

[54] **COKE OVEN DOOR AND JAMB CLEANERS**

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[58] Field of Search 202/241, 269, 248; 201/2, 201/2.5; 15/93 A, 302; 134/144, 151, 172

[56] **References Cited**

UNITED STATES PATENTS

3,056,699	10/1962	Randell et al.	15/93 A
3,454,426	7/1969	Taylor	202/241
3,745,110	7/1973	Allred	201/2
2,136,113	11/1938	Loftus	201/2

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[57] **ABSTRACT**

Apparatus for cleaning sealing surfaces of a door assembly for a coke oven has a first header arranged for directing steam onto sealing surfaces at the bottom

end of either a door or doorjamb to be cleaned, and a second header arranged for directing steam onto sealing surfaces at the top end of the same door or doorjamb. A third header is mounted on a carriage movable between the first and second headers for directing steam onto sealing surfaces between the top and bottom ends. The cleaning apparatus has a main frame provided with spaced ends, between which extends a guide rail guidingly engaged by the carriage. When specifically intended to be used for cleaning a coke oven door, the first and second headers are pivotally mounted on the main frame; the travel of the third header on the carriage is used to swing the first and second headers in a plane passing between the ends of the main frame when the third header is adjacent the first or second header. Further, this same movement of the third header is used to intermittently actuate valves supplying steam to the first and second headers. When specifically intended to clean a coke oven doorjamb, the first and second headers are mounted on a pair of further carriages also arranged engaging the guide rail and connected to the chain sprocket arrangement. These first and second headers are arranged so that the third header, which is also pivotally mounted on its carriage, and the first and second headers will swing in a plane passing between the ends of the main frame at appropriate times in an operating cycle of the apparatus. Advantageously, the steam used by a cleaning apparatus according to the present invention is dry steam under a pressure of 250 psi.

4 Claims, 11 Drawing Figures

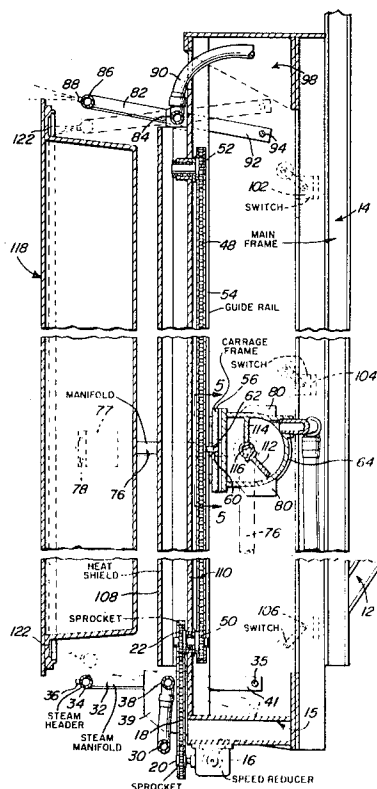


Fig. 1

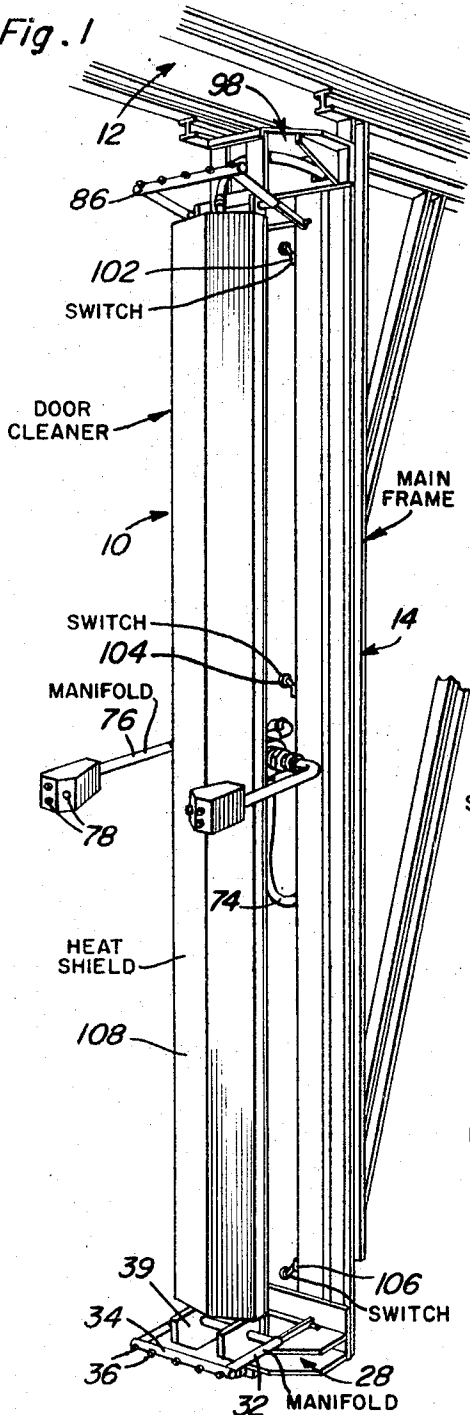


Fig. 5

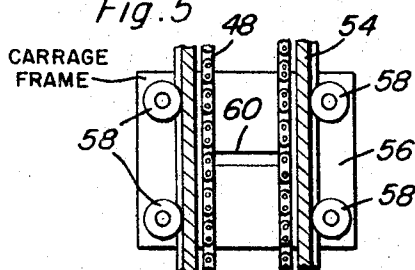


Fig. 6

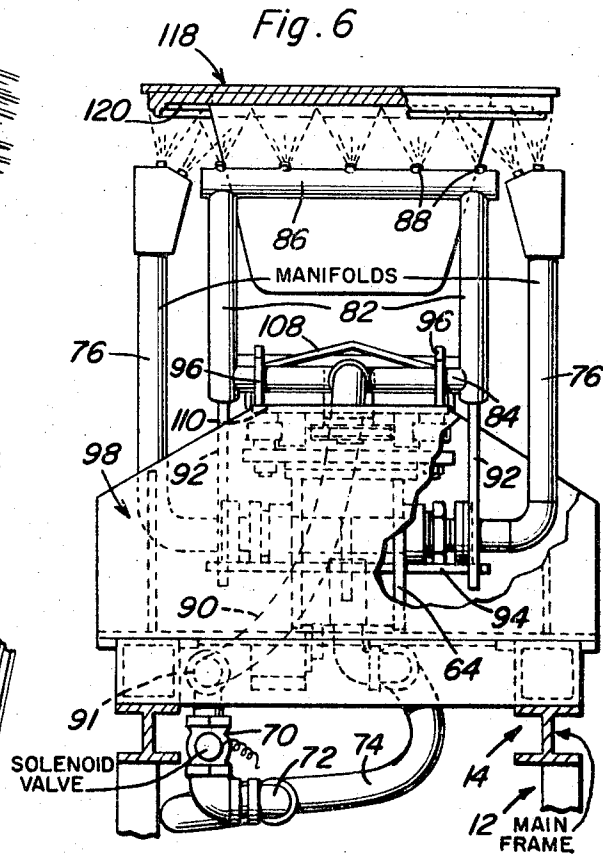
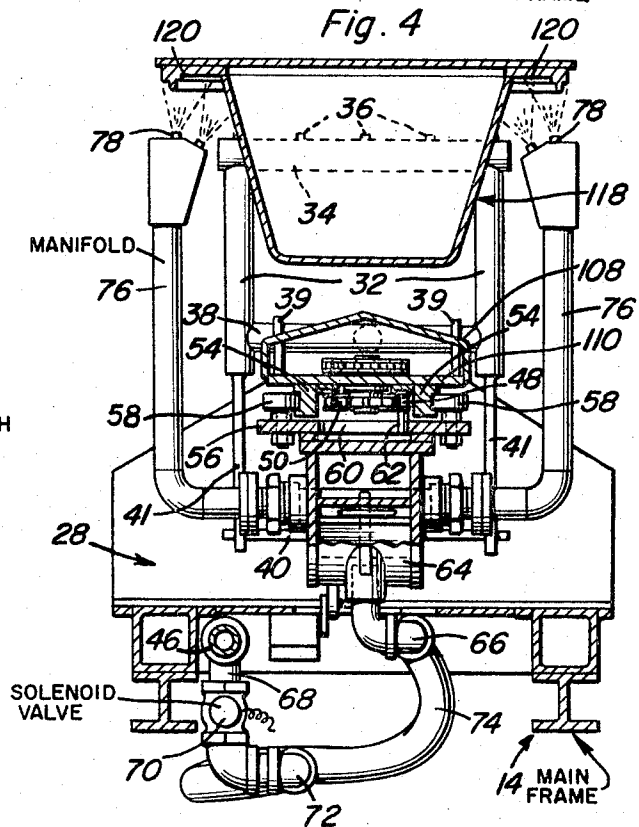
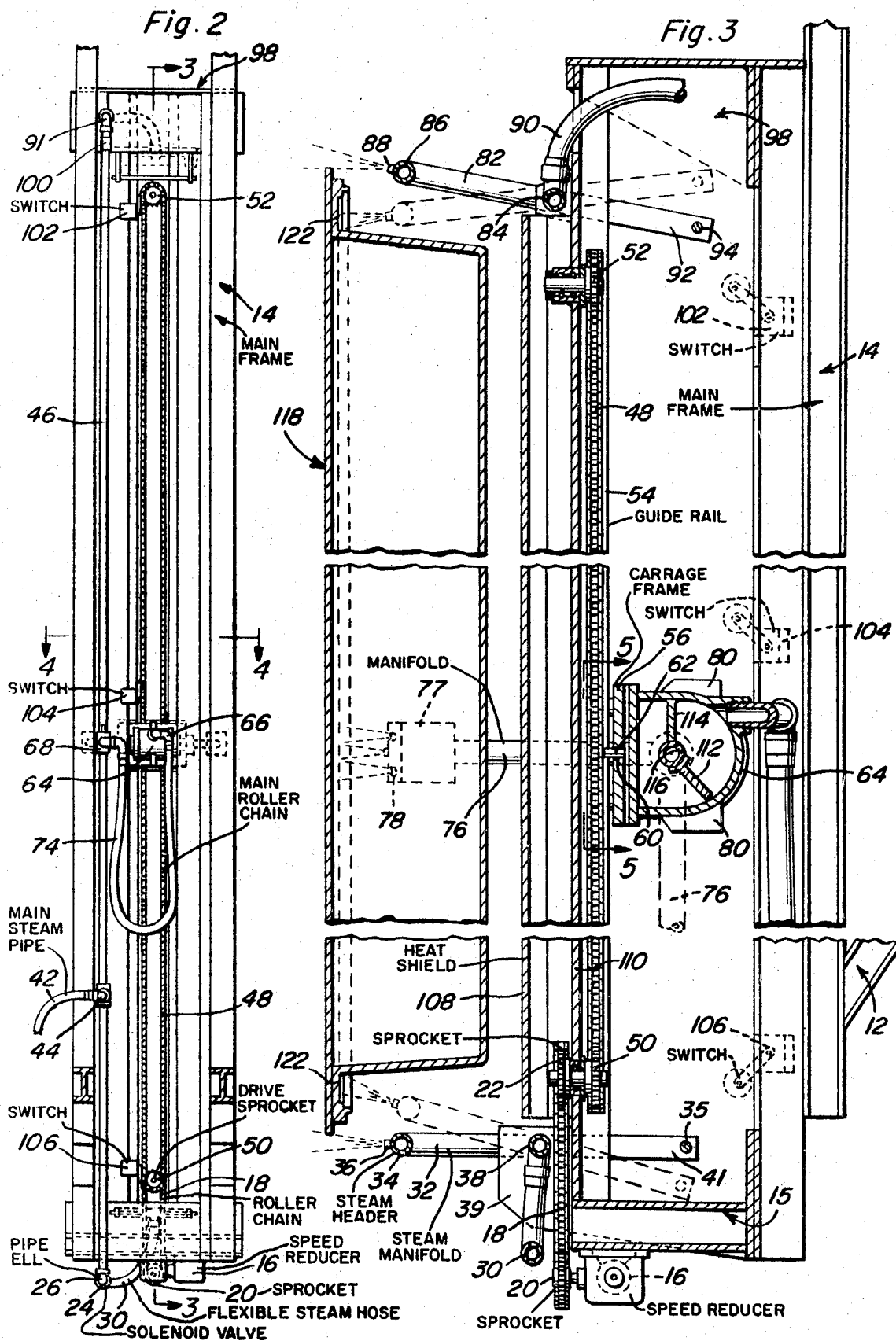
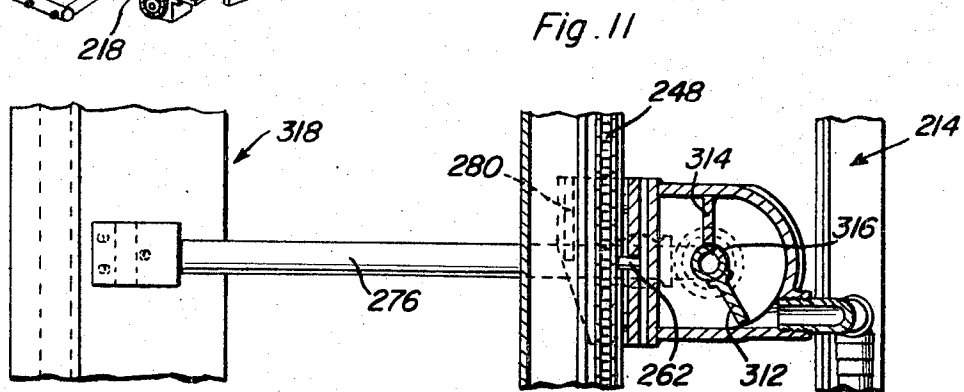
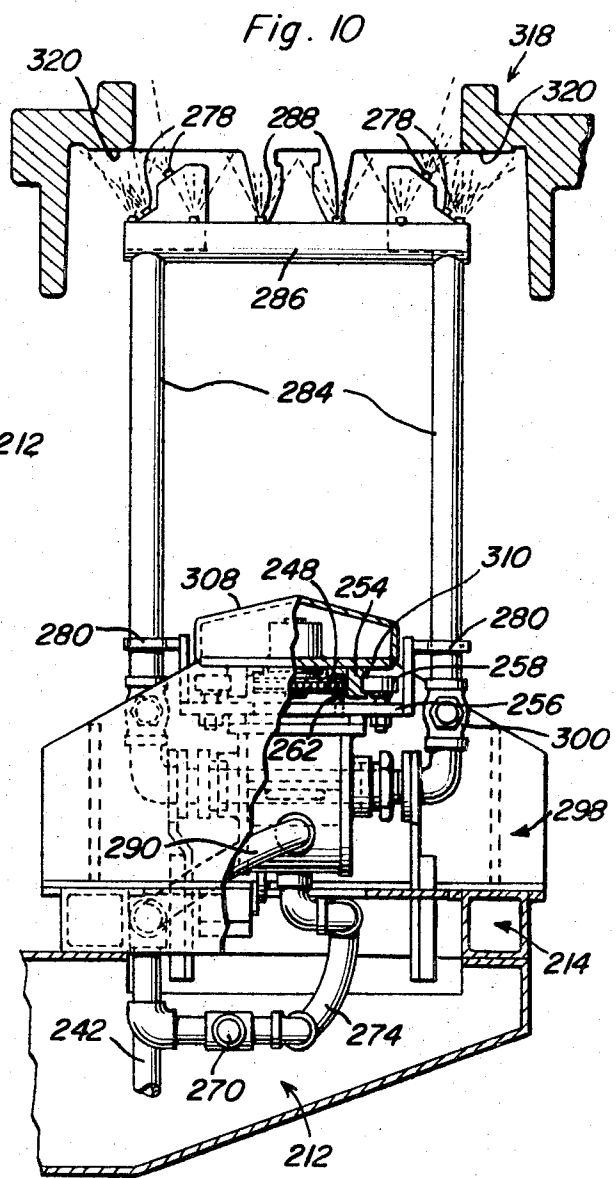
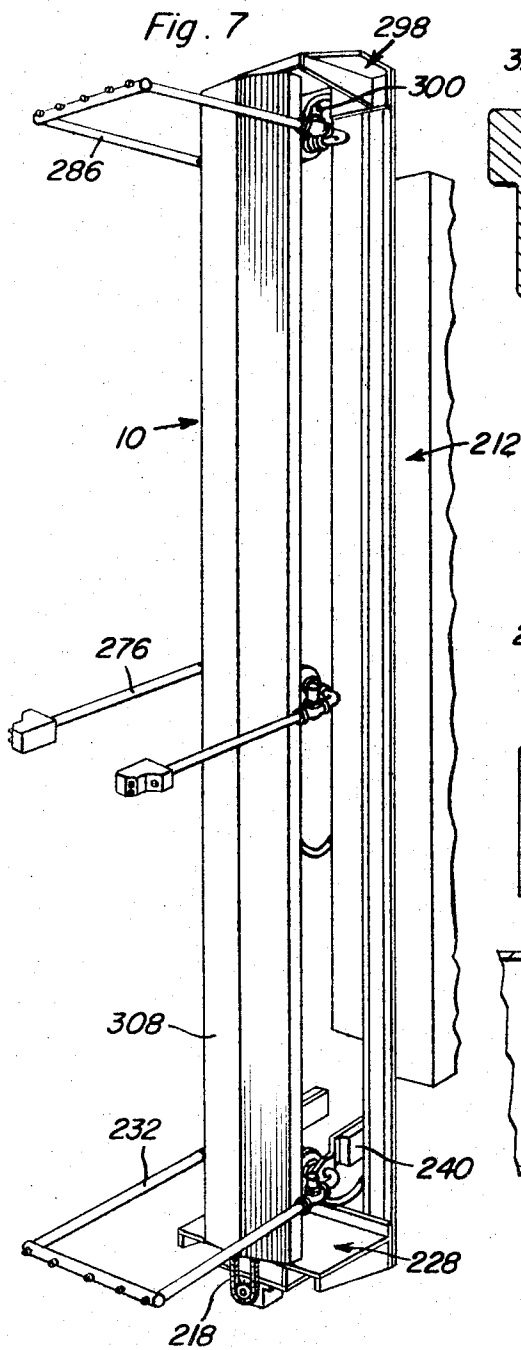
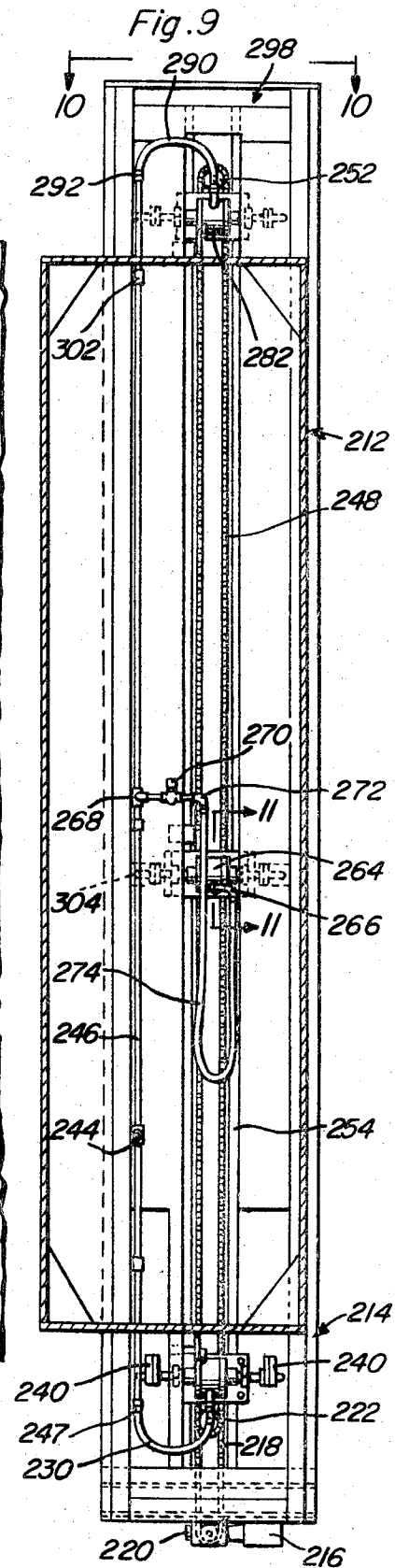
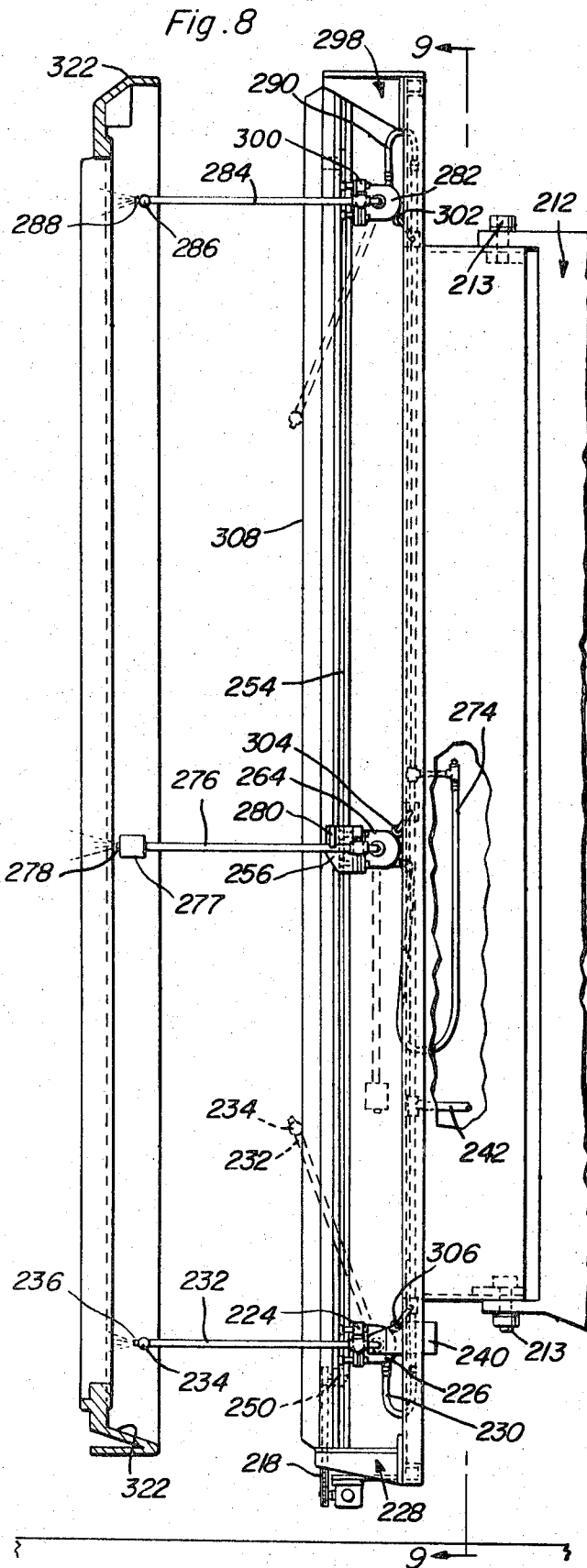


Fig. 4









COKE OVEN DOOR AND JAMB CLEANERS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to cleaning apparatus, and particularly to steam cleaning apparatus mountable on pusher and door cars for cleaning a self-sealing door assembly of a coke oven.

2. Description of the Prior Art

Coke ovens are a great cause of air pollution. One of the reasons for this pollution is that the door seals and sealing surfaces of mating doors and doorjamb are not kept clean. When a door seal makes contact with an associated doorjamb, carbon and other deposits left on the seals cause leakage by the door, permitting a flame in the furnace which in turn makes smoke.

Apparatus has been proposed to clean carbon and other foreign matter from the door seals of coke ovens. This seal is a surface around the inside of a coke oven door. There are usually two doors on each oven at any given coke oven site, one side of the oven being called the coke side and the opposite side being called the pusher side.

Mechanical jamb cleaners, such as shown in U.S. Pat. No. 2,986,758, are being used for reducing this air pollution by cleaning the sealing surfaces of a coke oven door assembly. Apparatus similar to this prior art device has found limited use in this country due to high costs, high overhead, and low efficiency. Further, the metal scrapers of this type of jamb cleaner have been found unsatisfactory as far as cleaning is concerned, and the cleaners have many mechanical parts which malfunction and cause excessive downtime and repair costs. For example, complex carriages are used to position the apparatus adjacent a door to be cleaned.

Another approach to solving the seal-cleaning problem referred to above is shown in, for example, U.S. Pat. No. 3,454,426. This proposal uses gas jets to clean both the door and doorjamb of a coke oven. The high velocity gas jets generated by this prior art system have also been found unsatisfactory in that the desired degree of cleaning and efficiency of operation is not obtained.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide apparatus utilizing steam under high pressure for cleaning sealing surfaces of a door assembly for a coke oven.

Another object of the present invention is to provide apparatus as set out above which eliminates the need for carriages for supporting the cleaning apparatus, and which send the apparatus into horizontal transverse, or retraction movements for positioning the apparatus prior to cleaning.

Yet another object of the present invention is to provide apparatus as set out above which has fewer moving and replaceable mechanical parts.

These and other objects are achieved according to the present invention by providing apparatus having steam-directing arrangements for cleaning spaced portions of the sealing surfaces of a member to be cleaned, and another steam-directing arrangement movable between the spaced sealing surface portions for cleaning other portions of the sealing surfaces of the member.

The spaced-portions cleaning arrangement advantageously includes a header arranged for directing steam onto the sealing surfaces at the bottom end of a mem-

ber to be cleaned, and a further header arranged for directing steam onto the sealing surfaces at the top end of the member to be cleaned. In all preferred embodiments of the present invention, the movable cleaning means includes a carriage and header mounted on the carriage for vertical movement between the spaced-portions headers.

Apparatus according to the present invention is advantageously supported by a main frame having spaced ends. A guide rail is mounted on the main frame and arranged extending between the frame's ends, with the carriage arranged guidingly engaging the guide rail for being moved between the spaced-portions headers by means of a chain and sprocket arrangement.

When cleaning apparatus according to the present invention is specifically intended for cleaning a door of a door assembly for a coke oven, the spaced-portions headers are pivotally mounted on the main frame. Structure is associated with the three headers for swinging a spaced-portions header in a direction toward the ends of the frame, or parallel to a plane passing through the frame ends, when the carriage-mounted header is adjacent the headers, and a control system intermittently actuated by movement of the header for supplying steam to the spaced-portions headers as the carriage-mounted header approaches one of the spaced-portions headers.

When apparatus according to the present invention is specifically intended for cleaning a doorjamb of a door assembly for a coke oven, the spaced-portions cleaning arrangement further includes a pair of further carriages engaging the guide rail and connected to the chain and sprocket. The spaced-portions headers are pivotally mounted on a respective further carriage, and the third header is pivotally mounted on its carriage. By design, all three headers are arranged for swinging movement toward the ends of the frame at a predetermined stage in an operating cycle of the cleaning apparatus.

The various headers in all embodiments of cleaning apparatus according to the present invention preferably direct dry steam under a pressure of, for example, 250 psi onto the sealing surfaces.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, perspective view showing a coke oven door cleaner according to the present invention affixedly mounted on existing beams of a pusher car.

FIG. 2 is a fragmentary, rear elevational view showing the door cleaner of FIG. 1.

FIG. 3 is a fragmentary, sectional view taken generally along the line 3—3 of FIG. 2.

FIG. 4 is a sectional view taken generally along the line 4—4 of FIG. 2.

FIG. 5 is a fragmentary, perspective, detail view taken generally along the line 5—5 of FIG. 3.

FIG. 6 is a top plan view, with some portions cut away and some parts in section, of the door cleaner of FIGS. 1 to 5.

FIG. 7 is a fragmentary, perspective view showing a coke oven doorjamb cleaner according to the present invention.

FIG. 8 is a fragmentary, side elevational view showing the doorjamb cleaner of FIG. 7.

FIG. 9 is a sectional view taken generally along the line 9—9 of FIG. 8.

FIG. 10 is a fragmentary, sectional view taken generally along the line 10—10 of FIG. 9.

FIG. 11 is a fragmentary, sectional view taken generally along the line 11—11 of FIG. 9.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 of the drawings shows a coke oven door cleaner 10 according to the present invention fixedly mounted on existing beams 12, or structural vertical supports, of a conventional pusher car (not shown). An example of a horizontal coke oven arrangement having a pusher car and a door car may be found in, for example, U.S. Pat. No. 2,986,758 referred to above. This patent was issued June 6, 1961 to G. E. C. Randell et al. While the door cleaner 10 is fixedly mounted on the pusher car, it may be mounted for swinging movement about a vertical axis on the door car. This mounting may be similar to the mounting for a jamb cleaner on the pusher car set out below.

Referring now to FIGS. 2 to 6 of the drawings, cleaner 10 has a main frame 14 provided with longitudinally spaced end portions which will be adjacent the bottom and top ends of a door when cleaner 10 is in operative position. A conventional electric drive, speed reducer 16 is mounted on the bottom of frame 14 for driving a lower roller chain 18 through a lower chain sprocket 20. A lower chain sprocket 22 cooperates with sprocket 20 to define a power transmission path for chain 18. A conventional electric solenoid valve 24 is connected to a pipe ell 26 arranged beneath a lower frame bracket 28 connected to main frame 14. Valve 24 and ell 26 form part of a steam transmission system to be discussed in more detail below.

A flexible steam hose 30 is connected to valve 24 and to a steam manifold 32, which is in turn connected to a steam header 34. A plurality of steam nozzles 36 are provided in header 34 for directing a steam jet onto a sealing surface. A pipe 38 forming part of manifold 32 is pivotally mounted on lower frame bracket 28 as by a pair of lower manifold pivot brackets 39. A spring steel rod 40 is connected between a pair of steam header pivot arms 41 forming longitudinal extensions of portions of manifold 32. A main steam pipe 42, which leads from a conventional high pressure boiler (not shown), connects at a pipe tee 44 to a vertical steam pipe 46 which is connected at its lower end to ell 26.

A main roller chain 48 is mounted on a drive sprocket 50, which is coaxially associated with sprocket 22, and on an upper chain sprocket 52. This chain 48 moves a header in a manner to be discussed below.

A guide rail 54, a pair of such rails shown as cooperating to form a guide which, guidingly, engagingly receives a carriage frame 56 (FIG. 5) as by means of four cam rollers 58. A slot 60 is provided in carriage 56 for receiving a steam operator carriage tram pin 62 connected to a pin of a link of chain 48 for moving carriage 56.

A traveling steam manifold 64 is mounted on carriage frame 56 for movement with it between the ends of frame 14. A swivel pipe ell 66 is mounted on manifold 64, and a pipe tee 68 and conventional electric solenoid valve 70 on steam pipe 46. A swivel pipe ell 72, connected to valve 70, forms a connection for one end of a flexible steam hose 74, the other end being connected to ell 66. A manifold 76 is mounted on and extends from manifold 64, and terminates in a header 77 provided with a plurality of nozzles 78 arranged for directing steam onto predetermined sealing surfaces of a member to be cleaned. Rod bumper brackets 80 extending above and below manifold 64 are arranged for engaging with spring steel rod 40 of pivot arm 41, and with a similar spring rod associated with an upper header to be discussed below, for pivoting the end, or spaced-portions headers when manifold 64 approaches an associated end position.

An upper steam manifold 82 (FIG. 6) has a pipe portion 84 pivotally mounted on frame 14. An upper steam header 86 is arranged at the outward end of manifold 82, and is provided with a plurality of nozzles 88. A flexible steam hose 90 is connected to pipe 46 as by a pipe ell 91, and to pipe 84. A pair of steam header pivot arms 92, similar to arms 41, extend longitudinally from portions of manifold 82, and have connected between them a spring steel rod 94. This rod 94 operates in a manner similar to rod 40, and is arranged to be engaged by the upper bracket 80. Pipe 84 is connected to frame 14 as by a pair of top manifold pivot brackets 96. An upper frame bracket 98, similar to lower frame bracket 28, caps off the assembly.

A conventional electric solenoid valve 100 is arranged between pipe ell 91 and pipe 46. An electric operator 102, which may be a conventional limit switch, a conventional electric timer switch 104, and another electric operator 106 are arranged mounted on frame 14 for controlling the various solenoid valves in a known manner and in an operating sequence to be set out below.

A heat shield 108 is arranged extending longitudinally between the ends of frame 14, and between carriage frame 56 and a door to be cleaned, for protecting the carriage frame, sprocket chain, and other elements from exposure to high heat which may be encountered during the cleaning of a coke oven door. This heat shield 108 has a backing plate 110 which provides a chamber affording further protection to the equipment.

As can be seen from FIG. 3 of the drawings, manifold 64 is provided with a steam operator vane 112 forming a chamber in conjunction with an affixed steam operator chamber wall 114. A suitable, known packing arrangement seals manifold 64 with respect to manifold 76. A chamber-to-header port 116, in a portion of manifold 76 arranged in manifold 64, provides communication with the space between vane 112 and wall 114 so that steam may pass through manifold 76, headers 77, nozzles 78, and onto a door 118. Vane 112 is connected in a known manner to the portion of manifold 76 in manifold 64. Specifically, the steam discharged by nozzle 78 is directed onto vertical sealing surfaces 120, while nozzles 36 and 88 are arranged for directing steam onto horizontal sealing surfaces 122.

Although the control and actuation systems, set out above, have been referred to as electrical, it is to be un-

derstood that fluid and other suitable systems may be used if desired.

When a door 118 is to be cleaned, an operator will align the door with cleaner 10 as shown in FIGS. 3, 4, and 6. For the door car side of the oven, the cleaner will be swung out about vertical pivots and aligned with the door. With main steam on pipe 42, the operator may open valve 70 and act on vane 112 to cause manifold 76 to rise horizontally from the fragmentary, broken line position shown in FIG. 3 to the horizontal broken line position. After manifold 76 is in the horizontal position, the operator may actuate speed reducer 16 and transmit motion through chain 48 so that carriage frame 56 is moved vertically until it contacts operator 102. Closing of operator 102 opens valve 100 and sends steam through header 86. At the moment of contact of manifold 64, which may be considered a traveling steam operator, with operator 102, spring steel rod 94 is also contacted, sending steam header 86 in a downward or counterclockwise motion (FIG. 3) and cleaning horizontal sealing surfaces 122 of door 118.

Now manifold 25 reverses to downward vertical motion leaving header 86 in upward or full line position as shown in FIG. 3. This full line position may be determined by balancing the header 86 unit. Manifold 25 continues its downward travel passing through operator 102 and closing valve 100, through timer switch 104, and making contact with control switch or operator 106. The latter opens valve 24 and sends steam through header 34. Manifold 64 now makes contact with spring steel rod 40 sending header 34 in vertical swinging motion. As manifold 64 returns upward, it passes by operator 106 cleaning, or releasing same. The latter closes valve 24 to stop steam to header 34. Manifold 64 now hits timer switch 104 and breaks the electric circuit to the switch to complete one cleaning cycle. The operator may now close valve 70 and cause manifold 76 to drop to its vertical position. Timer switch 104 controls the length of cycle.

When manifold 64 is in motion, manifold 76 is directing dry steam at 250 psi through steam nozzle 78 and cleaning the vertical sealing surfaces 120 on both sides of door 118. Headers 34 and 86 also direct dry steam at 250 psi when actuated.

Referring now to FIG. 7 of the drawings, a doorjamb cleaner 210 according to the present invention is shown mounted to a jamb cleaner carriage 212 of a pusher car for swinging movement about a vertical axis. This axis is illustrated in FIG. 8 as formed by pins 213. When a jamb cleaner 210 is mounted on a door car, it may be fixedly mounted and merely be positioned across from a doorjamb by control of the door car.

Jamb cleaner 210 is shown in greater detail in FIGS. 8 to 11 of the drawings. As can be readily appreciated from FIG. 8 of the drawings, a main frame 214 of cleaner 210 has an electric driven, speed reducer 216, similar to reducer 16, mounted at the lower end of frame 214. Reducer 216 drives a lower chain 218 through a speed reducer chain sprocket 220. A lower chain sprocket 222 completes the lower chain arrangement. A lower header solenoid operated steam valve 224 communicates with a lower header steam operator 226. A lower frame bracket 228, similar to bracket 28, finishes the bottom of frame 214.

A flexible steam hose 230 is connected at a one end to steam operator 226 for feeding steam to a lower

steam manifold 232. A lower steam header 234 is connected to manifold 232, and is provided with a plurality of nozzles 236 arranged for directing steam onto the lower portion of a doorjamb. To the rear of manifold 232 is mounted a lower steam manifold counterweight 240 which tends to keep manifold 232 and header 234 in their broken line position when steam is not passing through nozzles 236. A main steam line 242, which leads from a conventional high pressure boiler (not shown) is connected as by a pipe tee 244 to a vertical steam pipe 246. A conventional pipe coupling 247 couples hose 230 to pipe 246.

A traveling steam operator tram roller chain 248 is arranged about a lower chain sprocket 250, which is coaxially associated with sprocket 222 for receiving power from reducer 216, and an upper chain sprocket 252. Chain 248 functions and operates in a similar manner to chain 48.

A carriage guide rail 254 (FIG. 10) is arranged in a similar manner to guide rail 54 for guiding a carriage frame 256 by means of guidingly engaging carriage cam rollers 258. Although four such rollers 258 are illustrated, it is to be understood that any desired number may be used. A steam operator carriage tram pin 262 engages a slot (not shown) in carriage frame 256 for moving same between the ends of frame 214.

A traveling steam operator 264 is mounted on carriage frame 256 for travel with the carriage frame. A swivel ell 266 provides one connection to operator 264. A pipe tee 268 is provided in pipe 246, and an electric solenoid operated steam valve 270 is connected to tee 268. A 90° swivel ell 272 is in turn connected to valve 270, and a flexible steam hose 274 extends between ell 272 and 266. A traveling steam manifold 276 is pivotally mounted on operator 264, and terminates in headers 277 provided with a plurality of nozzles 278. Manifold upper stop brackets 280 limit the upward swing of manifold 276 to a substantially horizontal position, as shown in full lines in FIG. 8.

An upper header steam operator 282 has pivotally connected to it a manifold 284 at the outer end of which is arranged an upper steam header 286 provided with a plurality of nozzles 288. A flexible steam hose 290 is connected to pipe 246 as by a conventional steam pipe coupling 292. An upper frame bracket 298, similar to upper frame bracket 98, caps off frame 214.

An upper header, solenoid operated steam valve 300 is arranged on operator 282, and is actuated by an electric switch or operator 302 mounted on frame 214. An electric timer switch 304 and an electric switch or operator 306 are arranged on main frame 214 in positions similar to those for timer switch 104 and operator 106.

A head shield 308, similar to shield 108, and a backing plate 310, similar to backing plate 110, are provided on jamb cleaner 210 for the same reason as the similar structure on door cleaner 10.

A steam operator vane 312 (FIG. 11) cooperates with a steam operated chamber wall 314 in operator 264 to form a steam chamber communicating with a chamber-to-header port 316. Vane 312 operates in a manner similar to vane 112 to position manifold 276. That is, vane 312 is connected in a known manner to a portion of manifold 276 passing through manifold 264. The various nozzles on jamb cleaner 210 are arranged for directing dry steam into a doorjamb 318

having vertical sealing surfaces 320 and horizontal sealing surfaces 322. Operators 226 and 282 may be constructed in a similar manner to operator 264.

To use jamb cleaner 210, an operator first lines the cleaner up with a jamb 318. Main steam is placed on pipe 242. The operator may now open valve 270 and cause manifolds 276 and 284, by vane action, to rise to their horizontal or full line positions in FIG. 8. Manifold 232 will be forced down to its horizontal or full line position. Once this has been accomplished, the operator may put speed reducer 216 into motion sending traveling steam operator 264 in vertical travel from its FIG. 8 position until it makes contact with operator 302. Closing of operator 302 will open valve 300 and send steam through header 286. At the instance of contact of operator 302 by traveling steam operator 264, the latter contacts steam operator 282 and sends steam header 286 vertically across horizontal sealing surfaces 322 of the seal of doorjamb 318.

Now steam operator 264 reverses to downward motion and leaves steam operator 282 at its original location, passes through operator 302, and as a result of the latter closes valve 300. Steam operator 264 continues in motion crossing timer switch 304, and continues on to make contact with electric operator 306 and steam operator 226. Valve 224 is now opened and steam is sent through header 234 so that the latter is forced down across the lower or bottom horizontal sealing surface 322 of doorjamb 318. Steam operator 226 reverses vertically crossing operator 306, closing valve 224, and leaving steam operator 226 at its original position. Steam operator 264 continues vertically upwardly making contact with timer switch 304 and breaking the electric circuit to complete a one cycle cleaning operation. Operator may now break the circuit of valve 270 causing manifold 276 and manifold 284 to drop to their vertical, or broken line positions in FIG. 8, and causing header 234 to rise to its vertical or broken line position.

When steam operator 264 is in motion, steam headers 277 are directing 250 psi of dry steam through nozzles 278 and cleaning the vertical sealing surfaces 320 on both sides of jamb 318. Headers 234 and 286 also direct 250 psi of dry steam when actuated.

As can be readily understood from the above description and from the drawings, cleaners 10, 210 according to the present invention will efficiently clean sealing surfaces of door assemblies for coke ovens with a minimum of moving parts and a reduced possibility of mechanical failure and resulting downtime and high maintenance costs.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. Apparatus for cleaning sealing surfaces of a door

assembly for a coke oven, comprising, in combination:

- a. first header means for cleaning sealing surfaces at a one end of a member to be cleaned;
 - b. second header means for cleaning sealing surfaces at another end of the member to be cleaned;
 - c. a carriage arranged for movement along a path between the first and second header means;
 - d. third header means mounted on the carriage for movement therewith;
 - e. means associated with the first, second, and third header means for swinging the first and second header means about respective pivots arranged perpendicularly to the path of movement of the carriage and parallel to the door assembly whenever the carriage is adjacent the first and second header means;
 - f. a frame having spaced ends, a guide rail mounted on the frame and arranged extending between the ends of the frame, the carriage arranged engaging the guide rail, and means for moving the carriage along the guide rail between the first and second header means, the first, second, and third header means being steam directing headers, the first and second header means being pivotally mounted on the frame adjacent respective ends thereof, and the path of movement of the carriage being a vertical linear path; and
 - g. means actuated by the third header means for intermittently and alternately supplying steam to the first and second header means whenever the carriage is adjacent same.
2. A structure as defined in claim 1, wherein the header means all are arranged for directing dry steam under a pressure of approximately 250 psi onto the sealing surfaces.
3. A structure as defined in claim 1, further including a pair of further carriages engaging the guide rail and connected to the moving means, the first and second header means pivotally mounted on a respective further carriage, and the third header means pivotally mounted on the carriage, all three header means arranged for swinging movement between the spaced ends of the frame.
4. A structure as defined in claim 1, wherein the frame is arranged with the ends thereof spaced vertically, one end being an upper end and the other end a lower end, with the first and second header means being arranged for swinging about a horizontal pivot, the guide rail is a pair of spaced parallel guide rails co-operatively arranged forming a guide, and the moving means includes a pair of chain sprockets rotatably mounted on the frame adjacent the upper and lower ends thereof, a chain arranged on the sprockets for movement therewith, a pin extending from the chain, a plurality of cam rollers provided on the carriage and arranged engaging the guide rails, and a slot provided in the carriage and arranged for receiving the chain pin and connecting the carriage to the chain.

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