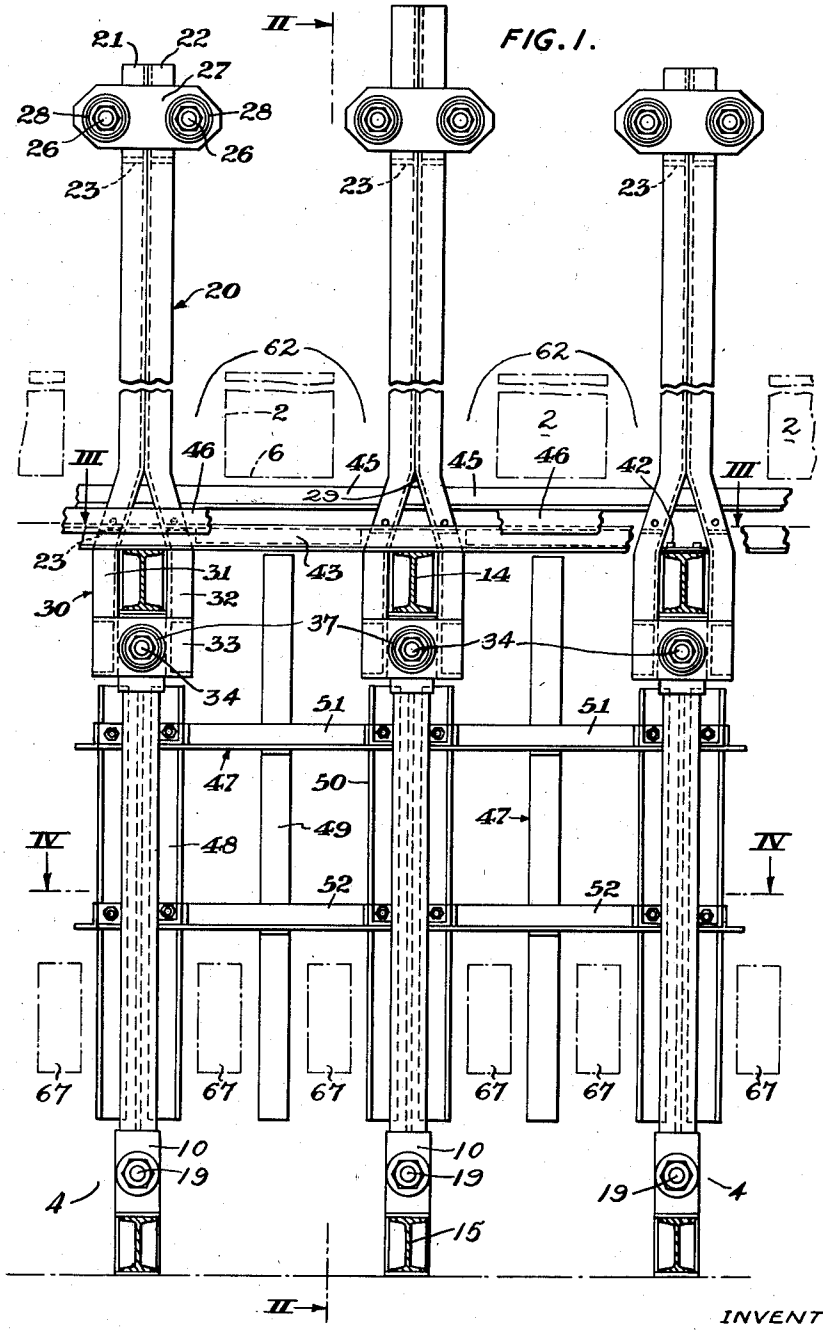
Jan. 15, 1952 F. W. DOBSON 2,582,238

COKE OVEN BUCKSTAY STRUCTURE

Filed March 4, 1947 3 Sheets-Sheet 1

FIG. 1.



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COKE OVEN BUCKSTAY STRUCTURE

Filed March 4, 1947 3 Sheets-Sheet 2

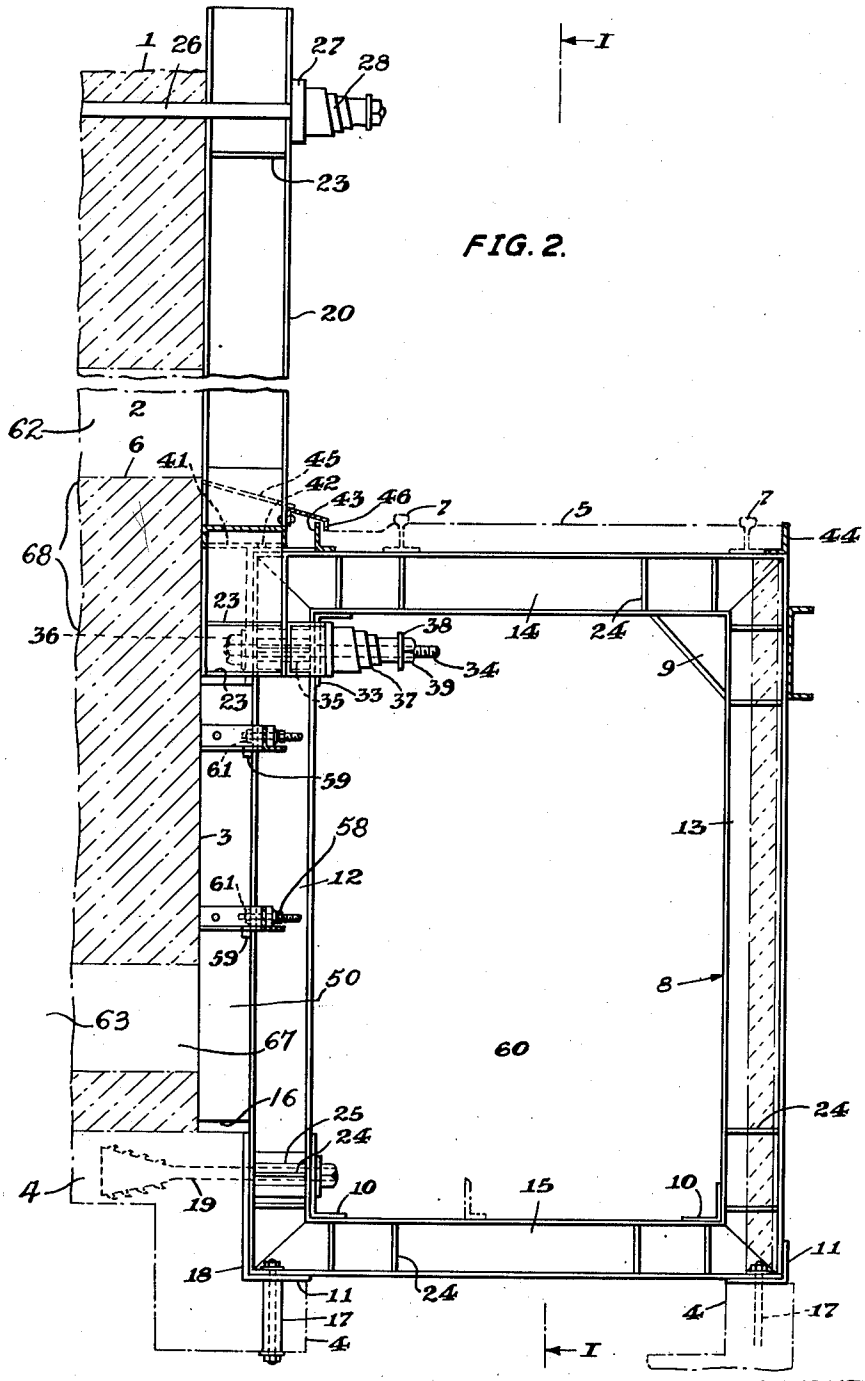


FIG. 2.

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COKE OVEN BUCKSTAY STRUCTURE

Filed March 4, 1947 3 Sheets-Sheet 3

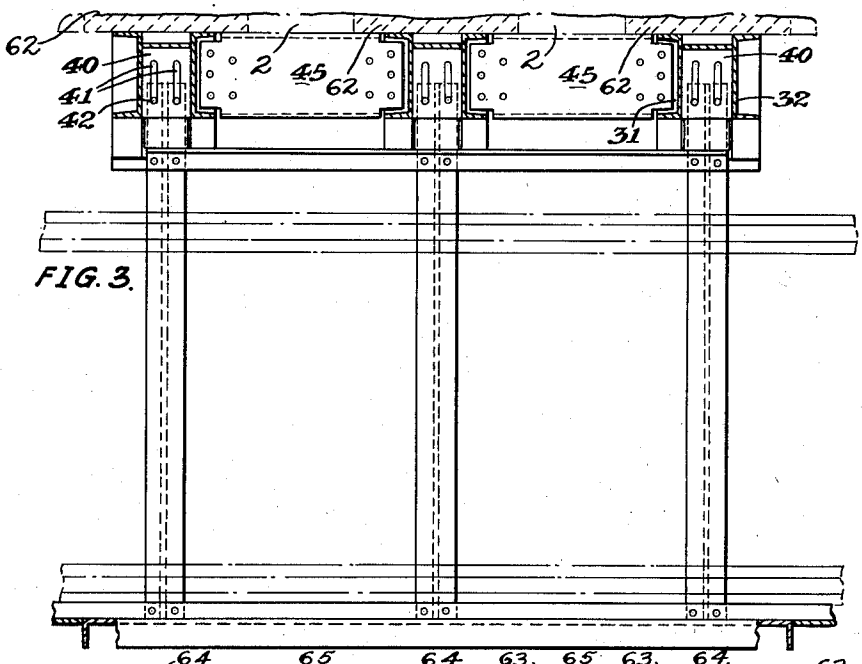


FIG. 3.

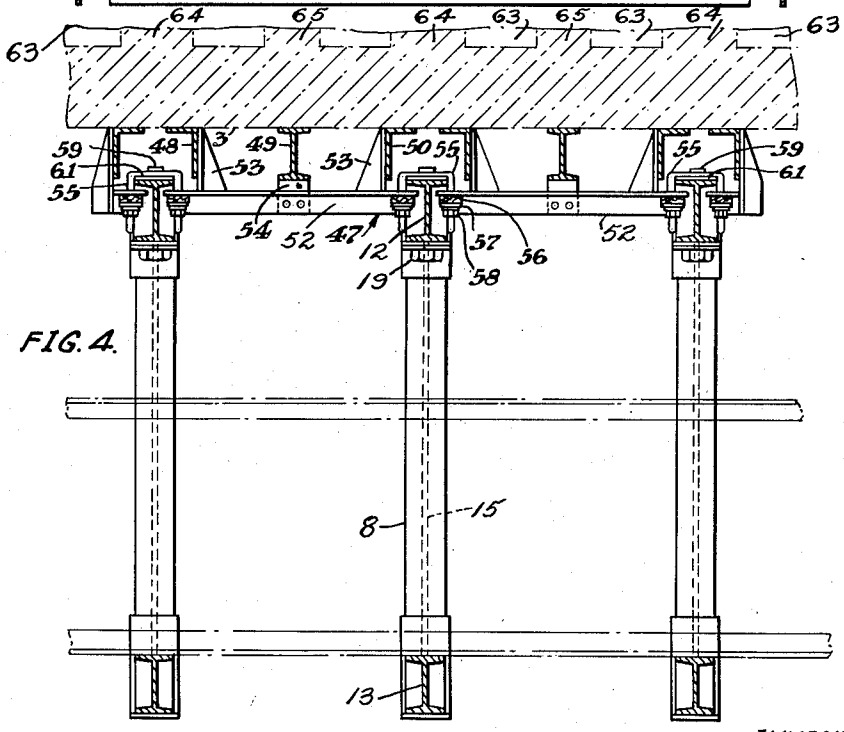


FIG. 4.

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2,582,238

UNITED STATES PATENT OFFICE

2,582,238

COKE OVEN BUCKSTAY STRUCTURE

Frederick William Dobson, London, England, assignor, by mesne assignments, to The Woodall-Duckham Vertical Retort and Oven Construction Company (1920) Limited, London, England, a British company

Application March 4, 1947, Serial No. 732,233
In Great Britain March 11, 1946

12 Claims. (Cl. 202—268)

1

This invention concerns improvements in or relating to coke oven structures and has particular reference to cross-regenerative batteries of coke ovens. More especially, the invention is concerned with improvements in the construction and arrangement of the external bracing means of cross-regenerative batteries of coke ovens and which bracing means comprise essentially a series of buckstays by which the oven end fittings, e. g. door frames or sectional flash plates, are held in position in the mouths or ends of the ovens and by which the masonry of the battery structure is also braced exteriorly to maintain an appropriate pressure thereon, with the object of retaining the masonry in a condition of alignment and thereby reducing the danger of the joints of the brickwork structure being opened or cracked with consequential detrimental effects upon the efficiency of the oven battery and the stability of the structure.

In batteries of cross-regenerative ovens constructed hitherto the buckstays, which were formed of metal girders, were arranged vertically at spaced intervals along the longitudinal sides (i. e. pusher and coke sides) of the battery and extended the full height of the latter. At their lower ends, the buckstays were individually anchored below the regenerators by tie bolts secured in the concrete foundation of the battery on which the regenerators rest, and the upper ends of the buckstays on the one side of the battery were tied to the upper ends of the corresponding buckstays on the opposite side of the battery by tie rods extending between the buckstays. With such an arrangement it has been customary to furnish adjustable resilient means (e. g. springs or spring washers or wood packs) on the tie bolts and tie rods whereby the buckstays are rendered capable of limited yielding movement in unison with the masonry of the batttery when this expands.

With cross-regenerative ovens, the buckstays cannot be anchored to the oven battery at the level below, but adjacent, to the oven soles, because the brickwork there is insufficient to afford the required anchorage, and the heat of the tops of the regenerators is too great for the anchoring tie rods to pass therethrough. The anchorage must be in the concrete foundation, below the regenerators, for security.

During the operation of a battery of ovens such as above described, the buckstays are subjected to deflection from their normal vertical condition due to the pressure exerted by the masonry upon the buckstays as a result of the expansion

2

of the masonry. The buckstay-deflection is most marked in the region of the centre of the height of the battery (i. e. in the vicinity of the oven soles, below the coking chambers and heating walls, but at the tops of the regenerators), where the setting expands more than at the top and bottom of a cross-regenerative oven. Thus, the buckstays of cross-regenerative ovens, which are anchored at the upper and lower ends as explained above, become longitudinally bowed, and no longer efficiently support the masonry of the battery and the oven door frames (or flash plates).

When the buckstays become bowed, as above explained, they only contact with the oven door frames (or flash plates) at upper and lower parts of the latter and consequently the outward forces exerted between these positions by the masonry of the battery are taken by the door frames (or flash plates) instead of by the buckstays. Consequently the door frames (or flash plates) are frequently distorted or ruptured and (particularly in the case of flash plates) forwardly displaced, all of which further aggravates the difficulties encountered as a result of the bowing or distortion of the buckstays, for not only are repairs or replacements of the door frames (or flash plates) rendered necessary, but air leakages to the ovens are permitted and the buckstays are, as a result, subjected to extraordinary heating conditions which results in their further deterioration.

It is, of course, usual to replace or repair unduly buckled or inefficient buckstays, and also to repair or renew the damaged door frames (or flash plates), but this does not undo the harm that may have been done to the setting as a result of the previous inefficiency or faultiness of the renewed or repaired buckstays.

The invention is also concerned with the construction and support of the operating or side benches which are located at either side of a battery of coke ovens just below the oven soles and longitudinally along the battery faces, these benches serving, inter alia, to provide a platform for the battery operators and to support the trackage along which the oven operating equipment such as the door machines and the coke guides are arranged to operate; these side benches are usually horizontal and form the top or roof of a passage or alley extending the full length of the battery.

Hitherto it has been customary to support the side benches upon a series of horizontal beams each secured at one end to a buckstay and extending perpendicularly away from the

adjacent longitudinal side face of the oven battery and supported at its outer end by a longitudinal member supported on vertical stanchions which are fewer in number than the buckstays, these vertical stanchions rising about as high as the regenerators and being fixed at their lower ends to the concrete foundations of the battery on which the regenerators rest.

Rigidly associating the operating bench-supporting structure with the buckstays in this way has a detrimental effect upon the buckstays and lessens their effective life particularly as the benches, especially that on the coke side of the battery, are subjected to considerable live loading and vibration which is transmitted to the buckstays; furthermore the buckstays communicate the said vibration to the masonry with which they are in contact and this contributes to the deterioration of the masonry.

The aforementioned disadvantages resulting from the support of the benches upon the buckstays have been considered previously and, in the specification of United States Patent No. 2,338,618, it has been proposed that they should be eliminated or reduced by the use of benches which are constructed independently of the buckstays, such benches being supported by longitudinally spaced gantries disposed in planes perpendicular to the longitudinal side faces of the battery and out of contact with the masonry thereof, the legs of the gantries being secured to the battery foundation at their lower ends.

However, even when using "independent" benches as described in the said patent specification, the aforementioned deterioration of the buckstays due to the expansion of the battery setting is still encountered and, whether independently supported benches or benches supported by the buckstays are employed, the lower ends of the buckstays and their anchorages are, in the said prior constructions, inaccessibly disposed in the alleys below the benches where the floor space of the alleys is in the region of the regenerator sole-channels and is very congested due to the presence of the reversing valves and other fittings and accessories that are mounted upon the floors of the alleys so as to be in proximity to the regenerator sole-channel inlets, and consequently it is not only difficult to adjust the pressure of the resilient means acting on the lower ends of the buckstays, but it is also extremely difficult to disconnect, remove and replace the buckstays when they require to be renewed or when renewal or repair of the oven door frames (or flash plates) or masonry is called for.

An object of the present invention is to provide an improved construction of external bracing for the masonry of a battery of cross-regenerative coke ovens whereby the aforementioned disadvantages of the known arrangements of buckstays will be eliminated or reduced and, in particular, whereby the oven door frames (or flash plates) and the masonry of the battery setting will be more efficiently supported, and the adjustment of the pressure of the buckstays, or the renewal of the buckstays and/or oven door frames (or flash plates), may be effected when necessary more readily than has hitherto been possible.

According to the invention, there is provided external bracing means for the opposite longitudinal sides (i. e. pusher and coke sides) of a battery of cross-regenerative coke ovens (hereinafter referred to as a "cross-regenerative coke oven battery"), such means comprising buckstays which terminate at their lower ends alongside the ends of the upper parts of the regenerators at positions below, but adjacent to, the oven chamber soles and which buckstays are, at or adjacent the said positions, each urged into contact with the sides of the battery through the medium of one or more pressure members, and a rigid structure for each buckstay, such rigid structure being rigidly associated at its lower part with the battery foundations below the regenerators and extending upwardly therefrom to the level of the oven-chamber soles, and being adapted to take the thrust of the pressure member or members of the associated buckstay at the level of the oven-chamber soles.

As shown on the drawings, and as described herein, each buckstay is otherwise free from anchorage to the oven battery at levels at and below the level of the base for the oven-chamber soles, and each of the rigid bracing structures is likewise otherwise free from anchorage to the oven battery above the battery foundation.

Each buckstay preferably has its lower part so anchored to its associated rigid bracing structure at the level of the base of the oven-chamber soles that it is free to make a limited movement only in a vertical plane perpendicular to the adjacent longitudinal side of the battery: thus the lower part of each buckstay is free to move, under the pressure of the battery masonry, to a limited extent more or less horizontally in a vertical plane perpendicular to the adjacent longitudinal side of the battery but is not free to move in the direction of the length of the battery.

The said individual rigid structures may each comprise a rigid closed frame disposed in a vertical plane at right angles to the adjacent longitudinal side of the battery. These frames may be, and preferably are, of rectangular form and may be built up from a series of members secured rigidly together, or they may be formed of reinforced concrete or in any other suitable manner. When formed wholly of metal, the frames may each consist of four members secured rigidly together at their ends so as to constitute a rigid box girder frame, and these four members may be of I- or channel- or other suitable shape in cross section, and may be formed by rolled or built-up metal structural sections.

According to another aspect of this invention, there is provided a coke oven battery having external bracing means comprising a series of pairs of buckstays, the buckstays of each pair being arranged on opposite longitudinal sides of the battery in alignment with one another so as to support the battery masonry and oven end fittings of the battery, such buckstays having their upper parts tied together whilst their lower ends terminate at positions adjacent, but below, the soles of the ovens of the battery, each such buckstay being yieldingly or resiliently anchored at this lower part to the upper part of a vertical rigid frame disposed in a plane perpendicular to the adjacent longitudinal side of the battery and rigidly associated at its lower part with the foundations of the battery and extending upwardly therefrom to the level of the base of the oven-chamber soles, such frame being adapted to receive from the buckstay anchored thereto at the level of the oven-chamber soles, and to transmit to the said foundations below the intervening regenerators, stresses applied to the buckstay by the battery masonry at the level of the base of the oven-chamber soles due, for example, to the greater expansion of the masonry and/or the discharging of the ovens.

Thus, according to this invention, the buckstays are considerably shorter than those hitherto used in coke oven batteries of the cross-regenerative type and terminate at a substantial distance above the base of the battery due to the intervening cross-regenerators. Moreover, the buckstays are yieldingly or resiliently supported against the forces exerted thereupon by the masonry and oven end fittings, this support being provided at the positions where the maximum movement of the buckstays takes place during the operation of the battery; moreover, the thrusts transmitted to the buckstays by the battery are taken by the said rigid structures or frames to which the buckstays are yieldingly or resiliently anchored and which are rigidly carried by the foundation of the battery.

The said rigid structures or frames on each side of the battery are preferably also employed as the supporting structure for the operating or side bench at the same side of the battery. Thus, according to a still further aspect, the invention comprises the provision of a coke oven battery provided with preheating means (regenerators) between the oven-chamber soles and the battery foundation having, on each longitudinal side, a rigid side-bench supporting structure constructed independently of the buckstays of the battery and comprising a series of rigid vertical frames rigidly secured at their lower parts to the battery foundations and disposed in planes perpendicular to the said longitudinal sides of the battery, said frames extending upwardly from the foundation so as to have their upper parts disposed adjacent, but below, the level of the soles of the ovens of the battery, and the corresponding buckstays on opposite sides of the battery being tied together at their upper ends and each having its lower end disposed adjacent the upper part of one of the said frames and being, at this position, yieldingly or resiliently associated with such frame.

The portion of the masonry of the battery setting above the foundation and below the lower parts of the buckstays is preferably braced or shored on each longitudinal side of the battery by a lower bracing or shoring structure or mattress independent of the buckstays and arranged wholly or mainly below the latter, such bracing or shoring structure or mattress being engaged with the masonry and supported by the said rigid structures or frames on the same side of the battery.

Each of the said lower bracing or shoring structures or mattresses may be adjustably associated with the appropriate rigid structures or frames and preferably is resiliently mounted on the latter so as to exert a yielding pressure upon the masonry, means desirably being provided whereby this pressure may be regulated. Thus according to a further aspect of this invention there is provided a coke oven battery with such preheating means having those parts of each longitudinal side of the oven masonry (i. e. the pusher and coke sides) that are respectively situated above and below a level adjacent, but lower than, the oven soles individually externally braced by separate upper and lower bracing systems each of which is independent of the other, and is at least in part, supported yieldingly or resiliently by a rigid structure outside the oven masonry.

The invention is thus especially useful in coke oven batteries provided with preheating means, as in the form of cross-regenerators, in which the regenerators extend transversely of the length of the battery at a level below the coking chambers and heating walls, and also in batteries where the upper heating walls are formed of silica and the lower regenerators are formed of fireclay or the like so that a marked expansion-differential arises.

In order that the nature of the invention shall be more readily understood and the invention carried into practice it will now be described with reference to the accompanying drawings as applied to a Woodall-Duckham horizontal coke oven battery of the cross regenerative type in which the preheating means comprises regenerators which extend transversely of the length of the battery, from one side to the other at a level below the coking chambers and heating walls.

In the drawings:

Figure 1 is a part sectional front elevation taken on line I—I, Figure 2, and shows an external bracing for a horizontal cross-regenerative coke oven battery constructed in accordance with this invention;

Figure 2 is a section on line II—II, Figure 1;

Figure 3 is a section on line III—III, Figure 1; and

Figure 4 is a section on line IV—IV, Figure 1.

In the drawings the coke oven battery 1 is indicated diagrammatically, the battery being furnished in its upper masonry (brickwork) mass with a series of ovens 2 extending from its longitudinal side 3 to the corresponding opposite longitudinal side of the battery, which ovens 2 alternate with intermediate heating walls 62 comprising combustion flues. The battery is built upon suitable concrete foundations 4 and along each longitudinal side of the battery, i. e. along the pusher machine side and the coke side, is arranged a horizontal side bench 5 extending the full length of the battery and disposed at a level slightly lower than that of the soles 6 of the ovens.

In the lower masonry (brickwork) mass of the battery, between the bottoms of the heating walls 62 and the oven chambers 2, on the one hand, and the concrete foundation 4, on the other hand, are arranged the cross-regenerator chambers 63, separated by the regenerator pillar walls 64, and curtain walls 65. The pillar walls 64 are disposed beneath the heating walls 62. 67 indicates the regenerator sole-flue channels to which gas inlet and outlet boxes are communicably connected in the alley 60, but which are not shown for clearness of illustration of other parts. The tops 68 of the pillar walls 64 constitute the base for the soles of the heating flues in the heating walls 62, and the base for the soles of the oven chambers 2.

Only a portion of the coke side of the battery is shown in the drawings, but it will be understood that arrangements are similar on both the pusher and the coke sides of the battery.

The side benches, e. g. the coke side benches 5, of the battery may, as usual, be provided with suitable trackways, such as that marked 7, for the appropriate door-operating machines, coke guide and the like, none of which is shown in the drawing.

The bench 5 is carried by a supporting structure which comprises a number of longitudinally spaced similar closed rigid bracing frames 8 which are preferably of rectangular shape as shown. These frames are all arranged in planes perpendicular to the adjacent longitudinal side face 3 of the oven battery and, although they may be formed of reinforced concrete or in any other suitable manner, are conveniently each formed,

as shown in the drawings, by four straight members each comprising a length of I-section metal girder, the several members being mitred and welded or otherwise rigidly secured together at the corners of the frame. An internal brace 9 may be provided at the upper outer corner of each frame, and the other corners of the frame may each be reinforced by internal and external corner plates respectively marked 10 and 11.

The frames 8 shown in the drawings are of oblong perimetrically closed form but are of open internal form, i. e. they have no cross members or similar obstructions. These frames have their longer sides 12 and 13 disposed vertically and their shorter sides 14 and 15 disposed horizontally. The longer side 12 of each frame is horizontally spaced from the adjacent longitudinal side 3 of the oven battery so as to leave a vertical gap 16 between the battery 1 and the nearest surface of the side member 12 of the frame 8.

Each of the rigid frames 8 is rigidly secured, as for example by bolts 17, to the foundation 4 of the battery and the inner lower corners of the frames may be set in a longitudinal recess 18 in the battery foundation and secured in position in this recess by substantial bolts 19 passing through metal tubes 25 welded in position between the flanges of the vertical I-section members 12 of the frames 8, the tubes 25 having their axes disposed in the planes of the webs of these members and being reinforced on either side by stiffening webs 24. The frames 8 are thus rigidly secured to the foundation 4 of the battery independently of the brick masonry of the battery 1 itself.

The lower frames 8 are each disposed so as to lie below, but centrally between, a pair of adjacent ovens 2, the frames being in vertical alignment with the masonry of the heating walls 62 containing the vertical heating flues between the pair of ovens 2. The upper surface of the upper horizontal member 14 of each frame 8 is disposed a short distance, e. g. one to three feet, below the level of the soles 6 of the ovens 2.

At each side of the battery a series of upper longitudinally spaced vertical buckstays 20 is arranged in contact with the longitudinal side wall of the battery and with the oven door frames, these buckstays being straight and being disposed one between each pair of successive ovens 2 and therefore one at one end of a heating wall 62 in vertical alignment with each of the hereinbefore-mentioned frames 8. Although the buckstays may be of any suitable shape in cross-section and be formed either of rolled section structural members or of built-up members, they are preferably, as shown in the drawings, each formed of a pair of back-to-back channel-shaped girders 21 and 22, it being the inner flanges of these girders that engage the longitudinal side, e. g. side 3, of the battery.

The channel members 21 and 22 forming the buckstays 20 may be stiffened at appropriate positions by stiffening webs 23 welded between their flanges, and, similarly, the frames 8 may be stiffened by stiffening webs 24 welded at appropriate positions between the flanges of the I-section members from which the frames are built up.

At its upper end each buckstay 20 on the one side of the battery is tied to the upper end of the corresponding buckstay on the other side of the battery by a pair of tie rods 26 extending through the battery or across the top thereof and carrying, at their ends, bridge pieces 27 bearing on the outer flanges of the buckstays 20 and pressed resiliently into contact therewith by means of volute springs 28 or other suitable and equivalent means carried by the tie rod ends, the latter ends being furnished with means, e. g. screw threaded ends and nuts, whereby the inward pressure exerted by the springs 28 upon the upper ends of the buckstays may be adjusted.

The buckstays 20 at each side of the battery do not extend the full depth of the setting but terminate at only a short distance below the level of the side bench 5 at their side of the battery. At their lower parts the buckstays are forked as shown at 29 to constitute a bridle 30, the two horns or arms 31 and 32 of which are formed by appropriately cranking the two members 21 and 22, of which the buckstay is formed, outwardly from one another and then again cranking them into parallelism.

The bridle 30 of each buckstay embraces or straddles the upper horizontal member 14 of a frame 8 of the bench supporting structure, and the two arms 31 and 32 of the bridle extend downwardly one on each side of the battery side member 12 of the same frame.

A cross piece 33 extends horizontally across the bridle 30 of each buckstay and seats at its opposite ends respectively upon the lower parts of the arms 31 and 32 of the bridle, and a horizontal bolt 34 passes centrally through the cross piece 33. The bolt 34 is anchored in a tube 35 welded in the web of the vertical member 12 of the adjoining frame 8, the tube 35 being secured in position in a similar manner to the tube 25 previously described. The bolt 34 is thus disposed in the medial plane of the frame 8 and has a head or nut 36 at its battery end to prevent its being drawn away from the battery out of the tube 35, and at its opposite end the bolt carries a strong volute or other suitable spring 37 or other suitable resilient or yieldable pressure member (e. g. a wood pack) bearing at one end against the cross piece 33 and at the other end against a washer 38 adjustable on the bolt 34 by a nut 39.

Thus the lower end of each buckstay 20 is urged resiliently or yieldingly into contact with the oven battery, the pressure of the buckstay on the battery being adjustable by means of the nut 39.

The lower end of each buckstay is constrained to move only in the plane of the associated frame 8, i. e. to move more or less horizontally and at right angles to the adjacent longitudinal side of the battery, by the horns 31 and 32 of the buckstay which are respectively arranged on opposite sides of the frame, whilst each buckstay is prevented from riding upwardly with the masonry of the battery, as this expands vertically, by means of a horizontally disposed web or plate 40, welded between the horns 31 and 32 of the buckstay, and studs or bolts 42 passing through slots 41 in the web or plate 40 and secured at their lower ends to the upper member 14 of the corresponding frame 8. Thus the studs or bolts 42 prevent the buckstay riding upwards from its frame 8 but leave the lower end of the buckstay free to move relatively to the frame more or less horizontally in a vertical plane at right angles to the longitudinal side 3 of the battery.

The bench 5 may be formed of concrete or reinforced concrete or of other suitable material and be disposed between parallel angle irons 43

and 44 supported in parallel spaced relationship on the frames 8.

To bridge the gap (left to allow for expansion of the battery masonry) between the rear edge of the bench 5 and the oven soles 6, plates 45 may be provided between successive buckstays 20, and these plates may carry, at their outer edges, an inverted channel-shaped member 46 carried by the buckstays and overlapping the battery edge of the bench 5. The plates 45 may be fixed at their ends to the buckstays as shown.

The portion of the masonry of the battery below the lower ends of the buckstays 20 includes the transversely arranged regenerators 63 of the battery and is braced or shored independently of the upper part of the masonry by a bracing or shoring structure conveniently in the form of a mattress or grid formed in a plurality of sections 47 each yieldingly or resiliently held against the face of the masonry, one section of the mattress or grid being arranged between each successive pair of frames 8.

Each of the sections 47 of the said mattress or grid may comprise, as shown in the drawings, three vertical girders 48, 49 and 50 spaced equally from one another in the longitudinal direction of the battery and connected and secured together by transverse angle section stretchers or girders 51 and 52 bolted, rivetted or otherwise suitably fixed to the vertical girders 48, 49 and 50. The horizontal stretchers or girders may be employed in any convenient number, but conveniently two are used as shown, these stretchers or girders being spaced apart from one another and from the top and bottom ends of the vertical girders 48, 49 and 50.

The stretchers or girders 51 and 52 are also preferably horizontally aligned with the stretchers or girders of the adjacent sections 47 of the mattress.

The vertical girders 48 and 50 are of L-shape in cross-section, being arranged in opposition with the flanges thereof engaging the battery side 3 and extending in opposite directions; these girders 48 and 50 are secured to the horizontal girders or stretchers 51 and 52 by brackets or plates 53 (Fig. 4). The central vertical girder 49 is of I-shape and is secured to the horizontal stretchers or girders 51 or 52 by brackets 54.

The battery engaging flanges of the vertical girders 48 and 50 support the masonry more or less directly below the buckstays 20 (at one end of the regenerator pillar walls 64) whereas the vertical girders 49 support the masonry substantially midway between the buckstays (at one end of the regenerator curtain walls 65).

The adjacent ends of the aligned stretchers or girders 51 and 52 of adjacent sections 47 of the mattress or grid are connected by U-bolts 55 arranged horizontally with their cross pieces engaging the battery-side face of the adjoining vertical member 12 of a frame 8, the two arms of each U-bolt 55 extending perpendicularly away from the battery masonry 1 through the ends of the horizontal girders 51 and 52 of adjacent sections 47 of the mattress or grid and each U-bolt arm is furnished with a yielding wooden packing piece 56 or a spring or springs and a bearing plate 57, an adjusting nut 58 being mounted on the end of the arm which is appropriately screw threaded. By adjusting the nuts 58 on the arms of the U-bolts the pressure that the mattress sections 47 exert upon the face of the battery masonry may be appropriately adjusted, and it will be seen that the load applied to the mattress sections is transmitted by the U-bolts to the frames 8 of the bench supporting structure and by these frames to the battery foundation.

The horizontal girders of the mattresses which are coupled by the U-bolts should, of course, be arranged with respect to the vertical members 48, 49 and 50 so that the pressure exerted by the resilient means or wooden blocks on the U-bolts 55 is more or less uniformly applied throughout the whole of the mattress section.

Stops 59 are provided on the rear vertical members 12 of the frames 8 for engagement with the cross pieces of the U-bolts 55 to support the mattress sections 47 in the proper position with respect to the masonry of the battery. Furthermore each of the cross pieces of the U-bolts 55 is preferably provided on its upper and lower sides with a flat bar 61 welded thereto to increase the bearing surface of the U-bolts upon the vertical members 12 of the frames 8.

If it is desired to omit the yielding or resilient devices for urging the mattress sections 47 towards the masonry of the setting, then provision should be made for the ample adjustment of the mattress sections with respect to the masonry of the setting.

It will be seen that the pressure applied by the mattress sections 47 to the lower part of the masonry of the battery setting is independent of the pressure applied by the buckstays 20 to the upper part of the setting and that there is no interconnection between the buckstays 20 and the mattresses 47 such that the one affects the other, the mattresses being entirely independent of the buckstays.

By constructing the external bracing of the battery as above described, the upper portion of the battery setting (which most needs support) is braced by the buckstays 20 whilst the lower portion of the battery is independently supported by the mattress sections 47 and, at the same time, the spans of the buckstays are reduced and their strength is thereby correspondingly increased and their liability to distortion reduced.

The bottom anchorage of each buckstay 20 is adjacent the position of maximum expansion of the setting and therefore the buckstay can be maintained throughout its whole length, or substantially its whole length, in contact with the oven end fittings (door frames or flash plates) and the masonry of the setting without being cambered or, at any rate, without being cambered to any detrimental extent. Furthermore, by arranging the bottom anchorages of the buckstays near the top of the alley 60, so as to be clear of the floor of the alleys 60 below the side benches 5, these buckstay anchorages are more readily accessible than has been the case in batteries hitherto constructed; also the adjustment of the buckstay anchorages for the variation of the pressure of the buckstays upon the masonry is very considerably facilitated. At the same time the floor of the alley is rendered less congested and consequently a better grouping of the reversing valves and fittings of the battery can be achieved than has been attained hitherto in battery constructions, and this has the effect of facilitating the maintenance and cleaning of the valves and fittings. Moreover, with a construction according to this invention the shortened buckstays themselves are more easily removable than hitherto should they need replacement or should the oven end fittings or brickwork require repair or adjustment. Also the culvert type of

rigid frame 8 employed for supporting the side benches 5 furnishes a very strong structure with which to support the side benches and superimposed live loads whilst leaving a clear alley 60.

What I claim is:

1. The combination with a horizontal coke oven battery comprising an upper masonry mass having horizontal coking chambers alternating in position side-by-side with heating walls, extending between the opposite longitudinal sides of the battery, and a lower masonry mass having gaseous combustion media preheating means below the oven chambers and heating walls and mounted on a battery foundation, of external bracing means for the opposite longitudinal sides of the battery, such means comprising buckstays which extend only down from the top of the battery at the sides thereof against the ends of the heating walls to the level of, and terminate at their lower ends at, a position below and adjacent the oven soles of the battery, and a rigid structure for each buckstay, said rigid structures each being rigidly secured to the battery foundation in fixed relation thereto, and to the battery, and being constructed independently of the buckstays, and spaced from the vertical side face of the battery, and said buckstays being each anchored to the battery at their upper ends and being each anchored at their lower ends to the upper parts of the rigid structures which are fixed relative to the oven battery and its foundation, by pressure members for yieldably urging the buckstays into contact with the side of the battery for limited relative movement between the lower ends of said buckstays and the upper parts of said rigid structures.

2. Apparatus as claimed in claim 1, and which includes a bracing a shoring structure for bracing or shoring the lower portion of the masonry mass of the battery setting that is below the lower terminal ends of the buckstays and constitutes the side faces of the battery in the region of the preheating means, and in which said bracing or shoring structure is mounted on said rigid structures for the buckstays and supported thereby independently of said buckstays and of the battery masonry.

3. Apparatus as claimed in claim 2, and in which said shoring structure is resiliently mounted on said rigid structures and so as to exert a yielding pressure on the masonry mass of the battery in the region of the preheating means therein.

4. Apparatus as claimed in claim 2, and in which the bracing or shoring structure for the lower part of the masonry is formed in a plurality of sections, each section comprising interconnected girders which extend upwardly and longitudinally of the battery, there being one section between each adjacent pair of said rigid structures, each section extending over the area of the side face of the preheating means part of the battery side wall, from the vertical plane of one buckstay to the vertical plane of a next adjacent buckstay.

5. Apparatus as claimed in claim 1, and in which the buckstays are resiliently anchored as aforesaid at their upper ends.

6. Apparatus as claimed in claim 1 and in which guiding means are provided between the lower end of said buckstays and the upper part of said rigid structures to constrain the lower end of each buckstay to move in a plane perpendicular to the adjacent side of the battery.

7. Apparatus as claimed in claim 1, and in which said rigid structures each comprises a four sided internally clear box girder frame disposed in a vertical plane perpendicular to the adjacent side of the battery and in alignment with its buckstay.

8. Apparatus as claimed in claim 1, and in which said rigid structures each comprise a rigid four-sided internally clear box girder frame disposed in a vertical plane perpendicular to the adjacent side of the battery and in alignment with its buckstay, and in which the lower part of each said buckstay is anchored to the upper part of its said rigid structure for limited movement relative thereto and is provided with means for constrained guided movement of the lower end of the buckstay to constrain the lower end to move outward in the plane of its rigid structure perpendicular to the adjacent longitudinal side of the battery.

9. A horizontal coke oven battery structure comprising an upper-masonry mass having horizontal coking chambers alternating in position side-by-side with heating walls with the chambers and walls extending between the opposite sides of the battery, and a lower masonry mass having gaseous combustion media preheating means below the oven chambers and heating walls and mounted on a battery foundation, external bracing means for the opposite longitudinal sides of the battery comprising, buckstays which extend down from the top of the battery at the sides thereof against the ends of the heating walls and terminate at their lower ends at positions below and adjacent the level of the oven soles; pressure members for urging said buckstays, at the position below and adjacent the oven soles, into contact with the battery at the said position; and means for anchoring said buckstays on to the oven battery; and in which said means for anchoring is restricted to confine all anchoring of said buckstays to anchoring of the same at and above the level of said position below and adjacent the oven soles, leaving said buckstays otherwise free from anchorage below the level of the said position below and adjacent the oven soles; said restricted anchoring means comprising upper means for anchoring the upper ends of said buckstays to the upper part of the battery; and for each said buckstay a lower rigid structure constructed independently of the buckstays of the battery, and horizontally spaced from the vertical side face of the battery and rigidly secured to the battery foundation, said lower rigid structure extending upwardly from the battery foundation to the said position at the level below and adjacent the oven soles, and anchoring its said buckstay at said position through the coaction of the pressure member of its associated buckstay with the upper part of said rigid structure.

10. Apparatus as claimed in claim 9, and in which said rigid structures each comprise a four-sided internally clear box girder frame arranged in planes perpendicular to the side face of the battery and in alignment with their said buckstays, said frames forming an accessible alleyway alongside the battery wall with the tops of the frames providing a support in the region of the level of the oven soles for the top of a side bench for the battery, and with the bases of the frames forming a region for the floor of the alleyway below the top of the side bench for grouping of reversing valves and fittings on the floor, whereby the lower terminal ends of said

buckstays, being anchored to the upper parts of said frames, are clear of the lower interior of the frames as an alleyway and also clear any fittings on the floor of the alleyway provided by the base of the frames.

11. A horizontal coke oven battery structure comprising an upper masonry mass having horizontal coking chambers alternating in position side-by-side with heating walls with the chambers and walls extending between the opposite sides of the battery, and a lower masonry mass having gaseous combustion media preheating means below the oven chambers and heating walls and mounted on a battery foundation; external bracing means for the opposite longitudinal sides of the battery comprising, buckstays which extend down from the top of the battery at the sides thereof against the ends of the heating walls and terminate at their lower ends at positions at least below and adjacent the level of the oven soles; pressure members for urging said buckstays, at the position below and adjacent the oven soles, into contact with the battery at the said position; and means for anchoring said buckstays on to the oven battery; and in which said means for anchoring is restricted to confine all anchoring of said buckstays to anchoring of the same at and above the level of said position below and adjacent the oven soles, leaving said buckstays otherwise free from anchorage below the level of the said position below and adjacent the oven soles; said restricted anchoring means comprising upper means for anchoring the upper ends of said buckstays to the upper part of the battery, and for each said buckstay a lower rigid structure constructed independently of the buckstays of the battery, and horizontally spaced from the vertical side wall of the battery, and secured to the battery foundation, said lower rigid structure extending upwardly from the battery foundation to the said position at a level below and adjacent the oven soles, and anchoring its said buckstay at said position through the coaction of the pressure member of its associated buckstay with the upper part of said rigid structure.

12. The combination in a horizontal coke oven battery structure comprising an upper masonry mass having coking chambers alternating in position side-by-side with heating walls, said chambers and walls extending between the opposite sides of the battery, and a lower masonry mass having gaseous combustion media preheating means below the oven chambers and heating walls and mounted on a battery foundation, of external bracing means for the opposite longitudinal sides of the battery, such means comprising buckstays which are anchored at, and extend down from, the top of the battery at the sides thereof against the ends of the heating walls and terminate at their lower ends at positions adjacent to but below the level of the oven soles, and which buckstays are, at the position adjacent to but below the oven soles, each urged into contact with the battery at the said positions through the medium of one or more pressure members; and a rigid bracing structure for each buckstay, such rigid structure being rigidly associated by anchorage at the level of the foundation with the battery foundations and extending upwardly therefrom to the said positions at the level below but adjacent the oven soles, and being adapted to take at said positions the thrust of the pressure members of the associated buckstay; said buckstays being otherwise free from anchorage below the level of the said positions below but adjacent the oven soles, and the rigid bracing structures likewise being otherwise free of anchorage to the battery at levels above the battery foundation, and in which the lower ends of the buckstays are forked, and the forked ends of the buckstays straddle the upper parts of their associated rigid frames; and compression springs, carried by said rigid frames, and arranged to urge the forked ends of the buckstays towards the battery.

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