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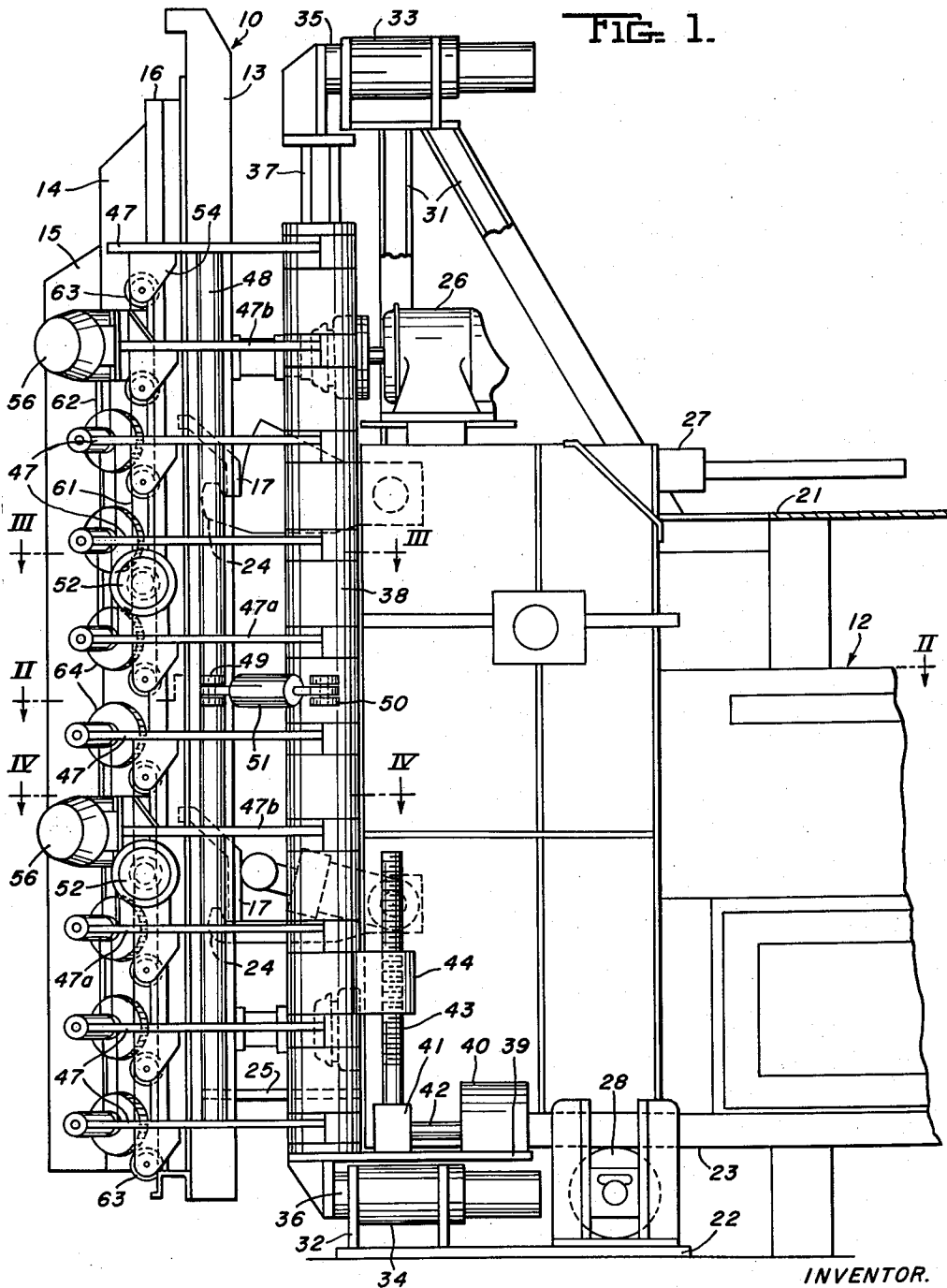
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3,115,655

APPARATUS FOR CLEANING COKE OVEN DOORS

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2 Sheets-Sheet 1



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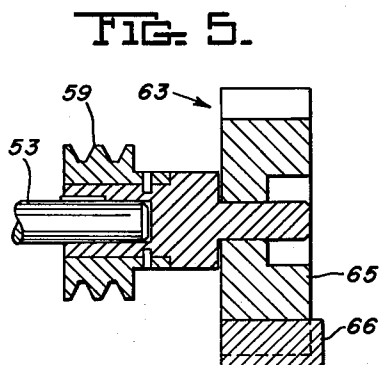
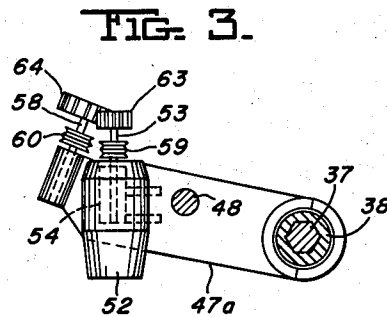
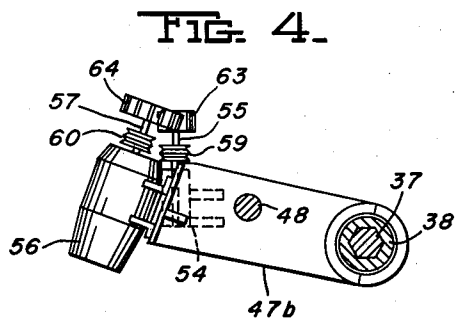
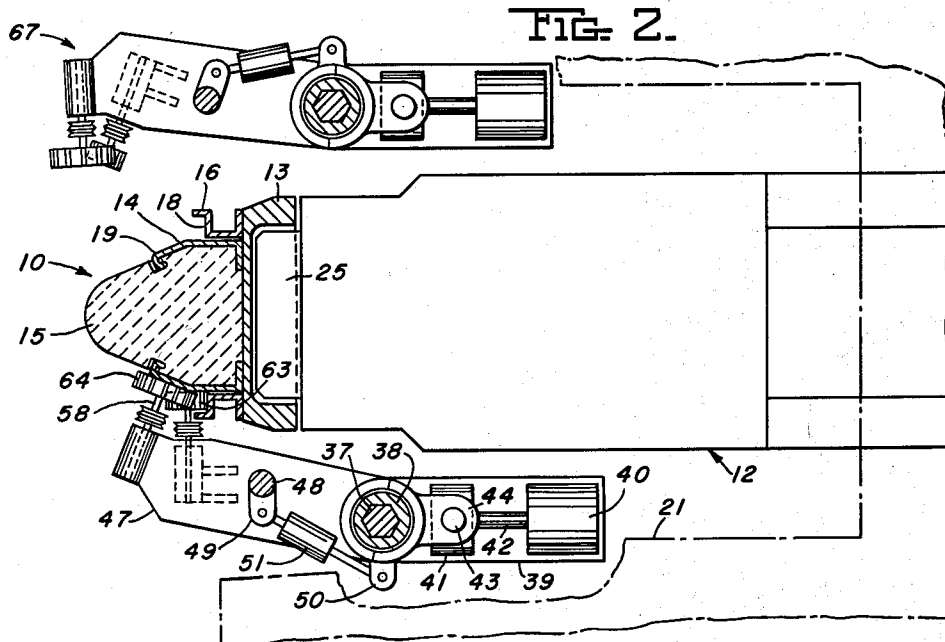
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APPARATUS FOR CLEANING COKE OVEN DOORS

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2 Sheets-Sheet 2



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3,115,655 APPARATUS FOR CLEANING COKE OVEN DOORS

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12 Claims. (Cl. 15—93)

This invention relates to an improved apparatus for cleaning the sealing surfaces at the edges of self-sealing coke oven doors.

A conventional coke oven battery includes a series of ovens which have removable doors on opposite sides. A pusher machine runs along a track at one side and a door machine along a track at the other side. Both the pusher machine and door machine carry mechanically operated door extractors for removing and replacing the doors on the respective sides. When a charge of finished coke is to be taken from an oven, the extractors remove the doors from the oven at both sides of the battery. The pusher machine has a ram which is inserted through the opening on the "pusher" side to push the coke out the opening on the "coke" side. One problem with self-sealing doors currently in use is that the sealing surfaces at the edges of the door must be cleaned of tarry deposits each time a door is removed. Extractors which handle older luted-type doors have been equipped with scrapers for cleaning off the luting material while the door is removed (for example as shown in McIntosh Patent No. 1,759,014), but such scrapers cannot reach the more intricate surfaces of a self-sealing door. It is also known to provide mechanical scrapers to which a self-sealing door can be carried for cleaning some of its sealing surfaces (for example as shown in Randell et al. Patent No. 3,056,699), but the operation is likely to be unduly time-consuming. If more than five or six minutes are required to clean a door, the whole coke-pushing schedule is disrupted.

An object of the present invention is to provide an improved cleaning apparatus which is mounted directly on a door extractor for removing tarry deposits from sealing surfaces of self-sealing doors rapidly and effectively while the extractor supports the door.

A further object is to provide an improved cleaning apparatus which removes such deposits while the extractor and door remain at their usual location, thus saving time by avoiding the need to transport the door to a more remote cleaning station.

A more specific object is to provide an improved cleaning apparatus which includes a frame pivotally mounted on a door extractor to swing on a vertical axis around the side edge of a self-sealing door, and vertically movable cleaning elements mounted on this frame to engage the sealing surfaces of the door.

In accomplishing these and other objects of the invention, I have provided improved details of structure, a preferred form of which is shown in the accompanying drawings, in which:

FIGURE 1 is a side elevational view of a self-sealing coke oven door and a portion of a door extractor equipped with my improved cleaning apparatus;

FIGURE 2 is a horizontal section on line II—II of FIGURE 1 but showing the cleaning apparatus at opposite sides of the extractor in different positions.

FIGURE 3 is a horizontal section on line III—III of FIGURE 1;

FIGURE 4 is a horizontal section on line IV—IV of FIGURE 1; and

FIGURE 5 is a vertical sectional view on a larger scale of one form of cleaning element I can use in the apparatus.

The drawings show a conventional self-sealing coke oven door 10 and door extractor 12. The door includes a metal casting 13, a retainer 14 fixed to the inside of the casting, a refractory plug 15, a metal sealing ring 16 surrounding the retainer, and lugs 17 on the outer face of the frame. As FIGURE 2 shows, the sealing ring and retainer form a channel 18 which faces inwardly and extends around the perimeter of the plug. Inwardly of this channel the door has tapered faces 19 formed partly on the retainer 14 and partly on the plug 15. Both the channel 18 and faces 19 require cleaning each time the door is removed from the oven. The extractor includes upper and lower decks 21 and 22 fixed to a pusher machine or door machine (not shown) for travel alongside the "pusher" or "coke" side of a coke oven battery, a carriage 23 movable in and out relative to the decks, and door hooks 24 mounted on the front of the carriage in positions to engage lugs 17. Preferably the front of the carriage has a guide 25 welded thereto or other appropriate means to hold the door in position for cleaning. The guide 25 is received within the dished outer face of the door casting 13 and thus prevents sideways play of the door. The extractor also includes conventional parts, such as a torque motor 26 for operating the door lock, a guide 27 for the carriage, and a front roller 28 on which the carriage rides, as well as others not shown. Since my invention does not involve these parts, I have not shown nor described them in further detail.

My cleaning apparatus includes a supporting truss 31 fixed to the upper deck 21, a support 32 fixed to the lower deck 22, upper and lower double-acting fluid pressure cylinders 33 and 34 fixed to the truss and support respectively, reciprocable pistons 35 and 36 mounted in the respective cylinders, and a vertical rod 37 rigidly joined at its ends to the two pistons. Thus I can operate the two cylinders to move pistons 35 and 36 and rod 37 translationally in a horizontal path parallel with the direction of movement of carriage 23. Rod 37 extends substantially the full height of the door, and is of non-circular cross section, for example hexagonal. A sleeve 38 of somewhat shorter height is mounted on the rod for vertical sliding movement, but constrained against rotation. A shelf 39 is fixed to the lower end of the rod and carries on its upper face a reversible drive motor and speed reducer 40 and a gear box 41. A horizontal drive shaft 42 extends from the speed reducer to the gear box, where it is geared to a vertical screw 43. Sleeve 38 carries a nut 44 which is threadably engaged with screw 43. Thus I can operate drive motor 40 to turn screw 43 in either direction to raise or lower sleeve 38.

A plurality of arms 47, 47a and 47b are pivoted to the exterior of sleeve 38. A vertical rod 48 rigidly connects all these arms, whereby the arms and rod form a frame which swings as a unit about the axis of the sleeve. Pivot ears 49 are fixed to rod 48, and other pivot ears 50 are fixed to sleeve 38. A double-acting fluid pressure cylinder and piston 51 is pivoted to ears 49 and 50. Thus I can operate cylinder 51 to swing the frame in either direction. I show two arms 47a, each of which carries a respective motor 52 on its upper face and a shaft 53 driven by the motor (FIGURE 3). With the exception of the two arms immediately above the respective motors 52, each arm 47, 47a and 47b has a respective bearing bracket 54 depending from its underside and an idler shaft 55 journaled in said bracket. I also show two arms 47b, each of which carries a respective motor 56 at its end and a shaft 57 driven by said motor (FIGURE 4). With the exception of the uppermost arm 47, each of the other arms 47 and 47a has a respective idler shaft 58 journaled in its end. Shafts 53 and 55 carry vertically aligned pulleys 59, while shafts 57 and 58 carry vertically aligned pulleys 60. A series

of belts 61 interconnect pulleys 59, and another series of belts 62 interconnect pulleys 60. Thus two motors 52 drive all the shafts 53 and 55, and two motors 56 drive all the shafts 57 and 58.

The ends of shafts 53 and 55 carry rotary cleaning elements 63, and the ends of shafts 57 and 58 carry rotary cleaning elements 64. I have illustrated both forms of cleaning elements as cutter heads, although it is apparent many equivalents are possible. The cleaning elements 63 are for the purpose of cleaning the channel 18 between the retainer 14 and the sealing ring 16. As FIGURE 5 shows, each cleaning element 63 includes a central body portion 65 and a series of blades 66 fixed around the circumference of its body portion. The blades project both from the circumference of the body portion to clean the bottom of the channel and from the outer face to clean the side of the channel. The cleaning elements 64 are for the purpose of cleaning the tapered face 19 of retainer 14 and plug 15. They can be of similar construction to the cleaning elements 63, except that they are of larger diameter and the blades project only from the outer face.

At the other side of the extractor 12 I mount a second cleaning apparatus 67 constructed as just described but of opposite hand, as FIGURE 2 shows. Before the extractor engages door 10, I fully project pistons 35 and 36 in cylinders 33 and 34 can retract the piston in cylinder 51 of my cleaning apparatus on both sides. Thus vertical rod 37, arms 47, 47a and 47b, and cleaning elements 63 and 64 are positioned at the limit of their travel toward the left, as viewed in FIGURE 2, and the arms are pivoted to the limit of their travel away from the door. FIGURE 2 shows the cleaning apparatus 67 in this position. I operate extractor 12 to pick up door 10 in the usual manner without interference from my cleaning apparatus. Next I project the pistons in cylinders 51 of the apparatus on both sides to pivot the arms in toward the door, and retract pistons 35 and 36 to move rod 37, sleeve 38 and the arms to the right. This movement brings the cleaning elements 63 into position in channels 18 on both sides, and the face of cleaning elements 64 into engagement with the tapered faces 19. Initially sleeve 38 is in its lowermost position with respect to rod 37. I operate all the motors 52 and 56 to drive the cleaning elements, and motors 40 of both apparatus to drive screws 43 in a direction first to raise the sleeves to their uppermost position on the rods and then to lower the sleeves. As the cleaning elements move upwardly, guide 25 acts as a hold-down for the door. Finally I return the parts to their starting positions, so that the extractor can replace the door.

My cleaning apparatus cleans the door while the extractor holds it in its usual position removed from the oven. The vertical travel of the cleaning elements is relatively short, commonly only six or seven inches in each direction. Thus the cleaning operation is performed expeditiously without interfering with the pushing schedule. Only the top and bottom sealing surfaces of the door need be cleaned manually. It is also apparent that my apparatus is readily adapted for automatic operation by the addition of an appropriate arrangement of limit switches and a control circuit constructed in accordance with well-known principles.

While I have shown and described only a single embodiment of my invention, it is apparent that modifications may arise. Therefore, I do not wish to be limited to the disclosure set forth but only by the scope of the appended claims.

I claim:

1. In an extractor which includes a deck and means movable with respect to said deck for picking up, supporting and replacing a coke oven door, the combination therewith of an apparatus for cleaning a sealing surface at the side of a self-sealing door, said apparatus comprising a frame pivotally supported on said deck to swing on

a vertical axis, at least one vertically movable cleaning element supported on said frame, means operatively connected with said frame for moving it between a first position in which said extractor can pick up or replace a door without interference from the apparatus and a second position in which said cleaning element engages the sealing surface, and means operatively connected with said frame for moving said cleaning element vertically along the sealing surface.

2. A combination as defined in claim 1 in which said cleaning element is of the rotating type, and said apparatus comprises drive means for rotating said cleaning element.

3. In an extractor which includes a deck and means movable with respect to said deck for picking up, supporting and replacing a coke oven door, the combination therewith of an apparatus for cleaning sealing surfaces at the side of a self-sealing door, which surfaces include an inwardly facing channel and a tapered face inwardly of the channel, said apparatus comprising a frame pivotally supported on said deck to swing on a vertical axis, at least one vertically movable cleaning element supported on said frame to be received in the channel, at least one vertically movable cleaning element supported on said frame to engage the tapered face, means operatively connected with said frame for moving it between a first position in which said extractor can pick up or replace a door without interference from the apparatus and a second position in which said cleaning elements engage the channel and tapered face respectively, and means operatively connected with said frame for moving said cleaning elements vertically along the channel and tapered face.

4. A combination as defined in claim 3 in which said cleaning elements are of the rotating type, and said apparatus comprises drive means mounted on said frame for rotating said cleaning elements.

5. In an extractor which includes a deck and means movable with respect to said deck for picking up, supporting and replacing a coke oven door, the combination therewith of an apparatus for cleaning sealing surfaces at the side of a self-sealing door, which surfaces include an inwardly facing channel and a tapered face inwardly of the channel, said apparatus comprising a frame pivotally supported on said deck to swing on a vertical axis, a plurality of spaced vertically movable cleaning elements supported on said frame to be received in the channel, a plurality of spaced vertically movable cleaning elements supported on said frame to engage the tapered face, means operatively connected with said frame for moving it between a first position in which said extractor can pick up or replace a door without interference from the apparatus and a second position in which said cleaning elements engage the channel and tapered face respectively, and means operatively connected with said frame for moving said cleaning elements vertically along the channel and tapered face.

6. A combination as defined in claim 5 in which said frame includes a plurality of vertically spaced arms each of which carries at least one cleaning element, and said cleaning elements are of the rotating type, and said apparatus comprises motors mounted on said arms and operatively connected with said cleaning elements for rotating them.

7. A combination as defined in claim 6 in which said cleaning elements include cutter heads, the cutter heads of said first-named cleaning elements having blades which project from both the circumference and one face to clean two faces of the channel, the cutter heads of said second-named cleaning elements having blades which project from one face to clean the tapered face.

8. In an extractor which includes a deck and means movable with respect to said deck for picking up, supporting and replacing a coke oven door, the combination therewith of an apparatus for cleaning sealing surfaces at the side of a self-sealing door, which surfaces include

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an inwardly facing channel and a tapered face inwardly of the channel, said apparatus comprising a frame, means mounted on said deck and supporting said frame for translational movement in a horizontal path parallel with the direction of movement of said first-named means and for pivotal movement on a vertical axis, a plurality of spaced vertically movable rotatable cleaning elements supported on said frame to be received in the channel, a plurality of spaced vertically movable rotatable cleaning elements supported on said frame to engage the tapered face, motors mounted on said frame and operatively connected with said cleaning elements for driving them, means operatively connected with said frame for moving it pivotally and translationally between a first position in which said extractor can pick up or replace a door without interference from the apparatus and a second position in which said cleaning elements engage the channel and tapered face respectively, and means operatively connected with said frame for moving said cleaning elements vertically along the channel and tapered face.

9. In an extractor which includes a deck and means movable with respect to said deck for picking up, supporting and replacing a coke oven door, the combination therewith of an apparatus for cleaning sealing surfaces at the side of a self-sealing door, which surfaces include an inwardly facing channel and a tapered face inwardly of the channel, said apparatus comprising an upper fluid pressure cylinder supported on said deck, a lower fluid pressure cylinder supported on the extractor beneath said upper cylinder, respective pistons in said cylinder movable in horizontal paths parallel with the direction of movement of said first named means, a vertical rod fixed to said pistons and movable therewith, a sleeve mounted on said rod for vertical sliding movement but constrained against rotation, a frame mounted on said sleeve for pivotal movement on a vertical axis, a plurality of spaced vertically movable rotatable cleaning elements supported on said frame to be received in the channel, a plurality of spaced vertically movable rotatable cleaning elements supported on said frame to engage the tapered face, mo-

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tors mounted on said frame and operatively connected with said cleaning elements for driving them, means operatively connected with said frame for moving it pivotally about said sleeve between a first position in which said extractor can pick up or replace a door without interference from the apparatus and a second position in which said cleaning elements are aligned with the channel and tapered face respectively and can be brought into engagement therewith by operation of said cylinders, and means operatively connected with said frame for moving said cleaning elements vertically.

10. A combination as defined in claim 9 in which said frame includes a plurality of vertically spaced arms each of which carries at least one cleaning element, said motors being mounted on selected arms, and belt and pulley means drivingly connecting the motors with the cleaning elements on other arms.

11. A combination as defined in claim 10 in which the means for moving said cleaning elements vertically includes a motor-driven screw supported on said rod, and a nut fixed to said sleeve and threadedly engaged by said screw, and in which the distance said frame moves vertically approximately equals the spacing between said arms.

12. A combination as defined in claim 9 including a second similar apparatus for cleaning the sealing surfaces at the other side of the door.

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