Dec. 26, 1961 F. K. HIBY 3,014,746

COKE OVEN DOORS

Filed Nov. 19, 1959 5 Sheets-Sheet 1

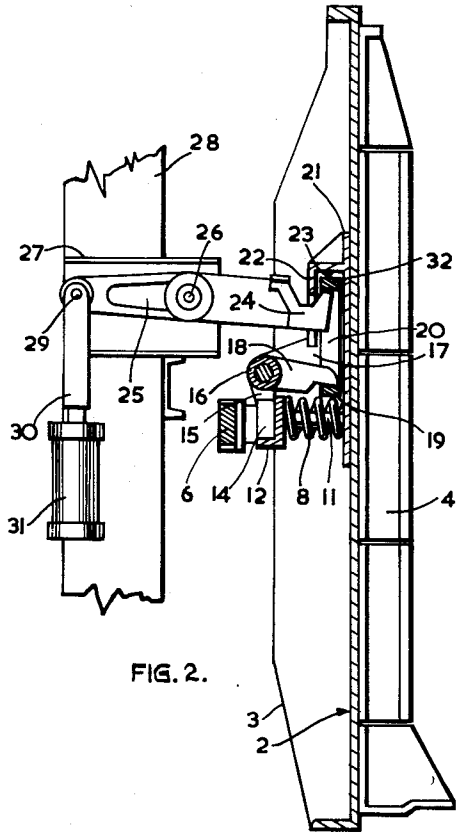

FIG. 2.

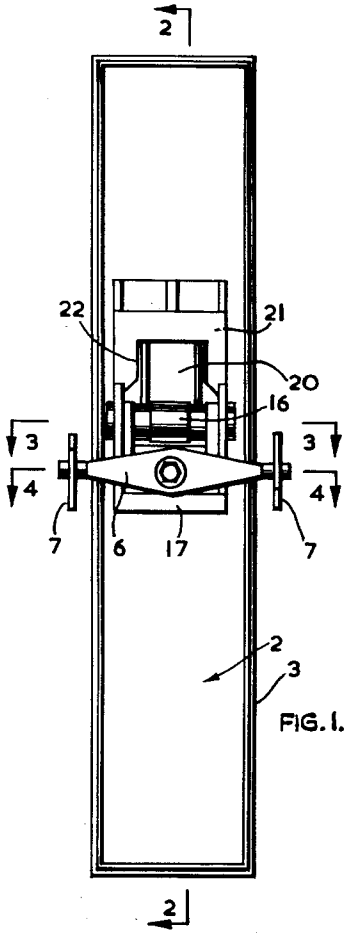

FIG. 1.

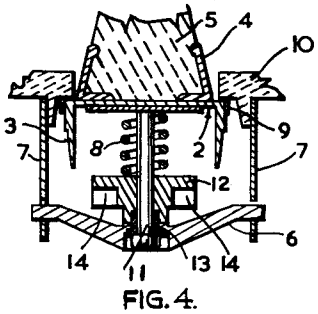

FIG. 4.

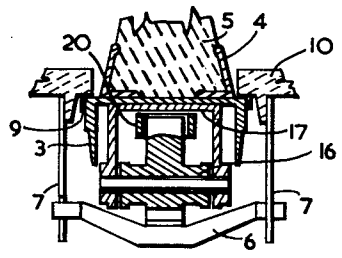

FIG. 3.

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COKE OVEN DOORS

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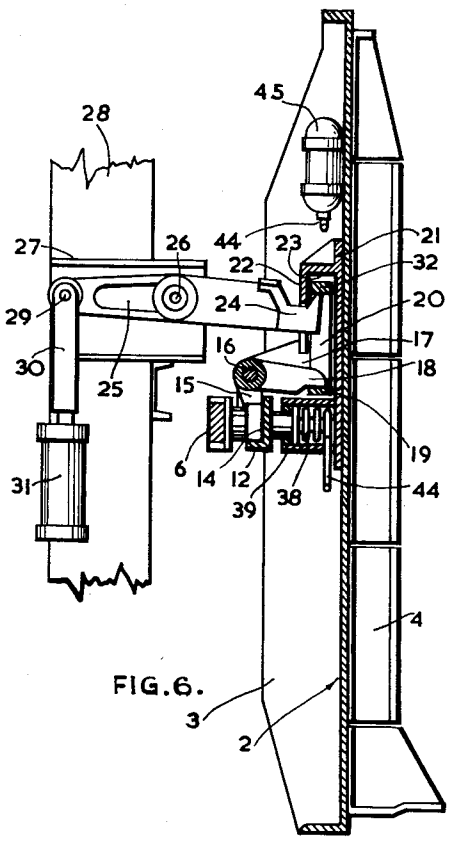

FIG. 6.

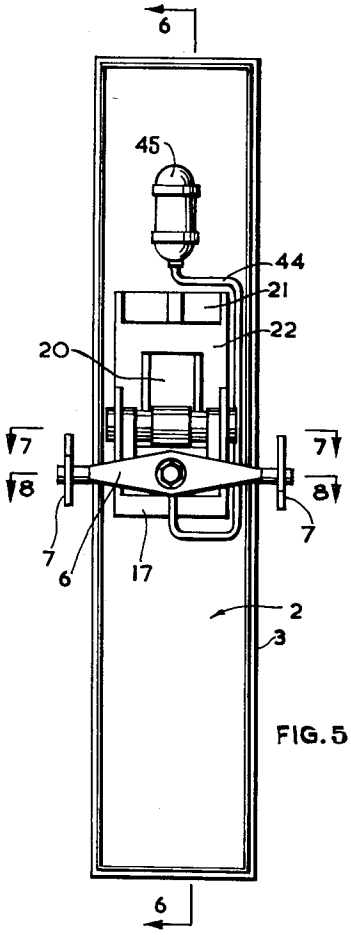

FIG. 5.

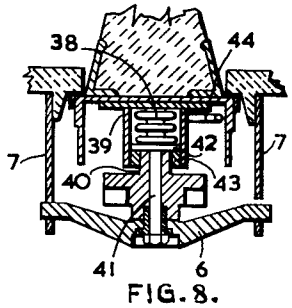

FIG. 8.

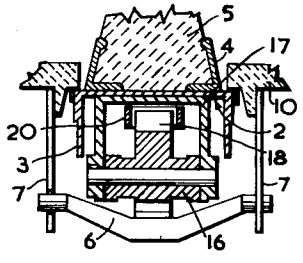

FIG. 7.

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COKE OVEN DOORS

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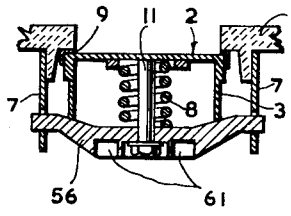

FIG.11.

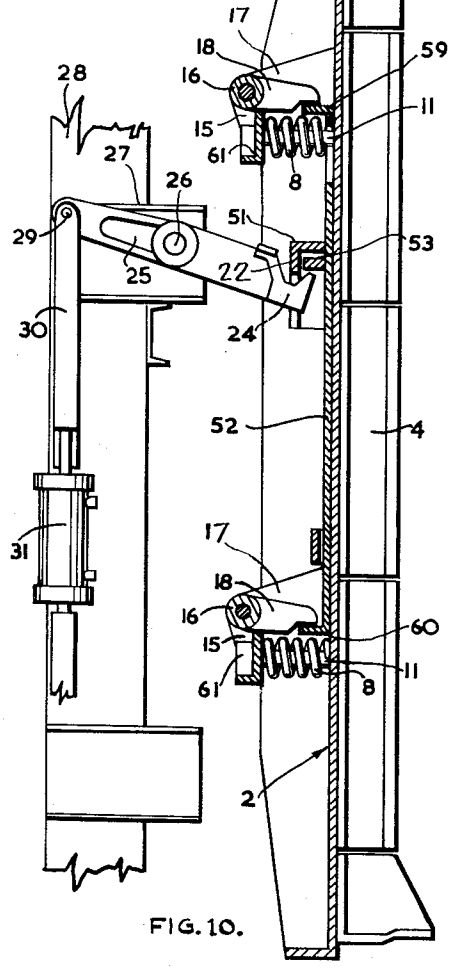

FIG. 10.

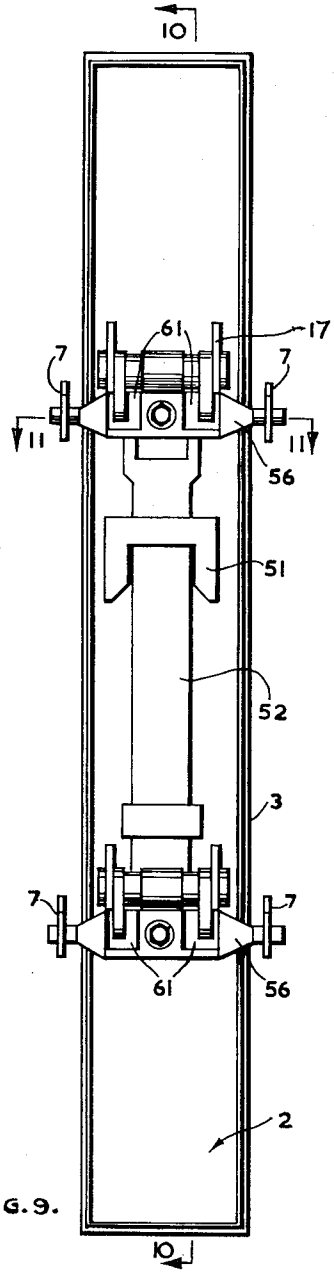

FIG. 9.

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COKE OVEN DOORS

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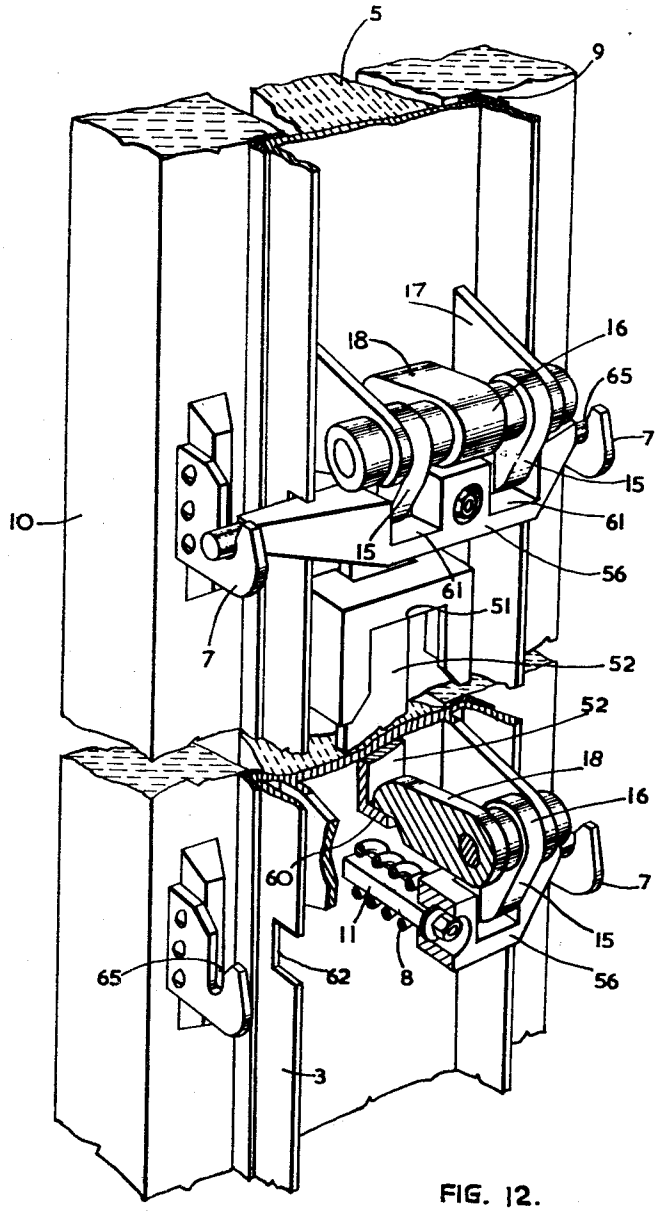

FIG. 12.

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COKE OVEN DOORS

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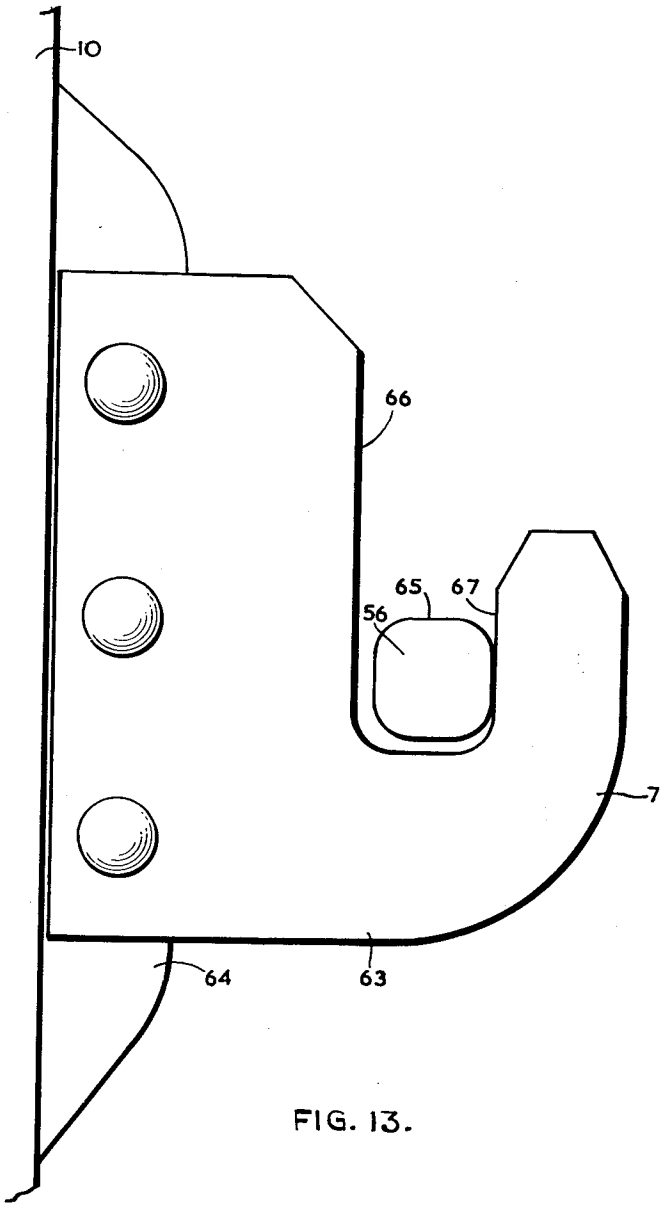

FIG. 13.

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3,014,746

COKE OVEN DOORS

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Claims priority, application Great Britain Dec. 9, 1958
8 Claims. (Cl. 292—259)

This invention is concerned with improvements in and relating to coke oven doors, and in particular relates to door removal means.

Coke oven doors are normally held closed by means of one or more horizontal locking bars on the door so arranged that their ends may be engaged behind locking hooks secured to the oven door frame. The locking bars are slidable in a plane perpendicular to the plane of the door and are normally urged away from the door by metallic or fluid springs in such a manner that when the ends of the locking bars are engaged behind the locking hooks, the springs are under a compression which presses the door firmly against its frame. Such doors are automatically locking in that the door is placed in position with the fluid spring relaxed or the metallic spring under additional compression and, when the locking bars have entered into the locking hooks, the fluid springs are inflated or the metallic springs are released to cause the locking bars firmly to engage behind the locking hooks, the reaction of the springs thus pressing the door firmly against the door frame.

Earlier types of door were not automatically locking, and those doors had to be manually screwed or wedged against the frame after the locking bars were engaged.

The latter locking means is slow and cumbersome and there is now a general inclination towards changing over from manual locking to automatic locking. Where automatic locking arrangements as previously known, however, are applied to existing doors of the manual locking type, such a changeover necessitates a heavy financial outlay as it entails extensive alterations to each door and may even necessitate the complete renewal of all doors.

One object of the present invention is to provide means whereby the so-called automatic locking feature may readily be applied to existing coke oven doors with a minimum of change in existing structures.

A further object of the invention is to provide an automatic locking feature whereby the doors may be removed by substantially any known door extracting device without any structural changes therein.

According to the invention, an automatic locking device for coke oven and like doors comprises a locking bar having its opposite ends protruding beyond portions of the periphery of the door and being slidable in directions perpendicular to the major plane thereof, said opposite ends each being adapted to be engaged behind a locking hook secured to, or adjacent, the frame of the door and to be urged into locking engagement with the locking hooks by resilient means normally urging the locking bar away from the door, a releasing member slidable in a plane substantially parallel with the surface of the door, and means operatively associated with the releasing member to move the locking bar towards the door upon sliding movement of the releasing member in one direction relative thereto upon engagement therewith of the door lifting member of a door extractor.

A better understanding of the invention may be obtained from the following description, when this is read with reference to the accompanying drawings, of which:

FIGURE 1 is a front elevation of a coke oven door and one form of the locking means therefor,

FIGURES 2, 3 and 4 are sections on the lines 2—2, 3—3 and 4—4 respectively, of FIGURE 1; FIGURES 3 and 4 showing portions of the adjacent oven structure and FIGURE 2 showing a portion of the door lifting and extracting means,

FIGURES 5, 6, 7 and 8 are views similar to FIGURES 1 to 4, respectively, but showing a further embodiment of the invention,

FIGURE 9 is a front elevation of a coke oven door similar to the door of FIGURE 1, but having duplicated locking bars,

FIGURES 10 and 11 are sections, respectively, on the lines 10—10 and 11—11 of FIGURE 9; FIGURE 11 showing adjacent portions of the oven structure and FIGURE 10 showing a portion of the door lifting and extracting means, and

FIGURE 12 is a perspective, broken, view of the door of FIGURE 9 showing the door hooks and their association with the locking bars.

FIG. 13 is a side view on a larger scale of the door locks taken from the right of FIG. 9.

As shown in FIGURES 1 to 4, a coke oven door 2 comprises a rectangular plate having a peripheral strengthening rib 3 which extends outwards perpendicularly to the plane of the door 2. To the inside of the door is secured a frame 4 which encloses a refractory plug 5 which, when the door is in position at the end of the oven, extends into the coking chamber of the oven and protects the door 2 and its associated mechanism from the intense heat developed within the coking chamber during carbonisation of the coal charge therein. This is in accordance with conventional coke oven practice and the door 2 may be one already applied to an existing oven which may be modified according to the invention, or it may be a new door to which the invention is applied at the time of manufacture.

Also according to normal practice, the door 2, when in position on the oven, is held thereon by a locking bar 6 which extends horizontally across the front of the door 2, parallel thereto, and engages behind hooks 7 secured to the structure of the oven. A helical compression spring 8 located between the locking bar 6 and the outer face of the oven door 2 reacts in both directions to press the locking bar 6 firmly against the abutments of the hooks 7 and also to press the door seal 9 firmly against the oven structure 10.

There may be a plurality of locking bars 6, although one only is shown in the present embodiment of the invention and, instead of the helical spring 8, fluid springs have also been used in the prior art, as also have manual means comprising screw-threaded jacks.

The automatic removal of the door from a remote point is highly desirable and it has already been proposed to do this. The arrangements previously proposed, however, have been of a complex nature and have meant the complete replacement of the door. As each coking chamber has a door weighing three or more tons at each end and, as there may be fifty or more coking chambers in a coke oven battery, the replacement of all the doors is a major item of expenditure which is eliminated by the present invention.

As shown in FIGURES 1 to 4, the locking bar 6 is arranged to slide on a pin 11 which is secured to the door 2 and extends perpendicularly therefrom. A helical compression spring 8 is passed over the pin 11 and lies with its inner end adjacent the outer surface of the door. A pressure plate 12 is also slidable on the pin 11 between the outer end of the spring 8 and the locking bar 6 and is secured to the locking bar by a hollow nut 13. The pressure plate 12 has two diametrically-opposite recessed portions 14 formed on horizontally-opposite sides of the pin 11 and in these recesses 14 the bifurcated short arms

15 of a bell crank lever 16 are located. The bell crank lever 16 is centrally pivoted between the ears of a plate 17 secured to the front of the door 2 and the long arm 18 of the lever 16 extends substantially horizontally inwards towards the door 2. The inner end of the long arm 18 of the lever 16 rests upon the ledge 19 of a rectangular box-like slide 20 which is arranged to slide vertically and parallel to the outer surface of the door 2 and is held in position by the vertical sides of a door-lifting hook 21 which is formed integrally with the plate 17 and extends outwardly of the door 2, perpendicularly thereto. Flanges 22 on the hook 21 form a recess 23 in which the slide 20 is slidably retained.

The door extracting mechanism, only a portion of which is shown in the drawings as the remaining portions follow conventional practice, comprises a door extracting hook 24 which is secured at one end of a lever 25 pivoted at 26 in a channel member 27 secured to a door extractor beam 28, which forms part of a door extractor of known type and the beam 28 of which may be advanced towards or retracted from the door 2, perpendicularly thereto, and is operated from a machine movable on rails parallel to the side of the oven battery. The pivot 26 is substantially midway of the lever 25, the outer end of which is pivoted at 29 in a clevis 30 secured to the piston rod of a fluid pressure piston and cylinder device 31, the cylinder of which is secured to the beam 28.

When it is desired to remove the door 2 from the oven, the extractor machine is brought into alignment with the door 2 in the known manner and the beam 28 is projected therefrom in the direction of the door. The fluid mechanism 31 is actuated to lower the hook 24 and as the beam 28 reaches the end of its travel the hook 24 enters into the space 23 below the upper flange 32 of the slide 20.

The fluid mechanism 31 is then actuated to rotate the lever 25 so that the hook 24 is caused to rise, and as the hook 24 engages the flange 32 of the slide 20 it moves the slide upwards so that its lower flange 19, upon which the long arm 18 of the bell crank lever 16 is resting, causes the bell crank lever 16 to rotate in a counterclockwise direction (as seen in FIGURE 2). This rotation of the lever 16 causes its bifurcated short arm 15 to compress the spring 8 and release the pressure thereof on the locking bar 6. The oven door 2 is now only held on its seal 9 by the effect of tar adhering to the door and frame adjacent the seal, and further upward movement of the hook 24 causes it to engage the lower edge of the horizontal portion of the flange 22 and thus to lift the door 2 vertically upwards, at the same time lifting the locking bar 6 clear of the hooks 7.

The extractor beam 28 is then retracted and the door 2, suspended on the hook 24, is withdrawn in a direction perpendicular to the face of the oven structure.

In replacing the door 2, the beam 28 is advanced until the door seal 9 engages the oven structure 10. The hook 24 is then lowered so that the door 2 moves downwards into position and the locking bar 6 engages the hooks 7. Continued lowering of the hook 24 permits the spring 8 to rotate the lever 16 in a clockwise direction to press the locking bar 6 against the hooks 7 and thus to press the door 2 firmly upon its seat.

In the embodiment of the invention shown in FIGURES 5 to 8, the arrangement and operation of the invention is substantially the same as that described hereabove in relation to FIGURES 1 to 4, except that in this case the spring 8 is replaced by a corrugated flexible aneroid or bellows 38 which is located in a cylindrical casing 39 secured to the plate 17 and extending perpendicularly therefrom towards the pressure plate 12, which has a cylindrical spigot 40 formed on its inner surface. The spigot 40 is slidable within an annular ring 43 secured in the open end of the cylinder 39. The pin 41 is shorter than the pin 11 and at its inner end is secured to a circular disc 42, slidable in the cylinder 39 and lying

between the annular ring 43 and the adjacent end of the bellows 38.

A conduit 44 leads from the interior of the bellows 38 to the hydraulic portion of an oleo-pneumatic recuperator 45 suitably secured to the door 2 above the hook 21.

The oleo-pneumatic recuperator 45 is of any suitable known type and comprises a closed container which is partially filled with hydraulic fluid and the remaining space of which is filled with compressed air or inert gas. The liquid and air or gas may be separated by a flexible diaphragm or by a free piston, as known in the art. The normal pressure of the air or gas is such as normally to cause the bellows 38 to hold the locking bar 6 firmly in the hooks 7.

When the hook 24 engages the flange 32 for removal of the door 2, as previously described, rotation of the bell crank 16 causes the spigot 40 of the pressure plate 12 to press the disc 42 of the pin 41 against the bellows 38 and partially to collapse them; thus displacing hydraulic fluid through the conduit 44 into the oleo-pneumatic device 45 and placing the air or gas therein under additional compression, simultaneously freeing the locking bar 6 and allowing the door to be raised and removed.

When the door 2 is replaced and the hook 24 is lowered, as previously described, the additional pressure in the oleo-pneumatic device 45 causes the displacement of hydraulic fluid therefrom back into the bellows 38, which expand and press the locking bar 6 into engagement with the hooks 7.

Although in the previous descriptions it has been assumed that the recessed portions of the hooks 7 are both pointing upwards and that the door 2 is lifted vertically until the locking bar 6 is clear of the hooks 7, this arrangement is not essential and, as shown in FIGURES 4 and 8, one hook recess may be directed upwards and the other one downwards. This latter is quite a conventional arrangement and is shown in FIGURES 4 and 8; its advantage being that the door 2 does not require to be lifted vertically to such an extent as is necessary when both hooks 7 are directed upwardly. Where the hooks 7 are disposed as shown in FIGURES 4 and 8, a lever device (not shown) is normally provided on the extractor beam 28 to rotate the locking bar 6 clear of the hooks 7 as soon as the pressure thereon has been released by the lifting hook 24, slide 21 and bell crank lever 16.

As previously referred to, a plurality of locking bars 6 and hooks 7 may be applied to the oven door 2, and in FIGURES 9 to 12 is shown such an arrangement.

The door 2 is substantially the same as that of FIGURES 1 to 4 or 5 to 8 but incorporates two locking bars 56 disposed one above and one below the vertical centre of the door 2. The door lifting hook 51 is secured to the front of the oven door 2, slightly above the vertical centre, so that the door 2 remains substantially vertical when suspended on the extracting hook 24.

The lifting hook 51 straddles a flat elongated plate 52 which lies vertically adjacent the front of the door 2 and is slidable relative thereto, and a horizontal plate 53 extends perpendicularly from the plate 52 and lies within the recess 23 behind the flange 22 of the hook 51. The plate 53 performs the same function as the flange 32 of FIGURES 2 and 6.

Flanges 59 and 60 extend from the respective upper and lower ends of the plate 52 and upon each of these rests the long arm 18 of bell crank levers 16 pivoted in plates 17 secured to the door 2 horizontally of the locking bars 56.

The locking bars 56 extend horizontally across the front of the oven door 2 and their outer ends engage behind the hooks 7 secured to the oven frame as previously described.

Pins 11 extend perpendicularly outwards from the oven

door **2** and at their outer ends each has a locking bar **56** slidably mounted thereon. A helical compression spring **8** surrounds each pin **11** and extends between the door **2** and the adjacent locking bar **56**.

On each side of the pin **11**, and on the surface thereof remote from the door **2**, each locking bar **56** has a recess **61** formed therein and the bifurcated short arm **15** of the corresponding lever **16** engages in these recesses.

The door extracting mechanism is substantially the same as in the embodiments previously described.

In the removal of the door, the door extracting hook **24** is raised to engage the flange **53** and raise it, together with the plate **52**. The flanges **59** and **60** each engage a long arm **18** of the bell crank levers **16** and rotate them, causing their arms **15** each to engage a locking bar **56** and slide it on its pin **11** towards the door **2** and to compress the springs **8**. Continued movement of the hook **24** then causes it to engage the door lifting hook **51** and lift the door **2** off its seat.

Replacement of the door **2** is effected by reverse operation of the various integers.

The hooks **7** may all be directed upwardly, as shown in FIGURE 12 and in such a case the locking bars **6** or **56** may be prevented from turning by providing non-circular sliding surfaces on the pins **11**, as by giving the pin **11** the square section shown in FIGURE 12 or by providing recesses **62** in the flanges **3** of the door **2**, also as shown in that figure.

The hooks **7** are preferably of the type more fully described in the specification of my concurrent British patent application No. 5878/61, U.S. Ser. No. 854,044, filed November 19, 1959 and comprise a flat plate secured to the oven structure **10** and having a recess **65** formed therein. The vertical sides of the recess **65** are substantially parallel so that as the arm **15** presses the locking bar **56** towards the door **2** the locking bar **56** engages the rear edge of the recess **65** and forces the door **2** perpendicularly away from the oven structure **10**.

What I claim is:

1. An automatic locking and unlocking device for doors of coke ovens having locking hooks on said ovens at each side of the door which comprises a door lifting hook to be secured to a door to be locked, said hook having a vertical guide-way, a slide slidable vertically in said guide-way and having a portion to be engaged and moved upwardly to the limit of movement of said slide by a lifting element of a door extracting mechanism, a locking bar mounted on said door and having ends projecting beyond the edges of said door to engage said locking hooks, resilient means mounted between said door and said locking bar to bias said locking bar away from said door into engagement with said locking hooks and a bell crank lever mounted on said door and having one arm engaging said slide and the other arm engaging said resilient means to compress said resilient means away from said bar when said lever is tilted by upward movement of said slide.

2. A device according to claim 1 comprising a door extracting mechanism having an upwardly directed projection adapted to engage a co-operating abutment on said door-lifting hook and to move said door-lifting hook upwards upon upward movement of the door extracting mechanism and said locking device further comprises a fixed abutment secured to said door adjacent the abutment on said door lifting hook, said fixed abutment being engageable by said door extracting mechanism upon upward movement of said bell crank lever sufficient to release the engagement of the locking bar with the locking hooks, whereby continued upward movement of the door extracting mechanism raises said door in a direction parallel to the major plane thereof.

3. A device according to claim 1, wherein said resilient means comprises a helical compression spring held in compression between the door and the locking bar.

4. A device according to claim 1 wherein said resilient means comprises the pressurised bellows of an oleo-pneumatic spring device.

5. A device according to claim 1, wherein said other arm of the bell crank lever engages the end of said resilient means remote from the door.

6. A device according to claim 1, wherein the said other arm of the bell crank lever engages the locking bar on the side thereof remote from the door.

7. A device according to claim 1 comprising a pair of locking bars, resilient means and bell crank levers, one located above and one located below the vertical centre of said door, and a single slidable door lifting hook arranged to be engaged by said extractor hook and simultaneously to rotate each said bell crank lever.

8. A device according to claim 7, wherein said door lifting hook comprises an elongated member slidable parallel to the major plane of the door and having an abutment at each end engaging said one arm of each bell crank lever, and an abutment substantially medially of said elongated member adapted to be engaged by the projection on said door extractor, said fixed abutment being associated with the medial abutment on said elongated member and being located slightly above the vertical centre of the door in such a manner that when the door is suspended by said fixed abutment on said door extractor it remains in a substantially vertical plane.

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