United States Patent [19]

Kinzler et al.

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[45] **Jan. 9, 1973**

[54] **APPARATUS FOR HANDLING LIDS AND CHARGING COAL INTO COKE OVENS**

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[21] Appl. No.: **156,445**

[52] **U.S. Cl.**.....**214/35 R,** 202/251, 202/262, 212/4, 214/18 PH

[51] **Int. Cl.**.....**B66c 13/00**

[58] **Field of Search**.....214/18 PH, 35 R; 212/4; 202/247, 248, 250, 251, 262, 263

[56] **References Cited**

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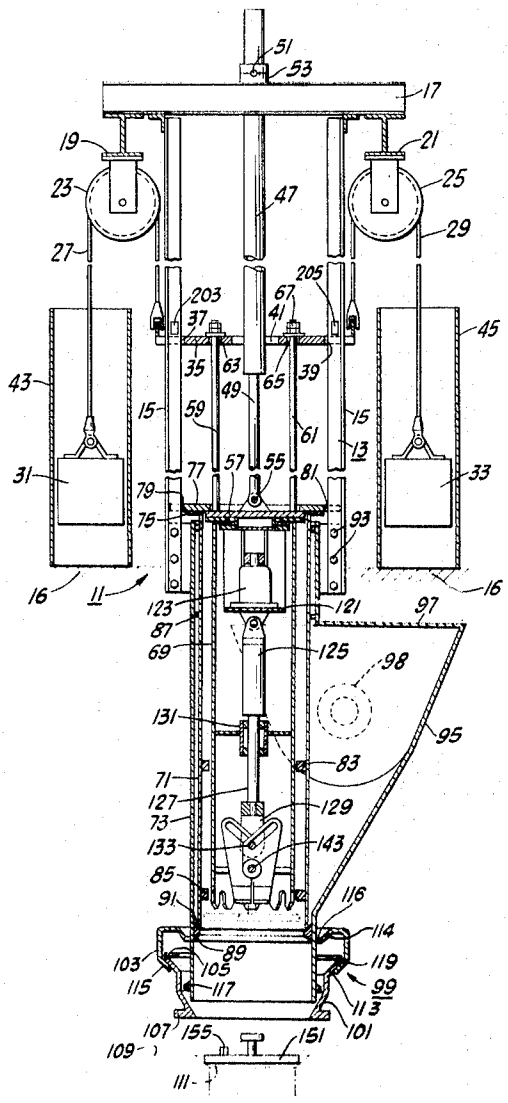
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[57] **ABSTRACT**

A larry car carrying a vertically movable lid lifting device is positionable over a row of charging lids on a coke oven. Fluid actuated cylinders actuate the pivoting cooperative lifting arms that grasp and raise a lid so that coal, moving by means of a screw feeder, flows through a closed conduit into the coking chamber. The apparatus is actuated then to replace and seat the lid.

7 Claims, 6 Drawing Figures



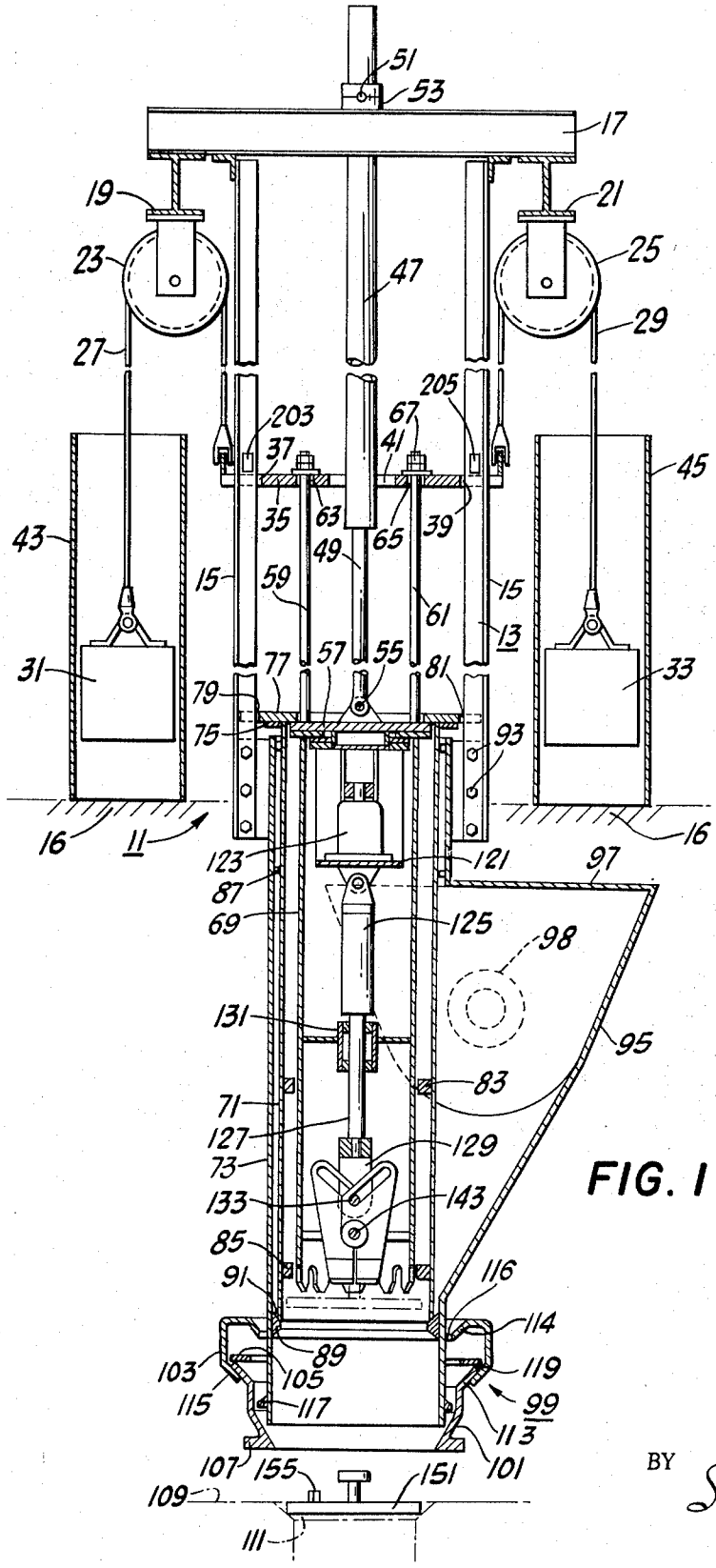


FIG. 1

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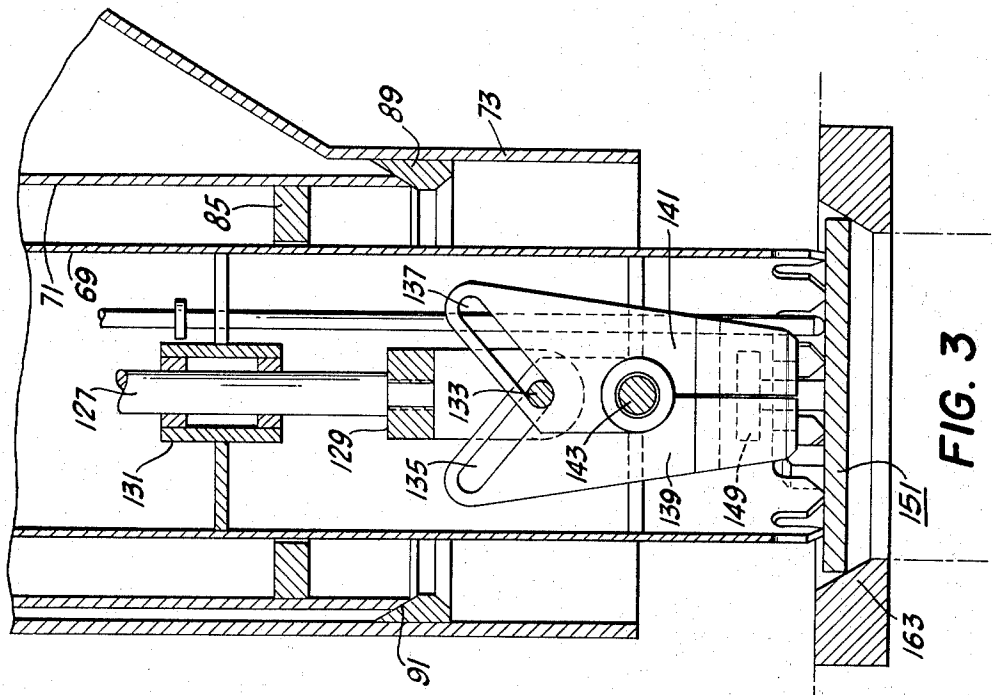


FIG. 3

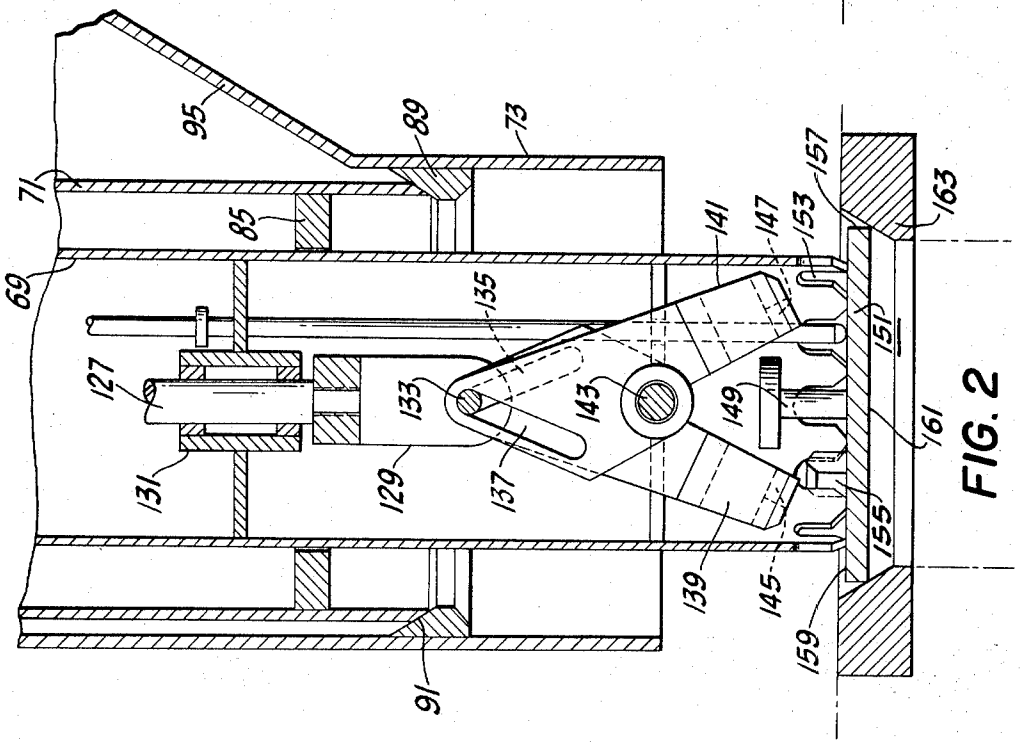


FIG. 2

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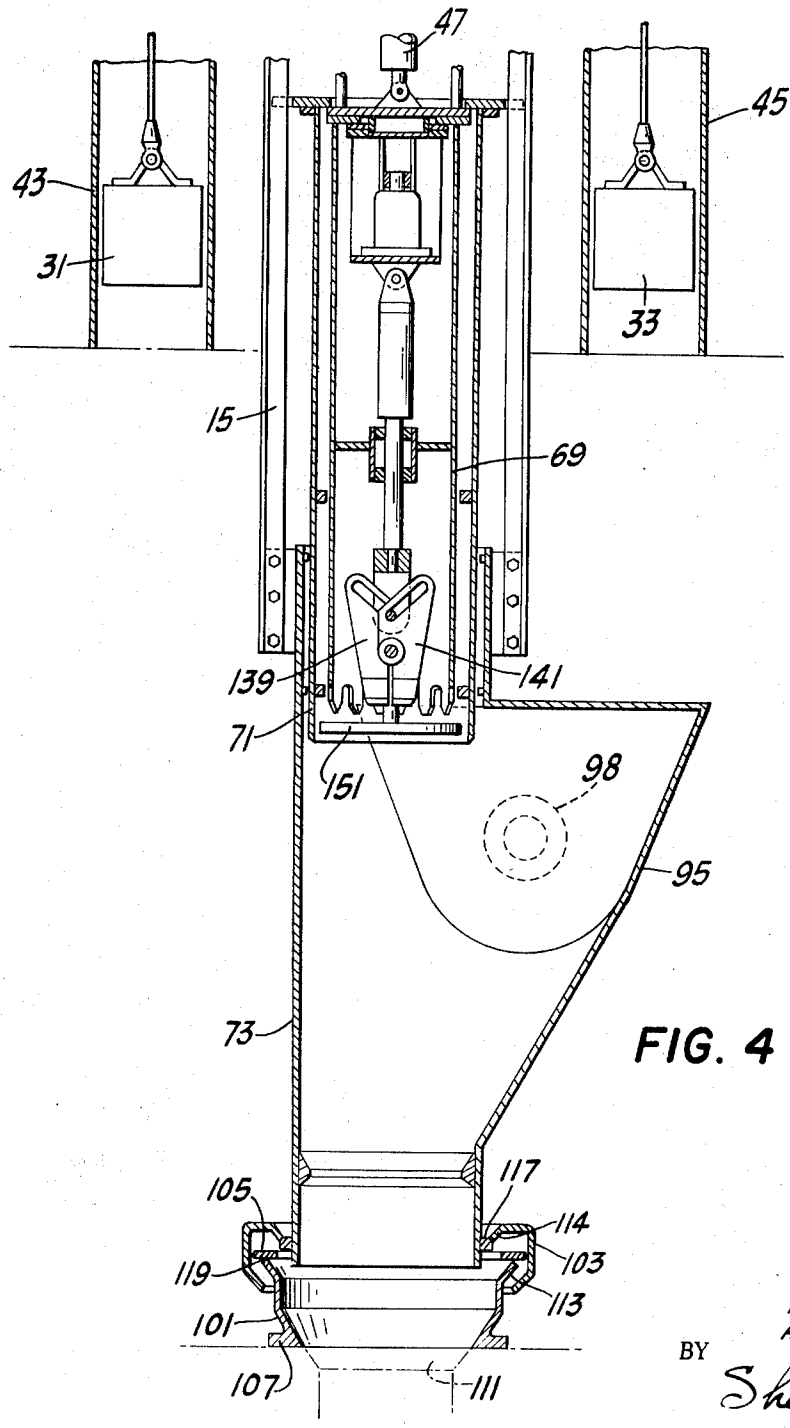


FIG. 4

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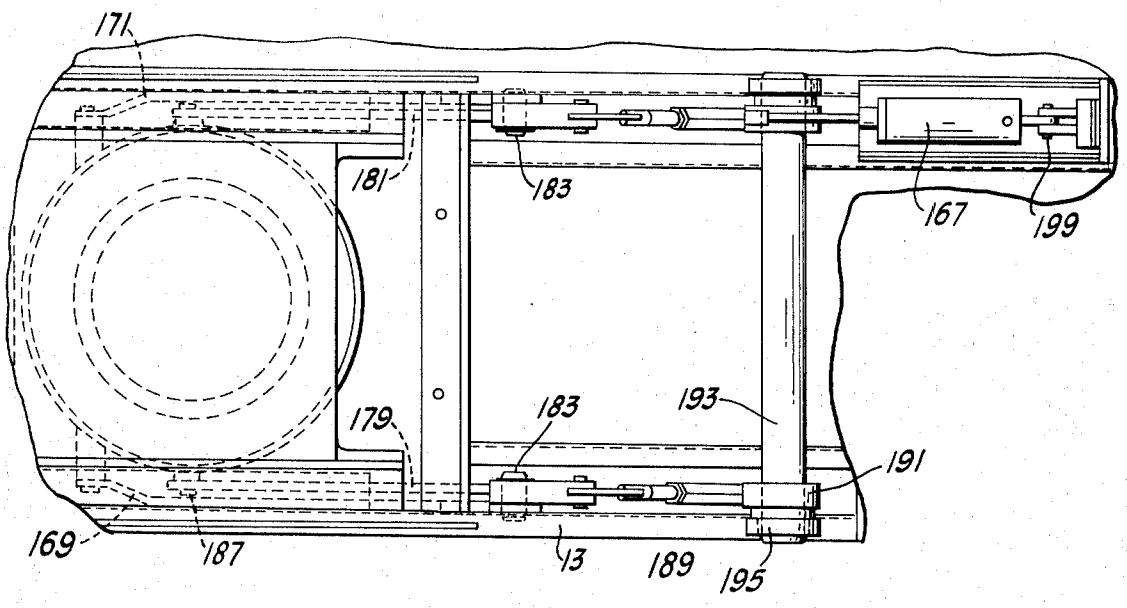


FIG. 6

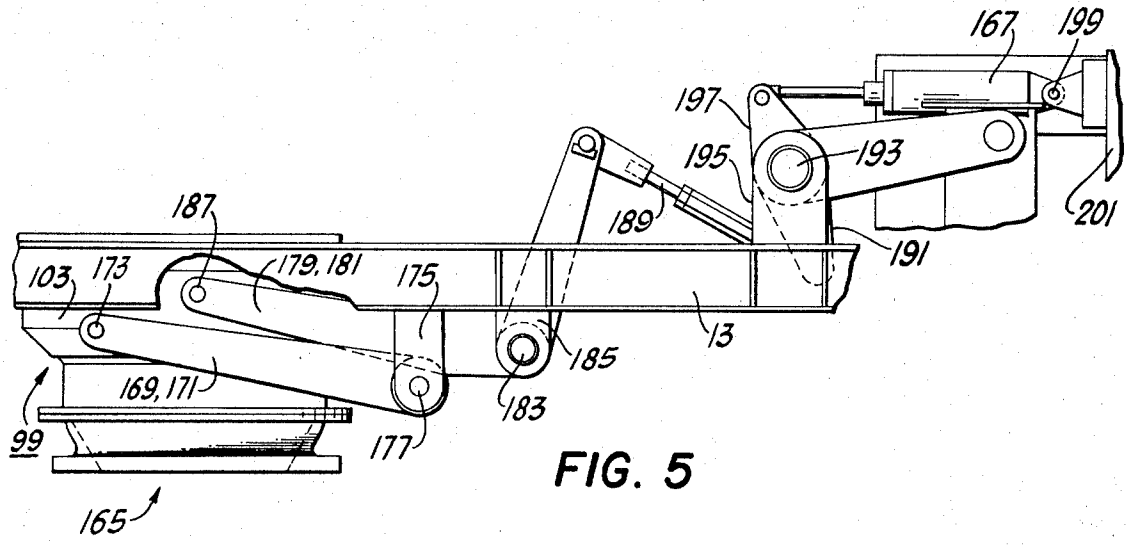


FIG. 5

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APPARATUS FOR HANDLING LIDS AND CHARGING COAL INTO COKE OVENS

BACKGROUND OF THE INVENTION

After each push of coke from a coke oven chamber, a larry car is maneuvered to a position over the empty oven and the coal charging hole lids are removed so that fresh coal can be charged into the oven chamber.

Heretofore, there was little or no care that the gases which were generated in the oven chamber when the fresh car contacted the hot oven walls was discharged to the atmosphere. But, nowadays, there are more stringent anti-pollution regulations that restrict the discharge of such gases to the atmosphere.

Numerous devices have been proposed in the prior art for collecting and handling the gases generated in a coke oven chamber during the coal charging process, but none of these has proved to be entirely satisfactory since they did not adequately prevent gas emissions.

In contrast to the foregoing prior art devices, the apparatus of the present invention is unique and unobvious and is adapted to handle coke oven lids and to prevent the discharge of gases to the atmosphere in a highly efficient manner when coal is charged through the apparatus into a coking chamber.

SUMMARY OF THE INVENTION

An improved mechanism for handling lids and for charging coal into a coke oven chamber includes a first tube fixed vertically to a larry car and a movable second tube disposed coaxially with the first tube. A movable third tube is disposed coaxially within the second tube and means is provided for moving the second tube relative to and into sealing engagement with the first fixed tube.

A movable tubular drop sleeve assembly surrounds the fixed first tube and, when the drop sleeve is lowered onto the coke oven, the drop sleeve forms a gas tight seal with both the first tube and the coke oven battery.

Means is provided for moving the third tube relative to the second tube and also into contact with a lid; a pair of movable fingers being movable to grasp the lid and lift it off the coke oven.

When the third tube is raised, a screw conveyor moves coal into a hopper forming a portion of the fixed first tube and coal charges into the coke oven.

Upon replacing the lid, the third tube is oscillated about a vertical axis to seat the lid in the coal charging hole.

For a further understanding of the invention and for features and advantages thereof, references may be made to the following description and the drawings which illustrate a preferred embodiment of equipment in accordance with the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is an elevational view, partly in section of apparatus in accordance with the invention showing it in one operative position;

FIG. 2 is a view, similar to that of FIG. 1, but showing only a portion of it in another operative position;

FIG. 3 is a view similar to FIG. 2, but showing the apparatus in a third position;

FIG. 4 is a view similar to FIG. 1, showing the apparatus in a fourth operative position;

FIG. 5 is a view of other apparatus associated with that of FIG. 1; and

FIG. 6 is a view of the apparatus of FIG. 5, showing it in another operative position.

DETAILED DESCRIPTION

FIG. 1 illustrates apparatus 11 in accordance with the invention and it also illustrates the apparatus in one operative position. The apparatus 11 comprises generally: a frame 13 that includes a pair of upright opposed tee-bar members 15 that are each fixed vertically to a larry car 16 at locations thereon which are in substantial alignment with the charging holes of a coke oven chamber; the tee-bar members 15 are connected together at the top by a cross member 17 which, as shown in FIG. 1, is an I-beam, but which may be any suitable structural shape. The cross member 17 carries a pair of pulley supports 19, 21 and pulleys 23, 25 journaled to these supports.

Each pulley 23, 25 cooperates with a wire rope 27, 29 that is connected at one end to a counterweight 31, 33 and at the other end to a transversely extending bar 35 having slots 37, 39 in the ends thereof through which pass the upright tee-bar members 15, and the bar 35 also has a central passage 41.

Each counterweight 31, 33 is surrounded by and reciprocates in, a tube 43, 45 which is fixed to the body structure of the larry car 16 the counterweights are thereby guided in vertical movement only.

The cross member 17 supports a cylinder-piston 47 assembly, having a piston rod 49, which is provided with trunnions 51 that are journaled in bearings 53 mounted to the cross member 17 as shown. The piston rod 49 is pivotally connected, as at 55, to a transverse plate 57, as shown in FIG. 1.

The transverse plate 57 is also connected, adjacent its ends, to a pair of guide rods 59, 61 which extend upwardly and freely through holes 63, 65 in the bar 35; the holes 63, 65 being slightly larger in diameter than the guide rods 59, 61. Nuts and washers 67 disposed on the ends of the rods 59, 61 provide engagement with the bar 35 in the manner and for the purpose described hereinafter.

The transverse plate 57 carries a cylindrical lid tube 69 which is the innermost tube of three concentric, spaced-apart tubes 69, 71, 73. The intermediate seal tube 71 is secured at its top edge to a flange 75 which is bolted, or otherwise suitably fastened to a transverse plate 77, that is similar to the transverse bar 35 in that the plate 77 has end slots 79, 81 in which the vertically extending tee-bars are located.

The intermediary seal-tube 71 is provided with spaced-apart annular rings 83, 85 that guide the inner or lid tube 69 as it moves vertically as described hereinafter.

The intermediary seal tube 71 is likewise guided during vertical movement, as hereinafter described, by an annular ring 87 mounted to the fixed outer tube 73. Adjacent the bottom of the fixed outer tube 73, there is an annular ring seat 89 which has a bevelled upper edge 91 against which the lower edge of the intermediary seal tube 71 abuts and forms a seal. The fixed outer tube 73 is secured to the lower end of the vertically extending tee-bars 15 in a suitable manner, such as by means of bolts 93, so that the tube 73 may, whenever it is deemed to be necessary, be removed and replaced.

The fixed outer tube **73** is provided with a coal hopper **95** having an upwardly and outwardly sloping side wall, as shown, and a top **97**. Coal is fed into the hopper **95** by means of a screw conveyor **98** which is a conventional apparatus, or it may be fed into the hopper **95** in any other known manner.

In spaced-apart, and free relation to the lower end of the fixed outer tube **73** there is a drop sleeve assembly **99** which includes three cooperative members: a drop ring **101**; a collar **103**; and a floating annular ring seal **105**.

The drop ring **101** is shaped in cross section about as shown in FIG. **1**, having a flat, flanged bottom **107** that is adapted to contact and form a seal with the top surface of the charging hole frame **163**, and that is disposed in spaced apart relation to each charging hole **111**. The upper portion **113** of the drop ring **101** is flared, as shown, so that it cooperates with the inwardly directed portion **115** of the collar **103**.

The collar **103** has a downwardly sloping top **114**, with a large central opening **116**; the inner edge of the opening **116** being engageable with a seal ring **117** welded about where shown to the lower end of the fixed outer tube **73**.

Within the collar **103** there is disposed the annular seal ring **105** which is so sized that its lower surface contacts and forms a seal with the upper edges **119** of the drop ring, while the outer perimetrical edge forms a seal with the inner surface of the collar **103**.

The transverse plate **57** carries in suspended fashion a platform **121** which is disposed within the innermost or lid tube **69**, about as shown in FIG. **1**. Mounted to the platform **121** is an hydraulic rotary actuator **123**, of the type which is marketed by Ex-Cell-O Corp., Greenville, Ohio under the trademark ROTAC. Those skilled in the art will understand that any other suitable rotary actuator may be used if preferred.

The ROTAC actuator carries in suspended fashion a cylinder-piston assembly **125** and piston rod **127** to which is connected a clevis **129**. The piston rod **127** is disposed to reciprocate vertically in a guide **131** mounted to the innermost lid tube **69**, about where shown in FIGS. **1** and **2**.

The clevis **129** carries a transversely extending pin **133** which coacts in slots **135**, **137** in the upper end portion of each of a pair of lifter arms **139**, **141**. The lifter arms are pivotable about a shaft **143** mounted transversely in the lower end of the innermost lid tube **69**.

Each lifter arm **139**, **141** is provided at its lower end with a slotted bottom **145**, **147** that coacts with the upstanding round Tee-head portion **149** of a charging hole lid **151**.

The bottom edge of the innermost or lid tube **69** is serrated about as shown at **153** in FIG. **2**, and the serrations **153** coact with a single lug **155** which is welded to the upper surface of the charging hole lid **151** in such a location that it will fit into one of the serrations **153**.

It will be noted that the lid lifter apparatus **11** is intended to be used with a lid **151** like that shown in FIG. **2**, which is a circular steel plate having a cylindrical peripheral surface **157**. A beveled edge is not provided on the lid, but such an edge is provided on a lid seat **163** set into the top of the coke oven battery.

FIGS. **5** and **6** illustrate an apparatus **165** for raising and lowering the drop sleeve assembly **99**. The apparatus comprises generally linkages and a fluid actuated cylinder-piston assembly **167**.

A pair of parallel outer compensator arms **169**, **171** are pivotally connected at **173** to the collar **103**, about where shown in FIGS. **5** and **6**, and to lugs **175** as by pivot pins **177**.

Another pair of inner drop-sleeve arms **179**, **181**, having the shape of bellcranks, are pivoted as at **183** to lugs **185**, and to the collar **103**, as at pivot pins **187**.

It will be noted from FIG. **5** that the distance between pivot pins **183**, **187** is equal to the distance between pivot pins **173**, **177**, and that the arms **179**, **181** are parallel to the arms **169**, **171**. In fact, the distance between pins **173**, **187** is equal to the distance between pins **177**, **183**. Thus, the arms **169**, **171** and **179**, **181** form the parallel sides of a parallelogram.

The bell cranks **179**, **181** are connected to a link **189** which is itself secured to a crank **191** mounted to a shaft **193** that is journaled to supports **195** mounted to the larry car **16**. Adjacent one end of the shaft **193** is another crank **197** which is connected to the piston rod portion of the cylinder-piston assembly **167**; the cylinder-piston assembly **167** being pivotally mounted as at **199** to adjacent fixed structure **201** on the larry car **16**.

Now, FIG. **1** represents the traveling position of the lid lifter apparatus **11** which has just been spotted above the charging hole lid **151**. The larry car **16** which carries the apparatus **11**, should be spotted within a preselected maximum allowable tolerance of the exact centerline of the coke oven chamber to be charged.

The pneumatic cylinder-piston **167** is actuated to pivot the bell cranks **179**, **181** counterclockwise, as viewed in FIG. **5**. Movement of the bell cranks in this direction, lowers the drop sleeve assembly into engagement with the top of the coke oven chamber, as shown in FIG. **4**. After the drop ring **101** engages the oven chamber, the collar **103** continues downward until the peripheral edge of the sloping top **114** engages and seats on the seal ring **117**. The internal floating ring seal then engages the upper edge **119** and forms a seal with it as well as a seal with the inner wall of the collar, as shown in FIG. **4**.

It should be noted that the seal tube **71** moves downward also, and the lower end of it engages the beveled surface **91** of the ring seat **89** and forms a seal with that surface. The seal tube **71** then is in position, as shown in FIG. **1**, while the drop sleeve assembly is being lowered.

Thereupon, the cylinder-piston assembly **47** is actuated so that the rod **49**, the lid tube **69** and the mechanism attached to the transverse plate **57** move downward. The lid tube **69** engages the top surface **159** of the lid **151**; the lug **155** coacting with one of the serrations **153**. In the down position (the lid tube being in contact with the lid), the lid lifter arms are open and in the position shown in FIG. **2**.

Cylinder-piston assembly **125** is then extended and the pin **133** coacts with the slots **135**, **137** and pivots the lid lifting arms about the fixed pin **143** to the closed position, shown in FIG. **3**, in which they surround the tee-head **149**.

Cylinder-piston assembly **47** is thereupon actuated to raise the lid tube and the lid. During the upward movement, the transverse plate **57** engages the other transverse plate **77** and the seal tube is thereafter raised vertically also.

It should be noted that when the lid tube is urged downward, the counterweights **31, 33** move upward within their respective guide tubes **43, 45**. So, too, when the lid tube and the seal tube move upwardly, the counterweights move downwardly.

The transverse-bar **35**, which moves upwardly along with the lid tube **69** and seal tube **73**, contacts a pair of stops **203, 205** that are suitably fastened to the vertical tee-bar members **15, 13** about where shown in FIG. **1**. Contact with these stops arrests the downward movement of the counterweights, but the tubes **69, 71** continue to rise until they reach the position shown in FIG. **4** with the lower ends of the tube **71** above the screw conveyor **98**.

As soon as the mechanism has stopped its upward movements, the screw conveyor **98** is actuated so that coal discharges into the hopper **95**. It then flows through the tube **73** and drop sleeve arrangement **99** and gravitates into the coke oven chamber.

Gases which evolve before, during and after the charging process cannot escape to the atmosphere because of the seal provided at surface **91** in the seal tube arrangement and because of the close tolerance between the ring seal **105** and the drop ring **101** and the collar **103**.

After charging is completed, the cylinder-piston assembly **47** is extended until the seal tube contacts and makes a seal with the beveled edge of the ring seat. This seals against smoke issuing into the hopper and screw trough, and also prevents any loose coal from running out of the discharge spout.

The cylinder-piston assembly **47** extends further until the lid contacts the charging hole and the lid tube contacts the lid. Thereafter, the rotary actuator, ROTAC, is activated to oscillate the lid tube and the lid about the vertical axis of the lid tube; the oscillatory action being confined to an arc of about 30°.

Thereupon, the cylinder-piston **125** is again actuated to move the clevis and pin **129, 133** downward, thereby opening the lifter arms. The mechanism may now be raised and made ready for movement to another oven to be charged.

This is accomplished by activating the cylinder-piston **47** which results in raising the lid tube and the apparatus connected to the transverse plate **57**. Simultaneously, or nearly so, the mechanism **165** must be activated to raise the drop sleeve arrangement to the up position shown in FIG. **1**.

It should be noted that the counterweights hold the lid tube and the mechanism attached to the transverse plate **57** in the up or travel position.

It is customary to move the larry car to the next coke oven chamber that is to be charged and to be dampered off. After the larry car is spotted at the oven, cylinder-piston assembly **47** is activated, thereby extending the piston rod **49**. The lid tube again contacts a lid and the cylinder-piston arrangement **125** is activated. The piston rod **127** is extended and the lifting fingers are brought into engagement with the Tee-head on the lid.

Now then, the cylinder-piston assembly **47** is activated to raise the lid tube and the lid to the travel position. The larry car next moves to the coal bin and, after receiving a supply of coal, it returns to the oven to be charged. The other charging hole lids are removed in the manner described hereinbefore and the oven is charged as described.

From the foregoing description, those skilled in the art will recognize numerous features and advantages among which the most significant are:

That the lid lifter unit is easily replaceable when it is desirable or necessary to do this. Only the bolts holding the tee-members to the larry car need to be removed and the entire lid lifter assembly may be quickly removed. A new or repaired lid lifter unit can be as quickly installed:

That the lid lifter assembly has effective seals that prevent smoke and dust from being emitted to the atmosphere;

That the lid lifter assembly is readily adaptable for use on any conventional type of coal charging larry car having either a screw feed, gravity feed, or turntable feed system;

That the assembly may be adapted for use with either a mechanical type of lid engagement apparatus, like that shown and described, or a magnetic lid lifting apparatus of a known type;

That the oscillation of the lid is due to a positive mechanical engagement of lid and lid tube, but it may be modified to accommodate any other type of oscillating apparatus, such as a saw blade that is associated with a magnetic lifter; and

That the several cylinder-piston assemblies may be activated by either air, hydraulic fluid, or they may be electrically operated cylinders.

Although the invention has been described herein with a certain degree of particularity it is understood that the present disclosure has been made only as an example and that the scope of the invention is defined by what is hereinafter claimed.

What is claimed is:

1. In a coke oven battery having a larry car and a lid on a coal charging hole of a coking chamber of said battery, the improved mechanism for handling such lid and charging coal into said chamber comprising:

a. a vertically aligned frame fixed to said larry car;

b. a first tube fixed vertically to said frame and positionable in vertical alignment with said charging hole, said first tube carrying an internal sealing ring and an external sealing ring;

c. a movable second tube disposed in coaxial, spaced-apart relation to and within said first tube;

d. a movable third tube disposed in coaxial, spaced-apart relation to and within said second tube;

e. first means for moving said second tube relative to and into sealing relation with said internal sealing ring;

f. a movable tubular assembly disposed coaxially with and surrounding said first tube;

g. second means for bringing said tubular assembly into contact with said coke oven battery and surrounding relation to said lid, said tubular assembly making a sealing engagement with said external sealing ring;

h. third means for moving said third tube relative to said second tube and into contact with said lid;

i. fourth means associated with said third tube for engaging and grasping said lid;
j. fifth means for activating said fourth means and raising said lid from said charging hole;
k. a hopper mounted to and communicating with interior of said first tube; and
l. means for moving coal into said hopper whereby it gravitates into said coking chamber.

2. The apparatus of claim 1 including:
a. a lug on said lid; and
b. means on said third tube engageable with said lug; and
c. means for oscillating said third tube about its vertical axis and also for oscillating said lid.

3. The apparatus of claim 1 including:
a. spacers mounted internally of said second tube for guiding said third tube as it moves relative to said second tube; and
b. a spacer mounted internally of said first tube for guiding said second tube as it moves relative to said first tube.

4. The apparatus of claim 1 wherein said movable tubular assembly comprises:
a. a first tubular ring concentrically surrounding said first tube in spaced-apart relation;
b. a second tubular ring concentrically surrounding said first tube and spaced apart from said first tubular ring, one portion of said first tubular ring being cooperative with a surface portion of said second tubular ring; and
c. an annular ring concentrically surrounding said first tube and being disposed freely within second tubular ring, said annular ring being engageable with said first tubular ring and being disposed closely adjacent said second tubular ring and forming seals therewith when said first tubular ring is in contact with said coke oven.

5. The apparatus of claim 1 wherein said second means includes:
a. a plurality of levers pivotally mounted to said tubular assembly and to adjacent structure of said larry car;
b. a fluid activated cylinder-piston assembly pivotally mounted to said larry car; and
c. linkage means connecting said levers and a piston-rod of said cylinder piston assembly whereby when said cylinder piston is actuated, said levers and linkage means raise and lower said tubular assembly relative to said first tube.

6. In a coke oven battery having a larry car and a lid on a coal charging hole of a coking chamber of said battery, the improved mechanism for handling such lid and charging coal into said chamber comprising:
a. a vertically aligned frame fixed to said larry car;
b. a first tube fixed vertically to said frame and positionable in vertical alignment with said charging hole, said first tube carrying an internal sealing ring and an external sealing ring;
c. a movable second tube disposed in coaxial, spaced-apart relation to and within said first tube;
d. a movable third tube disposed in coaxial, spaced-apart relation to and within said second tube;
e. a first cylinder-piston assembly having a piston rod connected to said third tube for moving it into engagement with said lid;
f. a lug on said lid;
g. serrations on the end of said third tube that are engageable with said lug for oscillating said lid when said third tube oscillates;
h. means for oscillating said third tube about its vertical axis;
i. means for moving axially said second tube into sealing engagement with said internal sealing ring;
j. a pair of lifter arms pivotally mounted within said third tube that are adapted to engage and hold said lid and raise said lid when said third tube moves axially, each lifter arm having an elongate slot in each arm that cooperates with a pin in a clevis secured to a piston rod;
k. said piston rod being coactive with a second cylinder-piston assembly so that, when the second cylinder-piston assembly is actuated, said lifter arms are pivotable for grasping and releasing said lid;
l. a first tubular ring concentrically surrounding said first tube in spaced-apart relation;
m. a second tubular ring concentrically surrounding said first tube and spaced apart from said first tubular ring, one portion of said first tubular ring being cooperative with a surface portion of said second tubular ring;
n. an annular ring concentrically surrounding said first tube and being disposed freely within said second tubular ring, said annular ring being engageable with said first tubular ring and being disposed closely adjacent said second tubular ring and forming seals therewith when said first tubular ring is in contact with said coke oven;
o. a plurality of levers pivotally mounted to said tubular assembly and to adjacent structure of said larry car;
p. a fluid actuated cylinder-piston assembly pivotally mounted to said larry car;
q. linkage means connecting said levers and a piston rod of said cylinder-piston assembly whereby, when said cylinder-piston assembly is actuated, said levers and linkage means raise and lower said tubular assembly relative to said first tube;
r. a hopper mounted to and communicating with said first tube; and
s. screw conveyor means for moving coal into said hopper and into said first tube so that said coal gravitates into said coking chamber after said lid has been raised.

7. The structure of claim 6 wherein:
a. said means for moving axially said second tube includes:
i. a first transverse member having an opening therein which is secured to the upper end of said second tube with the opening being coaxial with said second tube,
ii. means on said transverse member cooperating with said frame for guiding said second tube as it reciprocates vertically;
iii. a second transverse member secured to said frame and carrying a pair of spaced-apart pulleys;
iv. flexible means looped over said pulleys with one end of each flexible means being connected to a third transverse member that is secured to said first transverse member and with the other

end of each flexible means being connected to a counterweight, and

v. a fourth transverse member connected to said third tube and to said piston rod of said first cylinder-piston assembly, said fourth transverse member being engageable with said first transverse member as said fourth moves vertically and thereby axially moving said second tube.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,709,387 Dated January 9, 1973

Inventor(s) Raymond C. Kinzler and Albert G. Jonnet

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The name and address of the Assignee should be printed on the face of the patent as shown below:

Assignee: Koppers Company, Inc.,
a corporation of Delaware

Signed and sealed this 24th day of September 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents