June 25, 1946. J. BECKER 2,402,592

COKE-OVEN METHOD

Original Filed Nov. 10, 1939 3 Sheets-Sheet 1

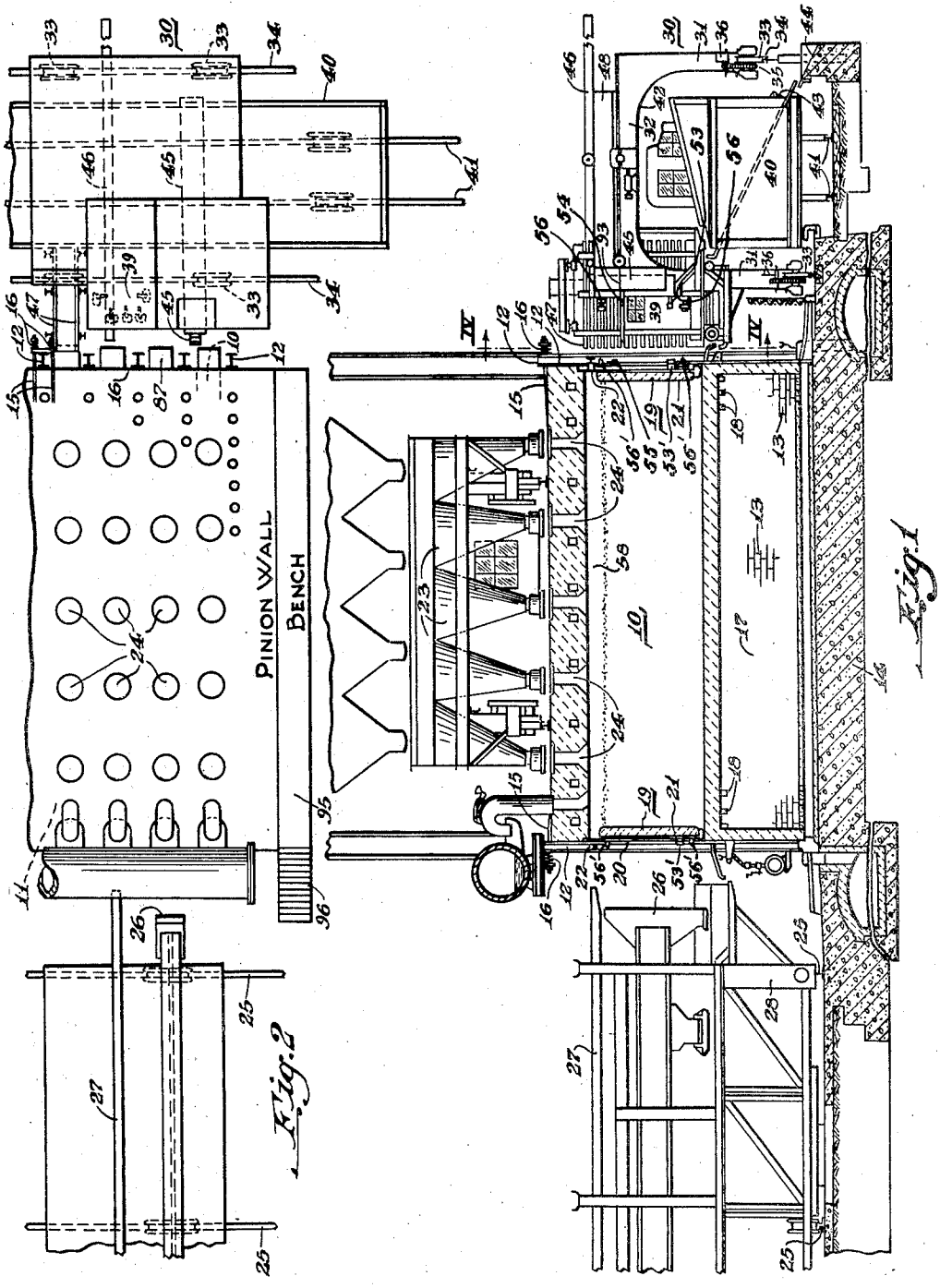


Fig. 2

Fig. 1

INVENTOR.
JOSEPH BECKER.
BY Henry Love Clarke
his ATTORNEY

June 25, 1946. J. BECKER 2,402,592

COKE-OVEN METHOD

Original Filed Nov. 10, 1939 3 Sheets-Sheet 2

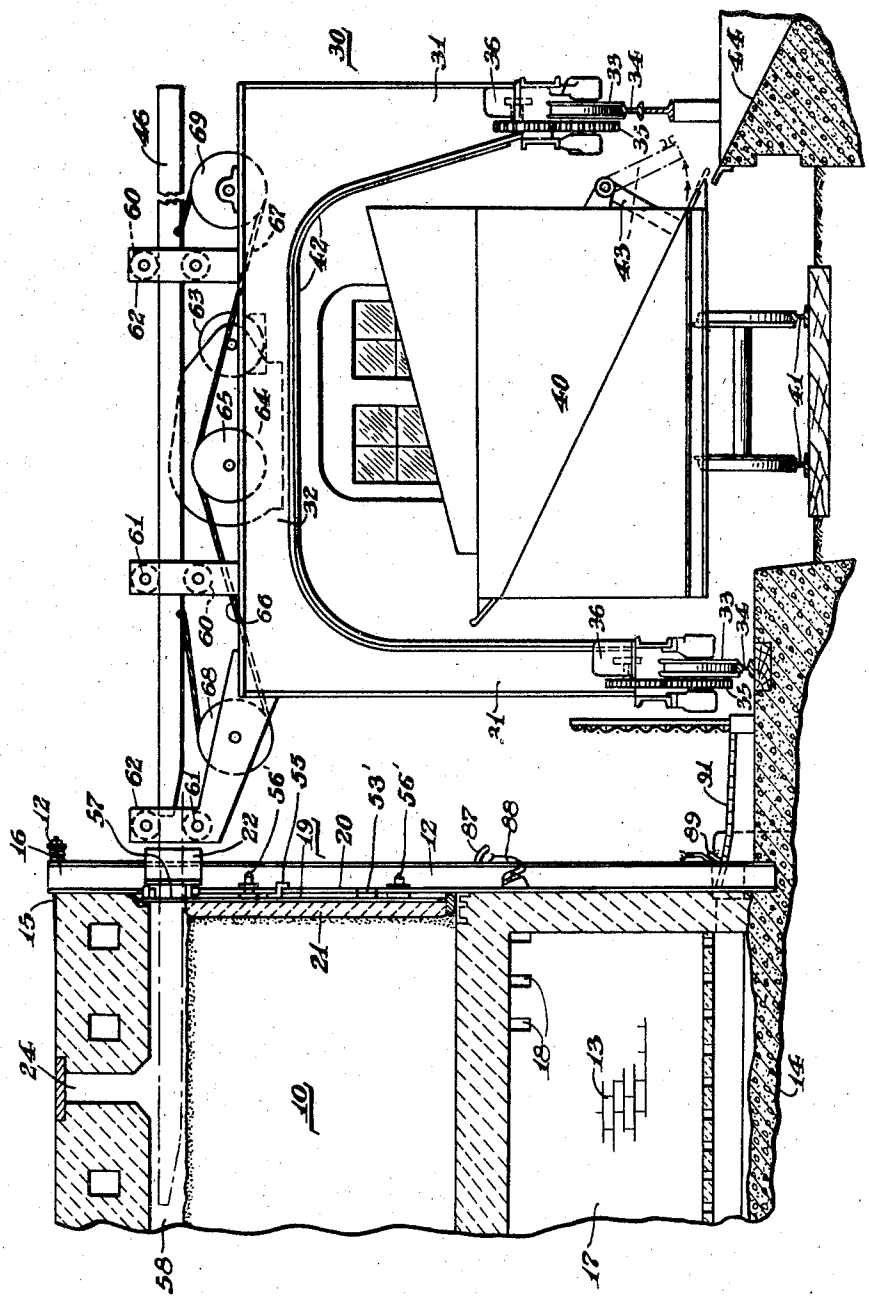


Fig. 3

INVENTOR.
JOSEPH BECKER.
BY Henry Loup Clarke
HIS ATTORNEY.

June 25, 1946. J. BECKER 2,402,592

COKE-OVEN METHOD

Original Filed Nov. 10, 1939 3 Sheets-Sheet 3

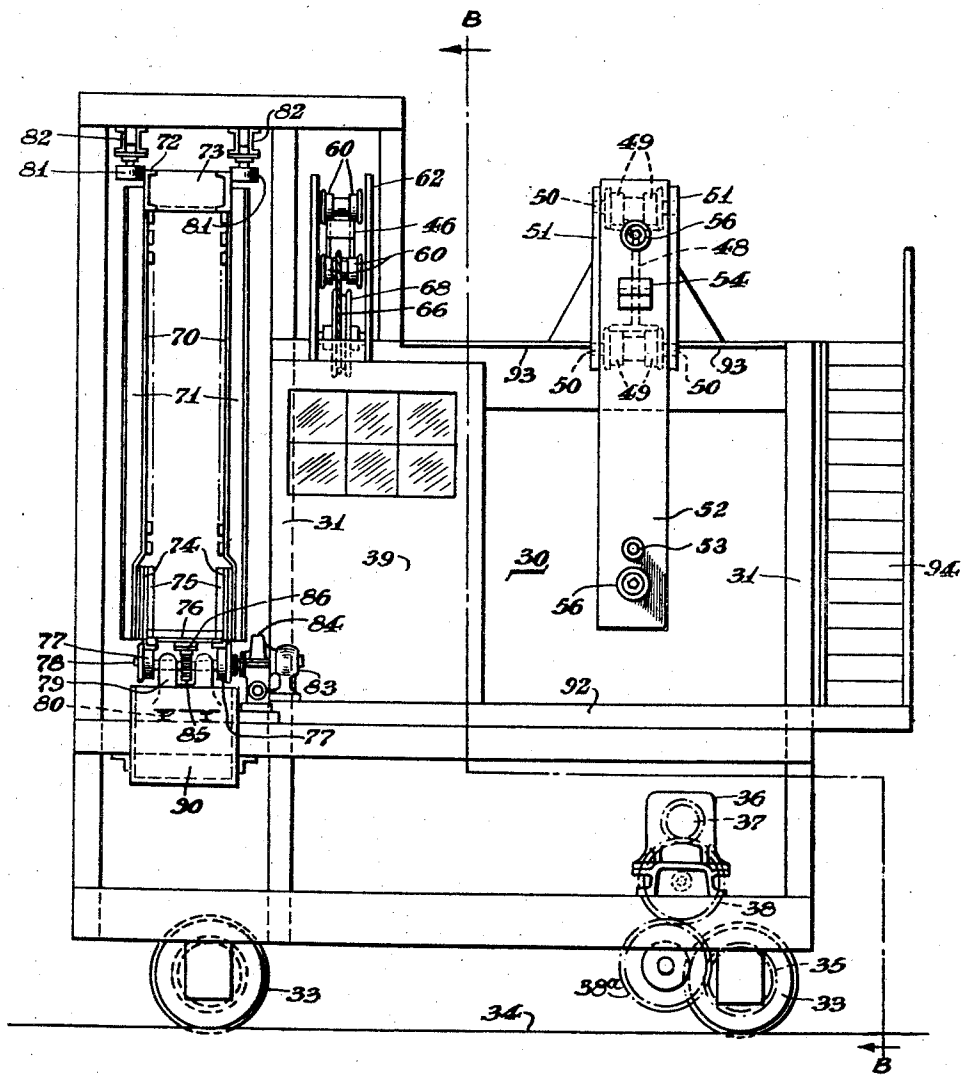


Fig. 4

INVENTOR.
JOSEPH BECKER.
BY Henry Long Clarke
his ATTORNEY.

Patented June 25, 1946 2,402,592

UNITED STATES PATENT OFFICE

2,402,592

COKE-OVEN METHOD

Joseph Becker, Pittsburgh, Pa., assignor, by mesne assignments, to Koppers Company, Inc., Pittsburgh, Pa., a corporation of Delaware

Original application November 10, 1939, Serial No. 303,722. Divided and this application January 7, 1943, Serial No. 471,630

3 Claims. (Cl. 202—26)

1

The present invention relates to an improved method of operating horizontal coke ovens more especially of the regenerative type and particularly contemplates improvements in levelling from the coke-side of a battery of such ovens, and this application is a division of my copending application Serial No. 303,722, filed November 10, 1939, for Coke-oven apparatus, now Patent No. 2,310,924, issued February 16, 1943.

In prior practice in coke ovens of the stated class, the door machine, the coke guide and other heavy equipment commonly employed in operative attendance at the coke-side of a battery have been propelled along that battery-face on trackage that is mounted on a bench supported by the battery buckstays at a level adjacent to and just beneath the oven-soles. Such coke-side operating-bench of a battery is of a construction sufficiently rugged to support not only the door-handling machine, the coke guide, and frequently other equipment as well, but also the massive coke-oven doors themselves as they are moved along the coke-side bench during their removal from and return to operating position in the coking-chamber mouths.

At the machine side (i. e. the pusher-machine side) of the battery, the heavy door-machine for that side and the leveler-bar for the ovens are usually supported on the pusher machine with the result that neither it nor the oven doors are ever carried by the machine-side bench or buckstays.

It has heretofore been general practice to level the coal-charges of a battery of horizontal coke ovens entirely from the one battery face; that is, from the pusher machine-side. In consequence of the relatively considerable length of modern coke ovens and of their large quantities of to-be-levelled coal and also of the high temperatures in the adjacent oven brickwork, this practice has severely taxed the leveler-bar for which the provision of a material that is able successfully to cope with the said operating conditions and to pass through a charged oven along a strictly horizontal course, without bending at its far end, is more a wish than a reality. The effects of any sagging or bending of the leveler-bar as well as its whipping action during movement are all most pronounced in those parts of the coal charge remotest from the leveler-bar support. In coke ovens having considerable length of coking chamber, the levelled coal-charge has thus tended to exhibit a locally higher bulk density adjacent the coke-side than obtains at the machine- side of the battery, thereby still

2

further increasing that normal discrepancy of heat requirements between a coke-side and a pusher machine-side heating wall area resulting from the tapering of the coking chambers, which increase in width from the pusher-side towards the coke-side. In so far as there is concerned only the simple supplying of the added coking heat required by these zones of coal having a higher bulk density, the situation can of course be simply accommodated by increasing the amount of fuel gas burned in those heating flues thereadjacent and, in those cases where the employed coals exhibit only contraction throughout the coking process, these circumstances offer no insurmountable disadvantages.

When, however, the charged coals are somewhat expanding or belong to those borderline groups exhibiting neither considerable expansion nor contraction during their coking, the presence or absence of such localized zones of higher bulk density in the levelled charge can be the difference between a damaged or undamaged heating wall, or between a relatively difficultly or easily pushed charge, and a brief consideration, at this point, of the situations created by their presence, more especially at the coke-side of an oven, may not be amiss in clarification of the difficulties they engender.

Due to the tapering of the coking chambers, the heating flues at the coke-side of an oven are of lesser cross-section than those at the machine-side and since the quantity of to-be-coked coal adjacent the former is always the larger because the oven chambers widen towards the coke-side, there is naturally required, for the bringing of the whole of an oven-charge simultaneously to the same degree of coking, higher temperatures in the coke-side heating flues so that coking heat can be flowed faster into the adjacent coal. If, in addition, the coal at the coke-side has a higher bulk density than at the opposite (pusher-side) oven-end, the difference in temperatures between the coke-side and the pusher machine-side heating flues must therefore be still further increased in compensation. Now, one of the interesting characteristics of expanding coals is that many of them can be coked at lower temperatures and at slower rates of coking without their exhibiting a serious degree of expansion, but, if their critical temperatures and rates-of-heating are exceeded, they expand with the exertion of considerable force. In modern coke ovens that are especially designed for operating at faster coking times there can thus be observed the phenomenon of a coke-

oven charge that has expanded at the coke-side sufficiently to cause "stickers" or even to damage the heating wall whereas at the machine-side it has produced no untoward situation.

From the above given, it becomes apparent that the increase of bulk density of the coke-side portion of a coke-oven charge, caused by its compression in that region through a sagging leveler-bar, can be the added influence causing damage to heating walls that would otherwise retain their integrity, and it is further apparent that, if compression of the levelled charge is unavoidable, it is advantageous that such conditions should rather exist at the oven's pusher machine-side and also that means for reducing the extremes to which bulk density is altered in any portion of the charge during the levelling operation will supply a needed contribution to the coking art.

The advantage of having the region of higher bulk density at the machine-side of an oven-charge does not reside exclusively in the increased protection provided to the walls but also in the advantage it furnishes in the pushing of the coked charge. For example, if the freshly charged coal has been levelled exclusively from the machine-side and its region of greatest bulk density is adjacent the coke-side of the oven there can exist in the finished coke-cake a zone of coke that is in pressure-contact with the oven walls at that side of the battery. This means that the pushing-pressure of the ram must be transmitted through a large part of the coke-cake which is substantially free of the oven walls, and that, in consequence, a major portion of the entire cake can be collapsed upon itself inside the oven without starting the plugged portion, and the entire cake will have to be dug out. When such circumstance arises, the pressure of the ram is transmitted to the oven walls and they are not adapted to resist such force. They should act only as a sort of coke-guide during the pushing operations. If, however, the densest part of the coal-charge is shifted from the coke-side to the machine-side of the oven by levelling exclusively from the former side of the battery, that portion of the resulting coke-cake with the greater tendency to wedge between the oven walls is located adjacent heating flues having lower temperatures and also more closely adjacent the pusher-ram itself so that the pressure exerted by the latter more nearly directly bears on the possibly wedged portion and, in the event, there results a collapse of any intermediate coke in attempting the starting of the coke-cake, it will be restricted to a relatively minor portion thereof and leave the more substantial part of the oven-charge intact for normal pushing.

The instant improvement now makes it feasible to employ a full-length leveler-bar at both the machine-side and the coke-side of a battery of horizontal coke ovens whereby those portions of greatest compression of the coal-charge, caused by the tendency of the leveler-bar to sag during the levelling operation, can be optionally disposed lengthwise of an oven in accordance with the coking characteristics exhibited by a coal or its mixture at the employed flue-temperatures and rates of coking. Other factors being equal, the zones of greatest bulk density of oven charge can be placed at the one side of the battery by levelling exclusively from its opposite side and if preferred such zones will tend to be positioned in the middle of the oven when each oven-half is levelled solely by the bar adjacent thereto. The last-mentioned method of course tends to effect the least change of bulk density in any portion of the charge and is of special advantage in use with coals having a tendency to expand during the coking process because the average sagging of the both leveler-bars will be the least.

The invention has for further objects such other improvements and such other operative advantages or results as may be found to obtain in the processes or apparatus hereinafter described or claimed.

According to the present invention a full length leveler-bar and the various mechanical features employed on the coke-discharge-side of the battery for handling coke-oven doors, for directing hot coke into the quencher-car and for general attendance to the required oven-operations at the coke-side face of an oven battery are mounted on a gantry that is propellable along the coke-side battery-front on trackage located substantially at yard level and out of contact with the structural mass of the battery, the legs of said gantry being disposed on opposite sides of the quencher-car trackage with the bridge section thereof at sufficient height above the top of said car to permit its free passage therebeneath. The gantry of the invention is adapted for employment in combination with a battery having the commonly-used operating-bench but it is especially advantageous when used in association with a benchless battery because with such structure it becomes possible to station closer to the mouths of the coking chambers, that leg of the gantry which more directly supports the said battery-operating mechanisms, thereby correspondingly to reduce the necessary span of the gantry. A small platform supported at a convenient level on the gantry can of course serve as adequate substitution for the extended operating bench of the prior art.

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

Fig. 1 is a vertical sectional view taken crosswise of a regenerative coke-oven battery through a coking chamber thereof and showing such accessory equipment as the larry-car, the pusher machine, and the like customarily employed in the operation of such ovens and also a gantry positioned at the coke-side of the illustrated battery, said gantry having mounted thereon a coke-oven bench, a door-handling mechanism, a coke-guide, and a leveler-bar for leveling the oven charges from the coke-side;

Fig. 2 is a plan view of Fig. 1 with the larry-car omitted;

Fig. 3 is a section taken substantially along the line B—B of Fig. 4, illustrating levelling from the coke-side of the battery; and

Fig. 4 is a view taken substantially along the line IV—IV of Fig. 1.

Referring now to the drawings:

For the purpose of demonstrating the improvement of the present invention and the constructional and operative advantages resulting from its employment in a coke-oven battery, there is shown in the accompanying drawings a diagrammatically represented coke-oven battery of the cross-regenerative type comprising many of the characteristic features of such a battery and some of the accessory equipment commonly used in its

operation. The illustrated coke-oven battery comprises essentially a plurality of coking chambers 10 that extend crosswise of the battery and are disposed lengthwise thereof in alternation with flued heating walls 11. The flued heating walls are formed of brickwork whose masonry terminates at either battery-face in jambs against which there abuts in pressure-contact the vertically-extending buckstays 12 which function to maintain the alignment of the heating walls as well as the brickwork thereof and the regenerator walls 13 in their designed positions in the heated battery. To effect this end the buckstays are each secured at their lower ends to the battery-supporting mat 14 and at their upper ends are joined to a similarly-positioned buckstay at the opposite battery-face by tie-rod means 15 that extend across the top of the battery. Resilient means, such as coil-springs 16, are provided at each end of the said tie-rods at their juncture with the buckstays thereby to provide for a certain amount of movement, at that point, whereby a limited expansion and contraction of the included heating wall can occur without seriously altering the extent of the pressure-contact existing between it and said buckstays.

Beneath the heating walls and extending crosswise of the battery in substantial parallelism therewith are cross-regenerators 17 for preheating combustion media before introducing the same into the lower parts of the heating flues individually through ducts 18. Coking chambers 10 are closed at each end by removable doors 19, each such door comprising an external metal framework 20 and a thereby supported heavy refractory plug 21 that operates to prevent overheating of the metallic framework. The doors for the coking chambers are provided at both the coke-side and the machine-side of the battery with chock-doors 22 so that coal charged into the ovens from larry-car 23 through charging-holes 24 can be levelled from both sides of the battery.

At the end of the carbonization period, the residue of coke in the coking chambers is pushed therefrom by the usual pusher machine which is moved along the machine-side of the battery from oven to oven on trackage 25, as shown in Fig. 1. The said pusher machine comprises heavy framework 26 that supports the diagrammatically illustrated pusher-ram 26 and leveler-bar 27 and the both of which are capable of individual reciprocatory movement lengthwise of the coking chamber by means not shown, the former serving to remove the residual coke-cakes from the coking chambers whereas the latter operates to provide the top of coal freshly charged into an oven with a level surface such that the finished coke-cake will have no irregularities protruding above the upper edge of the coking-chamber mouth. Although for purposes of convenience it is not illustrated in the drawings, apparatus for operating the door-latches and manipulating the pusher-machine-side doors are also normally supported on the pusher machine 26.

The heavy equipment customarily employed at the coke-side of a battery during routine oven operations is assembled on a gantry to form a unitary machine 30 that is propellable from oven to oven on trackage located substantially at yard level, said machine and its supported equipment being entirely out of contact with any of the battery's structural features.

As is clearly evident in the drawings the coke-side machine 30 comprises as its principal structural element a framework in the form of a gantry having legs 31 and a bridge-section 32. The legs of said gantry are mounted on several flanged wheels 33 that are adapted to engage tracks 34, and at least one wheel on either side of the gantry has attached thereto a gear 35 whereby the improved unitary machine is propelled by means of an electrical motor 36 that is preferably individual to each such driven wheel. Power is delivered from said motors to the gears 35 through an assembly of gears comprising pinion 37, idler gear 38, and intermediate gear 38—a, the motors being arranged by suitable wiring for individual control by the operator from cab 39.

Each bridge-section 32 is of sufficient span and height to permit free passage of coke quencher-car 40 therebeneath along its tracks 41. The bridge-sections of the gantry and the mechanisms that they support are protected against radiation from the incandescent coke contained in the quencher-car by means of an appropriate layer of insulation 42. Discharge gate 43 of the quencher-car permits loading of quenched coke on the coke-wharf 44.

Disposed on the gantry coke-side machine 30 and transportable thereby from coking chamber to coking chamber are a door-handling mechanism 45, a coke-side leveler-bar 46, and also a coke-guide 47 that is arranged to direct and transport the hot coke-cake, as it emerges from its coking chamber under pressure exerted by the above-mentioned pusher-ram 26 on the machine side, into the quencher-car 40 therefor whence it is taken to a quenching station and cooled before being unloaded unto the coke-wharf 44. Looking along the coke-side of the battery of Fig. 1, there is observed in succession the door-handling mechanism 45, the leveler-bar 46, and the coke guide 47 all supported at the top of the gantry. Each of these oven-operating devices is arranged with individual actuating means controllable from cab 39.

The door-lifting mechanism, shown in enlarged view in Fig. 4, comprises a ram 48 that is reciprocable longitudinally of the coking chambers between four pairs of flanged wheels 49, each such pair being mounted for rotation on shafts 50 that are themselves carried by the vertically-disposed supports 51. At the forward end of the ram 48 is the ram-head 52 that is provided with reciprocal motion at right angles to the body of the ram along a line controlled by guide-ways. The said ram-head directly supports the divers mechanisms employed for manipulating the doors and for operating their latches, said mechanisms comprising respectively bumper-pin 53, for engaging bumper-plate 53' on the doors 19, the door-hook 54, that is susceptible of actuation in a vertical plane so as to engage and release hook-plate 55 whereby the oven-doors are supported as they are moved by the reciprocal movement of ram 48 in removing them from and restoring them to their oven doorways, and the upper and lower latch-operating devices 56 for cooperation with latch pins 56', that are all constructed according to that design for such mechanism set forth in the co-pending application Ser. No. 140,960 of Berg and Crist, filed May 5, 1937 now Patent No. 2,179,608.

As shown in Fig. 3, the gantry of the invention is furnished with a leveler-bar 46 so that coal freshly charged into the coking chambers can be optionally levelled either solely from the machine-side or the coke-side or from both said sides of the battery either simultaneously or at

spaced intervals. It is supported on the gantry by means similar to that previously described for the support of the door-ram; that is, the leveler-bar is held between spaced and paired pairs of flanged wheels 60 that are rotatable on upper and lower surfaces of said bar, substantially as illustrated, the said pairs of wheelers being each supported on a shaft 61 therefor that is carried by an upright 62. The leveler-bar is provided with reciprocating motion longitudinally of the coking chambers so that by opening chock-hole 57 of the coke-side doors it can be moved along a path extending into the gas-collecting space 58 of the coking chambers, said reciprocating motion being imparted thereto by motor 63 that operates through speed-reducing gearing 64 to rotate drum 65 around which cables 66, 67, are wound in opposite directions, the said cables being attached to the leveler-bar adjacent respectively its inner and outer ends after passing respectively over sheaves 68, 69. Rotation of drum 65 in opposite directions will thus cause similar travel of the leveler-bar between the flanged wheels 60.

The coke-guide 47 is disposed on the gantry of the invention on the opposite side of the leveler-bar 46 from that at which the door-handling mechanism 45 is located, as shown in Fig. 2. It is made up in the present instance, as shown in Figs. 1, 4, of two rows of vertically-spaced, horizontally-extending metallic slats 70 that are supported on the inner side of a framework formed by the vertical H-beams 71, the horizontal channel-bars 72, 73, and the angle-irons 74 that are arranged substantially as shown in Fig. 4. Attached to the bottom of the framework are the heavy plates 75, 76, that are formed of a metal suitable for resisting the abrasive effect of the hot coke as it is pushed over their surfaces. The said framework of the coke-guide is also mounted on the gantry for reciprocating movement longitudinally of the coking chambers. To facilitate such movement its lower part rests on pairs of wheels 77 and between the flanges thereof, each such pair being supported on a rotatable shaft 78 that extends through the bushing-block 79 carried by I-beams 80, and the top of said framework is arranged to move between and be supported by spaced rollers 81 that depend from channel-bars 82. Actuation of the coke-guide is effected by motor 83 operating through the speed-reducing gearing 84 and the pinion gear 85 that is disposed for engagement with rack 86 located on the bottom of the framework of the coke-guide. Pinion gear 85 is also supported on bushing-block 79. The actuating mechanism for the coke-guide is preferably so arranged that, at its limit of travel toward the battery, there remains a small clearance between the slats of said guide and the jamb-plates surrounding the oven-mouth, so that vibrations of the former created by the passage of pushed coke therethrough are not directly transmitted to the battery structure. To this end, the divers features of the coke-guide are formed of structural materials that are sufficiently rugged independently to support the pushed coke without their distortion.

Projecting outward from the face of the battery at a level just beneath each of the oven-soles is a small shield-plate 87 that serves to carry the small amount of such detritus as breeze and the like, loosened from the coke-cake during its pushing, across the gas- and the air-flow reversing mechanisms, respectively 88, 89, into a receptacle 90 therefor on the gantry whence it can be intermittently removed to the quencher-car. The said shield-plates thus serve to protect the combustion-media flow-reversing mechanisms from becoming fouled with fine coke and to maintain the pavement of alley 91 along the battery-front in orderly condition.

With the present improvement those benches usually supplied at the coke-side face of the battery for the convenience of the operators during the oven-pushing operations, are located on the gantry as shown in Fig. 4. In the present instance there are two such members, a lower one 92 that is located a short distance below the oven-soles and an upper one 93 that has projecting therefrom small stages which give easy access to the tops of the doors for cleaning their sealing edges. A stairway 94 connects said lower and upper benches.

For access to bench 92 there is provided at the end of the battery and supported adjacent the outer surface of a pinion wall thereof, a bench having a stairway that reaches to yard level. The said bench is preferably at a level adjacent that of the operating platform 92 of the gantry thereby serving as a convenient means of access to the latter.

From the foregoing it will be manifest that by means of the gantry, the heavy mechanisms normally required more especially at the coke-side of a battery of horizontal coke ovens, can be stably supported in their required positions closely adjacent to the battery-face yet entirely out of contact with structural elements thereof while still retaining the quencher-bar in its normal position in respect of the battery. By means of the gantry it becomes also feasible to dispense with the extended battery-supported operating bench of the prior art and the large requirements of material for its construction. In consequence of its great stability, the gantry construction makes it feasible to employ a leveler-bar of effective length at the coke-side of the battery for use alone or in conjunction with a leveler-bar mounted as customarily on the pusher-side of the battery, to attain the novel features and ends set forth in the forepart of this specification in levelling coal in the oven chambers from their coke-side ends, whether solely from that end or conjointly with levelling from the pusher-side.

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

I claim:

1. In a method of operating a battery of side-by-side horizontal coke ovens for discharge of finished coke therefrom which comprises the steps of charging coal to be coked into the chambers through their tops, thereafter leveling the so charged-in coal by reciprocation of a leveler-bar with free suspended movement of the same over the tops of the charge from outside the oven through an end of the respective chambers and sagging of the leveler-bar towards its free end during its levelling action, and after the respective charges are finished coking, applying pushing force to the coked mass at one horizontal end of the chambers and thereby pushing the coked mass as a unitary whole through the respective chambers and out of the chambers through the opposite horizontal ends thereof; the improvement which comprises: levelling the coal charges throughout the entire length of the respective oven chambers, and in so doing disposing the zone of greatest levelling compression in the respective so-formed coal charges at a coking-

chamber zone lying between about the middle portion of the coking chamber and its mouth where pushing pressure for the coke-cake is to be applied, so that the zone of greatest density in the finished coke-cake will exist between about the middle portion of the coking chamber and that oven-mouth at which pushing pressure is to be applied and possible collapse in the coke-cake resulting from application of pushing pressure consequently will be restricted to a relatively minor rather than to a major portion of the coke-cake, by effecting the aforesaid leveling of the so-charged coal in the chambers by the operation of leveler-bars from both horizontal ends of the oven chambers.

2. In a method of operating a battery of side-by-side horizontal coke ovens for discharge of finished coke therefrom which comprises the steps of charging coal to be coked into the chambers through their tops, thereafter leveling the so charged-in coal by reciprocation of a leveler-bar with free suspended movement of the same over the tops of the charge from outside the oven through an end of the respective chambers and sagging of the leveler-bar towards its free end during its levelling action, and after the respective charges are finished coking, applying pushing force to the coked mass at one horizontal end of the chambers and thereby pushing the coked mass as a unitary whole through the respective chambers and out of the chambers through the opposite horizontal ends thereof; the improvement which comprises: levelling the coal charges throughout the entire length of the respective oven chambers, and in so doing disposing the zone of greatest levelling compression in the respective so-formed coal charges at a coking-chamber zone lying between about the middle portion of the coking chamber and its mouth where pushing pressure for the coke-cake is to be applied, so that the zone of greatest density in the finished coke-cake will exist between about the middle portion of the coking chamber and that oven-mouth at which pushing pressure is to be applied and possible collapse in the coke-cake resulting from application of pushing pressure consequently will be restricted to a relatively minor rather than to a major portion of the coke-cake, by effecting the aforesaid leveling of the so-charged coal in the chambers by the operation of the leveler-bar solely from the horizontal ends of the oven chambers opposite that end at which the pushing force is to be applied later to discharge the coked mass from the respective chambers.

3. In a method of operating a battery of side-by-side horizontal coke ovens for discharge of finished coke therefrom which comprises the steps of charging coal to be coked into the chambers through their tops, thereafter leveling the so charged-in coal by reciprocation of a leveler-bar with free suspended movement of the same over the tops of the charge from outside the oven through an end of the respective chambers and sagging of the leveler-bar towards its free end during its levelling action, and after the respective charges are finished coking, applying pushing force to the coked mass at one horizontal end of the chambers and thereby pushing the coked mass as a unitary whole through the respective chambers and out of the chambers through the opposite horizontal ends thereof; the improvement which comprises: levelling the coal charges throughout the entire length of the respective oven chambers, and in so doing disposing the zone of greatest levelling compression in the respective so-formed coal charges at a coking-chamber zone lying between about the middle portion of the coking chamber and its mouth where pushing pressure for the coke-cake is to be applied, so that the zone of greatest density in the finished coke-cake will exist between about the middle portion of the coking chamber and that oven-mouth at which pushing pressure is to be applied and possible collapse in the coke-cake resulting from application of pushing pressure consequently will be restricted to a relatively minor rather than to a major portion of the coke-cake, by effecting leveling of the so-charged coal in the chambers as aforesaid by the operation of a leveler-bar from the horizontal ends of the oven chambers opposite that end at which the pushing force is to be applied later to discharge the coked mass from the respective chambers.

JOSEPH BECKER.