preselected elevation and reflected by said reflective surfaces to said radiation pyrometer.

4. A method for measuring the temperature of a coke oven wall as set forth in claim 1 which includes,

controlling the position of said reflective surface within said ram head to selectively reflect the radiant energy from the coke oven walls on opposite sides of said ram head.

5. A method for measuring the temperature of a coke oven wall as set forth in claim 3 which includes,

controlling the position of said first, second and third reflective surfaces to selectively reflect the radiant energy from said coke oven wall on opposite sides of said ram head at said first, second and third preselected elevations from the base of said coke oven.

6. A method for measuring the temperature of a coke oven wall as set forth in claim 1 which includes,

conveying a stream of gas across said reflective surfaces to cool said reflective surfaces and to maintain said reflective surfaces substantially free of particulate material.

7. A method for measuring the temperature of a coke oven wall as set forth in claim 1 which includes,

reflecting the radiant energy emitted by said coke oven wall adjacent said ram head through an unobstructed passageway in the horizontal arm member of said pusher ram to the sensing head of a radiation pyrometer positioned externally of said coke oven in said pusher ram horizontal arm.

8. Apparatus for measuring the temperature of coke oven walls comprising,

a pusher ram having a ram head and an arm member secured to said ram head and extending horizontally therefrom,

said pusher ram head having a front vertical wall and a pair of spaced sidewalls, at least one of said side walls having an opening therein,

said arm member having a longitudinal unobstructed passageway therein,

reflective means positioned within said ram head with a reflective surface focused on said opening in said ram head sidewall and operable to reflect the radiant energy emitted by a coke oven wall adjacent to said opening along said unobstructed passageway in said arm member, and

a radiation pyrometer positioned in said unobstructed passageway of said arm member at a location remote from said ram head and focused on said reflective means so that the radiant energy entering through said opening in said ram head sidewall is reflected by said reflective surface into said radiation pyrometer.

9. Apparatus for measuring the temperature of a coke oven wall as set forth in claim 8 in which said reflective means includes,

a first mirror having a first reflective surface positioned in said ram head opposite said unobstructed passageway in said arm member, said first reflective surface being operable to reflect radiant energy along said passageway to said radiation pyrometer,

a second miror having a second reflective surface positioned in said ram head in spaced vertical relation to said first mirror, said second mirror operable to reflect radiant energy entering through said opening in said ram head sidewall onto said first reflective surface.

10. Apparatus for measuring the temperature of a coke oven wall as set forth in claim 9 in which,

both of said ram head sidewalls have openings opposite said first mirror and said second mirror, and

means to adjust the position of said mirrors within said ram head to thereby selectively reflect the radiant energy from either of the coke oven sidewalls into said radiation pyrometer.

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