Dec. 5, 1939. P. H. LAVELY 2,182,494

COKE-OVEN DOOR MACHINE

Filed Dec. 29, 1937 5 Sheets-Sheet 1

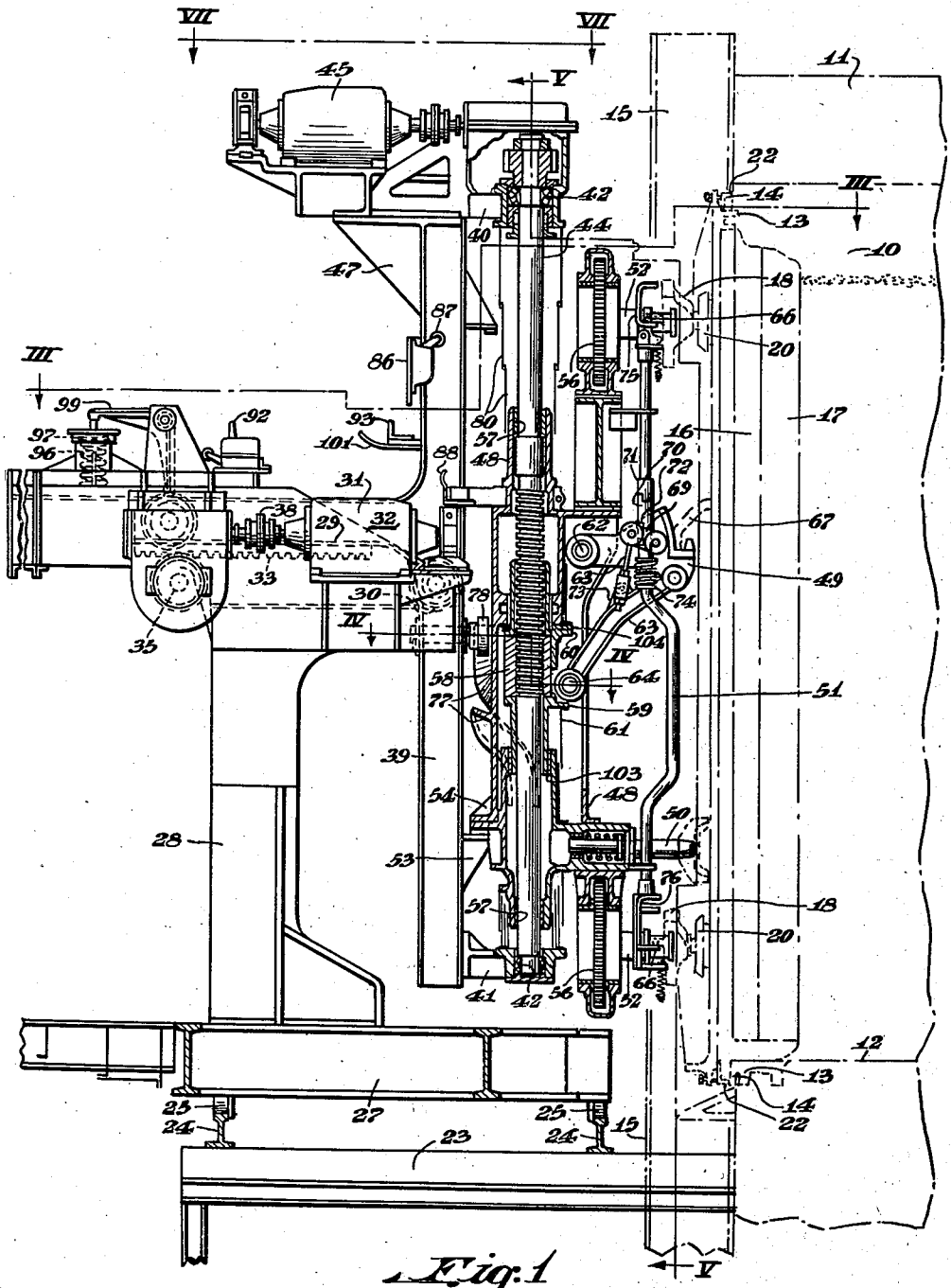


Fig. 1

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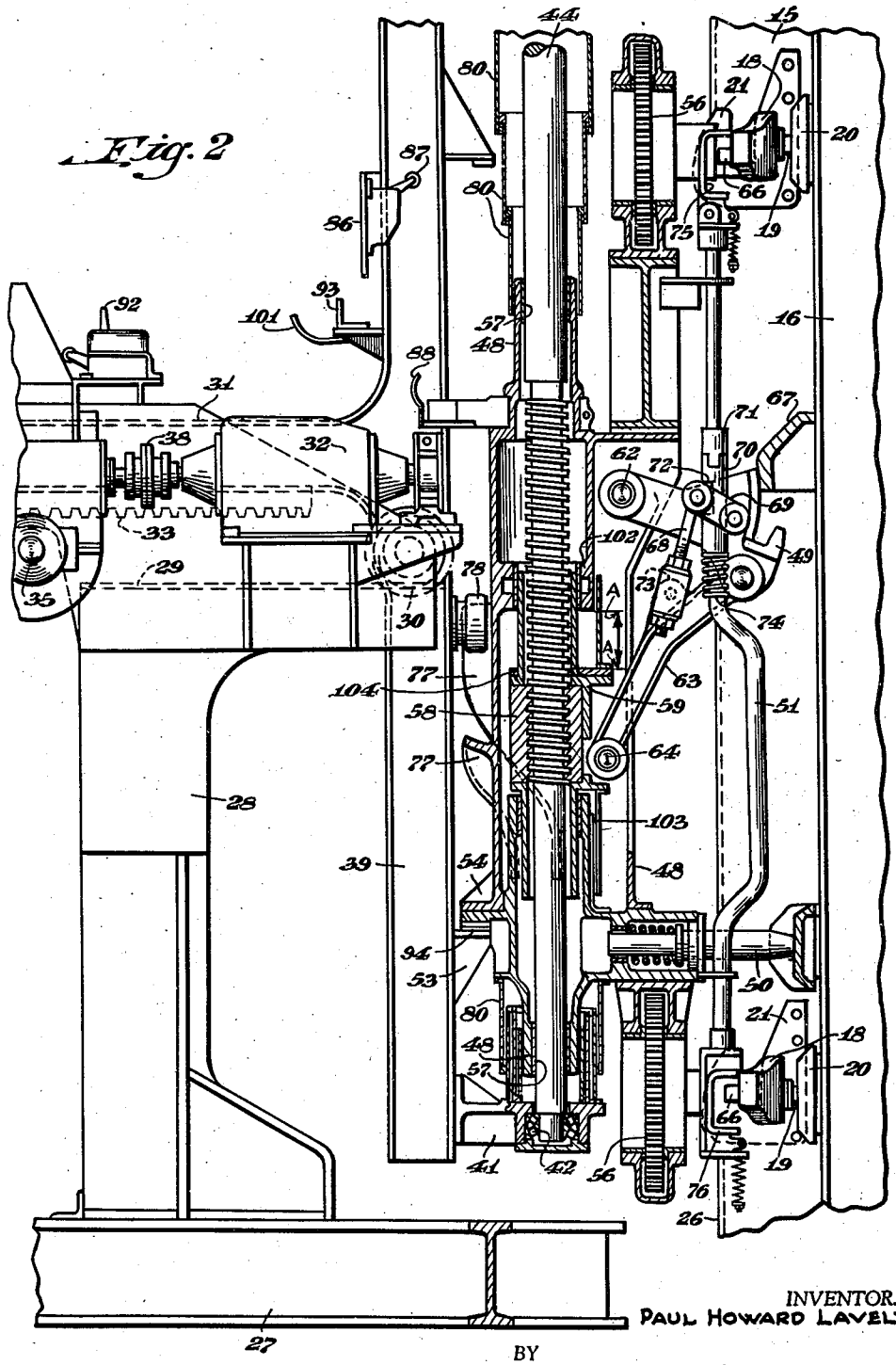
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Dec. 5, 1939. P. H. LAVELY 2,182,494

COKE-OVEN DOOR MACHINE

Filed Dec. 29, 1937 5 Sheets-Sheet 2

Fig. 2



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Dec. 5, 1939. P. H. LAVELY 2,182,494

COKE-OVEN DOOR MACHINE

Filed Dec. 29, 1937 5 Sheets-Sheet 3

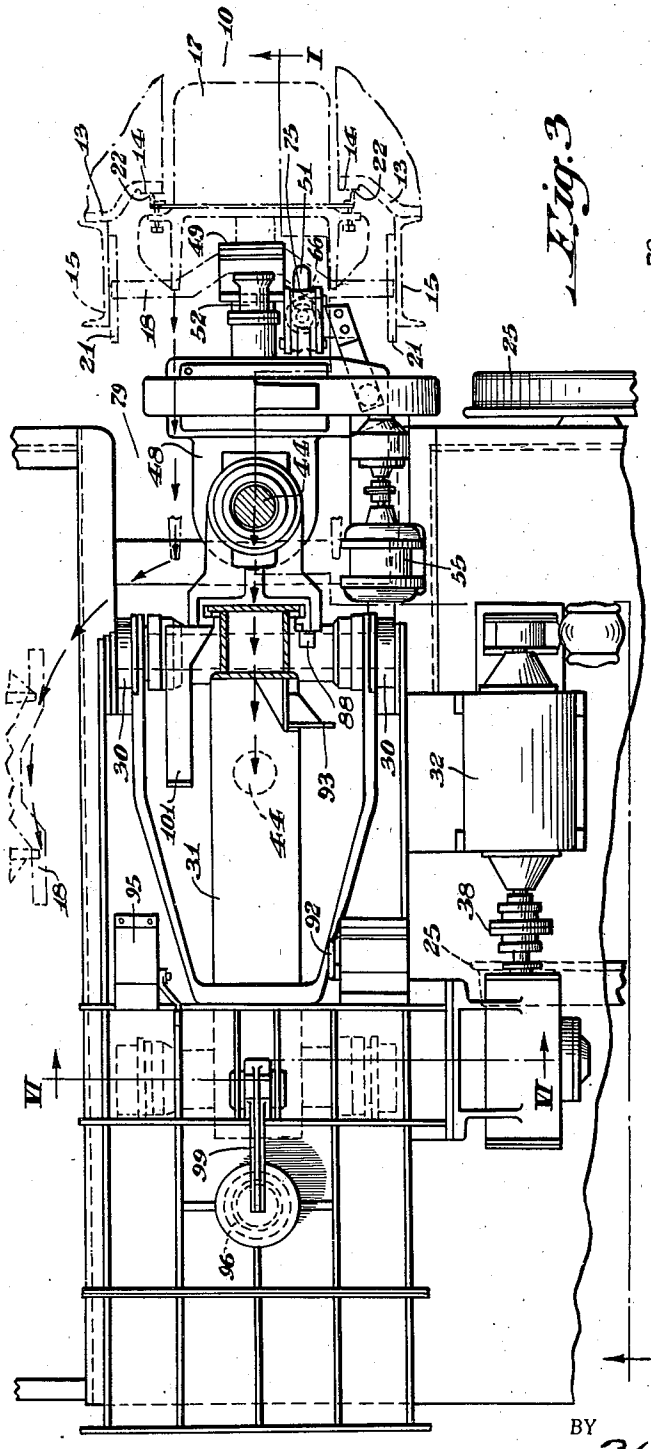


Fig. 3

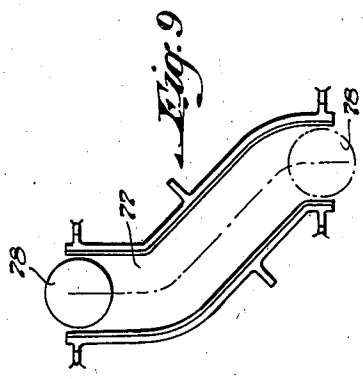


Fig. 9

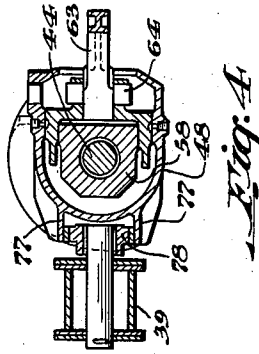


Fig. 4

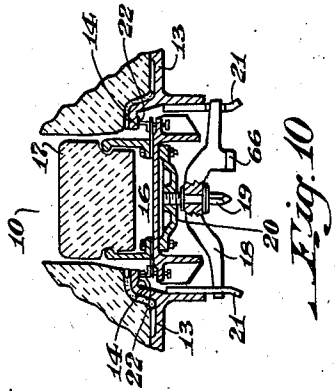


Fig. 10

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Dec. 5, 1939. P. H. LAVELY 2,182,494

COKE-OVEN DOOR MACHINE

Filed Dec. 29, 1937 5 Sheets-Sheet 4

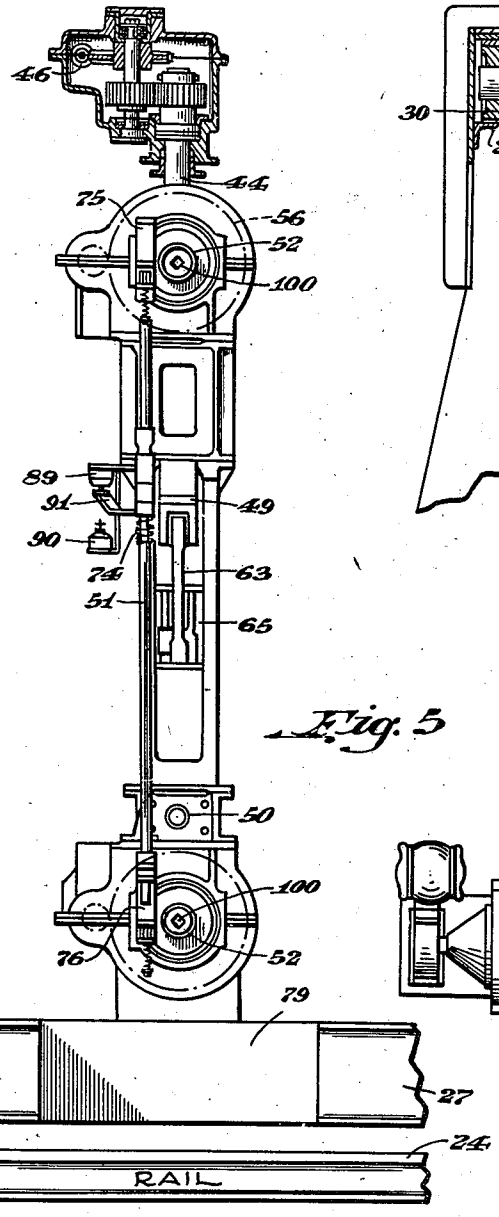


Fig. 5

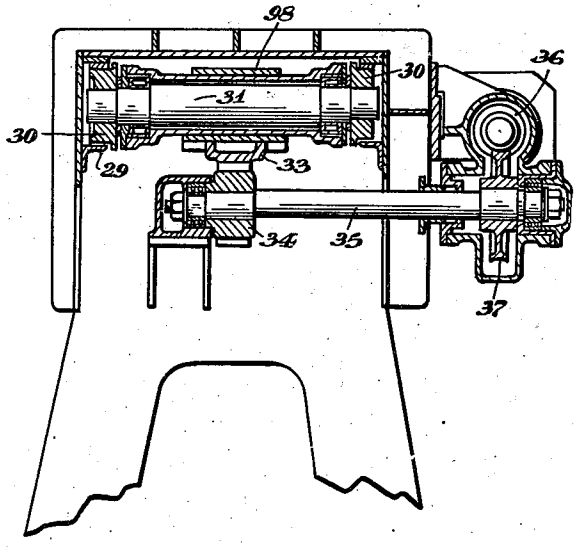


Fig. 6

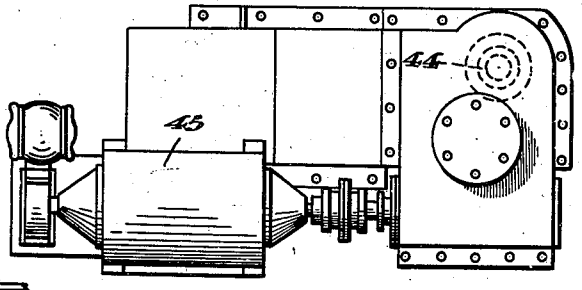


Fig. 7

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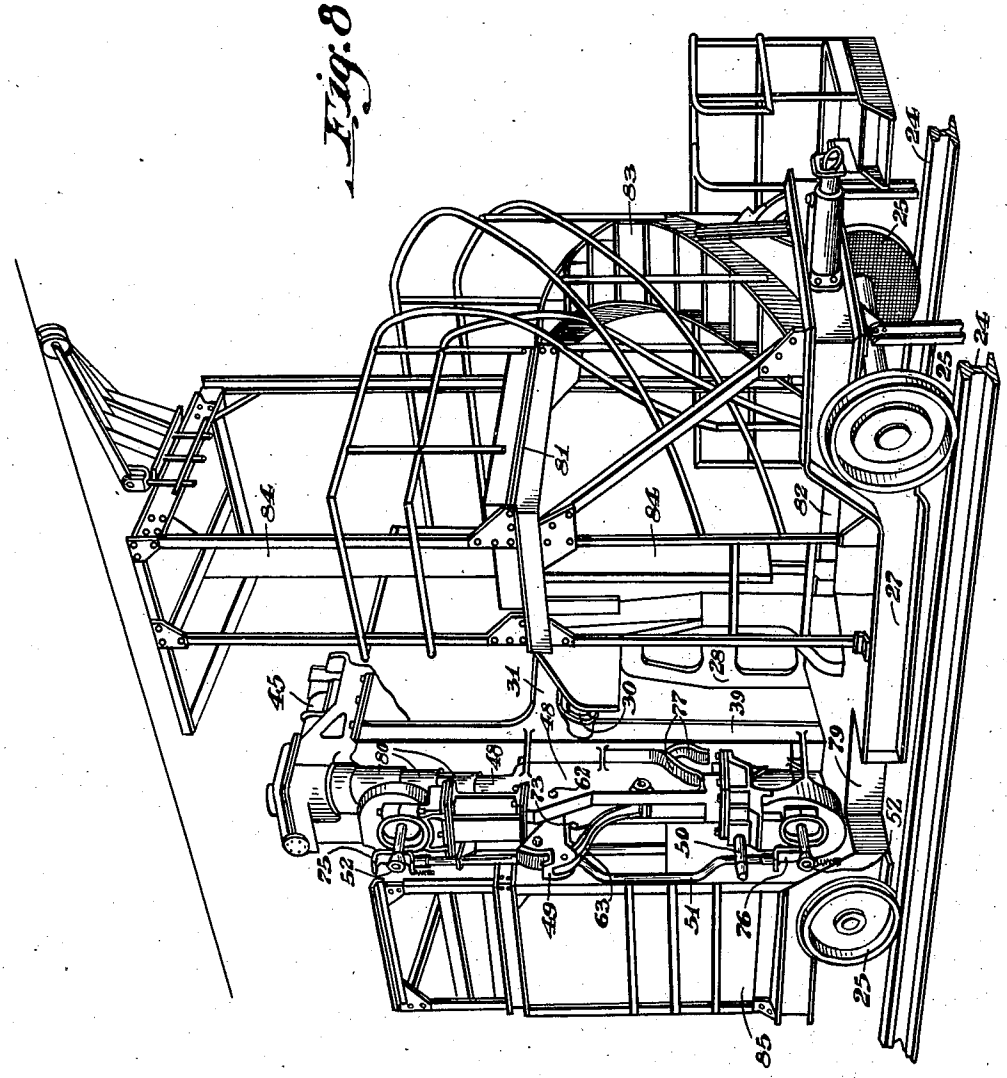
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COKE-OVEN DOOR MACHINE

Filed Dec. 29, 1937 5 Sheets-Sheet 5

Fig. 8



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Patented Dec. 5, 1939 2,182,494

UNITED STATES PATENT OFFICE

2,182,494

COKE-OVEN DOOR MACHINE

Paul Howard Lavely, Pittsburgh, Pa., assignor to Koppers Company, a corporation of Delaware

Application December 29, 1937, Serial No. 182,205

17 Claims. (Cl. 212—4)

The present invention relates to door machinery and contemplates more particularly the provision of an improved machine for operating and manipulating the doors of horizontal coke ovens.

In horizontal coke ovens of more recent construction there is an increasing tendency on the part of their builders to provide, instead of the older mud-luted doors, so-called "self-sealing" doors for closing the ends of the coking chambers against gaseous transfer between the interior of the coking chambers and the atmosphere. Self-sealing coke-oven doors have, in general, a peripherally extending metallic rim with relatively narrow edges so disposed as to rest in contact with a co-acting surface of the door-frame, which entirely surrounds the mouth of the coking chamber, when the oven door is in operating position. Pressure of the latch-bars of the door against the latch-hooks forces this peripheral sealing edge against the co-acting surface of the door-frame thus forming a metal-to-metal contact and seal therebetween. Unevenness or minor distortions of the sealing surface of the door-frame or of the sealing edge are compensated for by adjustable threaded members that apply pressure to said sealing-rim and thus force it to conform to and press against the door-frame and so form a continuous contact therewith along its surface when the door has been set in operating position and latched.

During the distillation of the coal charge in the oven chamber some of the volatilized fluids travel through the narrow interstitial spaces between the oven walls and the refractory plug of the door and are there condensed and deposited on the cooler metal surfaces adjacent the contact between the metal sealing-rim and the door-frame and eventually, in the course of a coking period, form a rather granular crusty deposit which may help perfect the sealing of the door, but which at times gives rise to difficulties in returning the sealing edge into satisfactory contact with the door-frame after the seal has been broken and the oven door has been removed to permit pushing of the coke charge. In consequence, it is customary operating procedure to remove these crust-like deposits from both the sealing-edge and the door-frame by scraping them manually along their entire periphery with appropriate tools each time they are removed from the oven mouth. In general, the operating bench on which the workman stands to carry out this scraping and cleaning operation is so disposed in respect of the oven doors that there is only a relatively small clearance between the bench and the lower edges of the doors thus making the lower portion of the sealing frames difficultly accessible for proper cleaning because the incandescent refractory door-plug protrudes a considerable distance beyond the sealing-edge and partially obscures sections thereof that require attention. If some provision is not made to turn or slue the door around horizontally during the cleaning operations, the workman is confronted with the necessity of changing his position on the bench several times in the course of the operation and of passing in front of the hot door-plug before he can properly remove the unwanted accumulations. This is both time consuming and awkward and also exposes the workman directly to the high temperatures of the door-plug. Another obstacle to proper cleaning of modern coke-oven doors from a single position on the bench is their height which may be as much as twelve or fourteen feet or more thus making the upper reaches of the sealing-edges quite difficultly accessible to the operators.

All these difficulties and disadvantages are overcome by means of the improved and herein disclosed coke-oven door machine of the invention which is adapted to unlatch an oven door and remove it from the mouth of a coking chamber automatically, and thereafter transport it into the framework of the door machine and therein slue it horizontally through an angle of substantially ninety degrees while simultaneously elevating the door sufficiently that the bottom edges thereof are easily reachable for cleaning by one standing substantially at the level of the battery bench or from platforms that are arranged on the door machine at levels thereof from which both the upper and lower parts of the slued door are easily accessible.

One of the objects of the present invention is to provide a coke-oven door machine that is adapted for propelling along the relatively narrow operating bench at the face of an oven battery and is disposed to mechanically unlatch and latch the doors of horizontal coking chambers and also to remove and restore them mechanically to the mouths of such chambers in a simple and efficient manner.

Another object of invention is the provision of a door machine that is not only arranged to accomplish the above-mentioned operations automatically but is in addition adapted to slue the removed door both out of and into alignment with the mouth of a coking chamber automatically, and also, during such sluing movement, is further adapted respectively to raise said door

above and thereafter lower it back into that horizontal position from which it can be inserted directly into the mouth of a coking chamber thereby greatly facilitating maintenance and cleaning of the door.

Another object of invention is to provide a door-machine whereby the simultaneous sluing and raising or lowering of the oven door can be effected within a short radius and with an economy of space such that its manipulation can follow within the relatively restricted space of a door-machine framework that is itself adapted for movement more especially along a high battery-operating bench of substantially the usual width and within the normal close clearances between a door-machine and the battery buckstays, and on which door-machine the manipulated door is always supported between the ends of the machine and the trucks on which it is propelled, so that its center of gravity will not be seriously shifted when the heavy door is received thereon.

A further object of the present improvement is to furnish a door-machine that will give the machine operator, and also the workman that cleans the door, adequate protection from the radiant heat given off by the highly heated refractory section of the door when it is slued out of alignment with the oven mouth. The invention has for further objects such other improvements and such other operative advantages or results as may be found to obtain in the apparatus hereinafter described or claimed.

Essentially, the mechanism, by means of which the oven door is manipulated according to the invention, has a supporting pedestal that is rigidly mounted on a chassis between trucks for moving it along the battery-bench. A vertical mast is adapted to reciprocate horizontally in a track-way therefor at the top of said pedestal. Vertically disposed and rotatably mounted on the mast, by bearings at the top and the bottom, is a screw-threaded shaft which carries a similarly threaded nut that is adapted for traveling upward or downward on said shaft, depending on the direction of rotation of the latter. Surrounding the threaded nut and shaft and slidably mounted on the latter is a sleeve-like member or housing that can be moved independently of the mast. On this housing are carried the various devices for controlling the operation of the oven doors, as for example, the door hook, the latch-tightening and loosening mechanism, a device for turning the latches, a buffer for steadying the door, and the like, so that when said housing is moved along the threaded shaft by the pressure thereagainst of the threaded nut in its travel, these door-controlling features are carried along with it. The door-hook itself and the device for turning the latch-bars are mounted, according to the invention, on a housing-section susceptible of a short length of travel along the threaded shaft independently of the main part of said housing, so that the door-hook may be moved into or out of engagement with the hook-plate of the door and the latch-bars may also be turned without changing the vertical position of the door. To this end, said housing-section is formed as a cross-head which carries the door-hook and a latch-turning device linked therewith. The cross-head is slidable along the vertical threaded shaft inside of the main housing and is attached to the threaded nut that moves along the threaded shaft as the latter is rotated. This nut and the affixed cross-head are so disposed in respect of the main-housing and the rotatable shaft that the former is engaged by said nut only at such times as the door-hook is securely engaged with the hook-plate on the oven door. Integral with the main housing is a spiral track-way in which a fixed roller on the mast is adapted to move. When the entire housing surrounding the threaded shaft is moved upward or downward by rotation of the latter, the pressure of said roller against the walls of the spiral track-way causes the housing to move horizontally simultaneously with its vertical movement thus elevating a door carried by the door-hook at the same time it is slued horizontally away from its position facing the battery. In short, the instant improvement provides means for moving a coke-oven door out of alignment with the mouth of a coking chamber to a relatively remote position through a helicoidal path of short radius.

In the accompanying drawings forming a part of this specification and showing for purposes of exemplification a preferred apparatus in which the invention may be embodied and practised but without limiting the claimed invention specifically to such illustrative instance or instances:

Figure 1 is an elevational end-view of a coke-oven door machine embodying the main features of the present improvement, parts of which are illustrated in section, and showing the improved machine in position on the operating bench of a battery of horizontal coke ovens and in front of a self-sealing door which is in sealed contact with a door-frame at the mouth of a coking chamber, the door-hook being shown in engagement with the oven door which is ready to be withdrawn from the oven; this view is taken substantially on the line I—I of Figure 3;

Fig. 2 is an enlarged fragment of Figure 1;

Fig. 3 is a section taken substantially along the line III—III of Figure 1;

Fig. 4 is a section taken substantially along the line IV—IV of Figure 1;

Fig. 5 is a section taken substantially along the line V—V of Figure 1;

Fig. 6 is a section taken substantially along the line VI—VI of Figure 3;

Fig. 7 is a plan view taken substantially along the line VII—VII of Figure 1;

Fig. 8 is a perspective view of the door machine provided by the present invention and showing a preferred embodiment of its features in a practical and convenient chassis which also incorporates in its construction novel features designed to facilitate oven operation and maintenance;

Fig. 9 is a fragment showing the contours of the guideway affixed to the shaft housing of the invention whereby said housing is moved horizontally; and

Fig. 10 is a horizontal section through a self-sealing door which the present invention is adapted to operate and showing especially the construction of the latch-bars and the arrangement for attaching them to the door.

The same characters of reference designate the same parts in each of the views of the drawings.

Referring now to the drawings and particularly to Figures 1 and 2, a battery of horizontal coke ovens comprises a series of coke ovens 10 of which a partial vertical section, taken longitudinally of one coking chamber, is shown in the drawings. The ovens are each provided with the usual top 11 and floor or sole 12. The oven

mouth at each end of a coking chamber is entirely surrounded by a continuous protective metal sheath or frame 13 which is provided, adjacent its inner edge, with a continuous well-machined surface 14 that forms a part of the sealing means for the coking chamber. Buckstays 15 serve to restrict movement of the masonry of the battery structure and to support the door frames and jamb-plates against the jamb bricks of each end of the heating walls. Each oven mouth is closed during the carbonization period with a door 16 comprising an outer metallic casting that supports a heavy plug 17 of heat-resisting material that extends well into the coking chamber 10. The oven doors 16 are supported in operating position by means of rigid latch-bars 18 that are rotatably mounted on threaded pins 19, said pins being themselves held in similarly threaded brackets 20 that are fixedly mounted on the door casting, so that the latch-bars are rotatable around said pin in the plane of the door and can be moved perpendicularly of the door by rotation of said threaded pin 19 in the bracket 20. Attached to the buckstay 15 are hooks 21 that are adapted to engage the latch-bars 18 when they are rotated, as shown in Figure 2, and against which the latch-bars can be pressed by proper rotation of the threaded-pin mounting. This pressure of the latch-bars against the latch-hooks retains the oven door in the mouth of the coking chamber and in turn presses the adjustable sealing-edge 22 against the flat surface of the door-frame 13. This pressure can be relieved by opposite rotation of the threaded pin, which then leaves the latch-bars free for rotation in the plane of the door and for disengagement with the latch-hooks.

Closely beneath the oven soles and extending along the face of the battery is the operating bench 23 on which are supported rails 24 which provide trackage for the door machine of invention. The door machine is propelled along said trackage on wheels 25 that are driven by any preferred means such as an electric motor suitably geared thereto for the purpose. As is clearly shown in Figure 1, the clearance between the face 26 or outer line of the buckstay 15 and the chassis 27, which supports those features of the door machine that are provided for manipulating the oven door, is significantly less than the overall thickness of the door and said chassis member 27 also extends upward above the level of floor line 12 of the sole of the coking chamber. For convenience of operation and for reasons of structural stability and economy, it is desirable that a coke-oven door-machine be operative to remove an oven door and slue it sideways of a coking chamber within these rather restricted space relationships and certain features of the improvement have been developed in solution of these circumstances, as will be evident from the hereinafter disclosure.

Rigidly mounted on chassis 27 is pedestal 28 which is provided with trackways 29 for the rollers 30 that in turn support the ram 31. Motor 32 is adapted to provide said ram with reciprocative movement longitudinally of the coking chamber 10 on said rollers 30 by means of the rack 33, which is attached to the lower side of the ram, and of the co-acting pinion 34 that is operatively rotatable by shaft 35, said shaft being arranged for rotation by worm-gear 37 and worm 36 that itself is directly connected with said motor 32 through coupling 38, as shown in Figures 1, 2 and 5.

At its end facing the coking oven, ram 31 carries vertically extending mast 39. Mounted on said mast are the different features of the invention for manipulating the oven doors. Protruding from this mast are the upper and lower brackets, respectively 40 and 41, provided with aligned bores. Within these bores are supported radial roller-bearings 42. The shaft 44, screw-threaded on the surface of its outer central part, is supported by said mast upon which is is rotatably and vertically mounted in the roller-bearings. Rotational movement of the shaft 44 around its vertical axis is provided by motor 45 operating through worm 46 and a therewith communicating system of gears, as shown at the top of Figures 1 and 5. Motor 45 is fixedly mounted at the top of mast 39 on bracket 47.

Slideably mounted on and surrounding shaft 44 than which it is shorter, is the shorter hollow housing 48, indicated in part by the cross-hatching in Figure 1, and to the door-hook 49, buffer-pin 50, the device 51 for turning the latch-bars, and the upper and lower latch-operating apparatus 52 are all fastened and by means of which they are movable upwardly and downwardly along shaft 44. When in lowered position, housing 48 is supported by stop bracket 53 that projects from mast 39 to engage stop dog 54 of said housing. The latch-actuating device 52 is rotatable by motor 55 (Figure 3) through geared-wheel 56 to turn the threaded pins 19, on which latch-bars 18 are supported in the door-brackets 20, thereby loosening or tightening the latch-bars in respect of the latch-hooks 21. This latch-actuating feature exemplified in the drawings is the invention of others and has been made the subject of the application Serial Number 140,960 filed on May 5, 1937, by Ragnar Berg and Robert W. Crist. To facilitate movement of hollow housing 48 along rotatable shaft 44, bearings 57 are provided therebetween at the upper and lower surfaces of contact.

Movement of housing 48 upwardly and downwardly along shaft 44 is effected by the action of threaded nut 58 which is arranged to travel in the surficial threads of said shaft when the latter is rotated by motor 45; the direction of its travel obviously depending upon the direction of rotation of shaft 44. Within hollow slideable housing 48 and also slideably mounted on shaft 44 is a cross-head 59 which according to the invention is provided with a short distance of travel (designated by A—A in Figure 2) along said shaft independently of said housing member. This cross-head partially surrounds threaded nut 58 and is carried along by the latter during any movement thereof resulting from the rotation of shaft 44. The upper and lower portions of said cross-head are formed as sleeves that are adapted to move over the threads of the rotatable shaft with a slight clearance at their inner surfaces and on their outer surfaces have sliding contact with bearings carried on inwardly-extending circumferential projections 102, 103, on the inside of the housing 48, as shown in Figures 1 and 2. According to the invention, nut 58 is not rigidly attached to cross-head 59, but, on the contrary, the contact therebetween is designed to permit the nut to float somewhat inside the cross-head, so that the former is free to follow minor irregularities or departures from precise alignment of portions of the threaded shaft without seriously straining the cross-head. Such an arrangement is shown in the accompanying Figure 4, and by reference thereto, it is obvious that

nut 58 cannot rotate around shaft 44 inside the cross-head but it can cant back and forth independently thereof in vertical planes. Adjacent their contacts with nut 58, the upper and lower sleeve-like portions of the cross-head member have projecting flange-like rims, respectively 60 and 61; the top of the upper 60 of these flange-like parts is a smooth surface arranged to engage the lower surface of the projection 102, that extends inwardly from the walls of the hollow housing 48. When the cross-head is moved upwardly by travel of nut 58, said member 102 therefore operates to establish the upper limit of independent travel of said cross-head. A portion of member 60 also extends outwardly beyond the walls of said housing through an opening 65 therein and supports a vertically disposed plate member, that moves up and down accordingly as member 60 travels, and functions as a covering for the opening 65 (see Figure 5). By means of the replaceable shim 104, the upper limit of independent travel of the door-hook and the cross-head can be regulated.

Door-hook 49 is pivotally mounted at 62 on the shaft-housing member 48 and is in addition pivotally connected to said cross-head 59 by link 63 and pin 64 through said opening 65 in the walls of the slideable housing, and by means of this arrangement in combination with the short distance of independent travel of the cross-head, it is possible to raise and lower said door-hook without moving member 48 or the thereto affixed latch-operating devices 52, so that these two last-mentioned members always remain in the same spatial relationship with the oven door irrespective of the position of the door-hook.

Attached to the door-hook is the means for turning the latch-bars in the plane of the door to take them into and out of engagement with the latch-hooks. As shown in Figure 1, and in the enlarged fragment thereof, Figure 2, this means comprises a metallic rod 51 which has at its upper and lower ends a U-shaped device into each of which a lug 66 of a latch-bar enters when the ram 31 moves the door-operating and -handling assembly into operating position in front of the oven door, said devices are thus adapted to press on said lugs and to turn both the upper and lower latch-bar simultaneously upon movement of said rod in a vertical plane. Vertical movement is imparted to rod 51 by the door-hook itself, as it is rotated around pivot 62 by travel of the threaded nut through the medium of a therewith communicating assembly comprising links 68, 69, sleeve 70 and the sleeve-stop 71. Sleeve 70 is slideably mounted on rod 51 and is provided with slots at its upper end which are adapted to mesh with similarly shaped projections on the sleeve-stop 71 which itself is held fast to rod 51 by any preferred means. The sleeve 70 is formed with a bored lug 72 that projects laterally therefrom. This lug is pivotally connected, according to the invention, both with the door-hook itself by means of link 69, and also with that heavy link 63, that serves to raise and lower said hook; the latter connection is formed by rod 68 which has its lower end, as shown in the drawings, pivotally connected with the bored lug 73 that is formed on the upper edge of said heavy link 63. The length of rod 68 is susceptible of adjustment by means of lock-nuts and a threaded section, as shown in Figure 2, and it determines the neutral position of the jaws that engage the latch-bars. Helical spring 74 mounted on rod 51 operates to press sleeve 70 firmly against its co-acting sleeve-stop 71 and to hold the slots of the former in engagement with the projections of the latter. This arrangement advantageously permits a certain amount of independent movement of said sleeve along the rod 51. This is a precautionary measure provided to obviate distortion of said rod 51 in the event that it becomes fouled for some reason, when the door-hook is being lowered out of the hook-plate 67. If that eventuality occurs and rod 51 is arrested in its downward movement while the door-hook continues to be lowered, the sleeve 70 can be lowered by said hook independently of the rod 51 by compressing the helical spring, which then at such time as the rod 51 is again free, will exert that pressure required to return said sleeve into engagement with member 71. The U-shaped members 75 and 76, respectively positioned at the top and bottom of rod 51 employed for engaging the latch-bars of the oven door, are pivotally mounted on said rod by pins and are retained in operating position by compressible springs, as shown in Figures 1 and 2, so that if for any reason the lugs on the latch-bars are incorrectly positioned to enter the recess of the U-shaped members but rather to exert pressure on the horizontal portions thereof when the door machine is moved into position for grasping the oven door, these members can be moved outwardly from the oven face on their pivots and be later returned to alignment with the rod 51 by spring pressure when the cause for misalignment has been corrected thereby preventing their permanent distortion or bending under those circumstances.

As shown in Figures 1, 2, the shaft housing 48 has a helicoidal guideway 77 that is an integral part of the housing. It is formed by two parallelly spaced ridges that protrude perpendicularly above the outer surface of said housing, and beginning at an upper point diametrically opposed that at which the door-hook is pivotally affixed to said housing, they continue downwardly helically through substantially ninety degrees of the housing's circumference. Roller 78 is rotatably affixed to the mast 39 and is of a diameter adapted to permit its passing between the walls of said guideway against which it presses when housing 48 is moved along threaded shaft 44, thereby causing said housing to rotate around the shaft at the same time it is moved longitudinally thereof. Both movements are effected by means of but one actuating motor.

According to the invention and as clearly shown in Figures 3, 5, and particularly in Figure 8, a recess 79 is provided in the lower chassis framework 23 of the door machine. This recess is located between the supporting trucks of the door machine and is of particular import in that it provides means whereby a coke-oven door can be withdrawn from the mouth of a coking chamber and can be slued sideways to a position at right angles to the lengthwise dimension of said chamber on a machine that has a substantial part of its supporting framework extending crosswise of the coking chamber above the level of the sole thereof at a distance less remote from the face line of the oven buckstays than the overall thickness of the oven door. Furthermore, the recess 79 makes it possible to effect the sluing movement with the bulk of the sluing door between the trucks and the tracks of the door machine thus contributing to it a greater stability and a lower center of gravity than would obtain on a machine of similar proportions if the door were suspended from the end

of the machine during the described manipulations.

The telescopically disposed series of tubes 80 are arranged to expand and contract and to follow the housing 48 up or down the rotatable shaft; their function is to obviate ingress into the housing of adventitious materials that could act as abrasive to score the bearings or threaded members.

Referring now particularly to Figure 8 wherein there is shown in perspective a practical apparatus in which already described features of the invention are embodied along with other improvements that add greatly to the facility of operation and to the convenience and comfort of the operators, the numeral 79, as aforesaid, designates the recess into which the oven door is arranged to be withdrawn by the reciprocative ram 31 before the oven door is elevated and slued sideways by the door-operating assembly positioned directly above said recess. This assembly is arranged to slue the door in the direction of the upper and lower platforms respectively 81 and 82, that are connected by a circular stairway 83, and from which platforms the operator can easily reach the top and bottom of the slued door to scrape the sealing edge thereof with appropriate tools for removing adventitious material that may have accumulated thereon during a coking interval. The vertically extending metal strip 84 is located in such position that it is directly between the operating platforms and the incandescent refractory plug of the slued door and serves to protect the workman from the high temperatures of said plug. Its width should preferably be such that the edges of the door are not obscured or made inaccessible.

The platform 85 at the opposite end of the door-apparatus chassis from the above-mentioned platforms 81, 82, is preferably reserved for the control-board from which are controlled the starting and stopping of the motors, employed to actuate the features of invention as well as their sequence of operation. The hot plug of the slued door is thus always slued away from that platform upon which the door operator is more or less constantly stationed thereby avoiding subjecting him to excessive temperatures.

Appropriately located limit switches, that prevent the over-running of the moving parts of the door-machine assembly, practically eliminate the danger of damage to the moveable elements of the described assembly. For example, the limit switch 86 is in the electrical circuit whereby motor 45 is actuated and its control handle 87 is disposed for turning off the current to said motor at such time as the travel of the shaft mounting 48 is elevated sufficiently to bring the thereto attached dog 88 into pressure contact with 87 thereby stopping said motor and preventing excessive elevating of the housing member; the limit switches 89, 90 (Figure 5), are also arranged in the electrical circuit to said motor 45 and they are adapted for actuation by the dog 91, attached to rod 51 of the latch-bar turning device, to open the circuit to said motor when rod 51 has reached the preferred limit of upwardly or downwardly travel, and they also operate to prevent excessive travel or door-hook 49 and nut 58; in similar manner, control 92 of a double-pole limit switch is operable by dog 93 to shut off motor 32 when racking ram 31 has reached the preferred outward limit of travel and simultaneously to restore current to the motor 45 so that said motor is again ready for operation to raise and slue an oven door after it has been withdrawn into recess 79 by outward travel of the ram, the circuit to said motor 45 having been previously opened by limit switch 89 so as to eliminate any possibility of elevating or sluing the oven door during travel of the ram. The limit switch 89 that stops the up travel of the door-hook is arranged to be by-passed when the whole assembly is racked outward from the oven face so that power can again be applied to motor 45 to turn the rotatable shaft. If preferred, a limit switch may also be placed at a point adjacent 94 which will break the circuit to motor 32 during the elevating and turning of housing 48, thus preventing possible movement of the ram during such positions of the door. In addition, limit switch 95 is arranged to open the circuit to the motor 45 after the housing has been lowered and turned back to its normal position against bracket 53, following which, the limit switch at 94, in the circuit to the racking-motor 32, is disposed to again energize that circuit, so that the mast can be moved forward by it in the direction of the oven mouth.

The latch tightening devices 52 are each operative independently by means of upper and lower electrical motors 55 (Fig. 3).

When the ram of the door machine is moved in the direction of the coking chamber, its motion is buffered by pressure from helical spring 96 which is pressed against its upper surface by the action of plunger 97 that is itself moved downwardly against said spring by the pressure of the dog 98, attached to the upper surface of the ram near its outer end, against the pivotally mounted bell crank 99.

The control switches for bringing of the various elements of the invention into operation are, as afore-mentioned, all preferably assembled on the control platform 85 so that the oven doors can be manipulated from one station.

The following description of a method of operating the above described coke-oven door-machine provided by the invention will help to a better understanding of the purpose, construction and the operating results that can be obtained with the various elements embodied therein. The door-machine assembly is moved along the face of a coke-oven battery on its trucks 25, while having the reciprocative ram and the various elements mounted thereon well retracted within the framework of the apparatus. Upon reaching a position directly in front of the door to be extracted from a coking chamber mouth, the machine is so stationed that the door-hook and the latch-operating devices are positioned substantially opposite respectively the hook-plate of the door and the threaded pins whereby the latch-bars are rotatably mounted on the door adjacent its upper and lower parts. During this operating interval, the traveling nut 58, the door-hook 49, the bumper bar 50 and the device 51 for turning the latch-bars in the plane of the door are all supported on the retracted reciprocative ram in the relative positions shown in Figure 2. From operating platform 85, racking motor 32 is then started to move the mast slowly forward until the door-hook is pressed against hook-plate 67, as shown in Figure 2; the movement of the ram being buffered through the pressing of helical spring 96 thereagainst by the dog 98. With the door-hook in this position, the heads of the threaded pins 19 will have entered square openings 100 of the latch-operating device 52, and between the jaws of the U-shaped members 75 and 76,

at the top and bottom of rod 51, the lugs 66, attached to the latch bars, will have assumed the position indicated in said Figure 2. Pressure thus exerted against the oven door, by the door-hook, is maintained, preferably by a self-locking device on the worm and gear 36, 37, and serves to relieve somewhat the pressure of the latch-bars against the latch-hooks 21, so that they may be loosened freely by the latch-tightening devices 52. These devices are then rotated by the motors 55, operating through the reducing gear 56, in a direction causing the latch-bars to move away from the door-hooks. These motors are also controlled by means of control switches accessible from platform 85.

After the loosening of the latch-bars, motor 45 is started causing shaft 44 to rotate, whereupon nut 58 starts to travel upward in the threaded section of said shaft to lift the door-hook into lifting-engagement with the hook-plate, in which position it is shown in Figure 1. Simultaneously, the jawed members 75 and 76 of the rod 51 are also elevated an amount greater than that traveled by the door-hook in consequence of the action of the lever linkage whereby said rod is connected with said hook, to press with their lower jaws against lugs 66 of the latch-bars and thus to rotate the latter out of engagement with the latch-hooks. The door 16 is now free to be withdrawn from the mouth of the oven. Motor 45 is allowed to continue to operate until the door has been raised vertically a short distance of from one-half to one inch so as to break-up and loosen any incrustations that may have been deposited along the metal sealing edge of the self-sealing door during the carbonization period and also to lift the bottom of the door slightly above the oven sole. When the door has been so elevated, motor 45 is stopped. If for any reason, however, it is not stopped at a preferred point, said motor will be shut-off by the pressure of dog 91 against limit switch 89 (Figure 4). The oven door is now securely supported on ram 31, and is withdrawn from the coking chamber by rotating motor 32 in a direction opposite that employed when moving the ram towards the face of the battery. The ram is allowed to continue its outward movement until the lower part of the thereon vertically disposed oven door is well within recess 79 which, according to the invention, is provided to receive the same and must be of sufficient depth to allow the inner face of the refractory door-plug 17 being removed beyond the face 26 of the buckstays. When this position has been reached, the racking motor is either shut off by the operator or excessive travel of the ram is obviated by the pressing of dog 93 against the actuating handle 92 of a limit switch in its motor-circuit. The door is now ready for elevating and sluing into a position at right angles to the oven mouth where it can be conveniently freed, by a workman standing on platforms 81, 82, of materials deposited thereon during the carbonization period. These movements or the door can be carried out with said door supported between the trucks of the door machine and substantially between the trackage along which it is propelled at the face of the battery, with the result that the thereby supported door does not significantly change the center of gravity of said machine and an improved stability is thus imparted to door machine of this class.

By means of features of the invention, only one motor 45 is required to effect the raising and the sluing movements of the oven door, and both movements are effected substantially simultaneously. These changes in position of the extracted door are brought about by the travel of nut 58 along shaft 44 and by the travel of roller 78 in the helicoidal guideway 77; the pressure of said roller on the walls of said guideway resolving part of the energy that results, from the pressure of nut 58 against housing 48, into a force causing said housing to turn on the rotating shaft. The contour of guideway 77 determines the preferred path described by the door during its elevating and sluing, and that contour chosen for the present embodiment is illustrated in Figures 1, 2 and 9. Reference to said figures shows that the walls of the guideway, at its upper parts, are substantially vertical and parallel for a short distance, and that thereafter they veer off tangentially into a spiral downward along the cylindrical walls of the slideable housing to assume again a vertical path for a short distance, at a point on the housing substantially at right angles to that of the upper vertically disposed section of said walls.

After the outward moving ram has removed the oven door to a position within the framework of the door-machine and its lower edge is well within recess 79 thereof, motor 45 is again started to rotate shaft 44 in that direction which will cause upward travel of nut 58, which has been previously so disposed, in respect of said slideable shaft housing and of the door-hook and of the hook-plate on the door, that the upper flange 60 of said nut is just in pressure contact with a similar flange of the shaft housing when the door-hook is in lifting engagement with the hook-plate. Thus, nut 58 in its upward travel now presses against the shaft-housing member 48 and as a result the whole thereon mounted assembly including the door starts to slide vertically along the rotating shaft and to leave contact with bracket 53. During this interval roller 78 is positioned between the vertically disposed walls of the upper part of guideway 77, and the path of the housing and the oven-door is in consequence solely a vertical one, which continues until the lower edge of the oven door has been raised sufficiently that it is clear of the upper edge of recess 79 formed in member 27. This position having been reached, the roller enters the helically disposed section of the guideway walls and the housing begins to turn or slue around the rotating shaft as it is elevated therealong directed by the pressure of the roller against the walls of the guideway. This sluing motion continues until the door has been turned through an angle of substantially ninety degrees while being raised a substantial portion of its lengthwise dimension. At the lower end of the guideway, the roller enters the lower, short, vertically-walled section thereof that serves to resist further sideways movement of the door which is thus retained in the preferred slued position with its hot refractory plug on that side of the protective metal-strip 84 opposite the platforms 81, 82, where a workman can stand and clean the door protected from direct heat of the refractory plug by said sheet of metal.

Excessive upward travel of nut 58, and consequently of the housing, is prevented by pressure of dog 88 against member 87 of the adjustable limit switch 86 which is in the circuit of motor 45. The limit switch at 94, the one teriminal of which is affixed to the mast and the other to said housing 48 which is in the electrical circuit that actuates ram-motor 32, is adapted to open the circuit to motor 32 as soon as the shaft housing

begins to turn, thus preventing movement of the reciprocative ram when the door is in raised or slued position.

After the cleaning of the oven door, motor 45 is again started and the door is lowered and slued back to its normal position, with the member 54 of the shaft housing resting in contact with bracket 53; this position having been reached, the limit switch 95 actuated by dog 101 will stop said motor. At this point, the limit switch at 94 is arranged to close the circuit to the racking-drive and permit moving the door-ram forward by motor 32. This forward movement of the ram is arranged to break the contact of limit switch 95 and again close the circuit to motor 45. When the door is restored to its position in the oven, motor 45 is again started and the door-hook is lowered until stopped by limit switch 90. This downward motion of said hook draws the latches into engagement with the latch-hooks attached to the door frames, and thereafter upper and lower motors 55 are started and the latch pins rotated to move the latch-bars outwardly into pressure contact with said latch-hooks thereby closing and sealing the oven. The ram is then moved outward and the door machine is ready to be moved to the next oven door.

The invention as hereinabove set forth is embodied in particular form and manner and may be variously embodied within the scope of the claims hereinafter made.

I claim:

1. Apparatus for manipulating coke-oven doors and comprising, a ram reciprocative longitudinally of a coking oven, a shaft rotatably mounted on said ram and having screw-threads on its surface, slideably mounted on said shaft a shorter housing provided with means for engaging a coke-oven door to remove it from an oven, a threaded member adapted to travel along said shaft in its screw-threads upon rotation of said shaft, means for engaging said threaded member with said housing so that movement thereof along the shaft effects vertical movement of the housing, and guide means to slue the slideable housing horizontally as it is moved vertically by the threaded member.

2. Apparatus for manipulating coke-oven doors as claimed in claim 1 and in which the guide means comprises a member stationary in respect of said housing and a vertically extending helicoidal groove arranged to receive said stationary member.

3. Apparatus for manipulating coke-oven doors and comprising, a ram reciprocative longitudinally of a coking oven, and means mounted on said ram that are adapted to move said door simultaneously both vertically and horizontally, said means comprising a member that is both pivotally mounted on said ram and vertically movable along said pivot, said member being provided with means for engaging and handling an oven door, a fixed member and a helicoidal groove arranged, upon relative movement, to coact to turn said pivoted member horizontally as it is being moved vertically along said pivot, and power means for moving said member vertically along said pivot.

4. Coke-oven apparatus comprising a mechanism for manipulating a coke-oven door, said mechanism having means for engaging a door to remove and restore it to the mouth of a coking chamber, said means being provided with reciprocative movement longitudinally of a coking chamber by means of a ram-like device upon which said means is pivotally mounted for horizontal rotary movement on a vertical pivot that is sufficiently longer than the pivot-engagement with the door-engaging means, and means for vertically adjusting the door-engaging means vertically relative to its pivot to permit of a desired vertical movement of said door-engaging means along said pivot, power actuated means for effecting one of said movements, and mechanical means for effecting the other of said movements, said mechanical means being adapted to be actuated by the movement of the first of said movements upon its movement under the influence of said power actuated means.

5. Coke-oven apparatus comprising a mechanism for manipulating a coke-oven door, said mechanism having a member, for engaging a door to remove and restore it to the mouth of a coking chamber, that is provided with reciprocative movement longitudinally of a coking chamber by means of a ram-like device on which said member is pivotally mounted for horizontal and vertical movement, said mechanism comprising a vertically directed helicoidal guideway and a device adapted to co-operate therewith in such manner as to turn said door-engaging member sideways of the coking chamber through a path determined by said guideway when said member is moved vertically along the pivot means therefor.

6. Coke-oven apparatus comprising a mechanism for manipulating a coke-oven door, said mechanism comprising, a ram reciprocative longitudinally of the coking chamber, a member adapted to engage an oven door and support it, pivot means for supporting said member on said ram, said pivot means being so disposed in respect of said ram and said member that the latter is susceptible of horizontal rotation on said pivot which is also sufficiently longer than the therewith engaging portion of said member to permit a desired movement lengthwise of said pivot means, a device for moving said member lengthwise of said pivot means, and guide means, arranged for turning said member horizontally during movement lengthwise along said pivot means, comprising, a vertically disposed helicoidal guideway and a therewith co-operative device that is arranged to turn the door-engaging member through a path determined by said guideway.

7. In coke-open apparatus adapted to manipulate coke-oven doors and to operate the latches thereof, door-grasping means, door-latch-operating means, and a ram, said door-grasping and door-latch-operating means being mounted for vertical and horizontal movement on the ram and said ram being mounted for reciprocative movement longitudinally of a coking oven to constitute means of which a coke-oven door can be grasped and unlatched and then withdrawn by said ram from the mouth of a coking chamber to a point beyond the buckstay line, and means operable in the retractive position of the ram to elevate and turn thereafter reversely return the mounting for the door-grasping means and door-latching-operating means to the mouth of the coking chamber without intermediate disengagement of said door-grasping and door-latch-operating means with the door.

8. In coke-oven apparatus adapted to manipulate coke-oven doors and to operate the latches thereof, door-grasping means, door-latch-operating means, and a ram, said door-grasping means and door-latch-operating means being both

mounted on a common carrier that is pivotally mounted for joint vertical and horizontal movement on the ram, and said ram being mounted for reciprocative movement longitudinally of a coking oven, said door-grasping means being connected with the common carrier for an amount of independent vertical movement such that said grasping means can be moved into and out of engagement with a coke-oven door without moving the door-latch-operating means, a power driven device for elevating the carrier, said device being operatively connected with the door-grasping means for independent movement of said grasping means and also operatively connected with the carrier for thereafter effecting movement of the common carrier for the joint movement as a unit of the door-grasping means and the latch-operating means with the door therewith, whereby an oven door can be grasped and unlatched and thereafter withdrawn, elevated and turned sideways, can be reversely returned by one power-driven device.

9. In coke-oven apparatus adapted to manipulate coke-oven doors, door-grasping means, a ram that is reciprocative longitudinally of a coking oven, said grasping means being so mounted on and arranged in respect of said ram that said means and its mounting can be moved vertically and horizontally independently of said ram, means for reciprocating the ram so that a coke-oven door can be grasped and can be withdrawn by said ram from the mouth of a coking chamber to a point beyond the buckstay line, means for shifting the grasping-means mounting vertically and laterally away from and reversely returning the same toward the mouth of the coking chamber while suspended by the ram without moving said ram other than longitudinally of the coking oven.

10. Coke-oven apparatus adapted for propelling within relatively close clearance of the buckstays of a coke-oven battery on trucks provided with trackage along a relatively narrow operating bench at the face of a coke-oven battery, said apparatus having means operative to grasp a coke-oven door, ram means to withdraw it from the mouth of a coking chamber to a point beyond the line of the buckstays of the battery, means to slue it relative to the ram sideways of the coking chamber said means for sluing being adapted to lift the door upwardly and having a member operable at the same time and adapted to utilize the upward movement to cause the turning of the door laterally during the elevation of the door upwardly, without moving said ram other than longitudinally of the coke oven, all of said means being so arranged and disposed in respect of said apparatus that an oven door in engagement with said means to grasp it is at all times supported between the trucks of the apparatus and the sluing of said door is effected substantially between the trackage for said trucks.

11. Coke-oven apparatus adapted for propelling within relatively close clearance of the buckstays of a coke-oven battery on trucks provided with trackage along a relatively narrow operating bench at the face of a coke-oven battery, said apparatus having means operative to grasp a coke-oven door, ram means to withdraw it from the mouth of a coking chamber to a point beyond the line of the buckstays of the battery, and means to shift it vertically and horizontally relative to the ram means in the withdrawn position of the ram, all of said means being so arranged and disposed in respect of said apparatus that an oven door in engagement with said means is at all times supported between the trucks of said apparatus and the shifting of said door is effected substantially between the trackage for said trucks.

12. Coke-oven apparatus adapted for propelling on trackage along the face of a coke-oven battery and including a device for grasping a coke-oven door, means for moving said door longitudinally of a coking chamber, shiftable means for shifting the device with the door thereon laterally of the means for moving said door longitudinally, a supporting chassis with trucks therefor, said chassis having a recess that extends back of a rail of said trackage an amount sufficient to receive a substantial part of an oven door between the trackage lines, said device and shiftable means being mounted between the trucks of the supporting chassis in alignment with the recess of said chassis, so that an oven door can be withdrawn into said recess directly from the mouth of a coking chamber and can be shifted sideways with the major load of the shifting door effectively disposed within the wheel-base and trackage lines of the said chassis.

13. Coke-oven apparatus adapted for propelling on trackage along the face of a coke-oven battery and including a device for grasping a coke-oven door, means for moving said door longitudinally of a coking chamber, shiftable means for shifting the device with the door thereon laterally and vertically of the means for moving said door longitudinally, a supporting chassis with trucks therefor, said chassis having a recess that extends back of a rail of said trackage an amount sufficient to receive a substantial part of an oven door between the trackage lines, said device and shiftable means being mounted between the trucks of the supporting chassis in alignment with the recess of said chassis, so that an oven door can be withdrawn into said recess directly from the mouth of a coking chamber and can be shifted sideways with the major load of the shifting door effectively disposed within the wheel-base and trackage lines of the said chassis.

14. In a battery of horizontal coke ovens, in combination: a relatively high operating bench that extends along the face of the battery at a level closely adjacent that of the soles of the coking chambers; trackage positioned on said bench for guiding therealong apparatus adapted to manipulate coke-oven doors; and apparatus disposed for propelling along said trackage at a distance from the buckstays less than the overall thickness of the oven doors, said apparatus including, a device for grasping a coke-oven door, means for moving said door longitudinally of a coking chamber means for shifting the door vertically and laterally thereof, and a chassis supported on trucks between which said device and said means are mounted, said chassis being at least in part above the level of the soles of the coking chambers of the battery and having between said trucks a recess arranged to permit a direct withdrawing of an oven door from the mouth of a coking chamber into the recess of the chassis to a point beyond the face-line of the buckstays and to such position that a substantial part of the door is between the lines of said trackage, said means for shifting being adapted to shift the door, when within the recess, vertically until the bottom of the door is above the part of the chassis that is above the oven sole, and at the same time turn the door laterally in

the recess during the elevation of the bottom of the door to a point above the upper part of the chassis that is above the oven sole, and said means for shifting being reversible for reversing the aforesaid operations within the recess.

15. Coke-oven apparatus adapted for propelling along the face of a battery of horizontal coke ovens and including means for grasping a coke-oven door to remove and restore it to the mouth of a coking chamber, other means for sluing said door sideways of said coking chamber, and a heat-resisting plate member located between the position occupied by the hot refractory part of a slued door and a station for cleaning it in that position, said plate member being of sufficient extent adequately to protect a workman in front of a slued door from heat given off by the refractory part thereof but of insufficient area to obstruct the periphery of the door and prevent its proper cleaning from said station.

16. Coke-oven apparatus provided with trucks for propelling it along trackage at the face of a battery of horizontal coke ovens, said apparatus including a ram for grasping a coke-oven door and for reciprocatively moving it longitudinally of a coking chamber, means for sluing said door laterally of said coking chamber and into a position between the trucks of said apparatus, an operating station on said apparatus conveniently located opposite the refractory lining of a door thus slued by said sluing means, and, between said station and the slued door, a heat-resisting plate member of adequate surface to protect a workman standing on said station from heat given off by the refractory part of the door but insufficient in extent to obstruct the periphery of the door and prevent its proper cleaning from said station.

17. Coke-oven apparatus as claimed in claim 16 and in which includes another operating station for controlling the actuation of said apparatus and in which the control operating station is so disposed relative to the means for sluing that the means for sluing the oven door is arranged to turn the refractory portion thereof away from the control operating station.

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