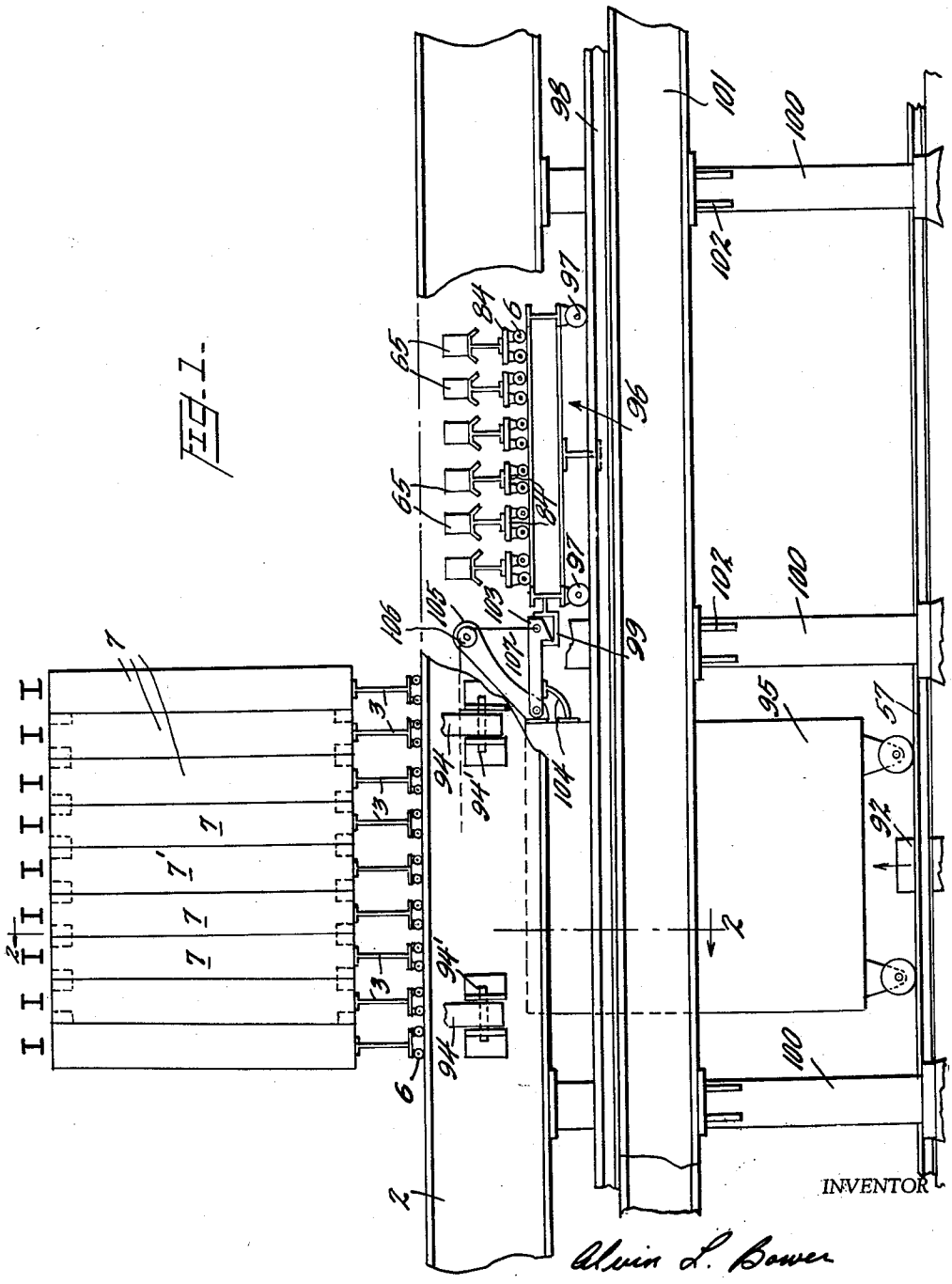
Jan. 15, 1963 A. L. BOWER 3,073,756

MOVABLE-WALL COKE OVEN

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FIG. 1.



INVENTOR

Alvin L. Bower

BY

Watson, Cole, Grindle & Watson

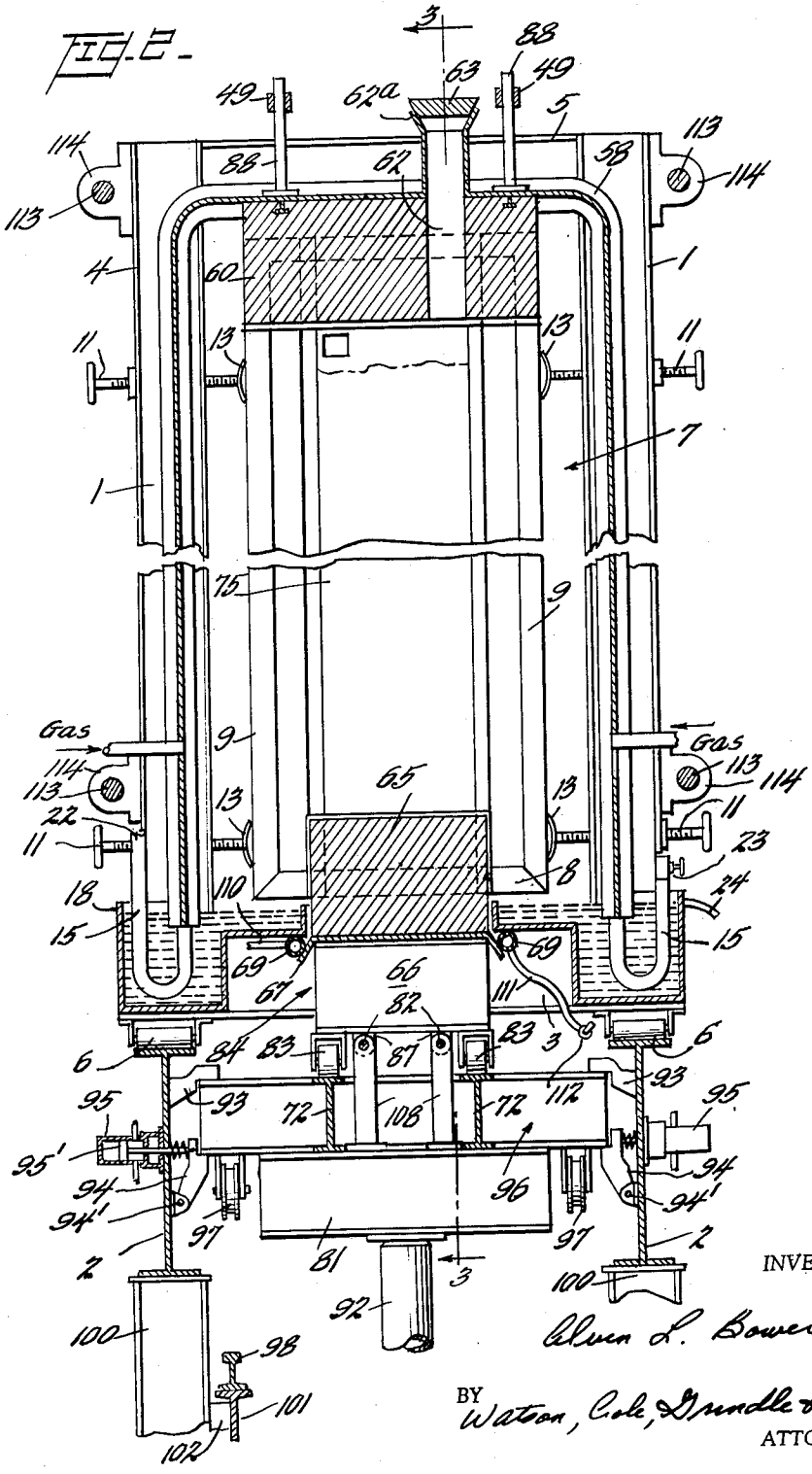
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MOVABLE-WALL COKE OVEN

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FIG. 2



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MOVABLE-WALL COKE OVEN

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FIG. 3.

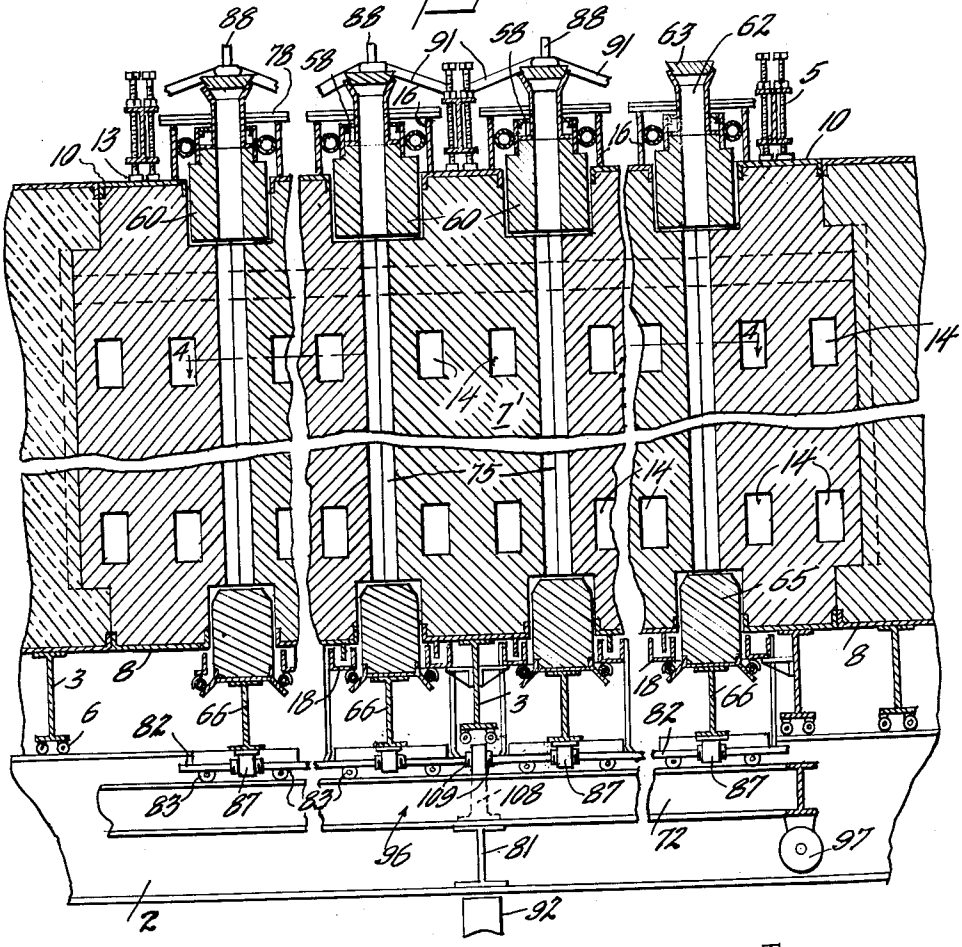
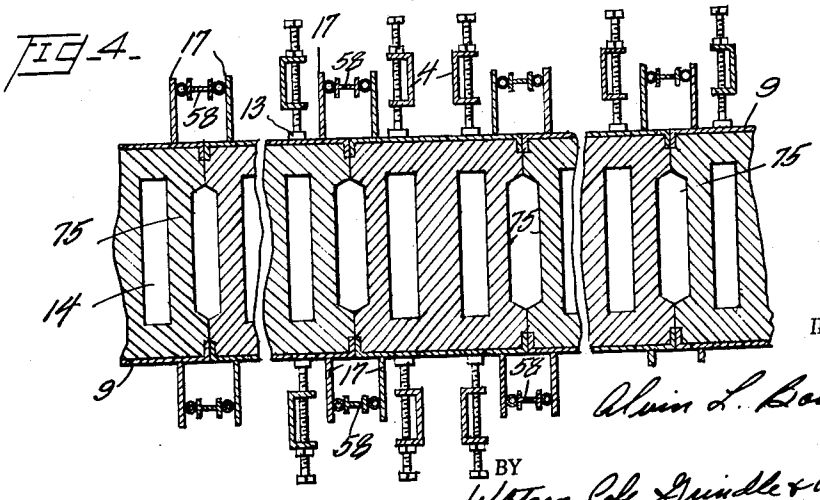


FIG. 4.



INVENTOR

Alvin L. Bower

BY

Watson, Cole, Grindle & Watson

ATTORNEYS

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MOVABLE-WALL COKE OVEN

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FIG. 5.

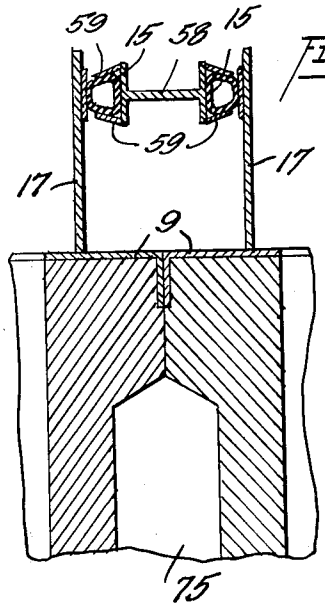


FIG. 6.

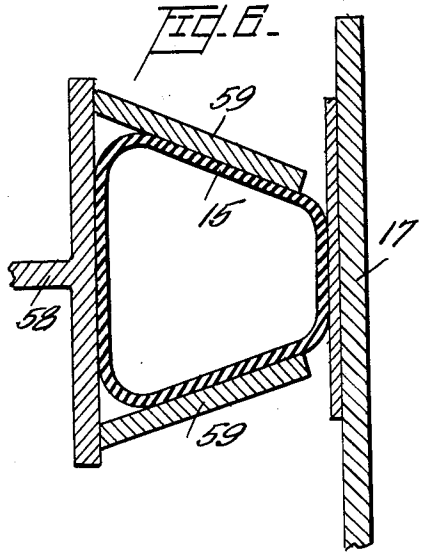
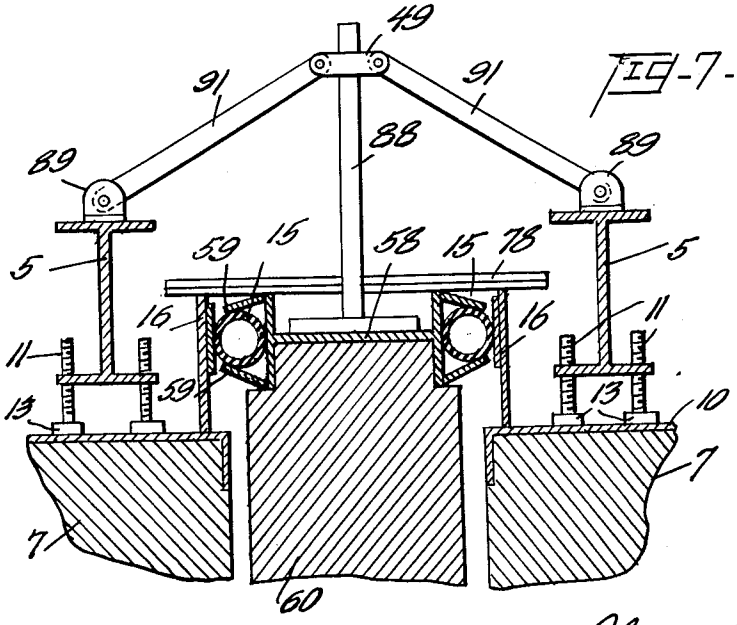


FIG. 7.



INVENTOR

Alvin L. Bower

BY Watson, Cole, Grindle & Watson

ATTORNEYS

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MOVABLE-WALL COKE OVEN

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FIG. 8.

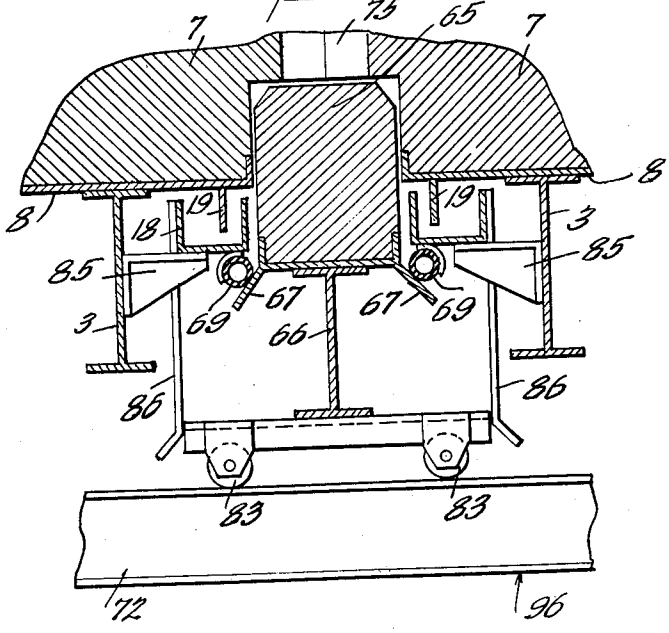
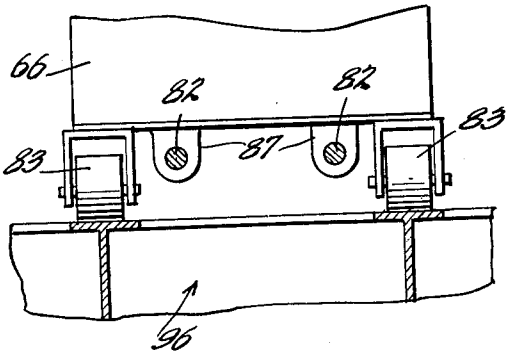


FIG. 9.



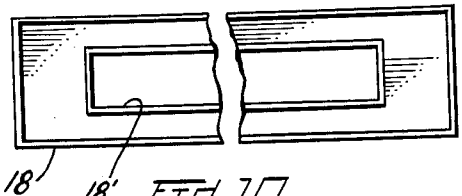


FIG. 10.

INVENTOR

Alvin L. Bower

BY

Watson, Cole, Grindle & Watson

ATTORNEYS

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3,073,756

MOVABLE-WALL COKE OVEN

Alvin L. Bower, 1847 17th St. SW., Allentown, Pa.

Filed July 24, 1959, Ser. No. 829,271
22 Claims. (Cl. 202—105)

This invention relates to improvements in a coke oven of the movable wall type such as exemplified in the United States Patent No. 2,490,090 to Puening and Bower.

In such ovens a plurality of coking oven compartments are defined between adjoining pairs of movable walls. The arrangement requires provision of effective sealing means for effecting a gas tight marginal seal between each pair of such walls when these are brought into their near contiguous coking relation, while still being operative to permit the walls to move apart for discharging their contents. Such seals must also be capable of remaining operative as the walls are moved apart to a limited extent as necessary to compensate for swelling of the coal or other material being heated within the oven compartments.

It is usual for such seals to be formed of composite construction. Generally such seals comprise water seals at the top and bottom horizontal edges of each adjoining pair of walls in conjunction with gasket or bellows type seals between the opposite vertical edges of the respective walls. The provision of such plurality of horizontal water seals, particularly the water seal at the top of the oven, has unduly complicated the seal construction by requiring provision of a gas tight juncture between the water seal and each of its associated gasket or bellows type seals.

It is the primary object of the present invention to simplify and improve the seal structure in such an oven by eliminating completely the top or upper water seal and by utilizing a single inverted U-shaped sealing element for sealing engagement with the upper horizontal edge portions and vertical side edge portions of each pair of cooperating walls. With such arrangement the lower ends of the depending legs of the U-shaped sealing element are received in a cooperating water trough extending beneath the oven compartment associated with each such element, and a sealing flange on each said wall projecting from its lower edge between the lower ends of the said legs is received in the water within the trough. Thus the resulting water seal cooperates with the U-shaped sealing element to form a complete marginal seal or enclosure around each oven compartment.

In accordance with a further important feature of this invention, the water troughs beneath the respective oven compartments are so arranged that they need not be tilted or emptied in order to permit removal of the oven floors and subsequent discharge of the oven contents at the conclusion of each coking operation. Moreover, the invention includes a novel cooperative relationship between the water troughs and the said floors in accordance with which the water troughs are respectively medially apertured so that the floors may be inserted into and removed from the lower end openings of their respective ovens through these apertures without disturbing the water troughs, the floors and water troughs being provided with cooperating sealing means around such apertures to provide a seal when the floors are operatively positioned. In this arrangement of the water troughs and floors, the floors support the oven contents above the level of and out of contact with the water, thereby replacing the use of coke breeze for this purpose, as in the prior art, and eliminating the rather extensive apparatus and procedures required as an incident to such use of the breeze.

An additional feature consists in providing charging openings directly through the horizontal upper portions

of the sealing elements as well as through oven tops or covers which may be carried by these elements.

The invention also contemplates a further novel feature in accordance with which in a unit of several ovens the several bottom floors are mounted on a common carriage for relative movement in the same direction as the walls and are moved in coordinated relation with the walls to maintain positions in centered relation between the walls. In turn, the carriage which thus supports the several floors is arranged to be selectively supported in raised position with the floors operatively projected through their respective troughs and into the bottom openings of their ovens. The carriage may be lowered onto the trackway to withdraw the oven floors from their respective ovens and troughs, whereupon the carriage may be moved along the trackway from beneath the ovens to thus permit unrestricted unloading or discharging of the several oven compartments.

This arrangement of the oven floors and their supporting carriage also contributes to a still further simplified unloading or discharging operation in which the quenching car for reception of the discharged coke may be moved into place beneath the oven and, incident to such movement will displace the carriage and floors. Incident to such positioning there is established a coupling between the quenching car and the carriage whereby the carriage may be drawn back into position beneath the oven and then raised into operative position incident to withdrawal of the loaded quenching car.

The foregoing as well as other incidental objects and advantages are all obtainable by the preferred embodiment of the invention illustrated merely by way of exemplification in the accompanying drawings.

In the accompanying drawings:

FIGURE 1 represents a side elevation, partly in section, showing generally a coke oven structure in its entirety incorporating the improved features of the invention.

FIGURE 2 is a cross-sectional view on the line 2—2 of FIGURE 1, showing the construction of one of the coking walls of the invention together with its supporting means.

FIGURE 3 is a section on the line 3—3 of FIGURE 2.

FIGURE 4 is a section on the line 4—4 of FIGURE 3.

FIGURE 5 is a vertical sectional view showing on an enlarged scale the arrangement of the gas seal at one side of a pair of adjoining oven walls.

FIGURE 6 is a further enlarged section through one of the seals shown in FIGURE 5.

FIGURE 7 is an enlarged vertical fragmentary section through the linkage means which centers one of the sealing elements between its associated coking walls.

FIGURE 8 is an enlarged view, partly in section and partly in side elevation of a portion of the oven wall and floor structure viewed from the same direction as FIGURE 1.

FIGURE 9 is a fragmentary end elevation of the structure shown in FIGURE 8.

FIGURE 10 is a plan view, with the central portion broken away, of one of the water troughs per se.

Referring now in detail to the accompanying drawings, reference is first made to FIGURE 1, in which there is shown on a reduced scale, the entire arrangement of the various components of the invention. The coking oven itself, generally designated capital "C" in this figure, is supported on a framework which in the preferred embodiment will be seen to consist of relatively spaced parallel horizontal girders 2 which are supported in elevated position above normal ground level by a plurality of rigid supporting columns 100. The oven itself comprises a plurality of normally adjoining vertical coking walls 7,

disposed in parallel relation and normally substantially contiguous to each other. The relatively adjacent faces of the walls of each pair are recessed in registry with each other throughout their entire vertical extent to define between each such pair of walls an oven compartment 75 (FIG. 2), having openings at both the top and bottom of the respective walls for charging and discharging purposes. Interiorly, each wall is provided with heating flues 14 (FIGURE 3) through which are passed hot gases which heat the walls and thus the ovens to coking temperature. Each such wall may be formed of brickwork (firebrick, silica, etc.) in more or less conventional manner and confined within an expansible frame extending around its outer margins. By reference to FIGURE 4, it will be seen that such frame comprises the relatively laterally opposed vertical side plates 9, of metal and similar lower and upper horizontal plates, 8 and 10 respectively, all of which are free for movement with respect to each other to permit both horizontal and vertical expansion and contraction of the brickwork with which they are associated responsive to temperature changes.

As shown in FIG. 1, each such wall further includes and is supported within a surrounding outer rigid frame of rectangular configuration comprising the vertical channel members 1, the supporting horizontal cross beam 3, which constitutes the bottom of this frame, and the upper cross beam 5 above the wall 7. In order to maintain the opposite sides of the wall under resilient compression at all times a series of bolts 11 adjustably threaded through vertical frame members or buckstays 4 are adjustable by means of rotary movement to transmit any desired degree of resilient thrust against the opposite sides of the wall 7, such thrust being resiliently transmitted through leaf springs 13 interposed between these walls and the ends of the respective bolts 11. A similar arrangement of bolts 11 threaded through the upper horizontal frame member 5, and having springs 13 interposed between their ends and the upper end of the wall, will maintain a resilient pressure against the upper end of the wall and this also may be adjusted as desired through rotary movement of the threaded bolts 11. (See FIGURE 7).

As above mentioned, when in operative coking position these several walls 7 are in mutually substantially contiguous relation to define the several coking oven compartments 75 (FIGURES 2, 3 and 4) between each adjoining pair of such walls.

However, in order to permit discharge of the coke that is formed in these compartments 75, provision is made for spreading apart the several walls 7 relative to one another, whereby the coke may be discharged through the bottom opening of each compartment. This general mode of operation is well known and accordingly will be understood readily by those skilled in the art.

Referring to FIGURES 1, 2 and 3, each such wall 7 in the present embodiment is supported by means of rollers or trucks 6 for movement normal to the respective walls in a predetermined direction along parallel underlying trackways defined by the relatively parallel girders 2. These girders are supported in spaced horizontal relation at the upper ends of the columns 100 and function as portions of the supporting framework or main frame of the structure.

In the illustrated form of the invention, there are an odd number of coking walls, namely seven, and the arrangement for relatively moving these walls is such that the middle wall, or in other words the fourth such wall from either end, will normally remain stationary while the walls on opposite sides of it will move in opposite directions along the girders 2 to thus spread the walls apart so that their oven contents may be readily discharged through the bottom openings of the respective ovens. This particular plan of movement, however, is not essential, it being necessary only that some suitable provision be made for separation of the oven walls for discharge purposes.

The contents of the respective ovens or oven compartments 75 will normally be supported and retained therein by means of oven floors 65 (FIGS. 2, 3 and 8) which are removably positioned in the bottom discharge openings of the respective oven compartments. The aforesaid FIGS. 2, 3 and 8 illustrate in detail the manner in which these several floors are mounted for movement to and from operative relation with the respective oven compartments and the manner in which they cooperate therewith.

Referring to FIG. 2, it will be seen that each such floor 65 is carried by a supporting truck 84 formed by a cross beam 66 which is supported on wheels 83 in such manner that the several floors 65 are movable relative to each other along the parallel trackways or rails 72 of a floor carriage or frame 96. This latter floor carriage normally supports the entire group or plurality of floors 65 in raised operative position with such floors in the respective bottom discharge openings of their oven compartments 75. Moreover, carriage 96 is provided with wheels 97 and may be lowered, both to retract the floors 65 from their respective discharge openings and also to bring the wheels 97 into operative rolling engagement on a supporting trackway defined by the rails 98 in FIGURES 1 and 2. These rails are supported on horizontal girders 101 constituting portions of the main frame of the structure, said girders being supported at least in part by means of brackets 102 on the upright columns 100.

Relative spreading movement of the several floors 65 simultaneously with the relative separating or spreading movement of the walls 7 is essential in order to permit such spreading movement of the walls after the floors are retracted to lowered positions. Accordingly there is provided mechanism for moving the walls apart relative to each other and for simultaneously moving the floors apart relative to each other in coordinated relation with the movement of the walls in a manner to maintain each of the floors at all times medially between its associated walls, or in other words, in a medial plane between the walls of its oven compartment.

Such mechanism may obviously assume various forms. In the present embodiment the mechanism for so moving the walls comprises a series of jack screws 113 (FIGURE 2) extending parallel to the movement of the walls and having threaded portions operatively disposed through internally threaded brackets or bushings 114 secured at the opposite corners of the main outer frame of each wall except as to the medial wall 7' in the preferred illustrated embodiment which as mentioned before will normally remain stationary. Accordingly, the brackets at the opposite corners of this particular wall or rather its outer frame merely provide smooth journals for the several jack screws 113 and the latter are secured against axial displacement through these journals as by means of radial flanges on opposite sides of the journals or in any other usual manner.

The specific arrangement of these jacks screws and their several threaded portions may be substantially as disclosed in my earlier Patent No. 2,490,090, it being understood that the threaded portions of each shaft which cooperate with different walls increase in pitch with each such wall, proceeding from the stationary middle wall 7' to the remote end walls 7. These jack screws may be rotated simultaneously through a usual driven connection with an electric motor, all as disclosed in my said patent.

A generally similar arrangement may be employed for spreading apart and drawing together the several floors 65 and their associated supporting trucks 84 in the manner above mentioned. Thus referring to FIGURES 2 and 3, the several floors are interconnected for the desired relative movement by means of a threaded jack shaft 82 having threaded portions of varying pitch thereon similar to those of the shafts 113. These are threadedly disposed through internally threaded brackets or nuts 87 secured to the respective floors at the lower edges

of the supporting cross beams 66 thereof. Each shaft 82 is rotatably supported also through a thrust bearing 108 fixed on the longitudinal supporting beam or rail 81 of the main floor carriage. As shown in FIGURE 3, collars 109 fixed on the shaft 82 on opposite sides of the bearing 108 abut axially thereagainst to positively prevent axial movement or displacement of the shaft 82.

An electric motor mounted on the carriage 96 in driving relation with the shaft 82, may be energized and de-energized simultaneously with the motor which drives the shafts 113, whereby to move all of the walls 7 and floors 65 in coordinated relation and to maintain the floors 65 medially between their respective walls at all times.

The floor carriage 96 will normally be supported in raised position above the trackway defined by rails 98 in order to secure the several floors in operative position in the bottom discharge openings of their respective oven compartments 75. Such function is attained by means of conventional spring projected latches 94 (FIGURE 2), pivoted as at 94' on the wall supporting girders 2 of the main frame. Retraction of these latches to permit lowering of the carriage 72 may be accomplished by any suitable means, as exemplified by the hydraulic piston and plunger mechanism 95 illustrated in FIGURE 2. The plunger 95' is connected to the free end of the latch and the latch is spring loaded toward latching position by means of a spring disposed about the plunger rod under compression between the latch and the girder 2.

For the purpose of raising and lowering the main carriage 96 to close or open the lower ends of the respective oven compartments 75 there may be provided a usual hydraulic or other type jack such as shown at 92 in FIGURES 1, 2 and 3, this jack being centered beneath the carriage 96 when the latter is in its operative position beneath the several oven walls 7. Obviously the jack 92 may be employed to lower the carriage 96 and floors 65 from the operative oven closing positions as shown in FIGURE 2 to a retracted position wherein the carriage rests for movement on the trackway provided by rails 98. Or the jack may be employed for raising the carriage from the track to position the floors in their respective discharge openings.

Thus the jack 92 exemplifies any suitable mechanism for raising the floor carriage 96 from its trackway 98 to position the floors in the respective bottom openings of their several oven compartments 75 and for lowering the carriage back on to the trackway to retract the floors from their respective openings to permit discharge of the coke at the conclusion of each coking operation. Obviously after the carriage 72 has been lowered into operative position on the trackway 98 it may be moved therealong from beneath the oven structure to approximately the position shown in full lines in FIGURE 1. This will not only move the floors 65 clear of the discharged coke as the latter descends from the ovens, but in addition will make way for the positioning of the usual quenching car 95 beneath the discharge openings of the ovens for reception of the coke. Such a car may be guided on rails 57 at ground level for movement therealong in conventional manner. It is a desirable feature of the invention also to provide a coupling between the quenching car and the floor carriage which may interconnect the two to move the carriage to inoperative position as shown in FIGURE 1 to permit loading of the quenching car and thereafter to permit return of the carriage into registering relation beneath the oven as the quenching car is moved away at the completion of the unloading operation.

Where the coupling means is employed, it may if desired be of the simplified form shown in FIGURE 1 comprising the coupling member 99 carried by the carriage 96 for cooperation with the coupling latch 103 which is pivotally mounted on the quenching car 95 for movement in a vertical plane and which normally projects horizontally from the quenching car toward the carriage,

being normally supported at a predetermined horizontal level by means of a bracket 104 on the quenching car. An inclined cam surface at the hooked end of the latch coupling member 103 is thus positioned at a level to engage and ride over the vertical holding portion or abutment at the relatively adjacent end of the coupling 99 as the quenching car 95 moves toward the carriage and into receiving position beneath the oven. An upstanding vertical wall at the end of the coupling remote from said coupling wall or abutment is engaged by the end of the latch and transmits the thrust thereof to the carriage 96 in order to move the latter from beneath the oven. Once such thrust is released it may be seen that the latch hook or coupling member 103 is free to drop into operative position behind the upstanding catch or abutment of the coupling 99 so that upon subsequent withdrawal of the quenching car upon completion of the oven unloading, this coupling will be operative to return the carriage to its former position in registry with the oven and over the jack 92. It will be noted, of course, that jack 92 may be lowered to a position wherein it will not interfere with the movement of the quenching car 95.

In order to permit uncoupling of the quenching car from the carriage after the latter has been returned to its registering position beneath the oven the latch 103 may be disengaged preferably from a remote point. To this end there is provided a rigid arm 105 on the quenching car and this arm serves as a mounting for a pulley 106 located above the normal operative range of the swinging movement of the free end of the latch 103 so that a draw string connected to this free end of the latch and passed over this pulley may be manually operated from any suitable point. Such a draw string is shown in part at 107.

As in well known in the art, it is necessary to provide some means establishing an efficient gas-tight seal extending completely around the external margin or periphery of each oven compartment 75 and also capable of withstanding the heat emanating from the ovens. Such means in the present embodiment includes a water tank or trough 18 such as shown in FIGURES 2, 3 and 10. Each such trough is supported beneath the bottom discharge opening of its respective compartment 75 and is so proportioned that its ends project laterally from the opposite sides of the oven for reception of and cooperation with further sealing components hereinafter described in more detail.

Each such water trough is in the form of an endless horizontal loop defining a central opening 18' therethrough to permit vertical movement of the cooperating oven floor 65 into and its withdrawal from coking position in the manner above described. A snug gas-tight seal is maintained between the oven floor and its respective trough by means of a sealing flange 67 extending marginally completely around the floor 65 and preferably inclined downwardly toward its outer marginal edges so that any coke or breeze dropping thereonto may be discharged by action of gravity to maintain the sealing surfaces of these flanges clear for efficient operation. Disposed around the opening of each such water trough on the underside thereof for engagement with the sealing flange 67, is a resilient gasket 69 which preferably comprises a flexible water hose in the form of an endless loop extending completely around said opening and adapted to seat snugly against the flange 67 as the floor 65 is raised into operative coking position. The disposition of this gasket 69 beneath the water pan is such that it will be protected from heat to a large extent by the water within the pan. In addition, water at a predetermined pressure is constantly circulated through hose 69 to insure the maintenance of same at a sufficiently cool temperature to prevent any damage or deterioration thereof due to excessive heat and to prevent the hose from collapsing under sealing pressure. The water may be delivered to such hose through a supply conduit 110

such as shown in FIGURE 2 and may be withdrawn through a generally similar conduit 111. Both of these conduits may, if desired, be flexible and the rate of flow of the cooling water through the hose 69 may be controlled by means of a valve 112 at the discharge end of conduit 111.

It will be apparent that each trough 18 must be capable of movement in the predetermined direction of relative spreading movement of the coking walls 7 and floors 65 and must move co-extensively and simultaneously with the floors 65 as the floors and walls are spread apart prior to discharging the oven contents. Obviously, various suitable means of mounting and moving the troughs 18 will occur to those skilled in the art and the means specifically illustrated herein is merely by way of exemplification. In the particular arrangement illustrated each water trough 18 is supported as shown in FIGURE 8 on shelves projecting laterally toward each other from the lower supporting frame members or cross beams 3 of the respective walls 7. The troughs are laterally slidable on these shelves to thus avoid any interference with the relative spreading movement of the associated walls 7 and may be themselves moved or positioned as required in order to maintain them accurately centered with respect to these walls at all times. In the present embodiment these water troughs normally are maintained centered by virtue of their depending brackets 86 (FIGURE 8) which receive and couple them to the operatively positioned or raised floors 65 during the spreading or closing movement of the walls.

Obviously with this arrangement the troughs may be maintained filled with water at all times. It is not necessary for them to be inverted or tilted incident to discharging of the oven contents as has been true in prior art structures. Consequently the structure above described permits considerable saving of time by avoiding the delay that would be involved incident to refilling of these troughs with water prior to the commencement of each coking operation, together with a substantial saving in the amount of water required.

Extending completly marginal around the inner frame, consisting of the members 8, 9 and 10 of each wall (FIG. 2) are outwardly projecting vertical sealing flanges, each comprising opposite sides 17—17 (FIG. 5) top 16 (FIG. 7) and bottom 19 (FIG. 8). The lower horizontal reach 19 of each such flange extends into and projects beneath the level of the water in the water troughs to establish a water seal such as is well known per se. The water troughs 18 are so dimensioned that the sealing flange portions 19 of the respective walls 7 received therein are permitted their full degree of movement relative to the pans such as will normally occur during the spreading apart and moving together of the walls.

In order to complete the seal on the other two vertical sides and around the top edge between each adjoining pair of walls 7 there is provided in the plane between each such pair of walls an inverted U-shaped sealing element 58 consisting of a U-shaped H beam. This element will be seen to include an upper horizontal bridge portion extending above the adjoining walls 7 and having depending legs extending downwardly into the water trough and beneath the surface of the water therein on opposite sides of the respective walls as in FIGURE 2. Each such sealing element presents a pair of relatively oppositely presented co-planar sealing surfaces respectively in opposed registering relation to the adjacent sealing flanges 16, 17 of its respective cooperating walls. Of course it will be understood that the length of immersion of the legs of the U-shaped sealing element 58 in the water of the trough 18 will be sufficient to insure a gas tight seal. Suitable gasket means carried by the respective elements 58 may cooperate with the water troughs to establish a complete unbroken marginal seal around each oven. Such gasket means is best exemplified by the water hoses 15, one of which, as shown in FIGURE 6, is supported on each of the opposite sealing faces of each element 58, extending completely around and co-extensive with the sealing element 58 with its opposed ends depending into the water trough on opposite sides of the oven structure. These hoses may be of a generally flexible resilient material such as natural or synthetic rubber compounds, plastics, or any other known material having the resilient and flexible characteristics desired. In order to provide for a constant cooling of these hoses 15 in order to prevent their deterioration due to the effects of the oven heat, and to create internal pressure, water is circulated through them. To this end, in the preferred embodiment the free ends of the respective hoses are reversely bent to project upwardly and out of the water within the troughs 18 as shown in FIGURE 2. Water from any suitable source may be delivered into the upwardly projecting intake end 22 of each hose and discharged from the other upwardly projecting end, if desired, its rate of flow being achieved by means of a control valve 23. The water discharged from each such hose may be received and collected within its associated water trough 18 to always maintain the water level at the desired height. Such level may be further controlled and maintained by means of an overflow pipe 24 associated with each trough.

With this arrangement it will be seen that as the several oven walls 7 are moved together into coking position, the hoses or gaskets 15 will be compressed between each U-shaped sealing element 58 and the relatively opposed faces of the sealing flange side and top portions 17—17 and 16 of its relatively adjacent cooperating coking walls 7.

In order that each such sealing element 58 may be maintained accurately centered at all times with respect to its associated coking walls, the upper or bridge portion of each such element 58 is suspended from horizontal brackets 78 (FIG. 7) secured to its upper edge and projecting therefrom in the direction of movement between the walls as shown in FIGS. 3 and 7. The projecting portions of these plates or brackets are slidably supported across the relatively adjoining flanges 16 with which they cooperate to form a seal. Such sliding suspension permits the desired degree of relative movement between each sealing element 58 and its respectively associated coking walls 7.

The desired centering of each sealing element 58 is attained in the preferred embodiment of the invention by means of the toggle joint shown in FIGURE 7 wherein toggle links 91 pivotally connected to brackets 89 on the respective outer frames 5 of their associated walls 7 have their relatively remote ends moved toward and away from each other by corresponding relative movement of the respective walls. The adjoining ends of the links 91 are interconnected by a knee element or link 49 having a vertical slide bearing therethrough which slidably receives a rigid stem 88 fixed on and projecting vertically upwardly from the sealing element 58. Due to the inherent mode of operation of such a toggle linkage, the knee link or bearing 49 thereof will always be maintained accurately centered between the walls 7 and their frames 5 and will thus coact with the stems 88 to center these. There will of course be a pair of such toggle joints and stems in spaced relation across the upper bridge portion of each member 58 to thus always maintain such member or element 58 properly centered between its associated coking walls 7.

It will also be seen in FIGURES 2 and 7 that a closure element or top cover 60 for the upper end opening of each oven compartment 75 is carried by and beneath the bridging portion or cross bar of each such sealing element 58. Each such top cover 60 obviously will always be centered by the element 58 between its cooperating coking walls 7 and will nearly fill the upper opening of its associated oven compartment when the walls are brought into coking position.

The foregoing disposition of parts permits of a novel

and extremely simplified manner of charging the oven with coal to be coked, the charging being accomplished from above as in the prior art but in a specifically different manner. Thus in accordance with the invention and as shown in FIGURE 1, each sealing element 58 is provided with a vertical charging opening 62 which extends completely through the horizontal bridging portion of such element and also through the top cover 60 into communication with its associated oven compartment 75.

If desired this opening may be extended upwardly through a funnel attachment 62*a*, the upper end of which is provided with a gas-tight removable closure in the form of a generally conical or oblong plug 63. It will thus be readily apparent that when the ovens are in coking position and ready for charging, the plugs may be readily removed to permit the charging operation through the openings 62 in a simplified manner.

As will be evident upon examination of FIGURE 7 an important part of my invention resides in the fact that it is possible, if desired, to make the charging opening 62 as wide as the coking chamber or oven itself.

The foregoing arrangement of parts and seals is such that the seal between adjoining walls will be maintained throughout a predetermined range of relative spreading movements of the respective walls such as may be required during the coking operation due to the expansion of the oven contents. This particular ability exists due to the fact that when the ovens are fully closed the respective sealing hoses 15 are deformed and partially flattened, and as this limited degree of relative spreading movement occurs the ensuing resilient tendency of the several sealing hoses to return to their normal round cross-sectional shape will maintain them in efficient sealing engagement with their cooperating flanges 16 and 17.

While the hoses 15 may be supported on their respective sealing elements 58 in various manners, one particular such arrangement found to be quite efficient consists in confining each such hose between a pair of retainer plates 59 such as shown in FIGURES 5 and 6. It will be seen that the said plates converge toward each other at their outer free ends. These ends are normally in engagement with the opposed sides of the hose and the hose projects substantially beyond them for sealing engagement with the cooperating sealing flanges 16 and 17 in each case. This arrangement permits a substantial range of movement between each sealing element 58 and its cooperating sealing flanges. Thus in FIGURE 7 the hose and its cooperating elements 58 and flanges 16 are seen in a position which they will occupy when the oven walls 7 are relatively spread to compensate for the swelling of coal within them during the coking operation. In FIGURES 5 and 6, however, the hose is shown partly flattened, as it will appear when the oven walls are completely closed and ready for charging of the coal therein prior to the actual commencement of the coking cycle. In FIGURE 5, it will be seen that the sealing flange 17 closely approaches the free ends of the retainer plates 59 and flattens its cooperating contacting area of the hose 15. The converging relation of the retainers or plates 59 has the particular advantage that it leaves between them an area or space which is not occupied by the hose when in its nearly round condition as shown in FIGURE 7 and into which space the hose may be readily compressed when the hose is partially flattened as in FIGURES 5 and 6.

It will be readily apparent that the sealing flange sections 16, 17—17, will be subjected to substantial expansion and contraction incident to heating and cooling of the oven and these parts may be accordingly provided with suitably located and disposed expansion joints which may be in accordance with known practice. Accordingly such joints are not illustrated herein, it being required only that the joints be so disposed as to maintain suitable sealing surfaces of unbroken extent for sealing engagement with the hoses 15 in each case.

Thus in the use of a coking oven in accordance with the invention, in order to prepare the oven for a coking operation the several walls 7 thereof are moved into contiguous coking position by actuation of their jack screws 113. The several oven floors 65 which will have been previously raised upwardly into the respective bottom openings of their oven compartments and held in such raised position by engagement of the latches 94 with the floor carriage, will move with the walls and their movement will be perfectly coordinated with that of the walls by means of the jack screws 82, the motors of which are driven in coordinated relation with the motor which actuates the jack screws 113 of the walls. Similarly, the toggle linkages 90, 91 associated with the respective sealing elements 58 will maintain these elements centered, each with respect to its cooperating pair of walls and will produce the desired movement of the sealing elements and also the top covers 60 with the walls. Thus when the walls are brought into their closed coking positions, gas-tight seals will be established completely around each oven. The ovens may be then charged in obvious manner through their respective charging openings 62. Circulation of heating gases as well as the withdrawal of gases emitted from the material within the ovens may be accomplished generally in the manner heretofore known in the art, and thus neither described in nor part of the present invention.

When it is desired to discharge the contents of the respective oven compartments 75 at the conclusion of a coking cycle, jack 92 is raised into supporting engagement with the floor carriage 96. The floor carriage latches 94 are retracted by actuation of their hydraulic controls 95 thus leaving the jack 92 as the sole support of the floor carriage 96. The jack is then actuated to lower the carriage until its rollers 97 come to rest on the trackway provided by the rails 98. The downward movement of the carriage also retracts the several floors downwardly out of their respective bottom openings of the ovens. As soon as the carriage has been received on its trackway 98 the quenching car 95 will be moved to a position beneath the oven 5 and its several bottom discharge openings, and incident to such movement coupling means 103 will interengage with the corresponding means 99 of the carriage. The carriage will thus be propelled to the right in FIGURE 1 to a position where it is displaced from beneath the oven structure. The respective oven walls and floors are then relatively moved apart by their respective jack screws in a manner which will be readily apparent from the above. As a result of such spreading or opening movement the coke will then be discharged from the various oven compartments into the quenching car 95.

After the coke is discharged into the quenching car as above mentioned, the car may be moved away on its tracks to the left as seen in FIGURE 1 whereupon its coupling latch or hook 103 will coact with the coupling means of the carriage to return the latter to its operative position beneath the oven. As the carriage is thus returned, the coupling will be released by actuation of the draw string 107 shown in FIGURE 1, to leave the carriage in a stationary position beneath the oven and above the hydraulic jack which, at this time, is retracted to such point as to permit the quenching car to pass over it. In order to again place the oven in condition for charging and for a further coking cycle, the jack 92 is raised into engagement with the carriage and on its continuing upward movement raises the carriage from the tracks 98 to the desired operative position which may be governed by interengagement between the carriage and suitable stops 93 fixed on the supporting girders 2 of the main frame of the oven.

It will be seen that the several oven floors at this time will be reinserted back upwardly through their respective water troughs and into operative positions in the respective bottom discharge openings of their several oven compartments 75. Incident to the operative positioning of

these floors 65 their sealing flanges 67 will be brought into sealing engagement with the hoses 69 carried by the water troughs around their respective openings.

Having thus described my invention what I claim and desire to secure by Letters Patent is:

1. A coke oven comprising a plurality of vertical coking walls, means supporting said walls in parallel relationship for relative movement toward and away from each other, each adjoining pair of said walls normally defining between them an oven compartment having a downwardly directed discharge opening, a series of water troughs mounted beneath said respective oven compartments for relative movement parallel to the movement of said walls, each said trough having a medial floor opening therethrough normally registering with the discharge opening of its respective oven compartment, a floor carriage having a plurality of oven floors supported thereon, releaseable means normally supporting the carriage in raised position beneath said oven with its several floors projected through the openings in said water troughs and operatively received in said discharge openings, each said floor and its associated trough being provided beneath said trough with sealing means extending marginally around said opening in the trough and operative in the raised position of the carriage to establish a gas-tight seal between each floor and its said trough, means supporting the respective floors for relative horizontal movement on said carriage, releaseable couplings operative in the raised position of said carriage for causing each said water trough to move horizontally with its associated floor, and an inverted U-shaped sealing element operatively supported by and normally compressed between each said pair of relatively adjoining walls, said sealing element including vertical legs extending down the sides of said respective walls and into said water trough and a bridging portion extending horizontally between said legs at the upper ends of said walls, each said wall having a sealing flange along its horizontal bottom edge received within said trough and forming a water seal between said opposite legs, means mounting said sealing elements for horizontal movement relative to each other and to said walls, and means operative for horizontally moving said sealing elements, walls and floors simultaneously and in coordinated relation to maintain the sealing elements and floors centered relative to their respective oven compartments.

2. A coke oven comprising a plurality of vertical coking walls, means supporting said walls in vertical relationship for relative horizontal movement toward and away from each other, each adjoining pair of said walls normally defining between them an oven compartment having a downwardly directed discharge opening, a series of water troughs mounted beneath said respective oven compartments for movement relative to each other parallel to the relative movement of said walls, each said wall having a depending flange along its lower edge received in said water trough to establish a water seal beneath said wall, a sealing element extending from opposite ends of said water seal between each adjoining pair of said walls and on opposite sides and over the top of the oven compartment formed therebetween, each said trough having a medial aperature between said flanges normally in vertical registry with said discharge opening of its associated oven compartment for removable reception of an oven floor, a plurality of oven floors and means for moving them vertically through said apertures in the respective troughs into the lower ends of the respective compartments, said troughs including sealing means on their lower faces disposed around said aperture for sealing engagement with said floors.

3. A coke oven as defined in claim 2, including brackets carried by each pair of adjoining coking walls for horizontally slidably supporting one of said troughs.

4. A coke oven as defined in claim 2, including means for causing relative horizontal movement of said water troughs in coordinated relation with the movement of said walls to maintain the apertures of said troughs constantly centered between said adjoining walls.

5. A coke oven as defined in claim 2 wherein the means supporting said walls for relative horizontal movement is disposed beneath said walls, and each said sealing element is slidably supported between its associated walls for movement relative to and in the same direction as said walls.

6. A coke oven as defined in claim 5, including a linkage interconnecting each said sealing element to its respective adjoining walls and operative responsive to relative movement of the walls for maintaining the sealing element centered therebetween.

7. A coke oven as defined in claim 6, wherein said linkage is a toggle linkage including rigid links pivotally connected at their adjoining ends to a central guide bearing, the relatively remote ends of said links being pivotally connected to said respective walls, said sealing element having a rigid guiding stem projecting edgewise therefrom and slidably disposed through said bearings.

8. A coke oven as defined in claim 2, including a carriage, said plurality of oven floors being supported on said carriage and normally spaced apart, said floors corresponding in number and spacing with the discharge openings of said oven compartments, a horizontal trackway disposed beneath said discharge opening and said troughs for guiding said carriage to and from a position beneath said oven wherein said oven doors are in vertical registry with the respective oven compartments.

9. A coke oven as defined in claim 8, including means located beneath said oven for raising and lowering said carriage to and from said trackway to operatively position all of said doors in the lower ends of their respective compartments.

10. A coke oven as defined in claim 9, including latch means on said oven for releasably supporting said carriage in its raised position.

11. A coke oven as defined in claim 2, wherein said means for vertically moving the oven floors includes a carriage, means for raising and lowering said carriage, means guiding same for horizontal movement to and from an operative position beneath said oven, a quenching car, means guiding said car for movement to and from an operative position beneath said oven, and cooperating automatic coupling mechanisms on said car and said carriage respectively positioned for coaction incident to movement of said car toward said carriage, whereby movement of said car to its operative position interlocks said couplings and displaces said carriage from beneath the oven, and retraction of the car from beneath the oven acts through said coupling to return the carriage to its operative position.

12. A movable wall coke oven as defined in claim 1, wherein said sealing elements respectively include flexible hoses supported thereon for sealing engagement with the respective side flanges of their cooperating coking walls, and extending co-extensively therewith from beneath the water level in the respective troughs on opposite sides of said walls, each said hose being adapted for reception and passage therethrough of cooling water.

13. A movable wall coke oven as defined in claim 12 wherein one end of each said hose is arranged to discharge its water into one of said water troughs to maintain the water supply therein up to a predetermined level.

14. In a coke oven of the class employing a plurality of relatively horizontally movable vertical coking walls, normally in substantially contiguous coking relation, with each pair of relatively adjoining walls oppositely recessed to jointly define a downwardly opening oven compartment, and means carried by said walls forming a continuous marginal gas-tight seal above and on opposite sides of each said compartment, the combination with said oven of a water trough in the form of an endless horizontal loop beneath each said oven compartment, flanges depending from the walls respectively into said troughs and supple-

menting the aforementioned gas-tight seals to form a complete gas-tight marginal seal around said oven, each said water trough defining a vertical aperture in vertical registry with one of said oven compartments for removable reception of oven floors, a plurality of oven floors normally in vertical registry with the respective compartments, and means for supporting and moving said floors vertically into and from the lower ends of the respective compartments through the apertures in the respective troughs, each said trough having endless sealing means extending marginally around its said aperture for cooperation with one of said floors.

15. A coke oven as defined in claim 14 in which the means for supporting and moving said floors comprises a carriage, means positioning said floors on the carriage for reception in the downwardly presented openings of the respective oven compartments, means for moving said carriage and floors horizontally beneath said troughs to and from a position beneath said oven wherein the floors register vertically with the respective openings of said oven compartments, and means for selectively raising and lowering said carriage to move said floors upwardly through said apertures in their water troughs into operative position in their said openings and into operative engagement with the sealing means of their respective water troughs.

16. The combination of claim 15 wherein said sealing means comprises an endless resiliently compressible gasket element disposed on the bottom of each said trough and protected from oven heat by the water within said trough.

17. The combination of claim 16 wherein each said oven floor includes a laterally projecting outwardly and downwardly inclined marginal flange for sealing engagement with said gasket element incident to raising of the floor to operative position, the inclination of said flange being such as to shed any coke or breeze that may drop thereonto, whereby to maintain the surface of said flange clear for sealing cooperation with its associated gasket element.

18. The combination of claim 17 wherein each said gasket element comprises a water hose, and means for passing water therethrough for cooling purposes.

19. The combination of claim 15 wherein said floors are mounted for relatively horizontal movement on said carriage, and including means on the carriage for moving said floors relatively toward and away from each other.

20. The combination of claim 19, including means operative in the raised position of said floors for interconnecting each said water trough to its associated floor for horizontal movement therewith.

21. The combination of claim 15 wherein said floors are mounted for relatively horizontal movement on said carriage, including means on the carriage for moving the floors relatively toward and away from each other, means operative in the raised position of said floors for interconnecting each water trough to its associated floor for horizontal movement therewith, means for moving said oven walls toward and away from each other, and means for coordinating the movements of said walls and said floors to maintain the floors at all times centered with respect to the downward openings of their respective ovens.

22. The combination defined in claim 14, including means mounting the said seal forming means from the respective walls for movement horizontally relative to each other and to the said walls, and linkage means interconnecting said seal forming means to the said pairs of adjoining walls for maintaining each said seal forming means centered in a plane between said walls throughout the relative movement of said walls.

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