FIG. 15
This invention relates to the cleaning of self-sealing coke oven doors and particularly to a door cleaner head utilized in apparatus for cleaning the sealing surfaces of coke oven doors.

BACKGROUND OF THE INVENTION

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. Thus, due to the formation of deposits of a pitchy, carbonsaceous nature along the sealing strip surface and area adjacent thereto during the coking operation, it is necessary to periodically clean these surfaces, preferably after each coking operation.

Coke oven door cleaning has in the past generally 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 jams. Further, such cleaning results in uneconomically long shut-down of the coke ovens between charges 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, such as the use of mechanical scrapers, rotary steel bristle brushes and burners. Such apparatus have not proved satisfactory due to wear characteristics on the sealing surfaces and their inability to meet self-cleaning requirements. Also separate complex, cumbersome mechanisms have been employed for scraping the horizontal, vertical and arcuately shaped corner sealing surfaces, respectively, of a door, such mechanisms being of high costs and requiring time consuming maintenance.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an apparatus for cleaning the sealing surfaces of self-sealing coke oven doors cheaply, quickly and efficiently wherein a novel door cleaner head is utilized.

BROADLY, the door cleaner head utilized in the apparatus of the present invention includes a frame having endless tracks located in the front and rear portions thereof for permitting a scraper means to travel thereabout in a continuous endless path to scrape the undesired deposits formed on the coke oven door. Means are further provided for orienting the cleaner head with the door to be cleaned along with means for removing debris from said front and rear tracks.

Specifically, in apparatus, for scraping undesired substances formed on a coke oven door during a coking operation, the door cleaner head includes a frame and endless tracks located in the front and rear portions of the frame, said tracks being of substantially rectangular configuration and lined with a wear resistant material. Means are provided for orienting the frame with respect to the door to be cleaned and includes top and bottom alignment assemblies for engaging preselected top and bottom receiving portions of the door. A latching mechanism, cooperatively associated with the frame, is then actuated in order to grasp and maintain the frame securely with the door in the oriented position. After latching, a scraper mechanism is actuated to move in a continuous patch over the endless tracks, said mechanism including a first pair of rollers for travel over the endless tracks and a second pair of rollers for travel over opposing sides of a guide rail extending about the frame to permit the scraper mechanism to travel smoothly and freely of any side pressures. The scraper mechanism also includes a scraper blade, means for permitting reciprocating linear movement of the blade across its scraping of irregular deposits of the undesired substances and its travel about the corner portions of the door, and means for permitting reciprocating arcuate movement of the blade upon its scraping of uneven deposits of the undesired substances from the door.

The scraper mechanism is movable by a scraper moving means which includes shafts extending between the front and rear portions of the frame near the corner portions thereof, sprockets connected near each end of the shafts, and endless chains provided about the sprockets located on the shaft ends near the front and end portions of the frame, each of said endless chains being connected to the scraper means. Additionally, bushing means are cooperatively associated with each sprocket and shaft end for adjustably moving its respective sprocket and shaft to and away from the corner portions of the frame for maintaining the chains under a desired tension to insure proper orientation of the scraper blade with the door and to prevent any slippage or breakage of the chains. Finally, track scraping means are provided with the scraper moving means for removing debris from the track to insure a free path of travel thereover by the scraper mechanism.

BRIEF DESCRIPTION OF THE DRAWING

Other objects and a fuller understanding of the invention may be had by referring to the drawings in which:

FIG. 1 is a side view, with cut away portions, of the door cleaner in contact with a coke oven door;
FIG. 2 is a rear view of the door cleaner head taken along the line 2—2 of FIG. 1;
FIG. 3 is a front view of the door cleaner head taken along the line 3—3 of FIG. 1;
FIG. 4 is an enlarged side view of the bottom alignment arm assembly;
FIG. 5 is an enlarged plan view of the bottom alignment arm assembly depicted in FIG. 4;
FIG. 6 is an enlarged plan view of the top alignment arm assembly;
FIG. 7 is an enlarged side view of the top alignment arm assembly depicted in FIG. 6;
FIG. 8 is an enlarged side view of the upper section of the door cleaner;
FIG. 9 is a rear view of the carriage assembly for supporting the door cleaner head;
FIG. 10 is a plan view of the carriage assembly depicted in FIG. 9;
FIG. 11 is a cross-sectional view of the carriage assembly counter-balance arms taken along the line 11—11 of FIG. 1;
FIG. 12 is an enlarged cross-sectional view of the carriage assembly spring-loaded rod units;
FIG. 13 is a plan view of the door cleaner head latching mechanism;
FIG. 14 is an enlarged view of one of the arms of the latching mechanism depicted in FIG. 13;
FIG. 15 is a rear view of the latching mechanism depicted in FIG. 13;
FIG. 16 is a side view of the door cleaner head scraper carriage assembly;
FIG. 17 is a plan view of the door cleaner head scraper carriages depicted in FIG. 16;
FIG. 18 is an enlarged view of the wear strip track scraper;
FIG. 19 is an enlarged view of the shaft take-up bearing units taken along the line 20—20 of FIG. 19.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring more particularly to FIGS. 1, 2 and 3 of the drawing, numeral 10 refers to a conventional coke oven door of rectangular configuration with acute corners. It is to be noted that the apparatus to be described herein is located on the pusher side of the battery for cleaning oven doors thereat; however, it is apparent that such apparatus may also be located on the coke side of the battery for cleaning oven doors thereat. As depicted, the door has been removed from a coke oven by conventional retractor means (not shown) and pivoted to such a position that the inner surface 11 of the door is presented to the door cleaner head, generally referred to at 12. A flanged seal 13 is located about the periphery of the door upon which vapors have condensed to form a carbon-tar substance which is to be removed by the door cleaner. The door is provided at the bottom end with an inverted U-shaped member 14 and at the top end with a substantially triangularly-shaped member 15 having a flat apex 15a, said members being cooperatively used for alignment of the door cleaner with the door, as described herein.

The door cleaner head 12 includes a vertically extending front bar frame 20 and a rear bar frame 21, each of said bar frames being of Z-shaped cross section as seen in FIG. 12. The bar frames are connected to each other by a plurality of outer braces 22—22 located thereabout. A guide rail 23 (FIG. 1) is positioned approximately midway between frames 20, 21 and is attached thereto by bolt members 24—24, said guide rail being of substantially rectangular configuration with acute corners and of the same contour as the door to be cleaned. As seen in FIGS. 2, 3 and 17, the front and rear bar frames are positioned with respect to each other so as to form a front rectangularly-shaped track 24 and a rear rectangularly-shaped track 26, in parallel relationship, around which a pair of scraper carriages, generally referred to at 30—30, are transported. The tracks 25, 26 are in parallel relationship with the guide rail 23 and surface of the door to be cleaned when the door cleaner is oriented with the door. The tracks are lined with wear resistant strips 31—31, such as cold rolled steel SAE 1018 which may be easily replaced when worn.

At the bottom of the door cleaner, as seen in FIGS. 1, 4 and 5, there is provided an alignment arm 35 which is connected to a base member 36 pivotally mounted on shaft 37 extending between front bar frame 20 and rear bar frame 28 is provided with a tapered front end 38 so that it may be easily inserted through the slot of the U-shaped member 14 to align the bottom of the door cleaner with the door. A stop 39 also is provided on arm 35 for limiting the forward movement of the door cleaner with respect to the door. Base member 36 is provided with a leaf spring 41 which, in cooperation with pivotal shaft 37, permits arcuate movement of the arm in a substantially vertical direction for enabling the door cleaner to engage and become oriented with doors that may vary slightly in length due to constructional variation.

The top end of the door cleaner, as seen in FIGS. 1, 6 and 7, is provided with an alignment assembly 42 for vertically and horizontally aligning the top of the door cleaner with respect to the door. The top alignment arm assembly 42 includes a pair of supporting arms 43—43 affixed to the top of the door cleaner assembly, and a pivot about which a skewed type roller 44 rotates. As the door cleaner is moved forward in contact with the door, the arcuate surface 45 of roller 44 moves along line 45a of the triangularly-shaped member 15 for providing the necessary vertical alignment therewith, while the laterally extendinginclined surfaces 46—46 of the roller ride along the lateral surfaces of member 15, thereby imparting any necessary horizontal movement of the door cleaner with the door for horizontal alignment therewith.

As seen in FIGS. 1, 8, 9 and 10, the door cleaner is fully supported by a carriage assembly, generally referred to at 50, which includes a main frame 51 having a pair of parallel disposed counter-balance arms 52—52 pivotally connected by pins 53—53 near the top end 51a of the frame, and a pair of bell-crank members 54—54 pivotally connected at 55—55 near the bottom end of the frame. The front ends of the counter-balance arms 52—52 are pivotally connected to extending members 56—56 of the door cleaner by pins 57—57, and the other ends of the arms are pivotally connected by pins 58—58 to links 59—59 which are attached to vertically extending rods 60—60. Each of the pivotal pin connections 53—53, 57—57 and 58—58 of arms 52—52, as seen in FIG. 10, are of the swivel ball joint type having respective self-aligning bearings 53a—53a, 57a—57a and 58a—58a, which are seated in respective retainer rings 53b—53b, 57b—57b and 58b—58b and envelop the pins for causing movement of the arms 52—52 in any direction and, in turn, enabling the door cleaner head to become aligned with the door upon its movement into contact therewith as later described.

The rods 60—60 are cooperatively associated with respective spring-loaded rod units 61—61, seen in detail in FIG. 11, and extend therethrough to supporting elements 65—62 extending from frame 51. Rods 60—60 are provided with sleeves 63—63 having nuts 64—64 located on either side thereof for adjusting the vertical position of the carriage assembly.

The bell-crank members 54—54 are pivotally connected by pins 65—65 to turnbuckles 66—66 which are attached to a lower projecting frame member 67. The other ends of the bell-cranks are pivotally connected to a common horizontally extending shaft 68 which is keyed to a vertically projecting arm 70 leading into a spring-loaded unit 71 for imparting the desired force on the bell-cranks. It can be seen that adjustment of the turnbuckles will cause relative horizontal movement of carriage assembly 50 and the door cleaner head, the cleaner head being in a preferred adjusted position when it is located at an incline with respect to the door prior to engagement therewith. During movement of the cleaner head towards the door,
as later described, the bottom end of the cleaner head makes initial contact with the bottom end of the door. Upon continued movement of the cleaner head the top assembly engages the top end of the door and, through the pivotal action of bell-crank members 54—54 together with movement of counter-balance arms 52—52, the door cleaner head is held in plumb position with respect to the door.

As seen in FIGS. 1 and 8, the top portion 51a of frame 51 is provided with a pair of parallel spaced front rollers 76—76 and rear rollers 77—77 for travel over a pair of parallel disposed racks 78—78 located in overhead bays. The carriage is moved along tracks 76—78 towards the door whereupon the bottom alignment arm 35 passes through the slot of inverted U-shaped member 14 and the top alignment arm roller 44 then engages top door member 15, thereby causing the door cleaner head to become vertically and horizontally aligned with the door as previously described. The door cleaner head is in full contact with the door, limit switch 83 striking member 84 to operate a suitable circuit (not shown) to actuate the scraper carriage 30—30. Thus, it can be seen that any variation in the length of the door, as well as any other horizontal or vertical movement resulting from engagement of the cleaner head with the door is compensated by the pivotal action of counterbalance arms 52—52 and bell-crank members 54—54 together with the action of spring-loaded units 61—61 and 71—71.

After a door cleaning operation, as later described, a circuit (not shown) is actuated causing the door cleaner head to move rearwardly until the cylinder rod is retracted. Limit switch 85 travels downwardly over member 86 thus causing a circuit to be actuated for operating the door retractor apparatus to return the door to the coke oven. During the return movement of the carriage, tapered ends 67—67 of counterbalance arms 52—52 pass into and through frustrational slots 89—89 to adjustably locate the arms in a centrally aligned position ready for the next forward movement of the door cleaner head.

As seen in FIGS. 13, 14 and 15, a latching mechanism is provided for securely holding the door cleaner head with the door engaged. The door cleaner head and the outer framework are movably and mutually engaged during operation of the scraper carriages 30—30. The latching mechanism includes a pair of latching links 90—90 located within fixed arms 91—91 which extend along the opposing lateral surfaces of the door cleaner head. One end of the links is connected by pins 92—92 to first angular portions of substantially triangularly shaped cranks 93—93 which have stationary pins 94—94 located at second angular portions thereof and connected to arms 91—91 for providing pivotal movement therefor. The third angular portions of cranks 93—93 are connected to the ends of links 95—95 by pins 96—96, the other ends of the links being connected to locking fingers 97—97 by pins 98—98. Locking fingers 97—97 are pivotally connected to arms 91—91 by pins 99—99 and are provided with substantially L-shaped locking surfaces 97a—97a for securely grasping the opposite surface 13a of flange 13.

The other ends of links 90—90 are connected by pins 101—101 to portions of angular parts 102—102 which are pivotally connected by stationary pins 103—103 located at second angular portions thereof to end members 104—104. Pins 105—105 are located at third angular portions of cranks 102—102 and connected to one end of turnbuckles 106—106 which are extended along the upper section of the door cleaner head. The other ends of the turnbuckles are connected by pins 107—107 to one end of a rotatable crank-shaft 108 which extends vertically downwards, the other end of the crank-shaft being connected to a handle 109 which extends laterally therefrom. The crank-shaft is secured to the frame by locking members 110—110.

The latching mechanism, as seen in FIGS. 13 and 14, is shown in the locking position. In order to unlock the locking fingers 97—97 from the door flange, handle 109 is manually moved to the opposite side thus causing the crank-shaft 108 to rotate clockwise. In turn, as illustrated by the arrows in FIG. 12, turnbuckles 106—106 are actuated causing pivotal movement of cranks 102—102 about fixed pivot pins 103—103 to retract links 90—90 which, in turn, cause pivotal action of links 90—90 about fixed pins 94—94 to result in a pivotal motion of fingers 97—97 about fixed pins 99—99 so as to reengage and retract finger surfaces 97a—97a from door flange surface 13a. While the aforementioned latching mechanism has been described as being operable by manual means, it is readily apparent that it may be operable by automatic means, for example, the crank-shaft may be connected to a drive mechanism which operates in response to the actuation of a circuit via closing limit switch 83.

The scraper carriages 30—30 are equally spaced from each other and are of similar structure, thus, the description of one carriage applies also to the other. As seen in detail in FIGS. 16 and 17, the carriage includes a shaft 115 provided with a front rotatable end roller 116 and a rear rotatable end roller 117 for travel along tracks 25, 26 respectively. A second shaft 118, disposed in parallel relationship beneath shaft 115, also is provided with a front rotatable roller 119 and a rear rotatable roller 120 for travel along tracks 25 and 26, shafts 115 and 118 being connected to each other by a housing 121. A third shaft 122 also is connected to housing 121 and is provided with a connecting member 124 thereon near the front end of the carriage which, in turn, is connected to an endless double chain 125. Similarly a connecting member 126 is located on shaft 122 near the other end thereof towards the back end of the scraper carriage and, in turn, is connected to an endless single chain 127. Chains 125 and 127 are connected to a drive mechanism, described hereinafter, for transporting the carriage. A pair of rotatable cam followers 128—128 are connected to shafts 129—129 which extend in parallel relationship through the carriage housing 121, the cam followers being movable along opposing sides of guide rail 23 for maintaining the chain straight and protected from side pressure for the description of the scraper carriage. A scraper head, generally referred to at 130, is connected to shafts 115 and 118 near the front ends thereof, said head including a rear section 131 and a front section 132. A spring loaded swivel element 133 is connected to front section 132 and has mounted thereon a scraper blade 134 for scrapping the deposits from the surface of the door flange 13. The front section 132 of the scraper head 130 is provided with springs 135—135 for resiliently urging swivel element 133 outwardly, said element being capable of imparting arcurate movement to the blade thus enabling the latter to scrape uneven deposits along the door flange. Scaper head 130 is movable along pins 136—136 projecting from rear section 131; thus, when blade 134 contacts an irregular deposit along the flange seal or passes about the arcurately shaped corners of the door, sufficient back-up movement is imparted to the blade as a result of front section 132 scraping along pins 136 while springs 135—135 provide the necessary pressure on the blade. As the blade travels on a relatively smoother, less dense surface along the flange, front section 132 extends forward therefor.
3,611,466

The scrapers, as seen in Fig. 18, are provided with connectors 142-142 which are attached at one end to a common shaft 143 extending between the front and rear tracks 25, 26 and at the other end to respective chains 125, 127 by fastening members 144—144. A pair of blade holders 145—145 are attached to the shaft and extend in parallel relationship therewith, the leading ends 146—146 tapering outwardly towards the track wear strips 31—31. Scraper blades 147—147 are adjustably mounted on the leading edges by fasteners 148—148 to cause the blades to have contact with the track wear strips. A spring 149 is connected between holders 145—145 to normally urge the blades outwardly against the track wear strips. During travel of scrapers 140—140, debris is scraped and removed from the wear strip during its travel along the bottom 31c, vertically upward 31b and top 31c sections of the wear strips, the collected debris falling by gravity during travel of the scrapers along the vertically downwardly section 31f of the wear strips.

A pair of horizontally disposed, parallel spaced, rotatable shafts 150, 151 (Figs. 1, 2 and 3) extend through respective upper corner portions of the door cleaner and a pair of horizontally disposed parallel spaced rotatable shafts 152, 153 extend through respective lower corner portions of the cleaner. As seen in Fig. 1, the ends of each of the shafts have dual-type sprockets 154—154 keyed thereto for imparting movement to double chain 125, and single type sprockets 155—155 keyed at the back ends of the shafts for imparting movement to single chain 127. A suitable motor 156 (Figs. 1 and 2) through a suitable gear reducer (not shown) drives a chain 157, about a sprocket 159, which is connected to shaft 150, the rotation of the latter causing rotation of sprockets 154—154 and, in turn, movement of the chains 125, 127, to transport the scraper carriages 30—30 and scraper blades 134—134 continuously about the periphery of the door surfaces and flange strip seal to scrape the carbon-tar deposits therefrom.

As seen in Figs. 3, 2, 3, 19 and 20, the end portions of each shaft 150, 151, 152 and 153 are housed in similar take-up bearing units 160—160. Each bearing unit includes a bushing 161 for supporting its respective shaft end, said bushing being movable within supporting guides 162—162. A set screw 163 is threadedly connected through a fixed member 164, one end of said screw being secured to the bushing head 161 for adjustable movement of the shaft towards and away from the corner of the cleaner head and, in turn, chain sprocket for maintaining the chain under the desired tension. A locking nut 165 is provided at the other end of the set screw for securing the latter against member 164 in order to hold the shaft in the desired adjusted position. It can be seen, therefore, that with the adjustable bearing units, an even distributive force may be applied against each of the chains 125—127 in a direction towards or from the door cleaner corners for maintaining the chains under the desired tension, thereby not only insuring proper orientation of the cutter blade with the door but also preventing any slippage or breakage of the chains.

In operation, after a door is removed from the coke oven, the door cleaner head is transported towards the door whereupon the bottom alignment arm 35 and top alignment roller 44 engage and travel over their respective door aligning members 14 and 15 to align the door cleaner head with the door. Coupled with the front and rear alignment of the cleaner head, and with movement of the cleaner head in any direction in response to all the aforementioned alignment mechanisms, the latching links 90—90 are actuated to cause finger surfaces 97a—97a of fingers 97—97 to grasp and hold the door in the aligned position. Next, motor 156 is energized to drive the endless chains 125—127 and, in turn, transport scraper carriages 30—30 about the door flange seal and adjacent inner surface area of the door. Scraper blades 134—134 quickly scrape clean the carbon-tar deposits from the door; typically, the door may be scraped clean within 1—2 minutes. The door cleaner thus described may be located at the end of a coke battery or mounted on a movable control apparatus having associated therewith a door extracting machine, a pusher machine including a door extracting mechanism or any combination of said machines.

We claim:

1. In apparatus for scraping undesired substances formed on a coke oven door during a coking operation, a door cleaner head which comprises:

a. an endless track located in the front portion of the frame;

b. an endless track located in the rear portion of the frame, said tracks being of substantially rectangular configuration,

c. means for orienting said frame with respect to the door to be cleaned, said means including:

d. top and bottom alignment assemblies for engaging respective preselected top and bottom receiving members located on the door, said assemblies including a grooved type roller located near the top end of the frame and having inclined lateral walls extending from the roller for movement over a complementary projecting receiving member on the door, and a spring loaded arm pivotally connected near the bottom end of the frame which includes a tapered end portion for insertion into a slotted complementary receiving member on the door, and a stop element therein for limiting the forward movement of the cleaner head with respect to the door, scraper means cooperatively associated with the cleaner head, and

e. means for moving said scraper means in an endless path for scraping undesired substances formed on the coke oven door.

2. In apparatus, according to claim 1, which further includes:

a. a latching mechanism cooperatively associated with the frame for grasping and maintaining the frame securely with the door in the oriented position.

3. In apparatus, according to claim 1, wherein the tracks are lined with a wear resistant material.

4. In apparatus, according to claim 1, which further includes:

a. the scraper means having a first pair of rollers for travel over the endless track,

b. a guide rail extending about the frame and being of the same contour as the endless tracks, and

c. a second pair of rollers connected to the scraper means for travel over opposing sides of said guide rail to permit the scraper means to travel smoothly and free of any side pressures.

5. In apparatus, according to claim 1, wherein the scraper moving means includes:

a. shafts extending between the front and rear portions of the frame near the corner portions thereof,

b. sprocket means connected near each end of the shafts, an endless chain provided about the sprockets located on the shaft ends near the front portion of the frame,

c. an endless chain provided about the sprockets located on the shaft ends near the rear portion of the frame, each of said endless chains being connected to the scraper means, and

d. drive means for moving the chains about their respective sprockets for transporting the scraper means over the endless tracks.

6. In apparatus, according to claim 5, which further includes:

a. bushing means cooperatively associated with each sprocket and shaft end for adjustable movement of its respective sprocket and shaft towards and away from the corner portions of the frame for maintaining the chains under a desired tension to insure proper ori-
entation of the scraper blade with the door and to prevent any slippage or breakage of the chains.

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